PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
Patrick L. Moulton	09/15/2006

RECEIVING PARTY DATA

Name:	Ionic Water Technologies, Inc.
Street Address:	9468 Double R Blvd., Suite A
City:	Reno
State/Country:	NEVADA
Postal Code:	89521

PROPERTY NUMBERS Total: 1

Property Type	Number
Patent Number:	7011745

CH $40.00 7011745

CORRESPONDENCE DATA

Fax Number: (775)586-9550
Correspondence will be sent via US Mail when the fax attempt is unsuccessful.
Email: sierrapatent@sierralaw.com
Correspondent Name: Sierra Patent Group, Ltd.
Address Line 1: 1657 Hwy. 395, Suite 202
Address Line 4: Minden, NEVADA 89423

ATTORNEY DOCKET NUMBER:	MOUL-001
NAME OF SUBMITTER:	Jonathan D. Hanish

Total Attachments: 81
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SECURITY AGREEMENT

THIS SECURITY AGREEMENT, dated as of September 15, 2006 ("Agreement"), is made and given by **IONIC WATER TECHNOLOGIES INC.**, a Nevada corporation , having its registered office at 9468 Double R Blvd. Suite A, Reno NV 89521 and its principal place of business at 202 East 45th Street, Boise, ID 83714 (the "Grantor"), to:

RAB SPECIAL SITUATIONS (MASTER) FUND LIMITED a company incorporated in the Cayman Islands whose head office is at Walker SPV Limited, Walker House, Mary Street, PO Box 908GT, Grand Cayman, Cayman Islands c/o RAB Capital Plc of 1 Adam Street, London, WC2N 6LE ("RAB");

MAJEDIE INVESTMENTS plc, a company incorporated in Great Britain, United Kingdom, whose head office is at 1 Minster Court, Mincing Lane, London EC3R 7ZZ ("**MAJEDIE**"); and

MARC BAMBER, an individual ("**BAMBER**"), having his principal contact office at c/o RAB Special Situations (Master) Fund Limited, Walker SPV Limited, Walker House, Mary Street, PO Box 908GT; and

RAB, MAJEDIE and BAMBER are collectively and each individually referred to herein as the "Secured Party".

RECITALS

A. The Grantor and the Secured Party have entered into a Loan Note Investment Agreement of even date herewith (as the same may hereafter be amended, supplemented, extended, restated, or otherwise modified from time to time, the "Loan Agreement") pursuant to which the Secured Party has agreed to invest in debt instruments of the Grantor and the Grantor has agreed to issue Loan Notes in the amount of up to US$2,810,000.

B. It is a condition precedent to the obligation of the Secured Party to make such investment under the Loan Agreement that this Agreement be executed and delivered by the Grantor to the Secured Party.

NOW, THEREFORE, in consideration of the premises and in order to induce the Secured Party to make investments under the Loan Agreement, the Grantor hereby agrees with the Secured Party for the Secured Party's benefit as follows:

Section 1. Defined Terms.

1(a) As used in this Agreement, the following terms shall have the meanings indicated:

"Account" means a right to payment of a monetary obligation, whether or not earned by performance, (i) for property that has been or is to be sold, leased, licensed, assigned, or otherwise disposed of, (ii) for services rendered or to be rendered, (iii) for a policy of insurance issued or to be issued, (iv) for a secondary obligation incurred or to be incurred, (v) for energy provided or to be provided, (vi) for the use or hire of a vessel under a charter or other contract, (vii) arising out of the use of a credit or charge card or information contained on or for use with the card, or (viii) as winnings in a lottery or other game of chance operated, sponsored, licensed or authorized by a State or governmental unit of a State, or person licensed or authorized to operate the game by a State or governmental unit of a State. The term includes health-care insurance receivables.

"Account Debtor" shall mean a Person who is obligated on or under any Account, Chattel Paper, Instrument or General Intangible.

"Chattel Paper" shall mean a record or records that evidence both a monetary obligation and a security interest in specific goods, a security interest in specific goods and software used in the goods, a security interest in specific goods and license of software used in the goods, a lease of specific goods, or a lease of specific goods and license of software used in the goods.

"Collateral" shall mean all property and rights in property now owned or hereafter at any time acquired by the Grantor in or upon which a Security Interest is granted to the Secured Party by the Grantor under this Agreement.

"Deposit Account" shall mean any demand, time, savings, passbook or similar account maintained with a bank.

"Document" shall mean a document of title or a warehouse receipt.

"Equipment" shall mean all machinery, equipment, motor vehicles, furniture, furnishings and fixtures, including all accessions, accessories and attachments thereto, and any guaranties, warranties, indemnities and other agreements of manufacturers, vendors and others with respect to such Equipment.

"Event of Default" shall have the meaning given to such term in Section 17 hereof.

"Financing Statement" shall have the meaning given to such term in Section 4 hereof.

"General Intangibles" shall mean any personal property (other than goods, Accounts, Chattel Paper, Deposit Accounts, Documents, Instruments, Investment Property, Letter of Credit Rights and money) including things in action, contract rights, payment intangibles, software, corporate and other business records, inventions, designs, patents, patent applications, service marks, trademarks, trade names, trade secrets, internet domain names, engineering drawings, good will, registrations, copyrights, licenses, franchises, customer lists, tax refund claims, royalties, licensing and product rights, rights to the retrieval from third parties of electronically processed and recorded data and all rights to payment resulting from an order of any court.

"Instrument" shall mean a negotiable instrument or any other writing which evidences a right to the payment of a monetary obligation and is not itself a security agreement or lease and is of a type which is transferred in the ordinary course of business by delivery with any necessary endorsement or assignment.

"Inventory" shall mean goods, other than farm products, which are leased by a person as lessor, are held by a person for sale or lease or to be furnished under a contract of service, are furnished by a person under a contract of service, or consist of raw materials, work in process, or materials used or consumed in a business or incorporated or consumed in the production of any of the foregoing and supplies, in each case wherever the same shall be located, whether in transit, on consignment, in retail outlets, warehouses, terminals or otherwise, and all property the sale, lease or other disposition of which has given rise to an Account and which has been returned to the Grantor or repossessed by the Grantor or stopped in transit.

"Investment Property" shall mean a security, whether certificated or uncertificated, a security entitlement, a securities account and all financial assets therein, a commodity contract or a commodity account.

"Letter of Credit Right" shall mean a right to payment or performance under a letter of credit, whether or not the beneficiary has demanded or is at the time entitled to demand payment or performance.

"Lien" shall mean any security interest, mortgage, pledge, lien, charge, encumbrance, title retention agreement or analogous instrument or device (including the interest of the lessors under capitalized leases), in, of or on any assets or properties of the Person referred to.

"Obligations" shall mean (a) all indebtedness, liabilities and obligations of the Grantor to the Secured Party of every kind, nature or description under the Loan Notes issued to or on behalf of the Secured Party, (b) all liabilities of the Grantor under this Agreement, and (c) in all of the foregoing cases whether due or to become due, and whether now existing or hereafter arising or incurred.

"Patent" means all of the following in which Grantor now holds or hereafter acquires which are related to or derive from the United States Patent No. 7,011,745, including : (a) all letters patent of the United States or any other country, all registrations and recordings thereof and all applications for letters patent of the United States or any other country, including, without limitation, registrations, recordings and applications in the United States Patent and Trademark Office or in any similar office or agency of the United States, any State thereof or any other country; (b) all reissues, divisions, continuations, renewals, continuations in part or extensions thereof; (c) all petty patents, divisionals and patents of addition; (d) all patents to issue in any such applications; (e) income, royalties, damages, claims and payments now and hereafter due and/or payable with respect to patents, including, without limitation, damages, claims and recoveries for past, present or future infringement; and (f) rights to sue for past, present and future infringements of any patent.

"Patent Rights" means any and all written agreements, in which Grantor now holds or hereafter acquires any interest, granting any right with respect to the Patent (whether Grantor is the licensee or the licensor thereunder).

"Person" shall mean any individual, corporation, partnership, limited partnership, limited liability company, joint venture, firm, association, trust, unincorporated organization, government or governmental agency or political subdivision or any other entity, whether acting in an individual, fiduciary or other capacity.

"Security Interest" shall have the meaning given such term in Section 2 hereof.

1(b) All other terms used in this Agreement which are not specifically defined herein shall have the meaning assigned to such terms in Article 9 of the Uniform Commercial Code as in effect in the State of Nevada.

1(c) Unless the context of this Agreement otherwise clearly requires, references to the plural include the singular, the singular, the plural and "or" has the inclusive meaning represented by the phrase "and/or." The words "include," "includes" and "including" shall be deemed to be followed by the phrase "without limitation." The words "hereof," "herein," "hereunder" and similar terms in this Agreement refer to this Agreement as a whole and not to any particular provision of this Agreement. References to Sections are references to Sections in this Security Agreement unless otherwise provided.

Section 2. Grant of Security Interest. As security for the payment and performance of all of the Obligations, the Grantor hereby grants to the Secured Party a security interest (the "Security Interest") in all of the Grantor's right, title, and interest in and to the following, whether now or hereafter owned, existing, arising or acquired and wherever located:

2(a) All Accounts.

2(b) All Chattel Paper.

2(c) All Deposit Accounts

2(d) All Documents.

2(e) All Equipment.

2(f) All General Intangibles.

2(g) All Instruments.

2(h) All Inventory.

2(i) All Investment Property

2(j) All Letter of Credit Rights

2(k) To the extent not otherwise included in the foregoing, all other rights to the payment of money, including rents and other sums payable to the Grantor under leases, rental agreements and other Chattel Paper; all books, correspondence, credit files, records, invoices, bills of lading, and other documents relating to any of the foregoing, including, without limitation, all tapes, cards, disks, computer software, computer runs, and other papers and documents in the possession or control of the Grantor or any computer bureau from time to time acting for the Grantor; all rights in, to and under all policies insuring the life of any officer, director, stockholder or employee of the Grantor, the proceeds of which are payable to the Grantor; all accessions and additions to, parts and appurtenances of, substitutions for and replacements of any of the foregoing; and all proceeds (including insurance proceeds) and products thereof.

Section 3. Grantor Remains Liable. Anything herein to the contrary notwithstanding, (a) the Grantor shall remain liable under the Accounts, Chattel Paper, General Intangibles and other items included in the Collateral to the extent set forth therein to perform all of its duties and obligations thereunder to the same extent as if this Agreement had not been executed, (b) the exercise by the Secured Party of any of the rights hereunder shall not release the Grantor from any of its duties or obligations under the Accounts or any other items included in the Collateral, and (c) the Secured Party shall have no obligation or liability under Accounts, Chattel Paper, General Intangibles and other items included in the Collateral by reason of this Agreement, nor shall the Secured Party be obligated to perform any of the obligations or duties of the Grantor thereunder or to take any action to collect or enforce any claim for payment assigned hereunder except as excepted at Section 4, below.

Section 4. Title to Collateral.

4(a) The Grantor has (or will have at the time it acquires rights in Collateral hereafter acquired or arising) and will maintain so long as the Security Interest may remain outstanding, title to each item of Collateral (including the proceeds and products thereof), free and clear of all Liens except the Security Interest and except Liens existing on the date hereof and except as otherwise provided herein. The Grantor will not license any Collateral without Secured Party's written consent. The Grantor will defend the Collateral against all claims or demands of all Persons (other than the Secured Party) claiming the Collateral or any interest therein. In accordance with the Loan Agreement, no later than thirty (30) days after the date of this Agreement, Grantor shall execute and file a Financing Statement in the State of Nevada (and in each other state where Grantor does business) that substantially conforms with the Financing Statement attached at **Exhibit A ("Financing Statement").** As of the date of execution of this Security Agreement, no effective UCC financing statement, U.S. Patent and Trademark Office Notice of

Security Interests or other similar document used to perfect and preserve a security interest under the laws of any jurisdiction covering all or any part of the Collateral is on file in any recording office, except such as may have been filed in favor of the Secured Party relating to this Agreement or as specifically identified and excepted herein.

4(b) As an express exception to the foregoing representations and restrictions, Secured Party acknowledges and consents to Grantor's issuance of a security interest in the Collateral in favor of Patrick Moulton ("Moulton") as part of the consideration given to Moulton pursuant to that Patent Transfer and Royalties Agreement and that Security Agreement between Grantor and Moulton (the "Patent Transfer Documents") or before the date of this Agreement. Pursuant to the Patent Transfer Documents, Moulton agrees to subordinate all of his security interest in the Collateral to Secured Party's Security Interest.

4(c) Secured Party has received and approves the terms and conditions of the Patent Transfer Documents. Secured Party agrees that in the event Secured Party exercises default remedies that include foreclosure upon that portion of the Collateral that constitutes the Patent or Patent Rights, Secured Party will (i) take the Patent and Patent Rights subject to and as an assignee of all of Grantors continuing and future obligations owed to Moulton in the Patent Transfer Documents, and (ii) will sell or transfer any interest in the Patent and Patent Rights only to transferee(s) who also accept assignment of Grantor's continuing and future obligations owed to Moulton in the Patent Transfer Documents.

Section 5. Disposition of Collateral. The Grantor will not sell, lease or otherwise dispose of, or discount or factor with or without recourse, any Collateral, except for sales of items of Inventory in the ordinary course of business and dispositions of Equipment which are immediately replaced with comparable replacement equipment.

Section 6. Names, Offices, Locations, Jurisdiction of Organization. The Grantor's legal name (as set forth in its constituent documents filed with the appropriate governmental official or agency) is as set forth in the opening paragraph hereof. The jurisdiction of organization of the Grantor is the state of Nevada, and the organizational number of the Grantor is set forth on the signature page of this Agreement. The Grantor will from time to time at the request of the Secured Party provide the Secured Party with current good standing certificates and/or state-certified constituent documents from the appropriate governmental officials. The chief place of business or chief executive office of Grantor are located at its address set forth on the signature page hereof. The Grantor will not locate or relocate any item of Collateral into any jurisdiction in which an additional Financing Statement would be required to be filed to maintain the Secured Party's perfected security interest in such Collateral without Secured Party's prior, reasonable consent. The Grantor will not change its name, the location of its chief place of business or chief executive office or its corporate structure (including without limitation, its jurisdiction of organization) unless the Secured Party has been given at least 30 days prior written notice thereof and the Grantor has executed and delivered to the Secured Party such Financing Statements and other instruments required or appropriate to continue the perfection of the Security Interest.

Section 7. Rights to Payment. Except as the Grantor may otherwise advise the Secured Party in writing, each Account, Chattel Paper, Document, General Intangible and Instrument constituting or evidencing Collateral is (or, in the case of all future Collateral, will be when arising or issued) the valid, genuine and legally enforceable obligation of the Account Debtor or other obligor named therein or in the Grantor's records pertaining thereto as being obligated to pay or perform such obligation. Without the Secured Party's prior written consent, the Grantor will not agree to any modifications, amendments, subordinations, cancellations or terminations of the obligations of any such Account Debtors or other obligors except in the ordinary course of business. The Grantor will perform and comply in all material respects with all its obligations under any items included in the Collateral and exercise promptly and diligently its rights thereunder.

Section 8. Further Assurances; Attorney-in-Fact.

8(a) The Grantor agrees that from time to time, at its expense, it will promptly execute and deliver all further instruments and documents, and take all further action, that may be necessary or that the Secured Party may reasonably request, in order to perfect and protect the Security Interest granted or purported to be granted hereby or to enable the Secured Party to exercise and enforce its rights and remedies hereunder with respect to any Collateral (but any failure to request or assure that the Grantor execute and deliver such instrument or documents or to take such action shall not affect or impair the validity, sufficiency or enforceability of this Agreement and the Security Interest, regardless of whether any such item was or was not executed and delivered or action taken in a similar context or on a prior occasion). Without limiting the generality of the foregoing, the Grantor will, promptly and from time to time at the request of the Secured Party: (i) execute and file such Financing Statements or continuation statements in respect thereof, or amendments thereto, and such other instruments or notices (including fixture filings with any necessary legal descriptions as to any goods included in the Collateral which the Secured Party determines might be deemed to be fixtures, and instruments and notices with respect to vehicle titles), as may be necessary or desirable, or as the Secured Party may request, in order to perfect, preserve, and enhance the Security Interest granted or purported to be granted hereby; (ii) obtain from any bailee holding any item of Collateral an acknowledgement, in form satisfactory to the Secured Party that such bailee holds such collateral for the benefit of the Secured Party; (iii) obtain from any securities intermediary, or other party holding any item of Collateral, control agreements in form satisfactory to the Secured Party (iv) and deliver and pledge to the Secured Party, all Instruments and Documents, duly indorsed or accompanied by duly executed instruments of transfer or assignment, with full recourse to the Grantor, all in form and substance satisfactory to the Secured Party; (v) obtain waivers, in form satisfactory to the Secured Party, of any claim to any Collateral from any landlords or mortgagees of any property where any Inventory or Equipment is located.

8(b) The Grantor hereby authorizes the Secured Party to file one or more Financing Statements or continuation statements in respect thereof, and amendments thereto, relating to all or any part of the Collateral without the signature of the Grantor where permitted by law. The Grantor irrevocably waives any right to notice of any such filing. A photocopy or other reproduction of this Agreement or any Financing Statement covering the Collateral or any part thereof shall be sufficient as a Financing Statement where permitted by law.

8(c) The Grantor will furnish to the Secured Party from time to time statements and schedules further identifying and describing the Collateral and such other reports in connection with the Collateral as the Secured Party may reasonably request, all in reasonable detail and in form and substance reasonably satisfactory to the Secured Party.

8(d) In furtherance, and not in limitation, of the other rights, powers and remedies granted to the Secured Party in this Agreement, the Grantor hereby appoints the Secured Party the Grantor's attorney-in-fact, with full authority in the place and stead of Grantor and in the name of Grantor or otherwise, from time to time in the Secured Party's good faith discretion, to take any action (including the right to collect on any Collateral) and to execute any instrument that the Secured Party may reasonably believe is necessary or advisable to accomplish the purposes of this Agreement, in a manner consistent with the terms hereof.

8(e) Taxes and Claims. The Grantor will promptly pay all taxes and other governmental charges levied or assessed upon or against any Collateral or upon or against the creation, perfection or continuance of the Security Interest, as well as all other claims of any kind (including claims for labor, material and supplies) against or with respect to the Collateral, except to the extent (a) such taxes, charges or claims are being contested in good faith by appropriate proceedings, (b) such proceedings do not involve any material danger of the sale, forfeiture or loss of any of the Collateral or any interest therein and (c) such taxes, charges or claims are adequately reserved against on the Grantor's books in accordance with generally accepted accounting principles.

Section 9. Books and Records. The Grantor will keep and maintain at its own cost and expense satisfactory and complete records of the Collateral, including a record of all payments received and credits granted with respect to all Accounts, Chattel Paper and other items included in the Collateral.

Section 10. Inspection, Reports, Verifications. The Grantor will at all reasonable times permit the Secured Party or its representatives to examine or inspect any Collateral, any evidence of Collateral and the Grantor's books and records concerning the Collateral, wherever located. The Grantor will from time to time when requested by the Secured Party furnish to the Secured Party a report on its Accounts, Chattel Paper, General Intangibles and Instruments, naming the Account Debtors or other obligors thereon, the amount due and the aging thereof. The Secured Party or its designee is authorized to contact Account Debtors and other Persons obligated on any such Collateral from time to time to verify the existence, amount and/or terms of such Collateral.

Section 11. Notice of Loss. The Grantor will promptly notify the Secured Party of any loss of or material damage to any material item of Collateral or of any substantial adverse change, known to Grantor, in any material item of Collateral or the prospect of payment or performance thereof.

Section 12. Insurance. The Grantor will keep the Inventory and Equipment insured against "all risks" for the full replacement cost thereof with an insurance company or companies satisfactory to the Secured Party, provided such insurance requirements are comparable to those generally required in similar commercial endeavors, the policies to protect the Secured Party as its interests may appear, with such policies or certificates with respect thereto to be delivered to the Secured Party at its request. Each such policy or the certificate with respect thereto shall provide that such policy shall not be canceled or allowed to lapse unless at least 30 days prior written notice is given to the Secured Party.

Section 13. Lawful Use; Fair Labor Standards Act. The Grantor will use and keep the Collateral, and will require that others use and keep the Collateral, only for lawful purposes, without violation of any federal, state or local law, statute or ordinance. All Inventory of the Grantor as of the date of this Agreement that was produced by the Grantor or with respect to which the Grantor performed any manufacturing or assembly process was produced by the Grantor (or such manufacturing or assembly process was conducted) in compliance in all material respects with all requirements of the Fair Labor Standards Act, and all Inventory produced, manufactured or assembled by the Grantor after the date of this Agreement will be so produced, manufactured or assembled, as the case may be.

Section 14. Action by the Secured Party. If the Grantor at any time fails to perform or observe any of the foregoing agreements, the Secured Party shall have (and the Grantor hereby grants to the Secured Party) the right, power and authority (but not the duty) to perform or observe such agreement on behalf and in the name, place and stead of the Grantor (or, at the Secured Party's option, in the Secured Party's name) and to take any and all other actions which the Secured Party may reasonably deem necessary to cure or correct such failure (including, without limitation, the payment of taxes, the satisfaction of Liens, the procurement and maintenance of insurance, the execution of assignments, security agreements and Financing Statements, and the endorsement of instruments); and the Grantor shall thereupon pay to the Secured Party on demand the amount of all monies expended and all costs and expenses (including reasonable attorneys' fees and legal expenses) incurred by the Secured Party in connection with or as a result of the performance or observance of such agreements or the taking of such action by the Secured Party, together with interest thereon from the date expended or incurred at the highest lawful rate then applicable to any of the Obligations, and all such monies expended, costs and expenses and interest thereon shall be part of the Obligations secured by the Security Interest.

Section 15. Insurance Claims. As additional security for the payment and performance of the Obligations, the Grantor hereby assigns to the Secured Party any and all monies (including proceeds of insurance and refunds of unearned premiums) due or to become due under, and all other rights of the Grantor with respect to, any and all policies of insurance now or at any time hereafter covering the Collateral or any evidence thereof or any business records or valuable papers pertaining thereto. At any time, whether before or after the occurrence of any Event of Default, the Secured Party may (but need not), in the Secured Party's name or in Grantor's name, execute and deliver proofs of claim, receive all such monies, indorse checks and other instruments representing payment of such monies, and adjust, litigate, compromise or release any claim against the issuer of any such policy. Notwithstanding any of the foregoing, so long as no Event of Default exists the Grantor shall be entitled to all insurance proceeds with respect to Equipment or Inventory provided that such proceeds are applied to the cost of replacement Equipment or Inventory.

Section 16. The Secured Party's Duties. The powers conferred on the Secured Party hereunder are solely to protect its interest in the Collateral and shall not impose any duty upon it to exercise any such powers. The Secured Party shall be deemed to have exercised reasonable care in the safekeeping of any Collateral in its possession if such Collateral is accorded treatment substantially equal to the safekeeping which the Secured Party accords its own property of like kind. Except for the safekeeping of any Collateral in its possession and the accounting for monies and for other properties actually received by it hereunder, the Secured Party shall have no duty, as to any Collateral, as to ascertaining or taking action with respect to calls, conversions, exchanges, maturities, tenders or other matters relative to any Collateral, whether or not the Secured Party has or is deemed to have knowledge of such matters, or as to the taking of any necessary steps to preserve rights against any Persons or any other rights pertaining to any Collateral. The Secured Party will take action in the nature of exchanges, conversions, redemptions, tenders and the like requested in writing by the Grantor with respect to the Collateral in the Secured Party's possession if the Secured Party in its reasonable judgment determines that such action will not impair the Security Interest or the value of the Collateral, but a failure of the Secured Party to comply with any such request shall not of itself be deemed a failure to exercise reasonable care with respect to the taking of any necessary steps to preserve rights against any Persons or any other rights pertaining to any Collateral.

Section 17. Default. Each of the following occurrences shall constitute an Event of Default under this Agreement: (a) the Grantor shall fail to observe or perform any covenant or agreement applicable to the Grantor under this Agreement that materially and immediately jeopardizes Secured Party's rights established herein; or (b) any representation or warranty made by the Grantor in this Agreement or any schedule, exhibit, supplement or attachment hereto or in any financial statements, or reports or certificates heretofore or at any time hereafter submitted by or on behalf of the Grantor to the Secured Party shall prove to have been false or materially misleading when made; or (c) any event of default shall occur under the Loan Notes.

Section 18. Remedies on Default. Upon the occurrence of an Event of Default and at any time thereafter:

18(a) The Secured Party may exercise and enforce any and all rights and remedies available upon default to a secured party under Article 9 of the Uniform Commercial Code as in effect in the State of Nevada, except as such rights may be extended or otherwise modified herein.

18(b) The Secured Party shall have the right to enter upon and into and take possession of all or such part or parts of the properties of the Grantor, including lands, plants, buildings, Equipment, Inventory and other property as may be necessary or appropriate in the judgment of the Secured Party to permit or enable the Secured Party to manufacture, produce, process, store or sell or complete the manufacture, production, processing, storing or sale of all or any part of the Collateral, as the Secured Party may elect, and to use and operate said properties for said purposes and for such length of time as the Secured Party may deem necessary or appropriate for said purposes without the payment of any compensation to Grantor therefor. The Secured Party may require the Grantor to, and the Grantor hereby

agrees that it will, at its expense and upon request of the Secured Party forthwith, assemble all or part of the Collateral as directed by the Secured Party and make it available to the Secured Party at a place or places to be designated by the Secured Party.

18(c) Any disposition of Collateral may be in one or more parcels at public or private sale, at any of the Secured Party's offices or elsewhere, for cash, on credit, or for future delivery, and upon such other terms as the Secured Party may reasonably believe are commercially reasonable. The Secured Party shall not be obligated to dispose of Collateral regardless of notice of sale having been given, and the Secured Party may adjourn any public or private sale from time to time by announcement made at the time and place fixed therefor, and such disposition may, without further notice, be made at the time and place to which it was so adjourned.

18(d) The Secured Party is hereby granted a license or other right to use, without charge, all of the Grantor's property, including, without limitation, all of the Grantor's labels, trademarks, copyrights, patents and advertising matter, or any property of a similar nature, as it pertains to the Collateral, in completing production of, advertising for sale and selling any Collateral, and the Grantor's rights under all licenses and all franchise agreements shall inure to the Secured Party's benefit until the Obligations are paid in full.

18(e) If notice to the Grantor of any intended disposition of Collateral or any other intended action is required by law in a particular instance, such notice shall be deemed commercially reasonable if given in the manner specified for the giving of notice in Section 23 hereof at least thirty (30) calendar days prior to the date of intended disposition or other action, and the Secured Party may exercise or enforce any and all other rights or remedies available by law or agreement against the Collateral, against the Grantor, or against any other Person or property. The Secured Party (i) may dispose of the Collateral in its then present condition or following such preparation and processing as the Secured Party deems commercially reasonable, (ii) shall have no duty to prepare or process the Collateral prior to sale, (iii) may disclaim warranties of title, possession, quiet enjoyment and the like except as specifically exempted as to the RCTS Patent at Section 3 herein, and (iv) may comply with any applicable state or federal law requirements in connection with a disposition of the Collateral and none of the foregoing actions shall be deemed to adversely affect the commercial reasonableness of the disposition of the Collateral. Upon notice of intention to sell Collateral, Grantor shall have until the tenth day pursuant to the scheduled sale date to cure the default in its entirety and upon doing so, Secured Party shall cease further action against the Collateral.

Section 19. Remedies as to Certain Rights to Payment. Upon the occurrence of an Event of Default and at any time thereafter the Secured Party may notify any Account Debtor or other Person obligated on any Accounts or other Collateral that the same have been assigned or transferred to the Secured Party and that the same should be performed as requested by, or paid directly to, the Secured Party, as the case may be. The Grantor shall join in giving such notice, if the Secured Party so requests. The Secured Party may, in the Secured Party's name or in the Grantor's name, demand, sue for, collect or receive any money or property at any time payable or receivable on account of, or securing, any such Collateral or grant any extension to, make any compromise or settlement with or otherwise agree to waive, modify, amend or change the obligation of any such Account Debtor or other Person. If any payments on any such Collateral are received by the Grantor after an Event of Default has occurred, such payments shall be held in trust by the Grantor as the property of the Secured Party and shall not be commingled with any funds or property of the Grantor and shall be forthwith remitted to the Secured Party for application on the Obligations.

Section 20. Application of Proceeds. All cash proceeds received by the Secured Party in respect of any sale of, collection from, or other realization upon all or any part of the Collateral may, in the discretion of the Secured Party, be held by the Secured Party as collateral for, or then or at any time thereafter be applied in whole or in part by the Secured Party against, all or any part of the Obligations (including, without limitation, any expenses of the Secured Party payable pursuant to Section 21 hereof).

Section 21. Costs and Expenses; Indemnity. The Grantor will pay or reimburse the Secured Party on demand for all out-of-pocket expenses (including in each case all filing and recording fees and taxes and all reasonable fees and expenses of counsel and of any experts and agents) incurred by the Secured Party in connection with the creation, perfection, protection, satisfaction, foreclosure or enforcement of the Security Interest and the preparation, administration, continuance, amendment or enforcement of this Agreement, and all such costs and expenses shall be part of the Obligations secured by the Security Interest. The Grantor shall indemnify and hold the Secured Party harmless from and against any and all claims, losses and liabilities (including reasonable attorneys' fees) growing out of or resulting from this Agreement and the Security Interest hereby created (including enforcement of this Agreement) or the Secured Party's actions pursuant hereto, except claims, losses or liabilities resulting from the Secured Party's gross negligence or willful misconduct as determined by a final judgment of a court of competent jurisdiction. Any liability of the Grantor to indemnify and hold the Secured Party harmless pursuant to the preceding sentence shall be part of the Obligations secured by the Security Interest. The obligations of the Grantor under this Section shall survive any termination of this Agreement.

Section 22. Waivers; Remedies; Marshalling. This Agreement can be waived, , terminated or discharged, and the Security Interest can be released, only explicitly in a writing signed by the Secured Party. Any modification or amendment requires signature of both parties. A waiver so signed shall be effective only in the specific instance and for the specific purpose given. Mere delay or failure to act shall not preclude the exercise or enforcement of any rights and remedies available to either party. All rights and remedies of the Secured Party shall be cumulative and may be exercised singly in any order or sequence, or concurrently, at the Secured Party's option, and the exercise or enforcement of any such right or remedy shall neither be a condition to nor bar the exercise or enforcement of any other.

Section 23. Notices. Any notice or other communication to any party in connection with this Agreement shall be in writing and shall be sent by manual delivery, facsimile transmission, overnight courier or United States mail (postage prepaid) addressed to such party at the address specified on the signature page hereof, or at such other address as such party shall have specified to the other party hereto in writing. All periods of notice shall be measured from the date of delivery thereof if manually delivered, from the date of sending thereof if sent by facsimile transmission, from the first business day after the date of sending if sent by overnight courier, or from four days after the date of mailing if mailed.

Section 24. Grantor Acknowledgments. The Grantor hereby acknowledges that (a) it has been advised by counsel in the negotiation, execution and delivery of this Agreement, (b) the Secured Party has no fiduciary relationship to the Grantor, the relationship being solely that of debtor and creditor, and (c) no joint venture exists between the Grantor and the Secured Party.

Section 25. Continuing Security Interest; Assignments. This Agreement shall (a) create a continuing security interest in the Collateral and shall remain in full force and effect until payment in full of the Obligations and the expiration of the obligations, if any, of the Secured Party, (b) be binding upon the Grantor, its successors and assigns, and (c) inure to the benefit of, and be enforceable by, the Secured Party and its successors, transferees, and assigns.

Section 26. Termination of Security Interest. Upon payment in full of the Obligations and the expiration of any obligation of the Secured Party, if any, the Security Interest granted hereby shall terminate. Upon any such termination, the Secured Party will return to the Grantor such of the Collateral then in the possession of the Secured Party as shall not have been sold or otherwise applied pursuant to the terms hereof and execute and deliver to the Grantor such documents as the Grantor shall reasonably request to evidence such termination. Any reversion or return of Collateral upon termination of this Agreement and any instruments of transfer or termination shall be at the expense of the Grantor and shall be without warranty by, or recourse on, the Secured Party. As used in this Section, "Grantor" includes any assigns of Grantor, any Person holding a subordinate security interest in any of the Collateral or whoever else may be lawfully entitled to any part of the Collateral.

Section 27. Governing Law and Construction. **THE VALIDITY, CONSTRUCTION AND ENFORCEABILITY OF THIS AGREEMENT SHALL BE GOVERNED BY THE LAWS OF THE STATE OF NEVADA, WITHOUT GIVING EFFECT TO CONFLICT OF LAWS PRINCIPLES THEREOF, EXCEPT TO THE EXTENT THAT THE VALIDITY OR PERFECTION OF THE SECURITY INTEREST HEREUNDER, OR REMEDIES HEREUNDER, IN RESPECT OF ANY PARTICULAR COLLATERAL ARE MANDATORILY GOVERNED BY THE LAWS OF A JURISDICTION OTHER THAN THE STATE OF NEVADA.** Whenever possible, each provision of this Agreement and any other statement, instrument or transaction contemplated hereby or relating hereto shall be interpreted in such manner as to be effective and valid under such applicable law, but, if any provision of this Agreement or any other statement, instrument or transaction contemplated hereby or relating hereto shall be held to be prohibited or invalid under such applicable law, such provision shall be ineffective only to the extent of such prohibition or invalidity, without invalidating the remainder of such provision or the remaining provisions of this Agreement or any other statement, instrument or transaction contemplated hereby or relating hereto.

Section 28. Consent to Jurisdiction. **AT THE OPTION OF THE SECURED PARTY, THIS AGREEMENT MAY BE ENFORCED IN ANY FEDERAL COURT OR NEVADA STATE COURT SITTING IN WASHOE COUNTY, NEVADA; AND THE GRANTOR CONSENTS TO THE JURISDICTION AND VENUE OF ANY SUCH COURT AND WAIVES ANY ARGUMENT THAT VENUE IN SUCH FORUMS IS NOT CONVENIENT. IN THE EVENT A PARTY HERETO COMMENCES ANY ACTION IN ANOTHER JURISDICTION OR VENUE UNDER ANY TORT OR CONTRACT THEORY ARISING DIRECTLY OR INDIRECTLY FROM THE RELATIONSHIP CREATED BY THIS AGREEMENT, THE OTHER PARTY AT ITS OPTION SHALL BE ENTITLED TO HAVE THE CASE TRANSFERRED TO ONE OF THE JURISDICTIONS AND VENUES ABOVE-DESCRIBED, OR IF SUCH TRANSFER CANNOT BE ACCOMPLISHED UNDER APPLICABLE LAW, TO HAVE SUCH CASE DISMISSED WITHOUT PREJUDICE, AND SUCH OTHER PARTY SHALL BE AWARDED REASONABLE LEGAL FEES AND COSTS INCURRED IN CONNECTION WITH THE TRANSFER OR DISMISSAL ACTION**

Section 29. Waiver of Notice and Hearing. **THE GRANTOR HEREBY WAIVES ALL RIGHTS TO A JUDICIAL HEARING OF ANY KIND PRIOR TO THE EXERCISE BY THE SECURED PARTY OF ITS RIGHTS TO POSSESSION OF THE COLLATERAL WITHOUT JUDICIAL PROCESS OR OF ITS RIGHTS TO REPLEVY, ATTACH, OR LEVY UPON THE COLLATERAL WITHOUT PRIOR NOTICE OR HEARING. THE GRANTOR ACKNOWLEDGES THAT IT HAS BEEN ADVISED BY COUNSEL OF ITS CHOICE WITH RESPECT TO THIS PROVISION AND THIS AGREEMENT.**

Section 30. Waiver of Jury Trial. **EACH OF THE GRANTOR AND THE SECURED PARTY, BY ITS ACCEPTANCE OF THIS AGREEMENT, IRREVOCABLY WAIVES ANY AND ALL RIGHT TO TRIAL BY JURY IN ANY LEGAL PROCEEDING ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE TRANSACTIONS CONTEMPLATED HEREBY.**

Section 31. Counterparts. This Agreement may be executed in any number of counterparts, each of which when so executed and delivered shall be deemed an original, but all such counterparts together shall constitute but one and the same instrument.

Section 32. General. All representations and warranties contained in this Agreement or in any other agreement between the Grantor and the Secured Party shall survive the execution, delivery and performance of this Agreement and the creation and payment of the Obligations. The Grantor waives notice of the acceptance of this Agreement by the Secured Party. Captions in this Agreement are for reference and convenience only and shall not affect the interpretation or meaning of any provision of this Agreement.

IN WITNESS WHEREOF, the Grantor has caused this Security Agreement to be duly executed and delivered by its officer thereunto duly authorized as of the date first above written.

IONIC WATER TECHNOLOGIES INC.,
A Nevada corporation

By _____

Title CEO & Director / Chairman of The Board

Address for Grantor:

IONIC WATER TECHNOLOGIES INC.
4232 Adams Street
Boise, ID 83714

With copy to:

Walsh, Baker & Rosevear PC
9468 Double R Blvd, Suite A
Reno NV 89521

Grantor's Identification#: C21228-2004

Addresses for the Secured Parties:

RAB SPECIAL SITUATIONS (MASTER) FUND LIMITED
c/o RAB Capital Plc
1 Adam Street
London, WC2N 6LE

With copy to:

Dorsey & Whitney LLP
370 Seventeenth Street, Suite 4700
Denver, CO 80202
Attn: Kenneth G. Sam

MAJEDIE INVESTMENTS plc,
Attn: Chris Simmons
1 Minster Court
Mincing Lane, London EC3R 7ZZ

MARC BAMBER
c/o RAB Capital Plc
1 Adam Street
London, WC2N 6LE

EXHIBIT A

FORM OF UCC FINANCING STATEMENT

[redacted]

UCC FINANCING STATEMENT

FOLLOW INSTRUCTIONS (front and back) CAREFULLY

A. NAME & PHONE OF CONTACT AT FILER [optional]

B. SEND ACKNOWLEDGMENT TO: (Name and Address)

WALSH, BAKER & ROSEVEAR PC.
9468 DOUBLE R. BLVD. SUITE A
RENO NV 89521

THE ABOVE SPACE IS FOR FILING OFFICE USE ONLY

1. DEBTOR'S EXACT FULL LEGAL NAME - insert only one debtor name (1a or 1b) - do not abbreviate or combine names

1a. ORGANIZATION'S NAME: IONIC WATER TECHNOLOGIES, INC.

OR

1b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

1c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY
4232 ADAMS STREET	BOISE	ID	83714	USA

1d. SEE INSTRUCTIONS	ADD'L INFO RE ORGANIZATION DEBTOR	1e. TYPE OF ORGANIZATION	1f. JURISDICTION OF ORGANIZATION	1g. ORGANIZATIONAL ID #, if any
		CORPORATION	NEVADA	C21228-2004 ☐ NONE

2. ADDITIONAL DEBTOR'S EXACT FULL LEGAL NAME - insert only one debtor name (2a or 2b) - do not abbreviate or combine names

2a. ORGANIZATION'S NAME: NONE

OR

2b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

2c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

2d. SEE INSTRUCTIONS	ADD'L INFO RE ORGANIZATION DEBTOR	2e. TYPE OF ORGANIZATION	2f. JURISDICTION OF ORGANIZATION	2g. ORGANIZATIONAL ID #, if any
				☐ NONE

3. SECURED PARTY'S NAME (or NAME of TOTAL ASSIGNEE of ASSIGNOR S/P) - insert only one secured party name (3a or 3b)

3a. ORGANIZATION'S NAME: RAB SPECIAL SITUATIONS (MASTER) FUND LIMITED

OR

3b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

3c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY
1 ADAM STREET	LONDON		WC2N 6LE	UK

4. This FINANCING STATEMENT covers the following collateral:

See Exhibit A attached hereto and made a part hereof.

5. ALTERNATIVE DESIGNATION [if applicable]: ☐ LESSEE/LESSOR ☐ CONSIGNEE/CONSIGNOR ☐ BAILEE/BAILOR ☐ SELLER/BUYER ☐ AG. LIEN ☐ NON-UCC FILING

6. ☐ This FINANCING STATEMENT is to be filed [for record] (or recorded) in the REAL ESTATE RECORDS. Attach Addendum [if applicable]

7. Check to REQUEST SEARCH REPORT(S) on Debtor(s) [ADDITIONAL FEE] [optional] ☐ All Debtors ☐ Debtor 1 ☐ Debtor 2

8. OPTIONAL FILER REFERENCE DATA

TO BE FILED WITH THE SECRETARY OF THE STATE OF NEVADA

FILING OFFICE COPY — UCC FINANCING STATEMENT (FORM UCC1) (REV. 05/22/02)

UCC FINANCING STATEMENT ADDITIONAL PARTY

FOLLOW INSTRUCTIONS (front and back) CAREFULLY

19. NAME OF FIRST DEBTOR (1a or 1b) ON RELATED FINANCING STATEMENT

19a. ORGANIZATION'S NAME

OR **IONIC WATER TECHNOLOGIES, INC.**

19b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME,SUFFIX

20. MISCELLANEOUS:

THE ABOVE SPACE IS FOR FILING OFFICE USE ONLY

21. ADDITIONAL DEBTOR'S EXACT FULL LEGAL NAME - insert only one name (21a or 21b) - do not abbreviate or combine names

21a. ORGANIZATION'S NAME

OR

21b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

21c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

21d. SEE INSTRUCTIONS	ADD'L INFO RE ORGANIZATION DEBTOR	21e. TYPE OF ORGANIZATION	21f. JURISDICTION OF ORGANIZATION	21g. ORGANIZATIONAL ID #, if any
				☐ NONE

22. ADDITIONAL DEBTOR'S EXACT FULL LEGAL NAME - insert only one name (22a or 22b) - do not abbreviate or combine names

22a. ORGANIZATION'S NAME

OR

22b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

22c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

22d. SEE INSTRUCTIONS	ADD'L INFO RE ORGANIZATION DEBTOR	22e. TYPE OF ORGANIZATION	22f. JURISDICTION OF ORGANIZATION	22g. ORGANIZATIONAL ID #, if any
				☐ NONE

23. ADDITIONAL DEBTOR'S EXACT FULL LEGAL NAME - insert only one name (23a or 23b) - do not abbreviate or combine names

23a. ORGANIZATION'S NAME

OR

23b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

23c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

23d. SEE INSTRUCTIONS	ADD'L INFO RE ORGANIZATION DEBTOR	23e. TYPE OF ORGANIZATION	23f. JURISDICTION OF ORGANIZATION	23g. ORGANIZATIONAL ID #, if any
				☐ NONE

24. ADDITIONAL SECURED PARTY'S NAME (or Name of TOTAL ASSIGNEE) - insert only one name (24a or 24b)

24a. ORGANIZATION'S NAME

OR **MAJEDIE INVESTMENTS plc**

24b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX

24c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY
1 MINSTER COURT, MINCING LANE	**LONDON**		**EC3R 7ZZ**	**UK**

25. ADDITIONAL SECURED PARTY'S NAME (or Name of TOTAL ASSIGNEE) - insert only one name (25a or 25b)

25a. ORGANIZATION'S NAME

OR

25b. INDIVIDUAL'S LAST NAME	FIRST NAME	MIDDLE NAME	SUFFIX
BAMBER	**MARC**		

25c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY
NO. 1 ADAM STREET	**LONDON**		**W2CN 6LE**	**UK**

FILING OFFICE COPY — UCC FINANCING STATEMENT ADDITIONAL PARTY (FORM UCC1AP) (REV. 05/22/02)

Debtor:	**IONIC WATER TECHNOLOGIES INC.**, a Nevada corporation
Secured Party:	**RAB SPECIAL SITUATIONS (MASTER) FUND LIMITED**
Additional Secured Party:	**MAJEDIE INVESTMENT, plc and MARC BAMBER**
Page No:	1

EXHIBIT A TO UCC FINANCING STATEMENT – 4 PAGES

COLLATERAL DESCRIPTION

This Financing Statement covers the following types (or items) of property:

All of the Debtor's right, title, and interest in and to the following, whether now or hereafter owned, existing, arising or acquired and wherever located:

All Accounts
All Chattel Paper
All Deposit Accounts
All Documents
All Equipment
All General Intangibles (including Patents and Patent Rights)
All Instruments
All Inventory
All Investment Property
All Letter of Credit Rights
All Patents and Patent Rights

To the extent not otherwise included in the foregoing, all other rights to the payment of money, including rents and other sums payable to the Debtor under leases, rental agreements and other Chattel Paper; all books, correspondence, credit files, records, invoices, bills of lading, and other documents relating to any of the foregoing, including, without limitation, all tapes, cards, disks, computer software, computer runs, and other papers and documents in the possession or control of the Debtor or any computer bureau from time to time acting for the Debtor; all rights in, to and under all policies insuring the life of any officer, director, stockholder or employee of the Debtor, the proceeds of which are payable to the Debtor; all accessions and additions to, parts and appurtenances of, substitutions for and replacements of any of the foregoing; and all proceeds (including insurance proceeds) and products thereof.

DEFINED TERMS

As used in this Financing Statement, the following terms shall have the meanings indicated:

"Account" shall mean a right to payment of a monetary obligation, whether or not earned by performance, (i) for property that has been or is to be sold, leased, licensed, assigned, or otherwise disposed of, (ii) for services rendered or to be rendered, (iii) for a policy of insurance issued or to be issued, (iv) for a secondary obligation incurred or to be incurred, (v) for energy provided or to be provided, (vi) for the use or hire of a vessel under a charter or other contract, (vii) arising out of the use of a credit or charge card or information contained on or for use with the card, or (viii) as winnings in a lottery or other game of chance operated, sponsored, licensed or authorized by a State or governmental unit of a State, or person licensed or authorized to operate the game by a State or governmental unit of a State. The term includes health-care insurance receivables.

"Chattel Paper" shall mean a record or records that evidence both a monetary obligation and a security interest in specific goods, a security interest in specific goods and software used in the goods, a security interest in specific goods and license of software used in the goods, a lease of specific goods, or a lease of specific goods and license of software used in the goods.

"Deposit Account" shall mean any demand, time, savings and passbook, or similar accounts maintained with any bank.

"Document" shall mean a document of title or a warehouse receipt.

"Equipment" shall mean all machinery, equipment, motor vehicles, furniture, furnishings and fixtures, including all accessions, accessories and attachments thereto, and any guaranties, warranties, indemnities and other agreements of manufacturers, vendors and others with respect to such Equipment.

"General Intangibles" shall mean any personal property (other than goods, Accounts, Chattel Paper, Deposit Accounts, Documents, Instruments, Investment Property, Letter of Credit Rights and money) including things in action, contract rights, payment intangibles, software, corporate and other business records, inventions, designs, patents, patent

applications, service marks, trademarks, trade names, trade secrets, internet domain names, engineering drawings, good will, registrations, copyrights, licenses, franchises, customer lists, tax refund claims, royalties, licensing and product rights, rights to the retrieval from third parties of electronically processed and recorded data and all rights to payment resulting from an order of any court.

"Instrument" shall mean a negotiable instrument or any other writing which evidences a right to the payment of a monetary obligation and is not itself a security agreement or lease and is of a type which is transferred in the ordinary course of business by delivery with any necessary endorsement or assignment.

"Inventory" shall mean goods, other than farm products, which are leased by a person as lessor, are held by a person for sale or lease or to be furnished under a contract of service, are furnished by a person under a contract of service, or consist of raw materials, work in process, or materials used or consumed in a business or incorporated or consumed in the production of any of the foregoing and supplies, in each case wherever the same shall be located, whether in transit, on consignment, in retail outlets, warehouses, terminals or otherwise, and all property the sale, lease or other disposition of which has given rise to an Account and which has been returned to the Debtor or repossessed by the Debtor or stopped in transit.

"Investment Property" shall mean a security, whether certificated or uncertificated, a security entitlement, a securities account and all financial assets therein, a commodity contract, or a commodity account.

"Letter of Credit Right" shall mean a right to payment or performance under a letter of credit, whether or not the beneficiary has demanded or is at the time entitled to demand payment or performance.

"Patent" means all of the following in which Grantor now holds or hereafter acquires which are related to or derive from the United States Patent No. 7,011,745, including : (a) all letters patent of the United States or any other country, all registrations and recordings thereof and all applications for letters patent of the United States or any other country, including, without limitation, registrations, recordings and applications in the United States Patent and Trademark Office or in any similar office or agency of the United States, any State thereof or any other country; (b) all reissues, divisions, continuations, renewals, continuations in part or extensions thereof; (c) all petty patents, divisionals and

patents of addition; (d) all patents to issue in any such applications; (e) income, royalties, damages, claims and payments now and hereafter due and/or payable with respect to patents, including, without limitation, damages, claims and recoveries for past, present or future infringement; and (f) rights to sue for past, present and future infringements of any patent.

"Patent Rights" means any and all written agreements, in which Grantor now holds or hereafter acquires any interest, granting any right with respect to the Patent (whether Grantor is the licensee or the licensor thereunder).

IONIC WATER TECHNOLOGIES, INC.

PATENT TRANSFER AND ROYALTIES AGREEMENT
(With Security Instrument)

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1. DEFINITIONS.

1.1. **"Agreement"** means this Patent Transfer and Royalties Agreement and all exhibits and appendix properly attached hereto.

1.2. **"Date of Patent"** means July 11, 2003 (the original filing date of the Patent).

1.3. **"Effective Date"** means September 14, 2006.

1.4. **"Gross Sale Price"** has the meaning defined at Section 9.2.

1.5. **"IWT"** means IONIC WATER TECHNOLOGIES, INC., a Nevada corporation in good standing and all of its officers, agents, employees, subsidiaries, affiliates for which it has authority to act and successors in interest.

1.6. **"Moulton"** means Patrick L. Moulton, an individual, and all of his employees, agents, affiliates for whom he has authority to act, heirs, assignees, estate and successors in interest.

1.7. **"Patent"** means the United States Patent No. 7,011,745 identified at **Exhibit A.**

1.8. **"Patent Rights"** means any and all rights enjoyed by or exercisable by Moulton due to Moulton's ownership interest in the Patent, whether set forth at **Exhibit A,** in any patent application related to the Patent, or otherwise as provided by applicable law.

1.9. **"RCTS"** means the Rotating Perforated Cylinder Treatment System and all attributes and components of RCTS described or defined in the United States Patent No. 7,011,745 attached hereto at **Exhibit A.**

1.10. **"RCTS Unit"** means each unit substantially representing the RCTS configurations identified Figure 1, 2 and/or 3 included in the Patent attached hereto at **Exhibit A.**

1.11. **"RCTS Derivative Unit"** means each unit produced by IWT pursuant to a design, invention or engineering concept for which IWT claims ownership of Patent Rights or otherwise which is a design, invention or engineering concept derived from properties identified in the RCTS, Patent Rights or Patent.

2. ASSIGNMENTS AND LICENSES.

2.1 Moulton hereby sells and assigns to IWT all of Moulton's right, title and interest in Patent Rights as of the Effective Date.

2.2. Moulton hereby assigns and delegates to IWT any and all rights set forth in license agreements and sublicense agreements that now exist or which may hereafter be invoked by third parties as to the RCTS, Patent or Patent Rights, provided that all such agreements, if any, shall be set forth in an appendix attached to this Agreement. IWT shall agree to and accepted such license and sublicense agreements in its sole discretion and judgment, within ten (10) days after execution of both parties of this Agreement. Any licensing agreements or obligations not disclosed and approved in a timely manner shall be deemed not accepted by IWT unless IWT waives the provisions of this section and accepts such agreements. Moulton shall be solely responsible for assuring that any third parties holding licensing agreements accept assignment of the accepted agreements by IWT. Moulton shall indemnify and hold harmless IWT in perpetuity for any and all actions and losses that may be incurred, to the same extent Moulton indemnifies and holds harmless IWT as to the Patent Rights, set forth below.

2.3 Moulton hereby grants to IWT an exclusive, perpetual, worldwide, assignable license (with the right to grant sublicenses) to all technologies and subject matter in which Moulton hereafter may have an interest that is found to be outside the scope of the Patent Rights but which is otherwise a derivative of, component of or related technology to the technology represented in the Patent Rights, RCTS, RCTS Units or RCTS Derivative Units. Moulton will be paid royalties as to monies received by IWT due to such licensed technologies described in this Section 2.3 pursuant to the royalties schedule set forth at Section 9.3.

2.4 IWT and Moulton agree and acknowledge that as to any use by IWT of the Patent Rights prior to the Effective Date, Moulton previously granted or now grants to IWT a worldwide, non-exclusive, non-assignable license to the Patent Rights beginning on the Date of Patent and ending on the Effective Date. Provided IWT pays Moulton the cash compensation obligated at Section 9.1, the parties agree that IWT has and will have no outstanding obligations to pay compensation to Moulton for license of Patent Rights arising prior to the Effective Date. "IWT" includes, *for this Section 2.4 only*, IWT's predecessors, affiliates and Ionic Water Technologies, Inc., a Nevada corporation.

2.5 Each party hereby agrees to execute such documents and to take such other actions as shall be necessary or appropriate to effectuate the assignments and licenses set forth in this Section 2.

3. REPRESENTATIONS BY MOULTON.

Moulton makes the following representations and warranties to IWT, each of which will survive the Effective Date and the Term, in perpetuity:

3.1 To the best of Moulton's knowledge, the Patent Rights include all of the patents and patent applications owned or controlled by Moulton on or prior to the Effective Date that cover RCTS technology and RCT Units, their manufacture or use. There are no other US or unpublished foreign filings owned or controlled by Moulton filed prior to the Effective Date which claim RCTS other than as set forth in Exhibit A, nor does Moulton have any present intention to make such filings. If Moulton becomes aware of any patents or patent applications that: (i) are owned or controlled by Moulton; (ii) claim inventions made prior to the Effective Date: (iii) cover RCTS technology or units; or (iv) are not included in Exhibit A, Moulton will

promptly notify IWT in writing and execute appropriate documents to transfer such patents and patent applications to IWT.

3.2 There are no derivatives of RCTS or the Patent presently existing to Moulton's knowledge that are not transferred to IWT pursuant to this Agreement. Moulton does not owe any royalties to any third party under any agreement nor does Moulton have or know of any potential or pending claims relating to the RCTS technology, Patent or Patent Rights.

3.3 Any fees required to be paid to maintain the Patent to date have been paid in full by Moulton or by third parties acting on his behalf.

4. TECHNOLOGICAL TRANSFER.

4.1 Moulton and IWT will cooperate in the filing and execution of any and all documents necessary to effectuate the assignment to IWT of the Patent Rights, including the filing of assignments or other transfer of title covenants with the U.S. Patent and Trademark Office and foreign patent offices as applicable to the Patent Rights. Within ten (10) days from the last date both parties have executed this Agreement, Moulton will notify any attorneys handling the prosecution of the Patent Rights, to provide IWT's counsel with an immediate status update on the Patent Rights and to coordinate with IWT's counsel in order to prepare the documents necessary to transfer the Patent Rights to IWT. Within thirty (30) days from the last date both parties have executed this Agreement, Moulton and his counsel will use reasonable best efforts to transfer all files and supporting documents relating to the Patent Rights to IWT, including but not limited to, all initial invention disclosure documents, all documents sent to the U.S. Patent and Trademark Office regarding inventions and claims, all draft patent applications, all filing or prosecution documents submitted to the patent offices, and all file wrappers. Conception notebooks and all other documents in the possession or under the control of Moulton or its counsel relating to conception and/or reduction to practice, such as scientist notebooks shall be obtained in accord with Moulton's ordinary document retention and made available to IWT upon IWT' reasonable request.

4.2 Moulton will make himself and any appropriate scientific staff with whom he may work who is not otherwise affiliated with IWT available to IWT for ongoing consultation on the subject matter of the Patent and RCTS. Moulton's consultation time will be compensated by receipt of the compensation set forth at Section 9 herein. Compensation for other scientific staff will be by separate agreement between IWT and such staff.

4.3. IWT will pay all costs incurred to effectuate the technological transfer as provided above, including Moulton's reasonable attorney's fees. Provided this Agreement is still then effective, IWT will pay all future maintenance fees required for United States and international patents (including maintenance fees now known to be due to the U.S. Patent & Trademark Office on September 14, 2009, September 14, 2013 and September 14, 2017).

5. TERM AND TERMINATION.

5.1. The term of this Agreement shall expire on the latest date occurring of: (a) the expiration of the life of the Patent; (b) the expiration of the life of any international patents for RCTS applied for while this Agreement is effective; or (c) the expiration of the life of any extensions of any of the foregoing described patents (herein the "Term).

5.2. This Agreement may be terminated earlier than the expiration date only by mutual agreement of IWT's Board of Directors (voting as provided pursuant to IWT's governing rules) and Moulton, or as otherwise provided below at Section 12 (Default).

6. PATENT MAINTENANCE AND PROSECUTION RESPONSIBILITIES.

6.1 On and after the Effective Date, IWT will take responsibility for any action or proceeding involving Patent Rights. If IWT elects not to take such responsibility involving Patent Right(s) in a particular country then IWT will timely notify Moulton thirty (30) days before the time future action is due, and thereafter Moulton shall undertake such responsibility. If Moulton elects to do so, IWT will grant any necessary authority to Moulton and if Moulton takes responsibility, he shall do so at his expense.

6.2 NOTICE OF INFRINGEMENT. IWT shall promptly notify Moulton in writing of any infringement of any assigned Patent Right(s) of which it becomes aware.

6.3 ENFORCEMENT OF PATENTS. Except as otherwise set forth in this Section 6, IWT may, but shall not be required to, prosecute any alleged infringement or threatened infringement of any assigned Patent Right(s) of which it is aware or which is brought to its attention. IWT shall act in its own name and at its own expense. If IWT has failed to prosecute under the first sentence of this paragraph with respect to alleged or threatened infringement relating to any Patent Right(s) (i) two months after it has been notified in writing of such alleged infringement, or (ii) one month before the time limit, if any, set forth in the appropriate laws and regulations for the filing of such actions, whichever comes first, Moulton may, but shall not be required to, prosecute any such alleged infringement or threatened infringement of a Patent within the Patent Rights. In any such event, Moulton shall be free to act in its own name and at its own expense. IWT shall cooperate fully with Moulton in any action by Moulton under this paragraph, including if required in order to bring such an action, the furnishing of a power of attorney.

7. INDEMNITY AND WARRANTY.

7.1 INDEMNITY BY IWT. IWT will indemnify, save, defend and hold Moulton and his agents, directors and employees harmless from and against any and all suits, claims, actions, demands, liabilities, expenses and/or loss, including reasonable legal expense and attorneys fees (collectively "Claims") resulting from activities under this agreement by IWT. If IWT fails to act in accordance with the obligations in this Section 7.1, Moulton's sole remedy shall be to defend against the Claims as he best deems appropriate and he shall then be entitled to judgment for reimbursement of all losses due to the Claims against IWT that were reasonably incurred by Moulton due to IWT's failure to indemnify Moulton as required by this Section 7.1.

7.2 INDEMNITY BY MOULTON. Moulton will indemnify, save, defend and hold IWT and its agents, directors, employees, shareholders, lienholders and lenders harmless from and against any and all suits, claims, actions, demands, liabilities, expenses and/or loss, including reasonable legal expense and attorney fees, resulting from (i) Moulton's, Moulton's sublicensee's or Moulton's assignee's activities relating to previously issued licenses regarding RCTS or the Patent; (ii) Moulton's contractual obligations to third parties; or (iii) Moulton's exercise of the Patent Rights prior to the Effective Date. This indemnification excludes activities occurring due to IWT's own actions as a sublicense or licensee of Moulton as to the RCTS or Patent.

7.3 WARRANTY. Moulton warrants that he has sufficient right and title to enter into and to perform its obligations under this Agreement. EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, THE PARTIES DISCLAIM ALL WARRANTIES OF ANY NATURE, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION WARRANTIES OF VALIDITY, MERCHANTABILITY, NONINFRINGEMENT, AND FITNESS FOR A PARTICULAR PURPOSE.

8. CONFIDENTIALITY.

Confidential Information under the terms of this Agreement is all information relating to the Patent and Patent Rights sold, assigned or licensed to IWT under Section 2 of this Agreement and the technology transfer to IWT by Moulton under Section 4 of this Agreement. Moulton agrees to treat the Confidential Information as confidential and to protect and maintain the confidentiality thereof. Moulton will use at least the same standard of care as it uses to protect its own Confidential Information to ensure that its employees, agents, and consultants do not disclose or make any unauthorized use of such Confidential Information. Moulton will promptly notify IWT upon discovery of any unauthorized use or disclosure of the Confidential Information. Confidential Information will not include any information which is generally available to the public, is otherwise part of the public domain other than through any act or omission of Moulton in breach of this Agreement, or which is required to be disclosed by law or contract entered into prior to this Agreement (provided that IWT shall have notice thereof in advance so that it can act to protect its interests should it decide to do so). Upon notice by IWT hereafter, Moulton and each of his affiliates and agents shall execute separate nondisclosure and confidentiality agreements that reasonably reflect the intentions herein, which will be effective at least as early as the Date of Patent (or earlier if agreed to by IWT and Moulton).

9. CONSIDERATION AND ROYALTIES.

IWT has paid or shall pay the following compensation in exchange for the technology transfer and other considerations by Moulton provided herein:

9.1. CASH. IWT will pay to Moulton the sum of Fifty Thousand Dollars (US$50,000) cash payment, to be paid upon receipt of funding by IWT as further described below at Section 10.2 (the "Funding"). IWT may elect to make this payment in four (4) equal quarterly payments of US$12,500.00, provided the first payment is made within ten (10) days after IWT receives the first $1,000,000 of the Funding; if IWT so elects quarterly payments, interest shall accrue on the

declining balance at a rate of six percent (6%) APR beginning on the eleventh (11th) day after receipt of at least $1,000,000 of the Funding and there shall be no penalty for early payoff.

9.2. ROYALTIES. IWT will pay Moulton royalties for each sale, lease or rental of a RCTS Unit or RCTS Derivative Unit sold during the term of this Agreement. Royalties will be calculated in USD, based on the gross sale price for each such bona fide sale, lease or rental of a RCTS Unit or RCTS Derivative Unit pursuant to the schedule set forth at Section 9.3. **"Gross sale price"** is defined as the contract price applicable to the sale, lease or rental of the applicable unit and does not include revenue realized for warranties, services or otherwise. Royalty payments shall be due and owing thirty (30) days after IWT receives payment from the customer.

9.3. ROYALTIES SCHEDULE. Royalties to Moulton shall be paid pursuant to the following schedule:

9.3.1. Five percent (5%) per unit gross sale price until aggregate royalties paid to Moulton equal US$350,000; then
9.3.2. Three percent (3%) per unit gross sale price until aggregate royalties paid to Moulton equal US$700,000; then
9.3.3. Two and one-half percent (2.5%) per unit gross sale price until aggregate royalties paid to Moulton equal US$1,000,000; then
9.3.4. Two percent (2%) per unit gross sale price for remaining Term as defined in Section 5 hereof.

10. SECURITY AGREEMENT.

10.1. IWT shall hereafter issue to Moulton a Patent Security Agreement in the form attached hereto at **Exhibit B.** The terms of that Patent Security Agreement are incorporated herein as if fully set forth in the text of this Agreement. In the event of Default as defined in Section 12 hereof, Moulton may exercise such remedies as available therein in accordance with applicable law.

10.2 SUBORDINATION TO LENDERS. As an express limitation as to the application of the Patent Security Agreement, Moulton acknowledges and agrees that this Agreement is being entered into contemporaneously with and as an enticement to enable IWT to secure funding in the form of convertible debt in an amount not to exceed US$2,810,000, pursuant to the terms and conditions now or to be set forth in the documents entitled (a) "Loan Note Investment Agreement (Ionic Water Technologies, Inc. and RAB Special Situations (Master) Fund Limited), Majedie Investments plc, Marc Bamber and Executive Officers of Company)", (b) "Security Agreement" and (c) "Loan Note Instrument" (collectively herein the "Loan Documents"). Moulton has been informed of the substantive terms and conditions contained in the Loan Documents and approves of the same. Moulton agrees that any security interest in the Patent Rights and Patent afforded by way of the Patent Security Agreement shall be subordinate and junior to the security interests set forth in the Loan Documents. This subordination is effective until discharge of the security interests identified in the Loan Documents as to the Patent Rights or Patent.

11. NOTICES.

Notices under this Agreement shall be sufficient only if personally delivered, delivered by a major commercial rapid delivery courier service, facsimile or mailed by certified or registered mail, return receipt requested, to a party at its addresses set forth as follows, to be effective upon receipt as verified by courier-collected signature or facsimile transmission record:

If to IWT: IONIC WATER TECHNOLOGIES, INC.
c/o 4232 Adams Street, Boise, Idaho 83714
Attn: Board of Directors
Phone: 208-377-2688 / Facsimile: 208-376-1831

With Copy To: Ann Rosevear, Esq.
Walsh, Baker & Rosevear, PC.
9468 Double R Blvd., Suite A
Reno NV 89521
Phone: 775-853-0883 / Facsimile: 775-853-0860

If to Moulton: Patrick Moulton
8812 West Shellie Lane
Boise, ID 83704

With Copy To: Sierra Patent Group
1657 Highway 395
Minden, NV 89423
Phone: 775-586-9500 / Facsimile: 775-586-9550

12. DEFAULT.

12.1. Events of Default Triggering Security Interest Rights. The following, and only the following, shall constitute an Event of Default under this Agreement for purposes of enforcement of rights under the Patent Security Agreement: (a) IWT fails to pay cash or royalty payments identified in Section 9 and fails to cure nonpayments within thirty (30) days of notice by Moulton; or (b) IWT fails to perform an obligation owing hereunder to maintain the Patent Rights in a manner that materially and immediately jeopardizes Moulton's security interest in the Patent Rights. Should IWT cause an Event of Default, Moulton may take such action as is permitted pursuant to the laws of the State of Nevada, United States and the Patent Security Agreement.

12.2. Other Breaches. As to any other breach of any term of this Agreement by either party, excluding those specific Events of Default defined at Section 12.1 or other remedies as may be specifically limited in this Agreement, the parties shall have all rights afforded to them under the laws of the State of Nevada, United States for breach of contract or other theories of contract or tort law.

13. COMPANY RECORDS AND REPORTS.

13. 1 IWT will make the following ready and available for inspection by Moulton during regular business hours upon forty-eight (48) hours written notice:

13.1.1 Complete books and records of account, including monthly profit and loss statements, in which will be entered fully and accurately all transactions and other matters relating to IWT;

13.1.2 A current list of the full name and last known business address of each client of IWT purchasing an RCTS unit or derivative therefrom;

13.1.3 A copy of all invoices and sales receipts representing sale of an RCTS unit or derivative therefrom for which Moulton may be entitled to receive royalty payment(s); and

13.1.4 A copy of all reports submitted to Moulton by IWT during the term of this Agreement.

13.2 All such books and records identified in Section 13.1 will be maintained at the main United States business office of IWT. IWT shall inform Moulton whether the records will be available at the main business office or IWT's United States counsel's or accountant's office, as it elects.

13.3 Other business records not includable in Section 13.1 shall be provided in a commercially reasonable time, not to exceed fifteen (15) business days unless unavoidable due to no fault of IWTs, after receipt of written request from Moulton that reasonably details the identification of the requested records.

14. REPORTING AND AUDIT RIGHTS.

14.1. Royalty payments shall be delivered with a comprehensive summary of the number, type and sales price of unit sales relating to the payment delivered. During the term of this Agreement and for two (2) years thereafter, IWT will maintain complete records regarding payment of royalties and the sales associated therewith.

14.2 Upon ten (10) days prior written notice, Moulton or his authorized agent shall have the right to make an examination and audit during normal business hours and not more frequently than once each calendar year (or once after termination or expiration of the Agreement) all records kept by IWT, and/or its clients and distributors bearing upon the amounts of royalties payable to Moulton under this Agreement. Prompt adjustment shall be made by the proper party to compensate for any errors or omissions disclosed by such examination or audit. Neither such right to examine and audit nor the right to receive such adjustments shall be affected by any statement to the contrary appearing on checks or otherwise, unless such statement appears in a letter signed by the party having such right and delivered to the other party. Any such audit conducted by Moulton will be paid for by Moulton; provided, however, that in the event any such audit reveals that IWT has underpaid Moulton by an amount greater than five percent (5%) of the amounts due Moulton in the period being audited, then, in addition to such other remedies as Moulton may have, IWT shall reimburse to Moulton the reasonable costs of such audit. In the event that the non-auditing party does not agree with the errors or

omissions presented, that party shall have the right to conduct its own audit at its own expense and the other party agrees to consider the findings of such audit in good faith.

15. MISCELLANEOUS PROVISIONS.

15.1 Agreement to Perform Necessary Acts. Each party hereto agrees to perform any further acts and execute and deliver any documents that may be reasonably necessary to carry out the provisions of this Agreement.

15.2 Amendments. The provisions of this Agreement may not be waived, altered, amended, or repealed, in whole or in part, except by written consent of both parties.

15.3 Successors and Assigns. This Agreement will be binding on, and will inure to the benefit of the Parties and their respective heirs, legal representatives, successors, and assigns.

15.4 Validity of Agreement. It is intended that each Section of this Agreement will be viewed as separate and divisible, and in the event that any Section will be held to be invalid, the remaining Sections will continue to be in full force and effect.

15.5 Governing Law. THIS AGREEMENT, AND ALL QUESTIONS RELATING TO ITS VALIDITY, INTERPRETATION, PERFORMANCE AND ENFORCEMENT (INCLUDING, WITHOUT LIMITATION, PROVISIONS CONCERNING LIMITATIONS OF ACTION), WILL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF NEVADA APPLICABLE TO AGREEMENTS MADE BY RESIDENTS OF AND TO BE PERFORMED ENTIRELY WITHIN SUCH STATE.

15.6 Exclusive Jurisdiction. It is agreed that the Second Judicial District Court of the State of Nevada, in and for the County of Washoe, will be the sole and exclusive forum for the resolution of any disputes arising among any of the Parties. The Company and each of the Parties expressly and unconditionally confer jurisdiction for the resolution of any and all disputes upon such Court. In the event that any litigation commenced in such Court is properly removable to a Federal Court under the laws of the United States of America, such removal will take place if the legal basis for removal exists; provided, however, that the parties to this Agreement agree that the exclusive venue of the Federal forum for the resolution of any disputes will be the United States District Court for the District of Nevada, Northern Nevada Division, located in Reno, Nevada.

15.7 Counterparts. This Agreement may be executed in one or more counterparts, each of which will be deemed an original, but all of which together will constitute one and the same instrument.

15.8 Gender and Number. As used in this Agreement, the masculine, feminine, and neuter gender, and the singular or plural number will be considered to include the others whenever the context so indicates.

15.9 Attorney's Fees. If any party brings an action or proceeding (including any cross-complaint, counterclaims, or third-party claim) against any other party by reason of a default by the other party or otherwise arising out of this Agreement, the non-prevailing party will pay to the prevailing party in such action or proceeding all of the prevailing party's costs and expenses of suit (including the costs and expenses of enforcing any judgment or settlement), including reasonable attorneys' fees, which will be payable whether or not such action is prosecuted to judgment. "Prevailing party" within the meaning of this Section 16.10 includes a party who dismisses an action for recovery hereunder in exchange for payment of the sums allegedly due, performance of covenants allegedly breached, or consideration substantially equal to the relief sought in the action.

15.10 Complete Agreement. This Agreement and the exhibits and appendix properly attached to and incorporated herein constitute the complete and exclusive statement among the Parties with respect to the subject matter contained therein. This Agreement and the Articles of Organization supersede all prior agreements by and among the Parties.

IN WITNESS WHEREOF, this Patent Transfer and Royalties Agreement is effective September 14, 2006, and executed by the parties on the dates set forth below.

IONIC WATER TECHNOLOGIES, INC.
Date: September _____, 2006.
BY:

_____
Representing the Board of Directors
Of IONIC WATER TECHNOLOGIES, INC.
A Nevada Corporation

PATRICK L. MOULTON:
Date: September 15, 2006.

_____
Individually and On Behalf of
Parties defined as "Moulton"

15.9 Attorney's Fees. If any party brings an action or proceeding (including any cross-complaint, counterclaims, or third-party claim) against any other party by reason of a default by the other party or otherwise arising out of this Agreement, the non-prevailing party will pay to the prevailing party in such action or proceeding all of the prevailing party's costs and expenses of suit (including the costs and expenses of enforcing any judgment or settlement), including reasonable attorneys' fees, which will be payable whether or not such action is prosecuted to judgment. "Prevailing party" within the meaning of this Section 16.10 includes a party who dismisses an action for recovery hereunder in exchange for payment of the sums allegedly due, performance of covenants allegedly breached, or consideration substantially equal to the relief sought in the action.

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A Nevada Corporation

PATRICK L. MOULTON:
Date: September _____, 2006.

Individually and On Behalf of
Parties defined as "Moulton"

EXHIBIT A:

U.S. Patent No. 7,011,745

US007011745B1

(12) **United States Patent**
Moulton

(10) **Patent No.: US 7,011,745 B1**
(45) **Date of Patent: Mar. 14, 2006**

(54) **ROTATING PERFORATED CYLINDER TREATMENT SYSTEM**

(76) Inventor: **Patrick L. Moulton**, 506 Perry St., Prescott, AZ (US) 86303

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 83 days.

(21) Appl. No.: **10/618,533**

(22) Filed: **Jul. 11, 2003**

Related U.S. Application Data

(60) Provisional application No. 60/395,262, filed on Jul. 11, 2002.

(51) **Int. Cl.**
C02F 1/58 (2006.01)

(52) **U.S. Cl.** **210/150**; 210/199; 210/205; 261/92; 261/DIG. 71; 366/305; 366/328.2

(58) **Field of Classification Search** ..... 210/619, 210/150, 151, 201, 202, 205, 209, 216, 199, 210/219; 261/92, DIG. 71; 435/294.1, 298.2; 366/305, 328.2
See application file for complete search history.

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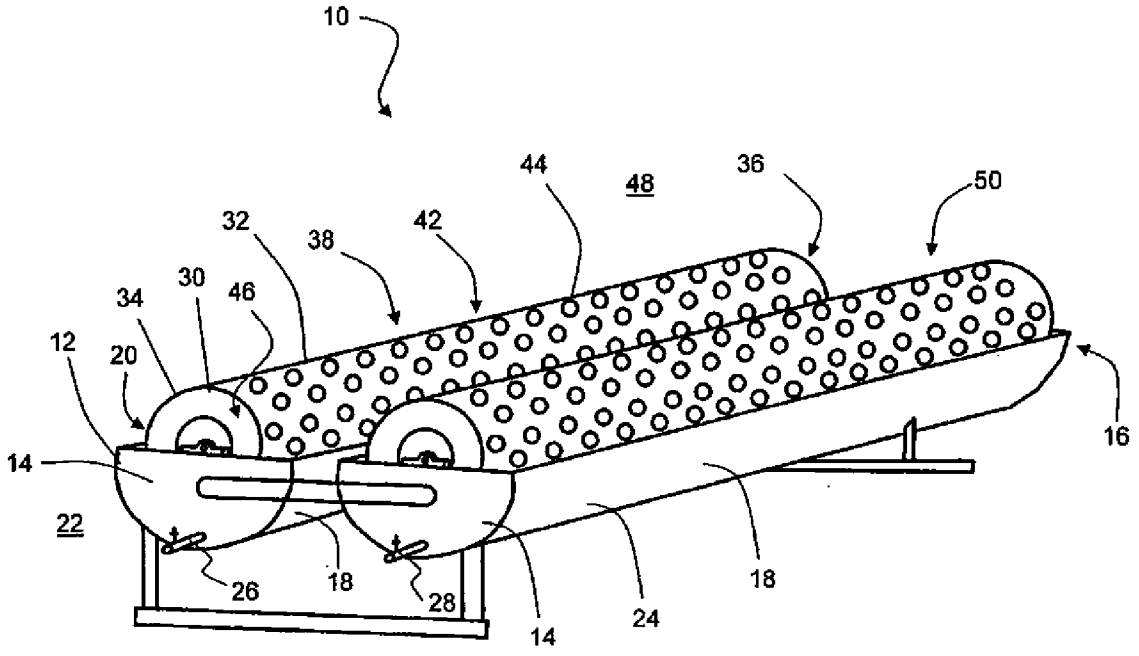
* cited by examiner

Primary Examiner—Peter A. Hruskoci
(74) *Attorney, Agent, or Firm*—Sierra Patent Group, Ltd.

(57) **ABSTRACT**

The disclosed device is directed toward a rotary water treatment system comprising at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to the at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

27 Claims, 3 Drawing Sheets



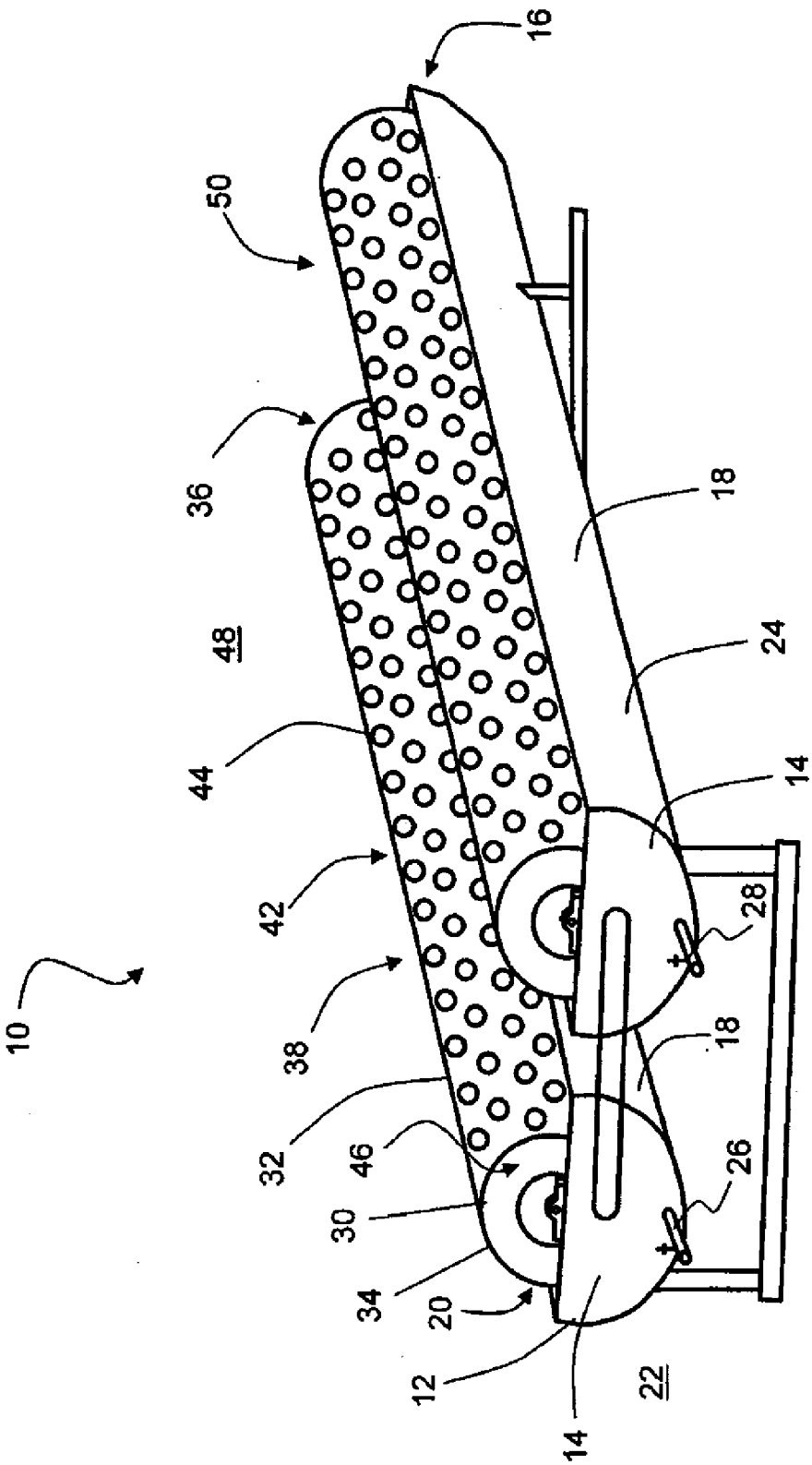


FIG. 1

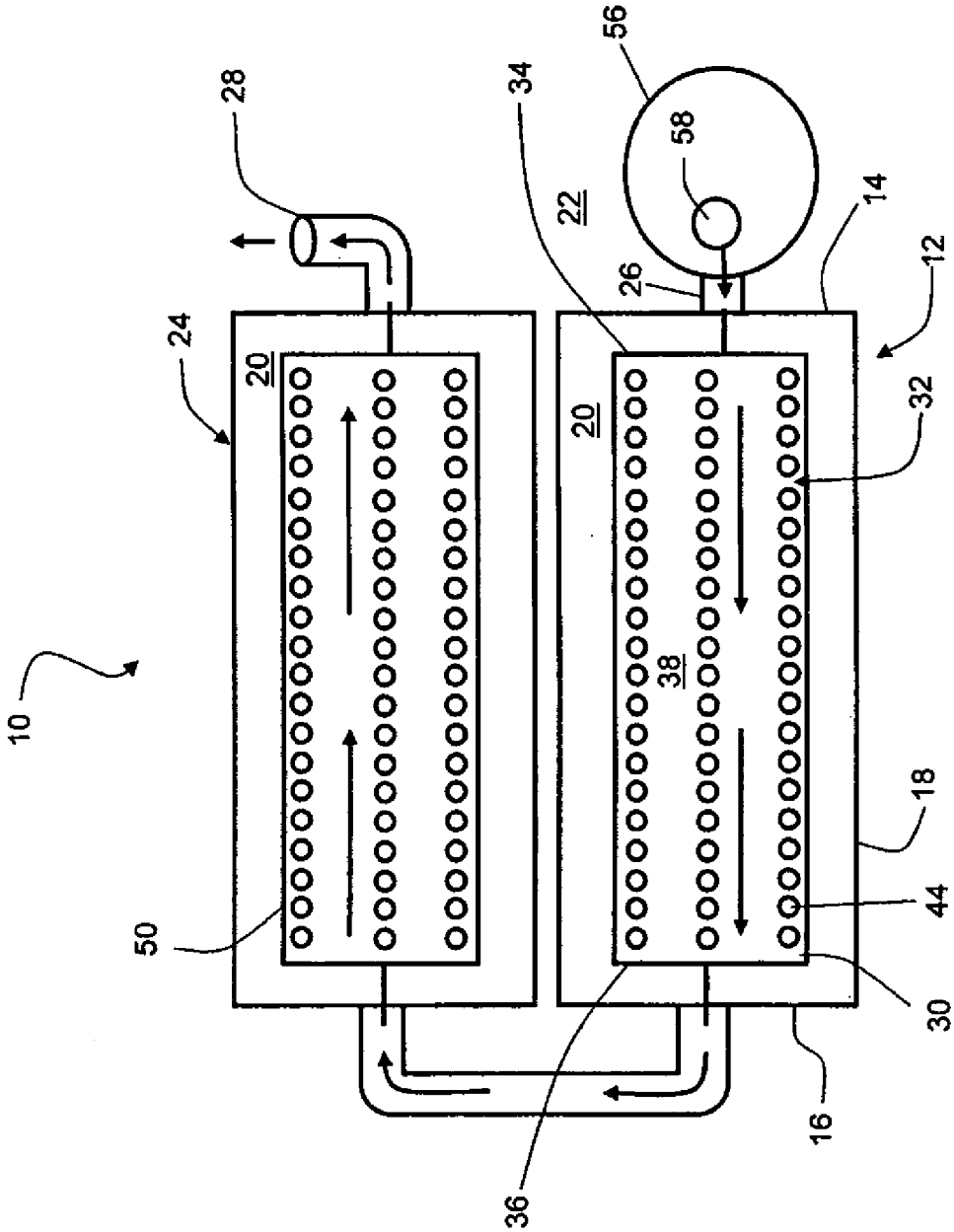


FIG. 2

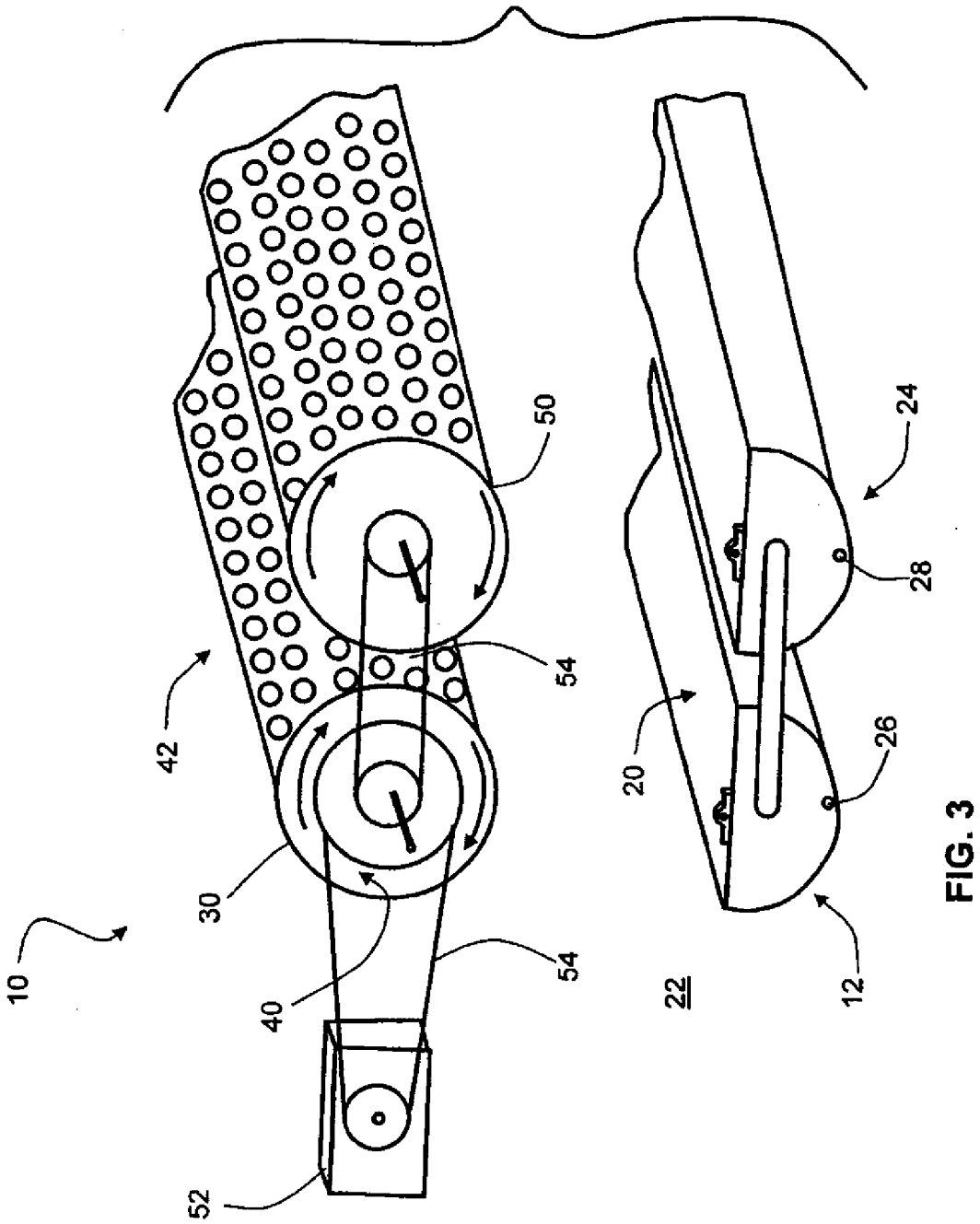


FIG. 3

ROTATING PERFORATED CYLINDER TREATMENT SYSTEM

PRIORITY CLAIM

This application claims priority to Provisional Patent Application No. 60/395,262 filed with the United States Patent and Trademark Office on Jul. 11, 2002.

BACKGROUND

The present disclosure relates to treatment systems, specifically to a low-energy treatment system for low-flow acid and alkaline drainage located in remote areas.

The precipitation of heavy metals from acidic or alkaline metal-laden water requires large amounts of dissolved oxygen to complete chemical reactions at certain pH plateaus. Complete oxidation of the heavy metal precipitant is key to producing a stable metal precipitant, thereby producing a stable filtered or decanted water for discharge after treatment. Reduced environments (dissolved oxygen deficient) remain unstable and the final pH and or residual metal content of the discharge water is unpredictable.

Air compressors and paddle type agitators used in prior art heavy metal treatment systems consume large amounts of energy during the oxidation and agitation phases of heavy metal precipitation. The efficiency of compressed air bubblers, used in aerating metal laden waters, depend on bubble size and the distribution of these bubbles in the water during the treatment phases. Agitation of the heavy metal laden waters with paddle type or propeller type blades require large amounts of energy, as they operate within tanks and move large amounts of water, in order to assure adequate introduction and mixing of oxygen enriched waters and pH adjusting reagents during treatment of heavy metal laden waters.

The prior art treatment systems rely on air compressors to add atmosphere to the heavy metal laden waters in order to raise the dissolved oxygen content of the water during treatment phases. Efficiency of the compressed air and the absorption of oxygen by the heavy metal laden water during treatment, depends on bubble size and the distribution of these bubbles within the prior art deep tanks. Excess amounts of compressed atmosphere must be added to insure that adequate oxygen is absorbed by the heavy metal laden water during the treatment and formation of the precipitants. This requires large amounts of energy to be expended in order to insure adequate oxidation takes place. Additionally, the remote nature of many impacted sites that require treatment systems often lack commercial electrical power.

Paddle type agitators used in prior art treatment systems move slowly within deep tanks and are largely unable to liberate the coated and un-reacted alkalinity providing reagent, thereby requiring the additional addition of reagent, to compensate for the un-reacted reagent previously added. The efficiency of the ionic exchange is also compromised as the large sized particle is not as efficient as a small particle during the formation of the precipitant. Prior art paddle type agitators also require and consume large amounts of energy as they have to move large amounts of water within deep tanks.

What is needed in the art is a treatment system designed to improve the efficiency of the oxidation and agitation phases of heavy metal precipitation during treatment, while utilizing a low-energy consumption power source.

SUMMARY

The disclosed device is directed toward a treatment system. The treatment system comprises a first container comprising a first end and a second end opposite the first end, a first container wall disposed between the first end and the second end. The first end, the container wall and the second end define a first interior and a first exterior. The first end, the container wall and the second end define a first container opening. A second container is fluidly coupled to the first container. The second container comprises a first end and a second end opposite the first end, a second container wall disposed between the first end and the second end. The first end, the container wall and the second end define a second interior and a second exterior. The first end, the container wall and the second end define a second container opening. A first aerator is partially disposed in the first interior through the first container opening. The first aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a first aerator interior and a first aerator exterior. The first aerator configured to partially rotatably dispose in a liquid contained in the interior of the first container. The first aerator is configured to aerate the liquid both at the first aerator interior and the first aerator exterior. A second aerator is partially disposed in the second interior through the second container opening. The second aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a second aerator interior and a second aerator exterior. The second aerator is configured to partially rotatably dispose in a liquid contained in the interior of the second container. The second aerator is configured to aerate the liquid both at the second aerator interior and the second aerator exterior. A rotary motive force element is operatively coupled to the first aerator and the second aerator. The rotary motive force element is configured to rotate the first aerator and the second aerator.

Another embodiment of the disclosed device is directed toward a rotary water treatment system comprises at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

A method of treating a liquid is disclosed. The method of treating a liquid comprises flowing the liquid through an influent supply into at least one open channel cell. The method includes rotating a cylinder through the liquid. The cylinder is partially disposed in at least one open channel cell. The cylinder comprises a first end and a second end opposite the first end and a perforated cylinder wall coupled between the first end and the second end. The first end, the perforated cylinder wall and the second end define an interior and an exterior of the cylinder. The method includes

lifting the liquid from at least one open channel cell onto the perforated cylinder wall at an interior surface and an exterior surface of the perforated cylinder wall. The method includes exposing the liquid to air from the exterior of the cylinder and the interior of the cylinder. The method includes flowing a treated liquid out of at least one open channel cell through an effluent discharge.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the figures, wherein like elements are numbered the same.

FIG. **1** is a perspective view of an exemplary treatment system.

FIG. **2** is a plan view of an exemplary treatment system.

FIG. **3** is a partial perspective view of an exemplary treatment system.

DETAILED DESCRIPTION

Persons of ordinary skill in the art will realize that the following description of the present disclosure is illustrative only and not in any way limiting. Other embodiments of the invention will readily suggest themselves to such skilled persons having the benefit of this disclosure.

The present disclosure describes a water treatment system for treating contaminated water, such as a heavy metal-laden water supply. In order to efficiently add dissolved oxygen from the atmosphere into a reduced environment of heavy metal laden waters (oxygen deficient) the surface of the water must be exposed to the atmosphere. An exemplary treatment system disclosed herein includes perforated rotating cylinders in order to exploit the surface tension properties of water, by lifting a thin film of the water from the cells and carrying the water on both the inside and outside surfaces of the rotating perforated cylinders. The perforations of the cylinders are "bridged" by a thin film of water as they rotate. This thin film of water absorbs oxygen from the atmosphere and effectively and efficiently raises the dissolved oxygen content of the heavy metal laden water.

One exemplary system operates with a flow rate of about 5 gpm of heavy metal laden water, with the perforated cylinders rotating at about 60 rpm, effectively distributes the influent over a total surface area of about 50,868 square feet.

The leading edge of the perforated cylinders, while rotating, also creates a cascading bubbling waterfall type action or, turbulent flow as the excess water that is lifted by the perforations is drained off of the cylinders. This cascading action also effectively and efficiently adds dissolved oxygen to the reduced environment (oxygen deficient) waters contained within the cells. The rotating action of the cylinders within the cells effectively and efficiently add large amounts of dissolved oxygen from the atmosphere, to the contained water in the cell, while thoroughly mixing the reduced and oxygen rich waters together, thereby raising the dissolved oxygen content of the contained waters.

Referring to FIGS. **1**, **2** and **3** a perspective view, a top view and a partial perspective view of an exemplary treatment system are illustrated. The treatment system **10** is shown in part without some of the subcomponents. The treatment system **10** includes at least one container (a first container or in an exemplary embodiment, an open channel cell) **12** preferably in a semi-cylinder shape. The container **12** includes a first end **14** and a second end **16** opposite the first end **14**. A container wall **18** is disposed between the first end **14** and the second end **16** to define an interior **20** and an exterior **22**. In an exemplary embodiment, the container **12** is an open-topped semi-circular cell having about a ten foot length and about an eighteen inch diameter. The total depth of the container **12** can be about nine inches and have a capacity of about sixty-six gallons. When the exemplary treatment system **10** is in operation, the depth of a liquid contained in the container **12** can be about five inches equaling a volume of about thirty-five gallons. The container **12** can be made of PVC or non-reactive corrosive resistant material. The container **12** is configured to contain liquid. The liquid is to be treated in the treatment system **10** and can comprise one of an acidic metal-laden water and an alkaline metal-laden water.

In an exemplary embodiment, the treatment system **10** includes another or second container **24** fluidly coupled (plumbed) to the first container **12**. The second container **24** includes the same physical features as the first container **12**. The first container **12** and second container are plumbed together to allow liquid to flow from an influent supply **26** through the first container to the second container **24** and to an effluent discharge **28** (See flow arrows in FIG. **2**). In an exemplary embodiment, the effluent discharge can be a sediment bag. The liquid can flow along the length of each cell **12**, **24**. In an exemplary embodiment, the containers **12**, **24** are plumbed to allow for influent and effluent to flow at various elevations or depths in the containers **12**, **24**.

An aerator (or first aerator) **30** is configured to be disposed in the container **12**. The aerator **30** includes a body **32** having a first end **34** and a second end **36** opposite the first end **34**. An aerator wall **38** is disposed between the first end **34** and the second end **36**. The aerator wall **38** includes an interior surface **40** and an exterior surface **42** opposite the interior surface **40**. The aerator wall **38** includes a plurality of perforations **44** formed in the aerator wall **38**. The perforations **44** allow fluid communication between the interior surface **40** and the exterior surface **46**. In a preferred embodiment, the perforations are one-half inch diameter holes formed in the aerator wall **38**. The first end **34**, aerator wall **38** and second end **36** define an aerator interior **46** and an aerator exterior **48**. The aerator **30** is configured to be partially disposed in the liquid contained in the interior **20** of the container **12**. The aerator **30** is only partially immersed in the liquid in the container **12**. The aerator **30** is configured to rotate about a longitudinal axis of the body **32** (See rotational arrows at FIG. **3**). The aerator **30** rotates through the liquid in the container **12**. As the liquid penetrates the perforations **44**, the liquid wets both the interior surface **40** of the aerator **30** and the exterior surface of the aerator **30**. While the aerator **30** rotates through the liquid, the liquid is aerated, (i.e., exposed to air).

A second aerator **50** having similar features to the first aerator **30** is disposed in the second container **24**. The second aerator **50** is also rotatably partially disposed in the interior **20** of the second container **24**. In an exemplary embodiment, the aerator **30**, **50** is a PVC cylinder **30** having a first end **34** and second end **36** coupled to a cylinder wall **38** similar to the aerator wall **38**. The cylinder **30** has a fifteen inch diameter and a nine foot length. The cylinder **30** has about 4,200 one-half inch diameter holes **44** through the cylinder wall **38**.

As illustrated in FIG. **3**, a motive force element **52** is operatively coupled to the first aerator **30** and in exemplary embodiments, also coupled to the second aerator **50**. The motive force element **52** is configured to rotate the aerator(s) **30**, **50**. In an exemplary embodiment, the motive force element **52** imparts rotary motion to the cylinder(s) **30**, **50**. A drive belt **54** and drive pulley arrangement can be employed to rotate the cylinder(s) **30**, **50**. In an exemplary

embodiment, the motive force element is a 110 volt, 1.7 amp gear reduced ac motor rotating the cylinder(s) **30, 50** at about 60 rpm.

A tank or reservoir **56** can be coupled to the influent supply **26** to provide a source of liquid to the treatment system **10**. In an exemplary embodiment, the tank **56** can be a flash reaction tank. A pump **58** can be employed to pump the liquid to the influent supply **26** from the tank **56**. In an exemplary embodiment, the pump can be a 5 gpm, 15 amp, 110 watt pump.

Exemplary Treatment System Test Results

Test results from an exemplary treatment system using acidic heavy metal laden water from a mine site in northeastern Nevada are as follows:

Dissolved oxygen contents of samples drawn from the mine site are consistently one (1) milligram per liter (mg) or less. A single pass of the acidic heavy metal laden water through the system, at a flow rate of 5 gpm, raised the dissolved oxygen content 800 to 900 percent. Dissolved oxygen levels rose from less than 1 mg/l to 8.5 mg/l or higher. The acidic metal laden waters were circulated through the system for as long as 3 hours, with no apparent improvement over the single pass, which takes approximately 15 minutes.

The removal of heavy metals from acidic, reduced environment water requires raising the pH of the impacted waters with an alkalinity providing reagent (e.g., lime slurry (CaOH2) or Sodium Hydroxide (NAOH) to remove (precipitate) the heavy metals from the impacted water. Either of these reagents are commonly the used in the treatment of heavy metal contaminated water. These tests were conducted using lime slurry (CaOH2) as the alkalinity providing reagent for the precipitation of the heavy metals from the impacted waters.

Test results showed that when the treated water and aerated water had a final dissolved oxygen content of less than 6 mg/l, the treated solution had an unstable and unpredictable final pH and residual heavy metal content after treatment. Tests results also showed that when the treated and aerated water had a final dissolved oxygen content of 6 mg/l or higher a stable pH and residual metal content after treatment was achieved. Following treatment the oxidized solution had a drop in pH of approximately 1 to 1.5 standard units (s.u.) after 12 hours. The dissolved oxygen content also dropped 1 mg/l to 3 mg/l while the chemical reactions were completed. Samples measured at up to five days after treatment have shown that the final pH and dissolved oxygen content remain stable after the preliminary drop.

Test results have shown that dissolved oxygen requirements and consumption for completing chemical reactions at certain pH plateaus are evident and predictable during treatment, reflecting the heavy iron content of the waters used during the tests. The pH plateau from 2.5 s.u. to 5.0 is relatively easy to achieve while remaining in an oxidized environment (dissolved oxygen content greater than 6 mg/l). The bulk of the heavy metal contaminates in the test waters are precipitated out of solution at a pH range between 5.0 s.u. and 8.0 s.u. in this series of tests. The pH plateau of 5.0 to 8.0 requires large amounts of dissolved oxygen in order to remain in an oxidized environment. The treatment system performed well in maintaining an "oxidized environment" during precipitation and sludge generation during treatment. The pH plateau of 8.0 to 10.0 was easily achieved while remaining in a oxidized environment as the remaining heavy metal concentration in the water was relatively low after the initial precipitation at pH 8.0 s.u. The testing of the prototype treatment system produced stable precipitants (heavy metal sludge) and clear discharge waters meeting or exceeding Federal EPA standards for secondary drinking water quality from heavily metal laden acidic mine waters in all of the tests performed.

The prototype treatment system was constructed and based on a flow rate of approximately 5 gpm of influent for testing purposes only. The final dimensions of the rotating perforated cylinder treatment system would be susceptible to several factors. Dissolved oxygen requirements at each site would vary, as the concentration of heavy metal contaminates in the impacted waters are different at each site. Dissolved oxygen requirements for precipitant formation will vary, depending upon the water chemistry and heavy metals removed by the treatment system. Flow rates of acid rock drainage and or alkaline rock drainage at each site are different and would require different sized rotating cylinders and cells and/or a series of cells required. Testing and optimization of the treatment system will be a determining factor on the physical size of the treatment system.

The rotating perforated cylinders and shallow cells used in this treatment system add large amounts of dissolved oxygen from the atmosphere with minimal energy expenditure and maximum efficiency.

Alkalinity providing reagents used in the treatment of heavy metal laden acidic waters are also efficiently and effectively agitated by the rotating perforated cylinders. The ionic exchange during precipitation of the heavy metals is also optimized by the rotating perforated cylinders action. The initial introduction of alkalinity providing reagents, into the heavy metal laden reduced environment, (flash reaction phase) produces a large sized particle precipitant. This large sized particle is mainly coated and un-reacted reagent. The rotating perforated cylinders agitate and pick this particle up and liberate the un-reacted reagent for an efficient ionic exchange during metal precipitation. While the ionic exchange is enhanced by the rotating perforated cylinders action, the oxidation process necessary for stable formation of precipitants, during the ionic exchange, is optimized by the particles being effectively exposed to the atmosphere in a thin film, thereby assuring complete oxidation of the precipitant during formation of the precipitant.

The rotating perforated cylinders and shallow cells used in the disclosed treatment system efficiently agitate and liberate the alkalinity providing reagent, while enhancing ionic exchange during the formation of the precipitant, with minimal energy expenditure and maximum efficiency.

In an exemplary treatment system, the power requirements have been tested and are extremely efficient compared to conventional treatments systems using air compressors and paddle or propeller type agitators. In the exemplary embodiment, the drive mechanism for the rotating perforated cylinders is a 110 volt ac gear reduced motor running at 1.7 full load amperes. The amperage consumption of the motor drops to approximately 1 ampere after the rotating cylinders reach an equilibrium turning at 60 rpm. A non-corrosive submersible pump rated at 5 gpm operating on 110 volts at 1.5 full load amps is used to circulate water through the cells. The operating amperage of the non-corrosive pump drops to approximately 1 ampere as the system is running. Operating energy consumption of the rotating perforated cylinder treatment system is approximately 2 amperes at 110 volts while in use.

A conventional treatment system, operating with an air compressor and paddle or propeller type agitator, at the same

flow rate of 5 gpm, will consume at least 10 times more energy than the rotating perforated cylinder treatment system.

The exemplary prototype treatment system constructed and tested has proven to be an efficient and effective system in the treatment of acidic heavy metal laden waters. The low energy consumption of the system, the efficiency of oxygen addition, as well as ionic exchange optimization and efficient alkalinity reagent consumption is evident in the testing results. The energy consumption of this treatment system is far less than the energy consumption of conventional systems. The efficiency of the rotating perforated cylinders operating with shallow cells has proven to be efficient and effective.

The rotating perforated cylinder treatment system has to date only been tested with acidic heavy metal laden waters. The treatment system has the capabilities to be applied to alkaline heavy metal laden waters also. The working theories are basically the same however reagents and pH plateaus are different when an alkaline environment is treated rather than an acidic environment.

It is contemplated that in addition to the disclosed treatment system being configured to treat liquids, such as heavy metal-laden water, other impacted waters having contaminants can be treated. The treatment system can remove volatile organic compounds, regular metals, or merely aerate the water for low dissolved oxygen environments. The treatment system disclosed can also be employed to bioremediate liquids, such as contaminated water supplies, and the like.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

What is claimed is:

1. A treatment system comprising:

a first container comprising a first end and a second end opposite said first end, a first container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a first interior and a first exterior, said first end, said container wall and said second end defining a first container opening;

a second container fluidly coupled to said first container, said second container comprising a first end and a second end opposite said first end, a second container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a second interior and a second exterior, said first end, said container wall and said second end defining a second container opening;

a first aerator partially disposed in said first interior through said first container opening, said first aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a first aerator interior and a first aerator exterior, said first aerator configured to partially rotatably dispose in a liquid contained in said interior of said first container, said first aerator configured to aerate said liquid both at said first aerator interior and said first aerator exterior, wherein said plurality of perforations formed in the first aerator wall are configured to lift a thin film of said liquid from said first container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said first aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said first aerator wall, as well as said liquid contained in said first container;

a second aerator partially disposed in said second interior through said second container opening, said second aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a second aerator interior and a second aerator exterior, said second aerator configured to partially rotatably dispose in a liquid contained in said interior of said second container, said second aerator configured to aerate said liquid both at said second aerator interior and said second aerator exterior, wherein said plurality of perforations formed in the second aerator wall are configured to lift a thin film of said liquid from said second container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said second aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said second aerator wall, as well as said liquid contained in said second container; and

a rotary motive force element operatively coupled to said first aerator and said second aerator, said rotary motive force element configured to rotate said first aerator and said second aerator.

2. The treatment system of claim 1 further comprising:

at least one influent supply fluidly coupled to one of said first container and said second container;

at least one effluent discharge fluidly coupled to one of said first container and said second container.

3. The treatment system of claim 2 wherein said at least one influent supply is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container, said at least one effluent discharge is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container.

4. The treatment system of claim 1 wherein said first aerator and said second aerator are substantially cylinders configured for rotary motion about a longitudinal axis formed along said cylinder from said first ends of said first and second aerators to said second ends of said first and second aerators.

5. The treatment system of claim 1 wherein said first container and said second container are substantially semi-cylinders configured for containing liquid in said first interior and said second interior along a longitudinal axis of said semi-cylinders.

6. The treatment system of claim 1 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

7. The treatment system of claim 1 wherein said plurality of perforations comprises about one-half inch diameter holes defined in said aerator wall.

8. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to rotate through said liquid and lift said liquid on an interior surface and an exterior surface of said first aerator wall and said second aerator wall.

9. The treatment system of claim 1 wherein said plurality of perforations of said first aerator are configured to fluidly couple said first aerator interior with said first aerator exterior wetting an exterior surface and an interior surface of said first aerator wall with said liquid, and wherein said plurality of perforations of said second aerator are configured to fluidly couple said second aerator interior with said second aerator exterior wetting an exterior surface and an interior surface of said second aerator wall with said liquid.

10. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to increase dissolved oxygen content of the liquid contained in said first container and said second container respectively.

11. The treatment system of claim 1 wherein said first aerator is configured to mix reduced liquid and oxygen rich liquid in said first container, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said first container and said second aerator is configured to mix reduced liquid and oxygen rich liquid in said second container, and wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said second container.

12. The treatment system of claim 1 wherein said first container and said second container are configured to promote flow of said liquid through said first container to said second container.

13. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to expose said liquid to air.

14. The treatment system of claim 1 wherein said first aerator is configured to immerse into said liquid contained in said first container a predetermined minimal depth, and said second aerator is configured to immerse into said liquid contained in said second container a predetermined minimal depth.

15. The treatment system of claim 1 wherein said first aerator is configured to agitate reagents in said liquid contained in said first container, and said second aerator is configured to agitate reagents in said liquid contained in said second container.

16. The treatment system of claim 1 wherein said first aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid and said second aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid.

17. The treatment system of claim 16 wherein said first and second aerators are configured to agitate and lift coated un-reacted reagent particles in said liquid and liberate said un-reacted reagent thereby increasing ionic exchange during metal precipitation.

18. The treatment system of claim 17 wherein said first and second aerators are configured to expose said reagent particles to air in a thin liquid film, wherein said precipitant is completely oxidized during precipitant formation.

19. The treatment system of claim 1 further comprising:

a pump fluidly coupled to one of said first container and said second container, said pump configured to circulate said liquid through said first container and said second container.

20. A rotary water treatment system comprising:

at least one open channel cell configured to contain a liquid;

a cylinder partially disposed in said open channel cell, said cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall, wherein said cylinder is configured to rotate through said liquid and lift a thin film of said liquid on an interior surface and an exterior surface of said cylinder wall by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said cylinder is configured to create a cascading bubbling turbulent flow in said liquid flowing along said cylinder wall, as well as said liquid contained in said at least one open channel cell;

a motive force element coupled to said cylinder configured to impart rotary motion to said cylinder;

at least one influent supply coupled to said at least one open cell;

at least one effluent discharge coupled to said at least one open cell; and

a pump fluidly coupled to said at least one influent supply.

21. The rotary water treatment system of claim 20 further comprising:

another open channel cell fluidly coupled to said at least one open channel cell;

another cylinder partially disposed in said another open channel cell, said another cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall.

22. The rotary water treatment system of claim 21 wherein said motive force element comprises a gear reduced motor coupled to said cylinder and said another cylinder configured to rotate about a long axis of said cylinder and said another cylinder.

23. The rotary water treatment system of claim 20, wherein said cylinder wall is configured to aerate said liquid on both an outer surface and an inner surface of said cylinder wall.

24. The rotary water treatment system of claim 20 wherein said cylinder is partially disposed in said liquid contained in said open channel cell, and more than half of said cylinder longitudinal cross section extending beyond said open channel cell.

25. The rotary water treatment system of claim 20 wherein the rotary treatment system is configured to increase dissolved oxygen content of the liquid contained in said at least one open channel cell.

26. The rotary water treatment system of claim 20 wherein said cylinder is configured to mix reduced liquid and oxygen rich liquid in said at least one open channel cell, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said at least one open channel cell.

27. The rotary water treatment system of claim 20 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

* * * * *

EXHIBIT B:

Patent Security Agreement

SECURITY AGREEMENT

THIS SECURITY AGREEMENT dated as of September 15, 2006 ("Security Agreement"), is made by IONIC WATER TECHNOLOGIES, INC., a Nevada corporation ("Grantor" or "IWT"), in favor of PATRICK L. MOULTON or assign ("Secured Party" or "Moulton").

RECITALS

Pursuant to that certain Patent Transfer and Royalties Agreement dated as of the date hereof by and among Grantor and Secured Party (the "Transfer Agreement"), Moulton has agreed to transfer all right and title to the Patent and Patent Rights identified in the Transfer Agreement and further described at **Exhibit A,** but only upon the condition, among others, that Grantor shall have executed and delivered to Secured Party this Security Agreement.

AGREEMENT

Grantor hereby represents, warrants, covenants and agrees as follows:

1. DEFINED TERMS. When used in this Security Agreement the following terms shall have the following meanings (such meanings being equally applicable to both the singular and plural forms of the terms defined):

"**Collateral**" shall have the meaning assigned to such term in Section 2 of this Security Agreement.

"**Contracts**" means all contracts, undertakings, purchase orders, licensing agreements, joint ventures or other agreements in or under which Grantor now holds or hereafter acquires any right, title or interest.

"**Event of Default**" shall have the mean ascribed to it in the Transfer Agreement, Section 12.

"**Lien**" means any mortgage, lien, deed of trust, charge, pledge, security interest or other encumbrance.

"**Patent**" means all of the following in which Grantor now holds or hereafter acquires which are related to or derive from the United States Patent No. 7,011,745 identified at **Exhibit A**: (a) all letters patent of the United States or any other country, all registrations and recordings thereof and all applications for letters patent of the United States or any other country, including, without limitation, registrations, recordings and applications in the United States Patent and Trademark Office or in any similar office or agency of the United States, any State thereof or any other country; (b) all reissues, divisions, continuations, renewals, continuations in part or extensions thereof; (c) all petty patents, divisionals and patents of addition; (d) all patents to issue in any such applications; (e) income, royalties, damages, claims and payments now and hereafter due and/or payable with respect to patents, including, without limitation, damages, claims and recoveries for past, present or future infringement; and (f) rights to sue for past, present and future infringements of any patent.

"**Patent Rights**" means any and all written agreements, in which Grantor now holds or hereafter acquires any interest, granting any right with respect to the Patent (whether Grantor is the licensee or the licensor thereunder).

"**Permitted Liens**" means those liens and security interests held against the Collateral pursuant to the Loan Documents identified in the Transfer Agreement at Section 10, and those other liens that may hereafter be placed against the Collateral upon written approval of the Secured Party.

"**Secured Obligations**" means (a) the obligation of Grantor to repay Secured Party all of the unpaid cash and royalty payments identified at Section 9 of the Transfer Agreement.

"UCC" means the Uniform Commercial Code as the same may, from time to time, be in effect in the United States, State of Nevada; provided, however, in the event that, by reason of mandatory provisions of law, any or all of the attachment, perfection or priority of Secured Party's security interest in any Collateral is governed by the Uniform Commercial Code as in effect in a jurisdiction other than the State of Nevada, the term "UCC" shall mean the Uniform Commercial Code as in effect in such other jurisdiction for purposes of the provisions hereof relating to such attachment, perfection of priority and for purposes of definitions related to such provisions.

In addition, the following terms if used herein shall be defined terms having the meaning set forth for such terms in the UCC: "Account Debtor"; "Accounts"; "Chattel Paper"; "Deposit Accounts"; "Equipment"; "Financial Assets"; "Fixtures"; "General Intangibles"; "Instruments"; "Inventory"; "Investment Property"; "Proceeds". Each of the foregoing defined terms shall include all of such items now owned, or hereafter acquired by Grantor.

All capitalized terms used herein and not otherwise defined herein shall have the respective meanings given to them in the Security Agreement.

2. GRANT OF SECURITY INTEREST. As collateral security for the prompt and complete payment and performance when due (whether at stated maturity, by acceleration or otherwise) of all the Secured Obligations and in order to induce Secured Party to execute and perform pursuant to the Transfer Agreement, Grantor hereby grants to Secured Party a security interest in all of Grantor's right, title and interest, if any, in, to and under the following (all of which being collectively referred to herein as the "Collateral"):

(a) The Patent and Patent Rights;
(b) All Deposit Accounts and other Accounts of Grantor;
(c) All Contracts of Grantor;
(d) All Equipment of Grantor;
(e) All Financial Assets of Grantor;

(f) All Fixtures of Grantor;
(g) All other intangible assets of Grantor, including, without limitation, all copyrights, trademarks, licenses, drawings, technical information, customer lists, trade secrets, proprietary or confidential information, inventions (whether or not patentable), procedures, know-how and models;
(h) All Inventory of Grantor;
(i) All other goods and personal property of Grantor, wherever located, whether tangible or intangible, and whether now owned or hereafter acquired, existing, leased or consigned by or to Grantor; and
(j) To the extent not otherwise included, all Proceeds of each of the foregoing and all accessions to, substitutions and replacements for and rents, profits and products of each of the foregoing; provided, however, that "Collateral" shall not include any equipment lease, equipment financing agreement or Equipment which is the subject of an equipment lease or equipment financing agreement to the extent and for so long as the grant of a security interest therein is expressly prohibited by the terms of any enforceable provision of such equipment lease or equipment financing agreement.

3. RIGHTS OF SECURED PARTY; COLLECTION OF ACCOUNTS.

(a) Notwithstanding anything contained in this Security Agreement to the contrary, Grantor expressly agrees that it shall remain liable under each of its Contracts to observe and perform all the conditions and obligations to be observed and performed by it thereunder and that it shall perform all of its duties and obligations thereunder, all in accordance with and pursuant to the terms and provisions of each such Contract. Secured Party shall not have any obligation or liability under any Contract by reason of or arising out of this Security Agreement or the granting to Secured Party of a lien therein or the receipt by Secured Party of any payment relating to any Contract pursuant hereto, nor shall Secured Party be required or obligated in any manner to perform or fulfill any of the obligations of Grantor under or pursuant to any Contract, or to make any payment, or to make any inquiry as to the nature or the sufficiency of any

payment received by it or the sufficiency of any performance by any party under any Contract, or to present or file any claim, or to take any action to collect or enforce any performance or the payment of any amounts which may have been assigned to it or to which it may be entitled at any time or times.

(b) Secured Party authorizes Grantor to collect its Accounts, provided that such collection is performed in a prudent and businesslike manner, and Secured Party may, upon the occurrence and during the continuation of any Event of Default and with prior written notice to Grantor, limit or terminate said authority at any time. Upon the occurrence and during the continuance of any Event of Default, at the request of Secured Party, Grantor shall deliver all original and other documents evidencing and relating to the performance of labor or service which created such Accounts, including, without limitation, all original orders, invoices and shipping receipts.

(c) Secured Party may at any time, upon the occurrence and during the continuance of any Event of Default, with prior written notice to Grantor of its intention to do so, notify Account Debtors of Grantor, parties to the Contracts of Grantor, obligors in respect of Instruments of Grantor and obligors in respect of Chattel Paper of Grantor that the Accounts and all or some of the right, title and interest of Grantor in and under such Contracts. Instruments and Chattel Paper have been assigned to Secured Party and that payments shall be made directly to Secured Party. Upon the request of Secured Party at any time after the occurrence and during the continuance of an Event of Default, Grantor shall so notify such Account Debtors, parties to such Contracts, obligors in respect of such Instruments and obligors in respect of such Chattel Paper. Upon the occurrence and during the continuance of any Event of Default, Secured Party may, in its name or in the name of others, communicate with such Account Debtors, parties to such Contracts, obligors in respect of such Instruments and obligors in respect of such Chattel Paper to verify with such parties, to Secured Party's satisfaction, the existence, amount and terms of any such Accounts, Contracts, Instruments or Chattel Paper.

4. REPRESENTATIONS AND WARRANTIES. Grantor hereby represents and warrants to Secured Party that:

(a) Except for the security interest granted to Secured Party under this Security Agreement and Permitted Liens, Grantor is the sole legal and equitable owner of each item of the Collateral in which it purports to grant a security interest hereunder, having good and marketable title thereto, free and clear of any and all liens except for Permitted Liens.

(b) No effective security agreement, financing statement, equivalent security or lien instrument or continuation statement covering all or any part of the Collateral exists, except for Permitted Liens.

(c) This Security Agreement creates a legal and valid security interest on and in all of the Collateral in which Grantor now has rights. Upon the filing of appropriate financing statements and the taking of other actions as Secured Party deems appropriate, Secured Party will have a fully perfected security interest in all of the Collateral in which Grantor now has rights subject only to Permitted Liens. This Security Agreement will create a legal and valid and fully perfected first priority security interest in the Collateral in which Grantor later acquires rights, when Grantor acquires those rights subject only to Permitted Liens and additional filings to be made with the United States Patent and Trademark Office and/or other offices as are necessary to perfect Secured Party's security interest in subsequent ownership rights and interests of Grantor in the Collateral.

5. COVENANTS. Grantor covenants and agrees with Secured Party that from and after the date of this Security Agreement and until the Secured Obligations have been performed and paid in full:

5.1 Disposition of Collateral. Grantor shall not sell, lease, transfer or otherwise dispose of any of the Collateral, or attempt or contract to do so, other than as permitted by the Security Agreement or as required due to obligations owing pursuant to the Permitted Liens.

5.2 Relocation of Business or Collateral. Grantor shall not relocate its chief executive office, principal place of business or its records, or allow the relocation of any Collateral (except as allowed

pursuant to Section 5.1 immediately above) from outside the states of Nevada or Idaho, USA, without prior written notice to Secured Party.

5.3 Limitation on Liens on Collateral. Grantor shall not, directly or indirectly, create, permit or suffer to exist, and shall defend the Collateral against and take such other action as is necessary to remove, any lien on the Collateral, except Permitted Liens.

5.4 Taxes, Assessments, Etc. Grantor shall pay promptly when due all property and other taxes, assessments and government charges imposed upon, and all claims (including claims for labor, materials and supplies) against, the equipment, fixtures or inventory, except to the extent the validity thereof is being contested in good faith and adequate reserves are being maintained in connection therewith.

5.5 Maintenance of Records. Grantor shall keep and maintain at its own cost and expense satisfactory and complete records of the Collateral.

5.6 Registration of Intellectual Property Rights. Grantor shall promptly register or cause to be registered (to the extent not already registered and consistent with good faith business judgment) the most recent version of any Patent which, individually or in the aggregate, is material to the conduct of Grantor's business, with the United States Patent Office, as applicable, including, without limitation, in all such cases the filing of applications for renewal, affidavits of use, affidavits of noncontestability and opposition and interference and cancellation proceedings.

5.7 Notification Regarding Changes in Intellectual Property. Grantor shall promptly advise Secured Party of any subsequent ownership right or interest of Grantor in or to the Patent, and as to any material copyright, trademark or license in which Grantor has an interest.

5.8 Defense of Intellectual Property. Grantor shall (i) protect, defend and maintain the validity and enforceability of the Patent, Patent Rights and all material current copyrights and trademarks, (ii) use its best efforts to detect material infringements of the Patent, Patent Rights and all material current copyrights and trademarks and promptly advise Secured Party in writing of material infringements detected and (iii) not
allow the Patent, Patent Rights and all material current copyrights and trademarks to be abandoned, forfeited or dedicated to the public without the written consent of Secured Party in each case unless reasonable business practice would determine that any such failure to act or abandonment is appropriate.

5.9 Further Assurances; Pledge of Instruments. At any time and from time to time, upon the written reasonable request of Secured Party, and at the sole expense of Grantor, Grantor shall promptly and duly execute and deliver any and all such further instruments and documents and take such further action as Secured Party may reasonably deem necessary or desirable to obtain the full benefits of this Security Agreement, including, without limitation, facilitating the filing of UCC-1 Financing Statements in all applicable jurisdictions and this Security Agreement (and any amendment hereto) or a collateral assignment (and any amendments thereto) with the United States Copyright Office and/or Patent and Trademark Office, as applicable.

5.10 Maintenance of Insurance. Grantor shall maintain, with financially sound and reputable companies, insurance policies insuring (a) its equipment, fixtures and inventory against loss by fire, explosion, theft and such other casualties as are usually insured against by companies engaged in the same or similar businesses and (b) to the extent requested by Secured Party, Grantor and Secured Party against liability for personal injury and property damage relating to such equipment, fixtures and inventory. Such policies are to be in such amounts and against at least such risk as are usually insured against in the same general area by companies of the same or a similar size engaged in the same or a similar business as Grantor. Grantor shall, if so requested by Secured Party, deliver to Secured Party, as often as Secured Party may reasonably request, a report of a reputable insurance broker satisfactory to Secured Party with respect to the insurance on its equipment, fixtures and inventory. All insurance with respect to the equipment, fixtures and inventory shall provide that no cancellation, reduction in amount or change in coverage

thereof shall be effective until at least thirty (30) days after receipt by Secured Party of written notice thereof.

5.11 Right of Inspection and Audit. Upon reasonable notice to Grantor (unless an Event of Default has occurred and is continuing, in which case no notice is necessary), Secured Party shall at all times have fall and free access during normal business hours to all the books and records and correspondence of Grantor, and Secured Party or any agents or representatives of Secured Party may examine the same, take extracts therefrom and make photocopies thereof, and Grantor agrees to render to Secured Party, at Grantor's cost and expense, such clerical and other assistance as may be reasonably requested with regard thereto. Upon reasonable notice to Grantor (unless an Event of Default has occurred and is continuing, in which case no notice is necessary), Secured Party and its agents and representatives shall also have the right to enter into and upon any premises where any of the equipment, fixtures or inventory is located for the purpose of conducting audits and making physical verifications of such equipment, fixtures and inventory and test verifications of the Accounts in any manner and through any medium that it considers advisable, and Grantor agrees to furnish all such assistance and information as Secured Party may reasonably require in connection therewith.

5.12 Continuous Perfection. Grantor shall not change its name, identity or corporate structure in any manner which might make any financing or continuation statement filed in connection herewith seriously misleading within the meaning of Section 9-402(7) of the UCC (or any other then applicable provision of the UCC) unless Grantor gives Secured Party prior written notice thereof and takes all action necessary or reasonably requested by Secured Party to amend such financing statement or continuation statement so that it is not seriously misleading.

5.13 Power of Attorney. Effective only upon the occurrence and during the continuance of an Event of Default, Grantor hereby irrevocably appoints Secured Party (and any of Secured Party's designated officers or employees) as Grantor's true and lawful attorney to: (a) send requests for verification of Accounts or notify account debtors of Secured Party's security interest in the Accounts; (b) endorse Grantor's name on any checks or other forms of payment or security that may come into Secured Party's possession; (c) sign Grantor's name on any invoice or bill of lading relating to any Account, drafts against account debtors, schedules and assignments of Accounts, verifications of Accounts, and notices to account debtors, (d) make, settle and adjust all claims under and decisions with respect to Grantor's policies of insurance; (e) settle and adjust disputes and claims respecting the accounts directly with account debtors, for amounts and upon terms which Secured Party determines to be reasonable; (f) modify, in its sole discretion, any intellectual property security agreement entered into between Grantor and Secured Party without first obtaining Grantor's approval of or signature to such modification by amending reference to any right, title or interest in any Copyrights, Patents or Trademarks, acquired by Grantor after the execution hereof or to delete any reference to any right, title or interest in any Copyrights, Patents or Trademarks, in which Grantor no longer has or claims any right, title or interest; (g) file, in its sole discretion, one or more financing or continuation statements and amendments thereto, relative to any of the Collateral without the signature of Grantor where permitted by law; and (h) transfer any intellectual property Collateral into the name of Secured Party or a third party to the extent permitted under the UCC. The appointment of Secured Party as Grantor's attorney in fact, and each and every one of Secured Party's rights and powers, being coupled with an interest, is irrevocable until all of the Secured Obligations have been fully repaid and performed and Secured Party's obligation to provide
advances hereunder is terminated.

6. RIGHTS AND REMEDIES UPON DEFAULT.

(a) If any Event of Default shall occur and be continuing, Secured Party may exercise in addition to all other rights and remedies granted to it under this Security Agreement and under any other instrument or agreement securing, evidencing or relating to the Secured Obligations, all rights and remedies of a secured party under the UCC. Without limiting the generality of the foregoing, Grantor expressly agrees that in any such event, and during the existence and continuance of an Event of Default, Secured Party, without demand of performance or other demand, advertisement or notice of any kind (except the notice specified below of time and place of public or private sale) to or upon Grantor or any other person (all and each of

which demands, advertisements and notices are hereby expressly waived to the maximum extent permitted by the UCC and other applicable law), may forthwith collect, receive, appropriate and realize upon the Collateral, or any part thereof, and may forthwith sell, lease, assign, give an option or options to purchase or sell or otherwise dispose of and deliver said Collateral (or contract to do so), or any part thereof, in one or more parcels at public or private sale or sales, at any exchange or broker's board or at any of Secured Party's offices or elsewhere at such prices as it may deem best, for cash or on credit or for future delivery without assumption of any credit risk. Secured Party shall have the right upon any such public sale or sales, and, to the extent permitted by law, upon any such private sale or sales, to purchase the whole or any part of said Collateral so sold, free of any right or equity of redemption, which equity of redemption Grantor hereby releases. Grantor further agrees, at Secured Party's request and during the existence and continuance of an Event of Default, to assemble the Collateral and make it available to Secured Party at places which Secured Party shall reasonably select, whether at Grantor's premises or elsewhere. Secured Party shall apply the net proceeds of any such collection, recovery, receipt, appropriation, realization or sale as provided in Section 6(d) hereof, Grantor remaining liable for any deficiency remaining unpaid after such application, and only after so paying over such net proceeds and after the payment by Secured Party of any other amount required by any provision of law, need Secured Party account for the surplus, if any, to Grantor. To the maximum extent permitted by applicable law, Grantor waives all claims, damages, and demands against Secured Party arising out of the repossession, retention or sale of the Collateral except such as arise out of the gross negligence or willful misconduct of Secured Party. Grantor agrees that Secured Party need not give more than thirty (30) days' notice (which notification shall be deemed given when mailed or delivered on an overnight basis, postage prepaid, addressed to Grantor at its address set forth in the Transfer Agreement, of the time and place of any public sale or of the time after which a private sale may take place and that such notice is reasonable notification of such matters. Grantor shall remain liable for any deficiency if the proceeds of any sale or disposition of the Collateral are insufficient to pay all amounts to which Secured Party is
entitled, Grantor also being liable for the reasonable fees of any attorneys employed by Secured Party to collect such deficiency.

(b) Grantor also agrees to pay all fees, costs and expenses of Secured Party, including, without limitation, reasonable attorneys' fees, reasonably incurred in connection with the enforcement of any of its rights and remedies hereunder.

(c) The Proceeds of any sale, disposition or other realization upon all or any part of the Collateral shall be distributed by Secured Party in the following order of priorities:

FIRST, to Secured Party in an amount sufficient to pay in full the reasonable costs of Secured Party in connection with such sale, disposition or other realization, including all fees, costs, expenses, liabilities and advances reasonably incurred or made by Secured Party in connection therewith, including, without limitation, reasonable attorneys' fees;

SECOND, to Secured Party in an amount equal to the then unpaid Secured Obligations; and

THIRD, upon payment in full of the Secured Obligations, to Grantor or its representatives, in accordance with the UCC or as a court of competent jurisdiction may direct.

(d) Secured Party acknowledges and understands that any rights and remedies provided herein or by applicable law are subject and subordinate to the priority rights of the Permitted Liens.

7. INDEMNITY. Grantor agrees to defend, indemnify and hold harmless Secured Party against (a) all obligations, demands, claims and liabilities claimed or asserted by any other party in connection with the transactions contemplated by this Security Agreement and (b) all losses or expenses in any way suffered, incurred or paid by Secured Party as a result of or in any way arising out of or following transactions between Secured Party and Grantor, whether under this Security Agreement or otherwise (including without limitation, reasonable attorneys' fees and expenses for one firm of counsel), except for losses arising from or out of Secured Party's gross negligence or willful misconduct.

8. LIMITATION ON SECURED PARTY'S DUTY IN RESPECT OF COLLATERAL. Secured Party shall deal with the Collateral in the same manner as it deals with similar property for its own account. Secured Party shall be deemed to have acted reasonably in the custody, preservation and disposition of any of the Collateral
if it takes such action as Grantor requests in writing, but failure of Secured Party to comply with any such request shall not in itself be deemed a failure to act reasonably and no failure of Secured Party to do any act not so requested shall be deemed a failure to act reasonably.

9. REINSTATEMENT. This Security Agreement shall remain in full force and effect and continue to be effective should any petition be filed by or against Grantor for liquidation or reorganization, should Grantor become insolvent or make an assignment for the benefit of creditors or should a receiver or trustee be appointed for all or any significant part of Grantor's property and assets and shall continue to be effective or be reinstated, as the case may be, if at any time payment and performance of the Secured Obligations, or any part thereof, is, pursuant to applicable law, rescinded or reduced in amount or must otherwise be restored or returned by any obligee of the Secured Obligations, whether as a "voidable preference," "fraudulent conveyance" or otherwise, all as though such payment or performance had not been made. In the event that any payment, or any part thereof, is rescinded, reduced, restored or returned, the Secured Obligations shall be reinstated and deemed reduced only by such amount paid and not so rescinded, reduced, restored or returned.

10. MISCELLANEOUS.

10.1 No Waiver; Cumulative Remedies.

(a) Secured Party shall not by any act, delay, omission or otherwise be deemed to have waived any of its respective rights or remedies hereunder, nor shall any single or partial exercise of any right or remedy hereunder on any one occasion preclude the further exercise thereof or the exercise of any other right or remedy.

(b) The rights and remedies hereunder provided are cumulative and may be exercised singly or concurrently and are not exclusive of any rights and remedies provided by law.

(c) None of the terms or provisions of this Security Agreement may be waived, altered, modified or amended except by an instrument in writing, duly executed by Grantor and Secured Party.

10.2 Releases.

(a) At such time as the Secured Obligations shall have been paid and performed in full, the Collateral shall be released from the Liens created hereby, and this Security Agreement and all obligations of Secured Party and Grantor hereunder shall terminate, all without delivery of any instrument or performance of any act by any party, and all rights to the Collateral shall revert to Grantor. At the request and sole expense of Grantor following any such termination Secured Party shall deliver to Grantor any Collateral held by Secured Party hereunder, and execute and deliver to Grantor such documents as Grantor shall reasonably request to evidence such termination.

(b) If any of the Collateral shall be sold, transferred or otherwise disposed of by Grantor in a manner permitted by the Credit, then Secured Party, at the request and sole expense of Grantor, shall execute and deliver to Grantor all releases or other documents reasonably requested for the release of the Liens created hereby on such Collateral.

(c) This Security Agreement and the security interests granted herein shall remain in full force and effect and continue to be effective if at any time payment and performance of the Secured Obligations, or any part thereof, is, pursuant to applicable law, avoided, rescinded or reduced in amount, or must otherwise be restored or returned by any obligee of the Secured Obligations, whether as a "voidable preference," "fraudulent conveyance" or otherwise, all as though such payment or performance had not been made. In the event that any payment, or any part thereof, is avoided, rescinded, reduced, restored or returned, the Secured Obligations and the security interests granted

herein shall be reinstated and the Secured Obligations shall be deemed reduced only by such amount paid and not so avoided, rescinded, reduced, restored or returned.

10.3 Successor and Assigns. This Security Agreement and all obligations of Grantor hereunder shall be binding upon the successors and assigns of Grantor, and shall, together with the rights and remedies of Secured Party hereunder, inure to the benefit of Secured Party, any future holder of any of the indebtedness and their respective successors and assigns. No sales of participations, other sales, assignments, transfers or other dispositions of any agreement governing or instrument evidencing the Secured Obligations or any portion thereof or interest therein shall in any manner affect the Lien granted to Secured Party hereunder.

10.4 Notices. Any notice or other communication hereunder to any party shall be addressed and delivered (and shall be deemed given) in accordance with the Security Agreement to the addresses set forth in the Transfer Agreement.

10.5 Counterparts. This Security Agreement may be executed in any number of separate counterparts, each of which, when so executed, shall be deemed an original, and all of said counterparts taken together shall be deemed to constitute but one and the same instrument.

10.6 Severability. If any provision of this Security Agreement is held to be unenforceable under applicable law for any reason, it shall be adjusted, if possible, rather than voided in order to achieve the intent of the parties to the extent possible. In any event, all other provisions of this Security Agreement shall be deemed valid and enforceable to the fullest extent possible under applicable law.

10.7 Governing Law. In all respects, including all matters of construction, validity and performance, this Security Agreement and the Secured Obligations arising hereunder shall be governed by, and construed and enforced in accordance with, the laws of the United States, State of Nevada applicable to contracts made and performed in such State.

IN WITNESS WHEREOF, each of the parties hereto has caused this Security Agreement to be executed and delivered by its duly authorized officer on the date first set forth above.

GRANTOR:
IONIC WATER TECHNOLOGIES, INC.
Date: September _____, 2006.
BY:

_____
Representing the Board of Directors
Of IONIC WATER TECHNOLOGIES, INC.

SECURED PARTY:
PATRICK L. MOULTON:
Date: September _____, 2006.

_____
Individually and On Behalf of
Parties defined as "Moulton"

EXHIBIT A TO PATENT SECURITY AGREEMENT

U.S. Patent No. 7,011,745

EXHIBIT A TO PATENT SECURITY AGREEMENT

U.S. Patent No. 7,011,745

US007011745B1

(12) **United States Patent**
Moulton

(10) **Patent No.: US 7,011,745 B1**
(45) **Date of Patent: Mar. 14, 2006**

(54) **ROTATING PERFORATED CYLINDER TREATMENT SYSTEM**

(76) Inventor: **Patrick L. Moulton**, 506 Perry St., Prescott, AZ (US) 86303

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 83 days.

(21) Appl. No.: **10/618,533**

(22) Filed: **Jul. 11, 2003**

Related U.S. Application Data

(60) Provisional application No. 60/395,262, filed on Jul. 11, 2002.

(51) **Int. Cl.**
C02F 1/58 (2006.01)

(52) **U.S. Cl.** **210/150**; 210/199; 210/205; 261/92; 261/DIG. 71; 366/305; 366/328.2

(58) **Field of Classification Search** ..... 210/619, 210/150, 151, 201, 202, 205, 209, 216, 199, 210/219; 261/92, DIG. 71; 435/294.1, 298.2; 366/305, 328.2
See application file for complete search history.

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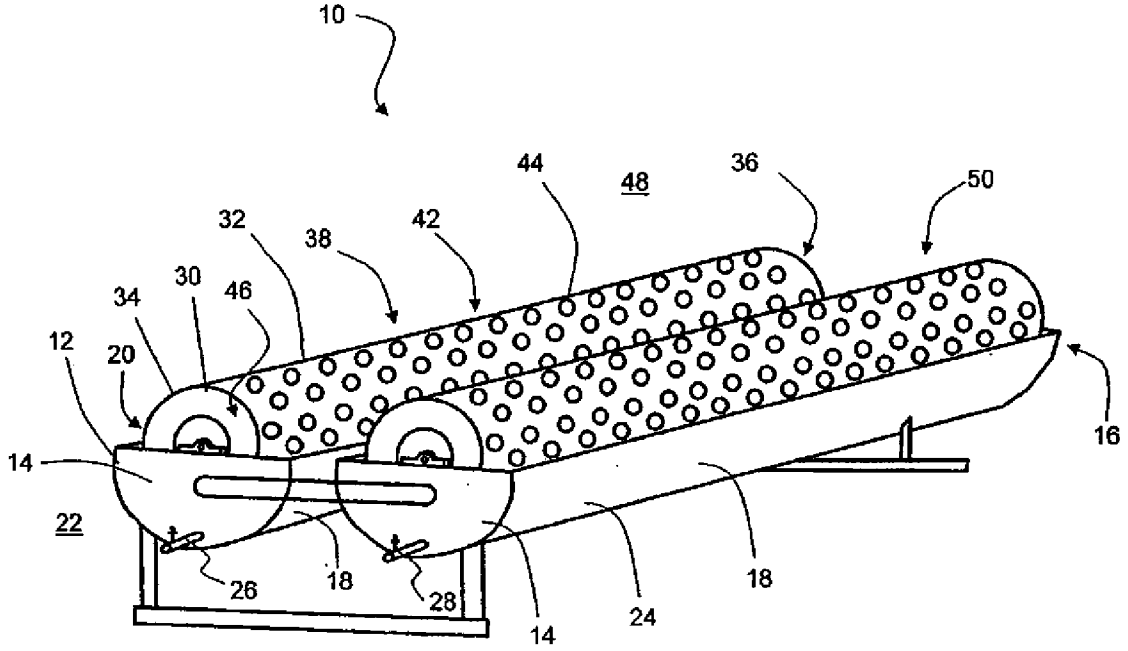
Primary Examiner—Peter A. Hruskoci
(74) *Attorney, Agent, or Firm*—Sierra Patent Group, Ltd.

(57) **ABSTRACT**

The disclosed device is directed toward a rotary water treatment system comprising at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to the at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

27 Claims, 3 Drawing Sheets



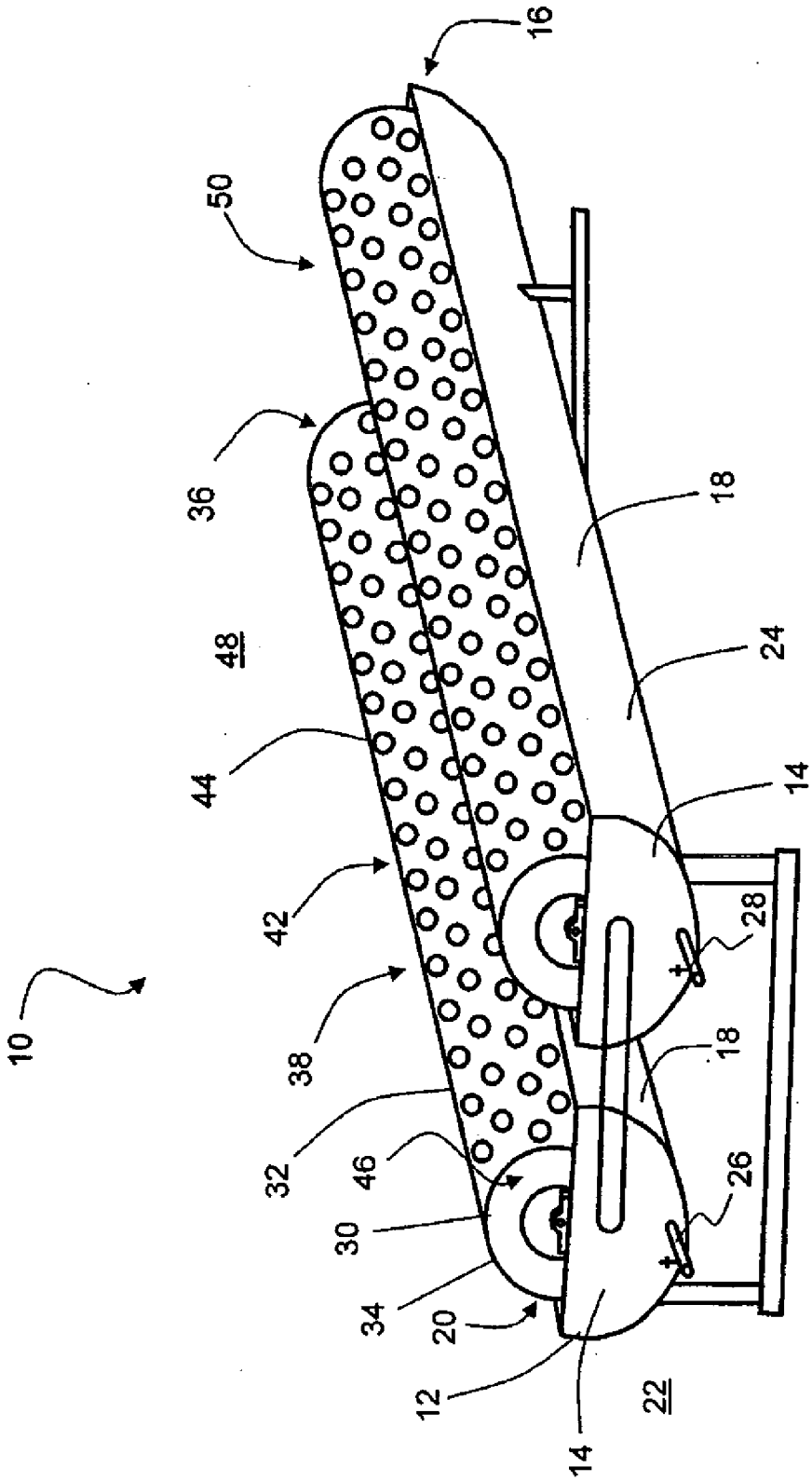


FIG. 1

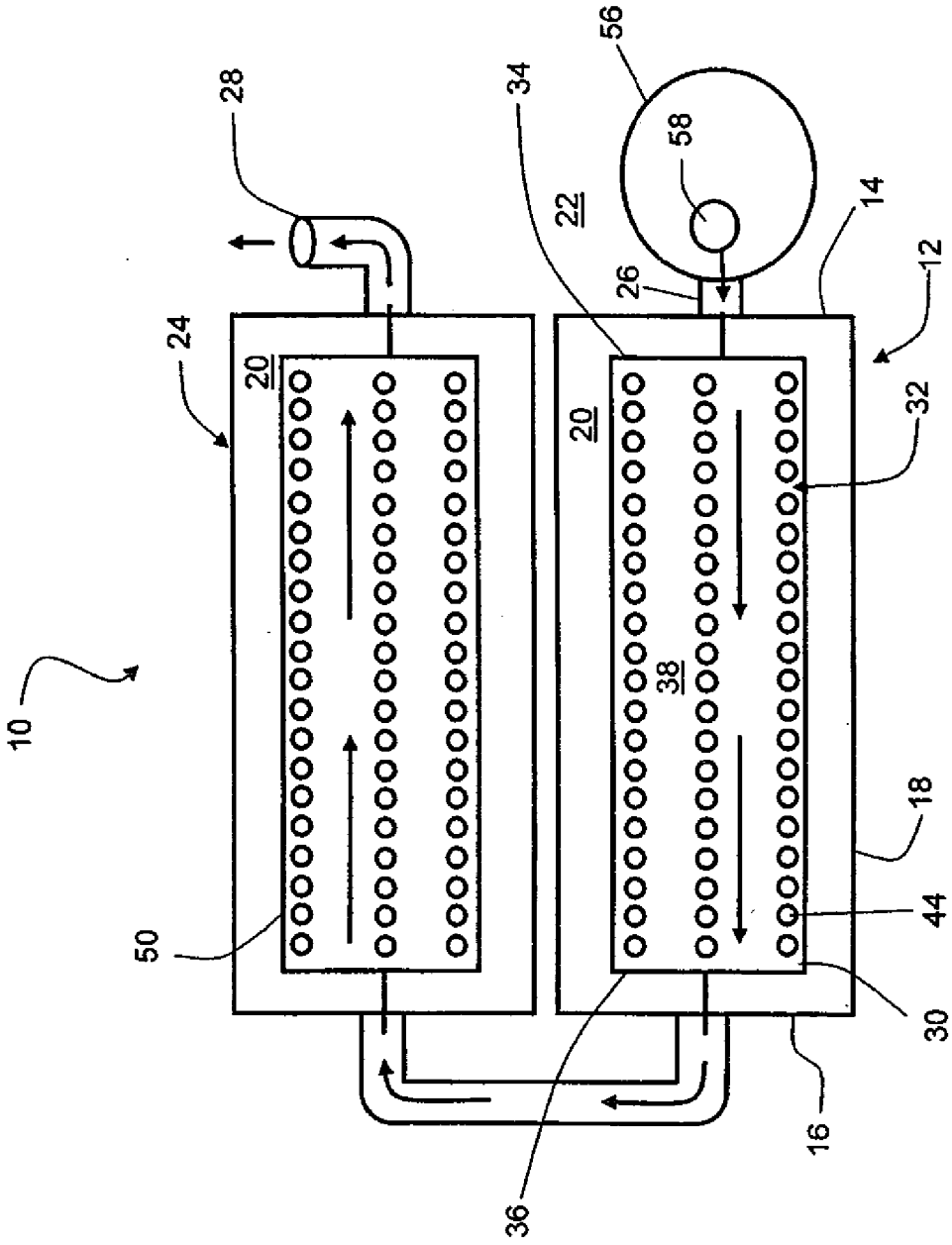


FIG. 2

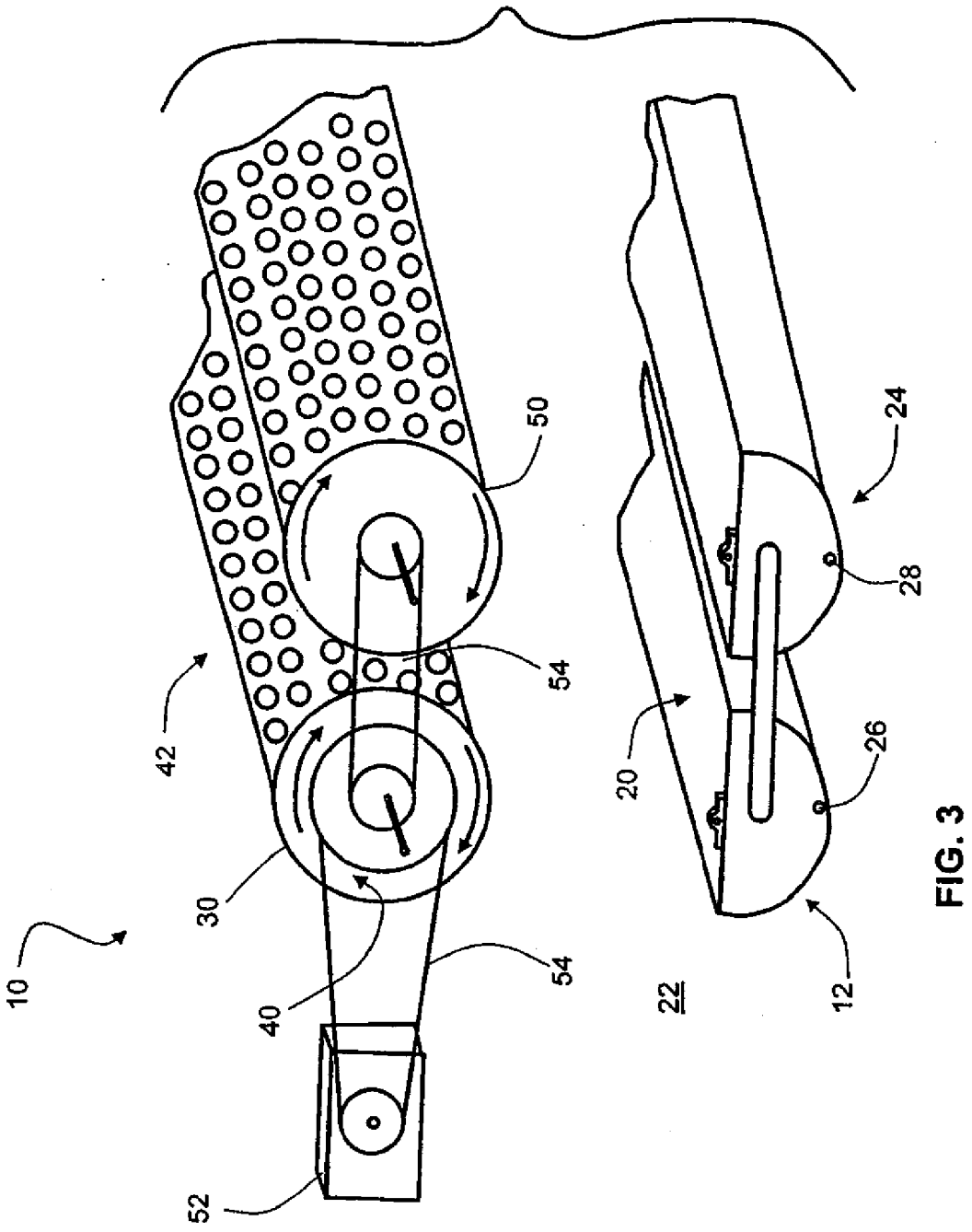


FIG. 3

ROTATING PERFORATED CYLINDER TREATMENT SYSTEM

PRIORITY CLAIM

This application claims priority to Provisional Patent Application No. 60/395,262 filed with the United States Patent and Trademark Office on Jul. 11, 2002.

BACKGROUND

The present disclosure relates to treatment systems, specifically to a low-energy treatment system for low-flow acid and alkaline drainage located in remote areas.

The precipitation of heavy metals from acidic or alkaline metal-laden water requires large amounts of dissolved oxygen to complete chemical reactions at certain pH plateaus. Complete oxidation of the heavy metal precipitant is key to producing a stable metal precipitant, thereby producing a stable filtered or decanted water for discharge after treatment. Reduced environments (dissolved oxygen deficient) remain unstable and the final pH and or residual metal content of the discharge water is unpredictable.

Air compressors and paddle type agitators used in prior art heavy metal treatment systems consume large amounts of energy during the oxidation and agitation phases of heavy metal precipitation. The efficiency of compressed air bubblers, used in aerating metal laden waters, depend on bubble size and the distribution of these bubbles in the water during the treatment phases. Agitation of the heavy metal laden waters with paddle type or propeller type blades require large amounts of energy, as they operate within tanks and move large amounts of water, in order to assure adequate introduction and mixing of oxygen enriched waters and pH adjusting reagents during treatment of heavy metal laden waters.

The prior art treatment systems rely on air compressors to add atmosphere to the heavy metal laden waters in order to raise the dissolved oxygen content of the water during treatment phases. Efficiency of the compressed air and the absorption of oxygen by the heavy metal laden water during treatment, depends on bubble size and the distribution of these bubbles within the prior art deep tanks. Excess amounts of compressed atmosphere must be added to insure that adequate oxygen is absorbed by the heavy metal laden water during the treatment and formation of the precipitants. This requires large amounts of energy to be expended in order to insure adequate oxidation takes place. Additionally, the remote nature of many impacted sites that require treatment systems often lack commercial electrical power.

Paddle type agitators used in prior art treatment systems move slowly within deep tanks and are largely unable to liberate the coated and un-reacted alkalinity providing reagent, thereby requiring the additional addition of reagent, to compensate for the un-reacted reagent previously added. The efficiency of the ionic exchange is also compromised as the large sized particle is not as efficient as a small particle during the formation of the precipitant. Prior art paddle type agitators also require and consume large amounts of energy as they have to move large amounts of water within deep tanks.

What is needed in the art is a treatment system designed to improve the efficiency of the oxidation and agitation phases of heavy metal precipitation during treatment, while utilizing a low-energy consumption power source.

SUMMARY

The disclosed device is directed toward a treatment system. The treatment system comprises a first container comprising a first end and a second end opposite the first end, a first container wall disposed between the first end and the second end. The first end, the container wall and the second end define a first interior and a first exterior. The first end, the container wall and the second end define a first container opening. A second container is fluidly coupled to the first container. The second container comprises a first end and a second end opposite the first end, a second container wall disposed between the first end and the second end. The first end, the container wall and the second end define a second interior and a second exterior. The first end, the container wall and the second end define a second container opening. A first aerator is partially disposed in the first interior through the first container opening. The first aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a first aerator interior and a first aerator exterior. The first aerator configured to partially rotatably dispose in a liquid contained in the interior of the first container. The first aerator is configured to aerate the liquid both at the first aerator interior and the first aerator exterior. A second aerator is partially disposed in the second interior through the second container opening. The second aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a second aerator interior and a second aerator exterior. The second aerator is configured to partially rotatably dispose in a liquid contained in the interior of the second container. The second aerator is configured to aerate the liquid both at the second aerator interior and the second aerator exterior. A rotary motive force element is operatively coupled to the first aerator and the second aerator. The rotary motive force element is configured to rotate the first aerator and the second aerator.

Another embodiment of the disclosed device is directed toward a rotary water treatment system comprises at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

A method of treating a liquid is disclosed. The method of treating a liquid comprises flowing the liquid through an influent supply into at least one open channel cell. The method includes rotating a cylinder through the liquid. The cylinder is partially disposed in at least one open channel cell. The cylinder comprises a first end and a second end opposite the first end and a perforated cylinder wall coupled between the first end and the second end. The first end, the perforated cylinder wall and the second end define an interior and an exterior of the cylinder. The method includes

lifting the liquid from at least one open channel cell onto the perforated cylinder wall at an interior surface and an exterior surface of the perforated cylinder wall. The method includes exposing the liquid to air from the exterior of the cylinder and the interior of the cylinder. The method includes flowing a treated liquid out of at least one open channel cell through an effluent discharge.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the figures, wherein like elements are numbered the same.

FIG. **1** is a perspective view of an exemplary treatment system.

FIG. **2** is a plan view of an exemplary treatment system.

FIG. **3** is a partial perspective view of an exemplary treatment system.

DETAILED DESCRIPTION

Persons of ordinary skill in the art will realize that the following description of the present disclosure is illustrative only and not in any way limiting. Other embodiments of the invention will readily suggest themselves to such skilled persons having the benefit of this disclosure.

The present disclosure describes a water treatment system for treating contaminated water, such as a heavy metal-laden water supply. In order to efficiently add dissolved oxygen from the atmosphere into a reduced environment of heavy metal laden waters (oxygen deficient) the surface of the water must be exposed to the atmosphere. An exemplary treatment system disclosed herein includes perforated rotating cylinders in order to exploit the surface tension properties of water, by lifting a thin film of the water from the cells and carrying the water on both the inside and outside surfaces of the rotating perforated cylinders. The perforations of the cylinders are "bridged" by a thin film of water as they rotate. This thin film of water absorbs oxygen from the atmosphere and effectively and efficiently raises the dissolved oxygen content of the heavy metal laden water.

One exemplary system operates with a flow rate of about 5 gpm of heavy metal laden water, with the perforated cylinders rotating at about 60 rpm, effectively distributes the influent over a total surface area of about 50,868 square feet.

The leading edge of the perforated cylinders, while rotating, also creates a cascading bubbling waterfall type action or, turbulent flow as the excess water that is lifted by the perforations is drained off of the cylinders. This cascading action also effectively and efficiently adds dissolved oxygen to the reduced environment (oxygen deficient) waters contained within the cells. The rotating action of the cylinders within the cells effectively and efficiently add large amounts of dissolved oxygen from the atmosphere, to the contained water in the cell, while thoroughly mixing the reduced and oxygen rich waters together, thereby raising the dissolved oxygen content of the contained waters.

Referring to FIGS. **1**, **2** and **3** a perspective view, a top view and a partial perspective view of an exemplary treatment system are illustrated. The treatment system **10** is shown in part without some of the subcomponents. The treatment system **10** includes at least one container (a first container or in an exemplary embodiment, an open channel cell) **12** preferably in a semi-cylinder shape. The container **12** includes a first end **14** and a second end **16** opposite the first end **14**. A container wall **18** is disposed between the first end **14** and the second end **16** to define an interior **20** and an exterior **22**. In an exemplary embodiment, the container **12** is an open-topped semi-circular cell having about a ten foot length and about an eighteen inch diameter. The total depth of the container **12** can be about nine inches and have a capacity of about sixty-six gallons. When the exemplary treatment system **10** is in operation, the depth of a liquid contained in the container **12** can be about five inches equaling a volume of about thirty-five gallons. The container **12** can be made of PVC or non-reactive corrosive resistant material. The container **12** is configured to contain liquid. The liquid is to be treated in the treatment system **10** and can comprise one of an acidic metal-laden water and an alkaline metal-laden water.

In an exemplary embodiment, the treatment system **10** includes another or second container **24** fluidly coupled (plumbed) to the first container **12**. The second container **24** includes the same physical features as the first container **12**. The first container **12** and second container are plumbed together to allow liquid to flow from an influent supply **26** through the first container to the second container **24** and to an effluent discharge **28** (See flow arrows in FIG. **2**). In an exemplary embodiment, the effluent discharge can be a sediment bag. The liquid can flow along the length of each cell **12**, **24**. In an exemplary embodiment, the containers **12**, **24** are plumbed to allow for influent and effluent to flow at various elevations or depths in the containers **12**, **24**.

An aerator (or first aerator) **30** is configured to be disposed in the container **12**. The aerator **30** includes a body **32** having a first end **34** and a second end **36** opposite the first end **34**. An aerator wall **38** is disposed between the first end **34** and the second end **36**. The aerator wall **38** includes an interior surface **40** and an exterior surface **42** opposite the interior surface **40**. The aerator wall **38** includes a plurality of perforations **44** formed in the aerator wall **38**. The perforations **44** allow fluid communication between the interior surface **40** and the exterior surface **46**. In a preferred embodiment, the perforations are one-half inch diameter holes formed in the aerator wall **38**. The first end **34**, aerator wall **38** and second end **36** define an aerator interior **46** and an aerator exterior **48**. The aerator **30** is configured to be partially disposed in the liquid contained in the interior **20** of the container **12**. The aerator **30** is only partially immersed in the liquid in the container **12**. The aerator **30** is configured to rotate about a longitudinal axis of the body **32** (See rotational arrows at FIG. **3**). The aerator **30** rotates through the liquid in the container **12**. As the liquid penetrates the perforations **44**, the liquid wets both the interior surface **40** of the aerator **30** and the exterior surface of the aerator **30**. While the aerator **30** rotates through the liquid, the liquid is aerated, (i.e., exposed to air).

A second aerator **50** having similar features to the first aerator **30** is disposed in the second container **24**. The second aerator **50** is also rotatably partially disposed in the interior **20** of the second container **24**. In an exemplary embodiment, the aerator **30**, **50** is a PVC cylinder **30** having a first end **34** and second end **36** coupled to a cylinder wall **38** similar to the aerator wall **38**. The cylinder **30** has a fifteen inch diameter and a nine foot length. The cylinder **30** has about 4,200 one-half inch diameter holes **44** through the cylinder wall **38**.

As illustrated in FIG. **3**, a motive force element **52** is operatively coupled to the first aerator **30** and in exemplary embodiments, also coupled to the second aerator **50**. The motive force element **52** is configured to rotate the aerator(s) **30**, **50**. In an exemplary embodiment, the motive force element **52** imparts rotary motion to the cylinder(s) **30**, **50**. A drive belt **54** and drive pulley arrangement can be employed to rotate the cylinder(s) **30**, **50**. In an exemplary

embodiment, the motive force element is a 110 volt, 1.7 amp gear reduced ac motor rotating the cylinder(s) **30**, **50** at about 60 rpm.

A tank or reservoir **56** can be coupled to the influent supply **26** to provide a source of liquid to the treatment system **10**. In an exemplary embodiment, the tank **56** can be a flash reaction tank. A pump **58** can be employed to pump the liquid to the influent supply **26** from the tank **56**. In an exemplary embodiment, the pump can be a 5 gpm, 15 amp, 110 watt pump.

Exemplary Treatment System Test Results

Test results from an exemplary treatment system using acidic heavy metal laden water from a mine site in northeastern Nevada are as follows:

Dissolved oxygen contents of samples drawn from the mine site are consistently one (1) milligram per liter (mg) or less. A single pass of the acidic heavy metal laden water through the system, at a flow rate of 5 gpm, raised the dissolved oxygen content 800 to 900 percent. Dissolved oxygen levels rose from less than 1 mg/l to 8.5 mg/l or higher. The acidic metal laden waters were circulated through the system for as long as 3 hours, with no apparent improvement over the single pass, which takes approximately 15 minutes.

The removal of heavy metals from acidic, reduced environment water requires raising the pH of the impacted waters with an alkalinity providing reagent (e.g., lime slurry (CaOH2) or Sodium Hydroxide (NAOH) to remove (precipitate) the heavy metals from the impacted water. Either of these reagents are commonly the used in the treatment of heavy metal contaminated water. These tests were conducted using lime slurry (CaOH2) as the alkalinity providing reagent for the precipitation of the heavy metals from the impacted waters.

Test results showed that when the treated water and aerated water had a final dissolved oxygen content of less than 6 mg/l, the treated solution had an unstable and unpredictable final pH and residual heavy metal content after treatment. Tests results also showed that when the treated and aerated water had a final dissolved oxygen content of 6 mg/l or higher a stable pH and residual metal content after treatment was achieved. Following treatment the oxidized solution had a drop in pH of approximately 1 to 1.5 standard units (s.u.) after 12 hours. The dissolved oxygen content also dropped 1 mg/l to 3 mg/l while the chemical reactions were completed. Samples measured at up to five days after treatment have shown that the final pH and dissolved oxygen content remain stable after the preliminary drop.

Test results have shown that dissolved oxygen requirements and consumption for completing chemical reactions at certain pH plateaus are evident and predictable during treatment, reflecting the heavy iron content of the waters used during the tests. The pH plateau from 2.5 s.u. to 5.0 is relatively easy to achieve while remaining in an oxidized environment (dissolved oxygen content greater than 6 mg/l). The bulk of the heavy metal contaminates in the test waters are precipitated out of solution at a pH range between 5.0 s.u. and 8.0 s.u. in this series of tests. The pH plateau of 5.0 to 8.0 requires large amounts of dissolved oxygen in order to remain in an oxidized environment. The treatment system performed well in maintaining an "oxidized environment" during precipitation and sludge generation during treatment. The pH plateau of 8.0 to 10.0 was easily achieved while remaining in a oxidized environment as the remaining heavy metal concentration in the water was relatively low after the initial precipitation at pH 8.0 s.u. The testing of the prototype treatment system produced stable precipitants (heavy metal sludge) and clear discharge waters meeting or exceeding Federal EPA standards for secondary drinking water quality from heavily metal laden acidic mine waters in all of the tests performed.

The prototype treatment system was constructed and based on a flow rate of approximately 5 gpm of influent for testing purposes only. The final dimensions of the rotating perforated cylinder treatment system would be susceptible to several factors. Dissolved oxygen requirements at each site would vary, as the concentration of heavy metal contaminates in the impacted waters are different at each site. Dissolved oxygen requirements for precipitant formation will vary, depending upon the water chemistry and heavy metals removed by the treatment system. Flow rates of acid rock drainage and or alkaline rock drainage at each site are different and would require different sized rotating cylinders and cells and/or a series of cells required. Testing and optimization of the treatment system will be a determining factor on the physical size of the treatment system.

The rotating perforated cylinders and shallow cells used in this treatment system add large amounts of dissolved oxygen from the atmosphere with minimal energy expenditure and maximum efficiency.

Alkalinity providing reagents used in the treatment of heavy metal laden acidic waters are also efficiently and effectively agitated by the rotating perforated cylinders. The ionic exchange during precipitation of the heavy metals is also optimized by the rotating perforated cylinders action. The initial introduction of alkalinity providing reagents, into the heavy metal laden reduced environment, (flash reaction phase) produces a large sized particle precipitant. This large sized particle is mainly coated and un-reacted reagent. The rotating perforated cylinders agitate and pick this particle up and liberate the un-reacted reagent for an efficient ionic exchange during metal precipitation. While the ionic exchange is enhanced by the rotating perforated cylinders action, the oxidation process necessary for stable formation of precipitants, during the ionic exchange, is optimized by the particles being effectively exposed to the atmosphere in a thin film, thereby assuring complete oxidation of the precipitant during formation of the precipitant.

The rotating perforated cylinders and shallow cells used in the disclosed treatment system efficiently agitate and liberate the alkalinity providing reagent, while enhancing ionic exchange during the formation of the precipitant, with minimal energy expenditure and maximum efficiency.

In an exemplary treatment system, the power requirements have been tested and are extremely efficient compared to conventional treatments systems using air compressors and paddle or propeller type agitators. In the exemplary embodiment, the drive mechanism for the rotating perforated cylinders is a 110 volt ac gear reduced motor running at 1.7 full load amperes. The amperage consumption of the motor drops to approximately 1 ampere after the rotating cylinders reach an equilibrium turning at 60 rpm. A non-corrosive submersible pump rated at 5 gpm operating on 110 volts at 1.5 full load amps is used to circulate water through the cells. The operating amperage of the non-corrosive pump drops to approximately 1 ampere as the system is running. Operating energy consumption of the rotating perforated cylinder treatment system is approximately 2 amperes at 110 volts while in use.

A conventional treatment system, operating with an air compressor and paddle or propeller type agitator, at the same

flow rate of 5 gpm, will consume at least 10 times more energy than the rotating perforated cylinder treatment system.

The exemplary prototype treatment system constructed and tested has proven to be an efficient and effective system in the treatment of acidic heavy metal laden waters. The low energy consumption of the system, the efficiency of oxygen addition, as well as ionic exchange optimization and efficient alkalinity reagent consumption is evident in the testing results. The energy consumption of this treatment system is far less than the energy consumption of conventional systems. The efficiency of the rotating perforated cylinders operating with shallow cells has proven to be efficient and effective.

The rotating perforated cylinder treatment system has to date only been tested with acidic heavy metal laden waters. The treatment system has the capabilities to be applied to alkaline heavy metal laden waters also. The working theories are basically the same however reagents and pH plateaus are different when an alkaline environment is treated rather than an acidic environment.

It is contemplated that in addition to the disclosed treatment system being configured to treat liquids, such as heavy metal-laden water, other impacted waters having contaminants can be treated. The treatment system can remove volatile organic compounds, regular metals, or merely aerate the water for low dissolved oxygen environments. The treatment system disclosed can also be employed to bioremediate liquids, such as contaminated water supplies, and the like.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

What is claimed is:

1. A treatment system comprising:

a first container comprising a first end and a second end opposite said first end, a first container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a first interior and a first exterior, said first end, said container wall and said second end defining a first container opening;

a second container fluidly coupled to said first container, said second container comprising a first end and a second end opposite said first end, a second container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a second interior and a second exterior, said first end, said container wall and said second end defining a second container opening;

a first aerator partially disposed in said first interior through said first container opening, said first aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a first aerator interior and a first aerator exterior, said first aerator configured to partially rotatably dispose in a liquid contained in said interior of said first container, said first aerator configured to aerate said liquid both at said first aerator interior and said first aerator exterior, wherein said plurality of perforations formed in the first aerator wall are configured to lift a thin film of said liquid from said first container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said first aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said first aerator wall, as well as said liquid contained in said first container;

a second aerator partially disposed in said second interior through said second container opening, said second aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a second aerator interior and a second aerator exterior, said second aerator configured to partially rotatably dispose in a liquid contained in said interior of said second container, said second aerator configured to aerate said liquid both at said second aerator interior and said second aerator exterior, wherein said plurality of perforations formed in the second aerator wall are configured to lift a thin film of said liquid from said second container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said second aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said second aerator wall, as well as said liquid contained in said second container; and

a rotary motive force element operatively coupled to said first aerator and said second aerator, said rotary motive force element configured to rotate said first aerator and said second aerator.

2. The treatment system of claim 1 further comprising:

at least one influent supply fluidly coupled to one of said first container and said second container;

at least one effluent discharge fluidly coupled to one of said first container and said second container.

3. The treatment system of claim 2 wherein said at least one influent supply is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container, said at least one effluent discharge is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container.

4. The treatment system of claim 1 wherein said first aerator and said second aerator are substantially cylinders configured for rotary motion about a longitudinal axis formed along said cylinder from said first ends of said first and second aerators to said second ends of said first and second aerators.

5. The treatment system of claim 1 wherein said first container and said second container are substantially semi-cylinders configured for containing liquid in said first interior and said second interior along a longitudinal axis of said semi-cylinders.

6. The treatment system of claim 1 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

7. The treatment system of claim 1 wherein said plurality of perforations comprises about one-half inch diameter holes defined in said aerator wall.

8. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to rotate through said liquid and lift said liquid on an interior surface and an exterior surface of said first aerator wall and said second aerator wall.

9. The treatment system of claim 1 wherein said plurality of perforations of said first aerator are configured to fluidly couple said first aerator interior with said first aerator exterior wetting an exterior surface and an interior surface of said first aerator wall with said liquid, and wherein said plurality of perforations of said second aerator are configured to fluidly couple said second aerator interior with said second aerator exterior wetting an exterior surface and an interior surface of said second aerator wall with said liquid.

10. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to increase dissolved oxygen content of the liquid contained in said first container and said second container respectively.

11. The treatment system of claim 1 wherein said first aerator is configured to mix reduced liquid and oxygen rich liquid in said first container, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said first container and said second aerator is configured to mix reduced liquid and oxygen rich liquid in said second container, and wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said second container.

12. The treatment system of claim 1 wherein said first container and said second container are configured to promote flow of said liquid through said first container to said second container.

13. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to expose said liquid to air.

14. The treatment system of claim 1 wherein said first aerator is configured to immerse into said liquid contained in said first container a predetermined minimal depth, and said second aerator is configured to immerse into said liquid contained in said second container a predetermined minimal depth.

15. The treatment system of claim 1 wherein said first aerator is configured to agitate reagents in said liquid contained in said first container, and said second aerator is configured to agitate reagents in said liquid contained in said second container.

16. The treatment system of claim 1 wherein said first aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid and said second aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid.

17. The treatment system of claim 16 wherein said first and second aerators are configured to agitate and lift coated un-reacted reagent particles in said liquid and liberate said un-reacted reagent thereby increasing ionic exchange during metal precipitation.

18. The treatment system of claim 17 wherein said first and second aerators are configured to expose said reagent particles to air in a thin liquid film, wherein said precipitant is completely oxidized during precipitant formation.

19. The treatment system of claim 1 further comprising:

a pump fluidly coupled to one of said first container and said second container, said pump configured to circulate said liquid through said first container and said second container.

20. A rotary water treatment system comprising:

at least one open channel cell configured to contain a liquid;

a cylinder partially disposed in said open channel cell, said cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall, wherein said cylinder is configured to rotate through said liquid and lift a thin film of said liquid on an interior surface and an exterior surface of said cylinder wall by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said cylinder is configured to create a cascading bubbling turbulent flow in said liquid flowing along said cylinder wall, as well as said liquid contained in said at least one open channel cell;

a motive force element coupled to said cylinder configured to impart rotary motion to said cylinder;

at least one influent supply coupled to said at least one open cell;

at least one effluent discharge coupled to said at least one open cell; and

a pump fluidly coupled to said at least one influent supply.

21. The rotary water treatment system of claim 20 further comprising:

another open channel cell fluidly coupled to said at least one open channel cell;

another cylinder partially disposed in said another open channel cell, said another cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall.

22. The rotary water treatment system of claim 21 wherein said motive force element comprises a gear reduced motor coupled to said cylinder and said another cylinder configured to rotate about a long axis of said cylinder and said another cylinder.

23. The rotary water treatment system of claim 20, wherein said cylinder wall is configured to aerate said liquid on both an outer surface and an inner surface of said cylinder wall.

24. The rotary water treatment system of claim 20 wherein said cylinder is partially disposed in said liquid contained in said open channel cell, and more than half of said cylinder longitudinal cross section extending beyond said open channel cell.

25. The rotary water treatment system of claim 20 wherein the rotary treatment system is configured to increase dissolved oxygen content of the liquid contained in said at least one open channel cell.

26. The rotary water treatment system of claim 20 wherein said cylinder is configured to mix reduced liquid and oxygen rich liquid in said at least one open channel cell, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said at least one open channel cell.

27. The rotary water treatment system of claim 20 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

* * * * *

SECURITY AGREEMENT

THIS SECURITY AGREEMENT dated as of September 15, 2006 ("Security Agreement"), is made by IONIC WATER TECHNOLOGIES, INC., a Nevada corporation ("Grantor" or "IWT"), in favor of PATRICK L. MOULTON or assign ("Secured Party" or "Moulton").

RECITALS

Pursuant to that certain Patent Transfer and Royalties Agreement dated as of the date hereof by and among Grantor and Secured Party (the "Transfer Agreement"), Moulton has agreed to transfer all right and title to the Patent and Patent Rights identified in the Transfer Agreement and further described at **Exhibit A,** but only upon the condition, among others, that Grantor shall have executed and delivered to Secured Party this Security Agreement.

AGREEMENT

Grantor hereby represents, warrants, covenants and agrees as follows:

1. DEFINED TERMS. When used in this Security Agreement the following terms shall have the following meanings (such meanings being equally applicable to both the singular and plural forms of the terms defined):

"Collateral" shall have the meaning assigned to such term in Section 2 of this Security Agreement.

"Contracts" means all contracts, undertakings, purchase orders, licensing agreements, joint ventures or other agreements in or under which Grantor now holds or hereafter acquires any right, title or interest.

"Event of Default" shall have the mean ascribed to it in the Transfer Agreement, Section 12.

"Lien" means any mortgage, lien, deed of trust, charge, pledge, security interest or other encumbrance.

"Patent" means all of the following in which Grantor now holds or hereafter acquires which are related to or derive from the United States Patent No. 7,011,745 identified at **Exhibit A**: (a) all letters patent of the United States or any other country, all registrations and recordings thereof and all applications for letters patent of the United States or any other country, including, without limitation, registrations, recordings and applications in the United States Patent and Trademark Office or in any similar office or agency of the United States, any State thereof or any other country; (b) all reissues, divisions, continuations, renewals, continuations in part or extensions thereof; (c) all petty patents, divisionals and patents of addition; (d) all patents to issue in any such applications; (e) income, royalties, damages, claims and payments now and hereafter due and/or payable with respect to patents, including, without limitation, damages, claims and recoveries for past, present or future infringement; and (f) rights to sue for past, present and future infringements of any patent.

"Patent Rights" means any and all written agreements, in which Grantor now holds or hereafter acquires any interest, granting any right with respect to the Patent (whether Grantor is the licensee or the licensor thereunder).

"Permitted Liens" means those liens and security interests held against the Collateral pursuant to the Loan Documents identified in the Transfer Agreement at Section 10, and those other liens that may hereafter be placed against the Collateral upon written approval of the Secured Party.

"Secured Obligations" means (a) the obligation of Grantor to repay Secured Party all of the unpaid cash and royalty payments identified at Section 9 of the Transfer Agreement.

"UCC" means the Uniform Commercial Code as the same may, from time to time, be in effect in the United States, State of Nevada; provided, however, in the event that, by reason of mandatory provisions of law, any or all of the attachment, perfection or priority of Secured Party's security interest in any Collateral is governed by the Uniform Commercial Code as in effect in a jurisdiction other than the State of Nevada, the term "UCC" shall mean the Uniform Commercial Code as in effect in such other jurisdiction for purposes of the provisions hereof relating to such attachment, perfection of priority and for purposes of definitions related to such provisions.

In addition, the following terms if used herein shall be defined terms having the meaning set forth for such terms in the UCC: "Account Debtor"; "Accounts"; "Chattel Paper"; "Deposit Accounts"; "Equipment"; "Financial Assets"; "Fixtures"; "General Intangibles"; "Instruments"; "Inventory"; "Investment Property"; "Proceeds". Each of the foregoing defined terms shall include all of such items now owned, or hereafter acquired by Grantor.

All capitalized terms used herein and not otherwise defined herein shall have the respective meanings given to them in the Security Agreement.

2. GRANT OF SECURITY INTEREST. As collateral security for the prompt and complete payment and performance when due (whether at stated maturity, by acceleration or otherwise) of all the Secured Obligations and in order to induce Secured Party to execute and perform pursuant to the Transfer Agreement, Grantor hereby grants to Secured Party a security interest in all of Grantor's right, title and interest, if any, in, to and under the following (all of which being collectively referred to herein as the "Collateral"):

(a) The Patent and Patent Rights;
(b) All Deposit Accounts and other Accounts of Grantor;
(c) All Contracts of Grantor;
(d) All Equipment of Grantor;
(e) All Financial Assets of Grantor;

(f) All Fixtures of Grantor;
(g) All other intangible assets of Grantor, including, without limitation, all copyrights, trademarks, licenses, drawings, technical information, customer lists, trade secrets, proprietary or confidential information, inventions (whether or not patentable), procedures, know-how and models;
(h) All Inventory of Grantor;
(i) All other goods and personal property of Grantor, wherever located, whether tangible or intangible, and whether now owned or hereafter acquired, existing, leased or consigned by or to Grantor; and
(j) To the extent not otherwise included, all Proceeds of each of the foregoing and all accessions to, substitutions and replacements for and rents, profits and products of each of the foregoing; provided, however, that "Collateral" shall not include any equipment lease, equipment financing agreement or Equipment which is the subject of an equipment lease or equipment financing agreement to the extent and for so long as the grant of a security interest therein is expressly prohibited by the terms of any enforceable provision of such equipment lease or equipment financing agreement.

3. RIGHTS OF SECURED PARTY; COLLECTION OF ACCOUNTS.

(a) Notwithstanding anything contained in this Security Agreement to the contrary, Grantor expressly agrees that it shall remain liable under each of its Contracts to observe and perform all the conditions and obligations to be observed and performed by it thereunder and that it shall perform all of its duties and obligations thereunder, all in accordance with and pursuant to the terms and provisions of each such Contract. Secured Party shall not have any obligation or liability under any Contract by reason of or arising out of this Security Agreement or the granting to Secured Party of a lien therein or the receipt by Secured Party of any payment relating to any Contract pursuant hereto, nor shall Secured Party be required or obligated in any manner to perform or fulfill any of the obligations of Grantor under or pursuant to any Contract, or to make any payment, or to make any inquiry as to the nature or the sufficiency of any

payment received by it or the sufficiency of any performance by any party under any Contract, or to present or file any claim, or to take any action to collect or enforce any performance or the payment of any amounts which may have been assigned to it or to which it may be entitled at any time or times.

(b) Secured Party authorizes Grantor to collect its Accounts, provided that such collection is performed in a prudent and businesslike manner, and Secured Party may, upon the occurrence and during the continuation of any Event of Default and with prior written notice to Grantor, limit or terminate said authority at any time. Upon the occurrence and during the continuance of any Event of Default, at the request of Secured Party, Grantor shall deliver all original and other documents evidencing and relating to the performance of labor or service which created such Accounts, including, without limitation, all original orders, invoices and shipping receipts.

(c) Secured Party may at any time, upon the occurrence and during the continuance of any Event of Default, with prior written notice to Grantor of its intention to do so, notify Account Debtors of Grantor, parties to the Contracts of Grantor, obligors in respect of Instruments of Grantor and obligors in respect of Chattel Paper of Grantor that the Accounts and all or some of the right, title and interest of Grantor in and under such Contracts. Instruments and Chattel Paper have been assigned to Secured Party and that payments shall be made directly to Secured Party. Upon the request of Secured Party at any time after the occurrence and during the continuance of an Event of Default, Grantor shall so notify such Account Debtors, parties to such Contracts, obligors in respect of such Instruments and obligors in respect of such Chattel Paper. Upon the occurrence and during the continuance of any Event of Default, Secured Party may, in its name or in the name of others, communicate with such Account Debtors, parties to such Contracts, obligors in respect of such Instruments and obligors in respect of such Chattel Paper to verify with such parties, to Secured Party's satisfaction, the existence, amount and terms of any such Accounts, Contracts, Instruments or Chattel Paper.

4. REPRESENTATIONS AND WARRANTIES. Grantor hereby represents and warrants to Secured Party that:

(a) Except for the security interest granted to Secured Party under this Security Agreement and Permitted Liens, Grantor is the sole legal and equitable owner of each item of the Collateral in which it purports to grant a security interest hereunder, having good and marketable title thereto, free and clear of any and all liens except for Permitted Liens.

(b) No effective security agreement, financing statement, equivalent security or lien instrument or continuation statement covering all or any part of the Collateral exists, except for Permitted Liens.

(c) This Security Agreement creates a legal and valid security interest on and in all of the Collateral in which Grantor now has rights. Upon the filing of appropriate financing statements and the taking of other actions as Secured Party deems appropriate, Secured Party will have a fully perfected security interest in all of the Collateral in which Grantor now has rights subject only to Permitted Liens. This Security Agreement will create a legal and valid and fully perfected first priority security interest in the Collateral in which Grantor later acquires rights, when Grantor acquires those rights subject only to Permitted Liens and additional filings to be made with the United States Patent and Trademark Office and/or other offices as are necessary to perfect Secured Party's security interest in subsequent ownership rights and interests of Grantor in the Collateral.

5. COVENANTS. Grantor covenants and agrees with Secured Party that from and after the date of this Security Agreement and until the Secured Obligations have been performed and paid in full:

5.1 Disposition of Collateral. Grantor shall not sell, lease, transfer or otherwise dispose of any of the Collateral, or attempt or contract to do so, other than as permitted by the Security Agreement or as required due to obligations owing pursuant to the Permitted Liens.

5.2 Relocation of Business or Collateral. Grantor shall not relocate its chief executive office, principal place of business or its records, or allow the relocation of any Collateral (except as allowed

pursuant to Section 5.1 immediately above) from outside the states of Nevada or Idaho, USA, without prior written notice to Secured Party.

5.3 Limitation on Liens on Collateral. Grantor shall not, directly or indirectly, create, permit or suffer to exist, and shall defend the Collateral against and take such other action as is necessary to remove, any lien on the Collateral, except Permitted Liens.

5.4 Taxes, Assessments, Etc. Grantor shall pay promptly when due all property and other taxes, assessments and government charges imposed upon, and all claims (including claims for labor, materials and supplies) against, the equipment, fixtures or inventory, except to the extent the validity thereof is being contested in good faith and adequate reserves are being maintained in connection therewith.

5.5 Maintenance of Records. Grantor shall keep and maintain at its own cost and expense satisfactory and complete records of the Collateral.

5.6 Registration of Intellectual Property Rights. Grantor shall promptly register or cause to be registered (to the extent not already registered and consistent with good faith business judgment) the most recent version of any Patent which, individually or in the aggregate, is material to the conduct of Grantor's business, with the United States Patent Office, as applicable, including, without limitation, in all such cases the filing of applications for renewal, affidavits of use, affidavits of noncontestability and opposition and interference and cancellation proceedings.

5.7 Notification Regarding Changes in Intellectual Property. Grantor shall promptly advise Secured Party of any subsequent ownership right or interest of Grantor in or to the Patent, and as to any material copyright, trademark or license in which Grantor has an interest.

5.8 Defense of Intellectual Property. Grantor shall (i) protect, defend and maintain the validity and enforceability of the Patent, Patent Rights and all material current copyrights and trademarks, (ii) use its best efforts to detect material infringements of the Patent, Patent Rights and all material current copyrights and trademarks and promptly advise Secured Party in writing of material infringements detected and (iii) not
allow the Patent, Patent Rights and all material current copyrights and trademarks to be abandoned, forfeited or dedicated to the public without the written consent of Secured Party in each case unless reasonable business practice would determine that any such failure to act or abandonment is appropriate.

5.9 Further Assurances; Pledge of Instruments. At any time and from time to time, upon the written reasonable request of Secured Party, and at the sole expense of Grantor, Grantor shall promptly and duly execute and deliver any and all such further instruments and documents and take such further action as Secured Party may reasonably deem necessary or desirable to obtain the full benefits of this Security Agreement, including, without limitation, facilitating the filing of UCC-1 Financing Statements in all applicable jurisdictions and this Security Agreement (and any amendment hereto) or a collateral assignment (and any amendments thereto) with the United States Copyright Office and/or Patent and Trademark Office, as applicable.

5.10 Maintenance of Insurance. Grantor shall maintain, with financially sound and reputable companies, insurance policies insuring (a) its equipment, fixtures and inventory against loss by fire, explosion, theft and such other casualties as are usually insured against by companies engaged in the same or similar businesses and (b) to the extent requested by Secured Party, Grantor and Secured Party against liability for personal injury and property damage relating to such equipment, fixtures and inventory. Such policies are to be in such amounts and against at least such risk as are usually insured against in the same general area by companies of the same or a similar size engaged in the same or a similar business as Grantor. Grantor shall, if so requested by Secured Party, deliver to Secured Party, as often as Secured Party may reasonably request, a report of a reputable insurance broker satisfactory to Secured Party with respect to the insurance on its equipment, fixtures and inventory. All insurance with respect to the equipment, fixtures and inventory shall provide that no cancellation, reduction in amount or change in coverage

thereof shall be effective until at least thirty (30) days after receipt by Secured Party of written notice thereof.

5.11 Right of Inspection and Audit. Upon reasonable notice to Grantor (unless an Event of Default has occurred and is continuing, in which case no notice is necessary), Secured Party shall at all times have fall and free access during normal business hours to all the books and records and correspondence of Grantor, and Secured Party or any agents or representatives of Secured Party may examine the same, take extracts therefrom and make photocopies thereof, and Grantor agrees to render to Secured Party, at Grantor's cost and expense, such clerical and other assistance as may be reasonably requested with regard thereto. Upon reasonable notice to Grantor (unless an Event of Default has occurred and is continuing, in which case no notice is necessary), Secured Party and its agents and representatives shall also have the right to enter into and upon any premises where any of the equipment, fixtures or inventory is located for the purpose of conducting audits and making physical verifications of such equipment, fixtures and inventory and test verifications of the Accounts in any manner and through any medium that it considers advisable, and Grantor agrees to furnish all such assistance and information as Secured Party may reasonably require in connection therewith.

5.12 Continuous Perfection. Grantor shall not change its name, identity or corporate structure in any manner which might make any financing or continuation statement filed in connection herewith seriously misleading within the meaning of Section 9-402(7) of the UCC (or any other then applicable provision of the UCC) unless Grantor gives Secured Party prior written notice thereof and takes all action necessary or reasonably requested by Secured Party to amend such financing statement or continuation statement so that it is not seriously misleading.

5.13 Power of Attorney. Effective only upon the occurrence and during the continuance of an Event of Default, Grantor hereby irrevocably appoints Secured Party (and any of Secured Party's designated officers or employees) as Grantor's true and lawful attorney to: (a) send requests for verification of Accounts or notify account debtors of Secured Party's security interest in the Accounts; (b) endorse Grantor's name on any checks or other forms of payment or security that may come into Secured Party's possession; (c) sign Grantor's name on any invoice or bill of lading relating to any Account, drafts against account debtors, schedules and assignments of Accounts, verifications of Accounts, and notices to account debtors, (d) make, settle and adjust all claims under and decisions with respect to Grantor's policies of insurance; (e) settle and adjust disputes and claims respecting the accounts directly with account debtors, for amounts and upon terms which Secured Party determines to be reasonable; (f) modify, in its sole discretion, any intellectual property security agreement entered into between Grantor and Secured Party without first obtaining Grantor's approval of or signature to such modification by amending reference to any right, title or interest in any Copyrights, Patents or Trademarks, acquired by Grantor after the execution hereof or to delete any reference to any right, title or interest in any Copyrights, Patents or Trademarks, in which Grantor no longer has or claims any right, title or interest; (g) file, in its sole discretion, one or more financing or continuation statements and amendments thereto, relative to any of the Collateral without the signature of Grantor where permitted by law; and (h) transfer any intellectual property Collateral into the name of Secured Party or a third party to the extent permitted under the UCC. The appointment of Secured Party as Grantor's attorney in fact, and each and every one of Secured Party's rights and powers, being coupled with an interest, is irrevocable until all of the Secured Obligations have been fully repaid and performed and Secured Party's obligation to provide
advances hereunder is terminated.

6. RIGHTS AND REMEDIES UPON DEFAULT.

(a) If any Event of Default shall occur and be continuing, Secured Party may exercise in addition to all other rights and remedies granted to it under this Security Agreement and under any other instrument or agreement securing, evidencing or relating to the Secured Obligations, all rights and remedies of a secured party under the UCC. Without limiting the generality of the foregoing, Grantor expressly agrees that in any such event, and during the existence and continuance of an Event of Default, Secured Party, without demand of performance or other demand, advertisement or notice of any kind (except the notice specified below of time and place of public or private sale) to or upon Grantor or any other person (all and each of

which demands, advertisements and notices are hereby expressly waived to the maximum extent permitted by the UCC and other applicable law), may forthwith collect, receive, appropriate and realize upon the Collateral, or any part thereof, and may forthwith sell, lease, assign, give an option or options to purchase or sell or otherwise dispose of and deliver said Collateral (or contract to do so), or any part thereof, in one or more parcels at public or private sale or sales, at any exchange or broker's board or at any of Secured Party's offices or elsewhere at such prices as it may deem best, for cash or on credit or for future delivery without assumption of any credit risk. Secured Party shall have the right upon any such public sale or sales, and, to the extent permitted by law, upon any such private sale or sales, to purchase the whole or any part of said Collateral so sold, free of any right or equity of redemption, which equity of redemption Grantor hereby releases. Grantor further agrees, at Secured Party's request and during the existence and continuance of an Event of Default, to assemble the Collateral and make it available to Secured Party at places which Secured Party shall reasonably select, whether at Grantor's premises or elsewhere. Secured Party shall apply the net proceeds of any such collection, recovery, receipt, appropriation, realization or sale as provided in Section 6(d) hereof, Grantor remaining liable for any deficiency remaining unpaid after such application, and only after so paying over such net proceeds and after the payment by Secured Party of any other amount required by any provision of law, need Secured Party account for the surplus, if any, to Grantor. To the maximum extent permitted by applicable law, Grantor waives all claims, damages, and demands against Secured Party arising out of the repossession, retention or sale of the Collateral except such as arise out of the gross negligence or willful misconduct of Secured Party. Grantor agrees that Secured Party need not give more than thirty (30) days' notice (which notification shall be deemed given when mailed or delivered on an overnight basis, postage prepaid, addressed to Grantor at its address set forth in the Transfer Agreement, of the time and place of any public sale or of the time after which a private sale may take place and that such notice is reasonable notification of such matters. Grantor shall remain liable for any deficiency if the proceeds of any sale or disposition of the Collateral are insufficient to pay all amounts to which Secured Party is
entitled, Grantor also being liable for the reasonable fees of any attorneys employed by Secured Party to collect such deficiency.

(b) Grantor also agrees to pay all fees, costs and expenses of Secured Party, including, without limitation, reasonable attorneys' fees, reasonably incurred in connection with the enforcement of any of its rights and remedies hereunder.

(c) The Proceeds of any sale, disposition or other realization upon all or any part of the Collateral shall be distributed by Secured Party in the following order of priorities:

FIRST, to Secured Party in an amount sufficient to pay in full the reasonable costs of Secured Party in connection with such sale, disposition or other realization, including all fees, costs, expenses, liabilities and advances reasonably incurred or made by Secured Party in connection therewith, including, without limitation, reasonable attorneys' fees;

SECOND, to Secured Party in an amount equal to the then unpaid Secured Obligations; and

THIRD, upon payment in full of the Secured Obligations, to Grantor or its representatives, in accordance with the UCC or as a court of competent jurisdiction may direct.

(d) Secured Party acknowledges and understands that any rights and remedies provided herein or by applicable law are subject and subordinate to the priority rights of the Permitted Liens.

7. INDEMNITY. Grantor agrees to defend, indemnify and hold harmless Secured Party against (a) all obligations, demands, claims and liabilities claimed or asserted by any other party in connection with the transactions contemplated by this Security Agreement and (b) all losses or expenses in any way suffered, incurred or paid by Secured Party as a result of or in any way arising out of or following transactions between Secured Party and Grantor, whether under this Security Agreement or otherwise (including without limitation, reasonable attorneys' fees and expenses for one firm of counsel), except for losses arising from or out of Secured Party's gross negligence or willful misconduct.

8. LIMITATION ON SECURED PARTY'S DUTY IN RESPECT OF COLLATERAL. Secured Party shall deal with the Collateral in the same manner as it deals with similar property for its own account. Secured Party shall be deemed to have acted reasonably in the custody, preservation and disposition of any of the Collateral
if it takes such action as Grantor requests in writing, but failure of Secured Party to comply with any such request shall not in itself be deemed a failure to act reasonably and no failure of Secured Party to do any act not so requested shall be deemed a failure to act reasonably.

9. REINSTATEMENT. This Security Agreement shall remain in full force and effect and continue to be effective should any petition be filed by or against Grantor for liquidation or reorganization, should Grantor become insolvent or make an assignment for the benefit of creditors or should a receiver or trustee be appointed for all or any significant part of Grantor's property and assets and shall continue to be effective or be reinstated, as the case may be, if at any time payment and performance of the Secured Obligations, or any part thereof, is, pursuant to applicable law, rescinded or reduced in amount or must otherwise be restored or returned by any obligee of the Secured Obligations, whether as a "voidable preference," "fraudulent conveyance" or otherwise, all as though such payment or performance had not been made. In the event that any payment, or any part thereof, is rescinded, reduced, restored or returned, the Secured Obligations shall be reinstated and deemed reduced only by such amount paid and not so rescinded, reduced, restored or returned.

10. MISCELLANEOUS.

10.1 No Waiver; Cumulative Remedies.

(a) Secured Party shall not by any act, delay, omission or otherwise be deemed to have waived any of its respective rights or remedies hereunder, nor shall any single or partial exercise of any right or remedy hereunder on any one occasion preclude the further exercise thereof or the exercise of any other right or remedy.

(b) The rights and remedies hereunder provided are cumulative and may be exercised singly or concurrently and are not exclusive of any rights and remedies provided by law.

(c) None of the terms or provisions of this Security Agreement may be waived, altered, modified or amended except by an instrument in writing, duly executed by Grantor and Secured Party.

10.2 Releases.

(a) At such time as the Secured Obligations shall have been paid and performed in full, the Collateral shall be released from the Liens created hereby, and this Security Agreement and all obligations of Secured Party and Grantor hereunder shall terminate, all without delivery of any instrument or performance of any act by any party, and all rights to the Collateral shall revert to Grantor. At the request and sole expense of Grantor following any such termination Secured Party shall deliver to Grantor any Collateral held by Secured Party hereunder, and execute and deliver to Grantor such documents as Grantor shall reasonably request to evidence such termination.

(b) If any of the Collateral shall be sold, transferred or otherwise disposed of by Grantor in a manner permitted by the Credit, then Secured Party, at the request and sole expense of Grantor, shall execute and deliver to Grantor all releases or other documents reasonably requested for the release of the Liens created hereby on such Collateral.

(c) This Security Agreement and the security interests granted herein shall remain in full force and effect and continue to be effective if at any time payment and performance of the Secured Obligations, or any part thereof, is, pursuant to applicable law, avoided, rescinded or reduced in amount, or must otherwise be restored or returned by any obligee of the Secured Obligations, whether as a "voidable preference," "fraudulent conveyance" or otherwise, all as though such payment or performance had not been made. In the event that any payment, or any part thereof, is avoided, rescinded, reduced, restored or returned, the Secured Obligations and the security interests granted

herein shall be reinstated and the Secured Obligations shall be deemed reduced only by such amount paid and not so avoided, rescinded, reduced, restored or returned.

10.3 Successor and Assigns. This Security Agreement and all obligations of Grantor hereunder shall be binding upon the successors and assigns of Grantor, and shall, together with the rights and remedies of Secured Party hereunder, inure to the benefit of Secured Party, any future holder of any of the indebtedness and their respective successors and assigns. No sales of participations, other sales, assignments, transfers or other dispositions of any agreement governing or instrument evidencing the Secured Obligations or any portion thereof or interest therein shall in any manner affect the Lien granted to Secured Party hereunder.

10.4 Notices. Any notice or other communication hereunder to any party shall be addressed and delivered (and shall be deemed given) in accordance with the Security Agreement to the addresses set forth in the Transfer Agreement.

10.5 Counterparts. This Security Agreement may be executed in any number of separate counterparts, each of which, when so executed, shall be deemed an original, and all of said counterparts taken together shall be deemed to constitute but one and the same instrument.

10.6 Severability. If any provision of this Security Agreement is held to be unenforceable under applicable law for any reason, it shall be adjusted, if possible, rather than voided in order to achieve the intent of the parties to the extent possible. In any event, all other provisions of this Security Agreement shall be deemed valid and enforceable to the fullest extent possible under applicable law.

10.7 Governing Law. In all respects, including all matters of construction, validity and performance, this Security Agreement and the Secured Obligations arising hereunder shall be governed by, and construed and enforced in accordance with, the laws of the United States, State of Nevada applicable to contracts made and performed in such State.

IN WITNESS WHEREOF, each of the parties hereto has caused this Security Agreement to be executed and delivered by its duly authorized officer on the date first set forth above.

GRANTOR:
IONIC WATER TECHNOLOGIES, INC.
Date: September _____, 2006.
BY:

_____
Representing the Board of Directors
Of IONIC WATER TECHNOLOGIES, INC.

SECURED PARTY:
PATRICK L. MOULTON:
Date: September 15, 2006.

_____
Individually and On Behalf of
Parties defined as "Moulton"

herein shall be reinstated and the Secured Obligations shall be deemed reduced only by such amount paid and not so avoided, rescinded, reduced, restored or returned.

10.3 Successor and Assigns. This Security Agreement and all obligations of Grantor hereunder shall be binding upon the successors and assigns of Grantor, and shall, together with the rights and remedies of Secured Party hereunder, inure to the benefit of Secured Party, any future holder of any of the indebtedness and their respective successors and assigns. No sales of participations, other sales, assignments, transfers or other dispositions of any agreement governing or instrument evidencing the Secured Obligations or any portion thereof or interest therein shall in any manner affect the Lien granted to Secured Party hereunder.

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GRANTOR:
IONIC WATER TECHNOLOGIES, INC.
Date: September 15, 2006.
BY: _____
Representing the Board of Directors
Of IONIC WATER TECHNOLOGIES, INC.

SECURED PARTY:
PATRICK L. MOULTON:
Date: September _____, 2006.

_____
Individually and On Behalf of
Parties defined as "Moulton"

EXHIBIT A TO PATENT SECURITY AGREEMENT

U.S. Patent No. 7,011,745

EXHIBIT A TO PATENT SECURITY AGREEMENT

U.S. Patent No. 7,011,745

US007011745B1

(12) **United States Patent**
Moulton

(10) **Patent No.: US 7,011,745 B1**
(45) **Date of Patent: Mar. 14, 2006**

(54) **ROTATING PERFORATED CYLINDER TREATMENT SYSTEM**

(76) Inventor: **Patrick L. Moulton**, 506 Perry St., Prescott, AZ (US) 86303

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 83 days.

(21) Appl. No.: **10/618,533**

(22) Filed: **Jul. 11, 2003**

Related U.S. Application Data

(60) Provisional application No. 60/395,262, filed on Jul. 11, 2002.

(51) **Int. Cl.**
C02F 1/58 (2006.01)

(52) **U.S. Cl.** **210/150**; 210/199; 210/205; 261/92; 261/DIG. 71; 366/305; 366/328.2

(58) **Field of Classification Search** ..... 210/619, 210/150, 151, 201, 202, 205, 209, 216, 199, 210/219; 261/92, DIG. 71; 435/294.1, 298.2; 366/305, 328.2
See application file for complete search history.

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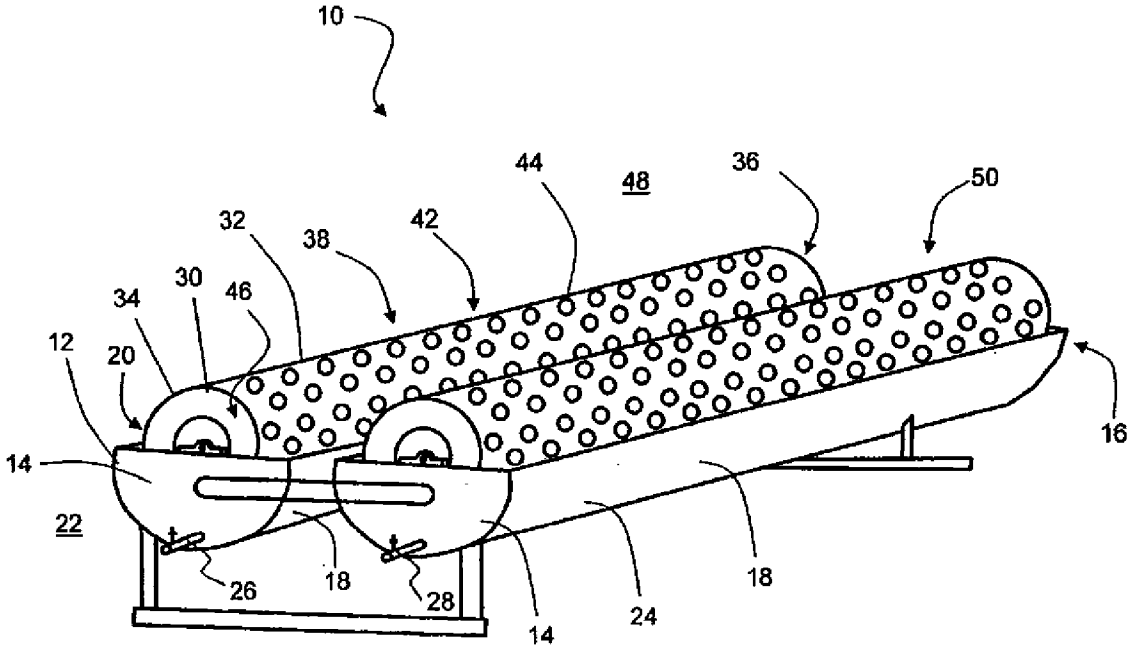
Primary Examiner—Peter A. Hruskoci
(74) *Attorney, Agent, or Firm*—Sierra Patent Group, Ltd.

(57) **ABSTRACT**

The disclosed device is directed toward a rotary water treatment system comprising at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to the at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

27 Claims, 3 Drawing Sheets



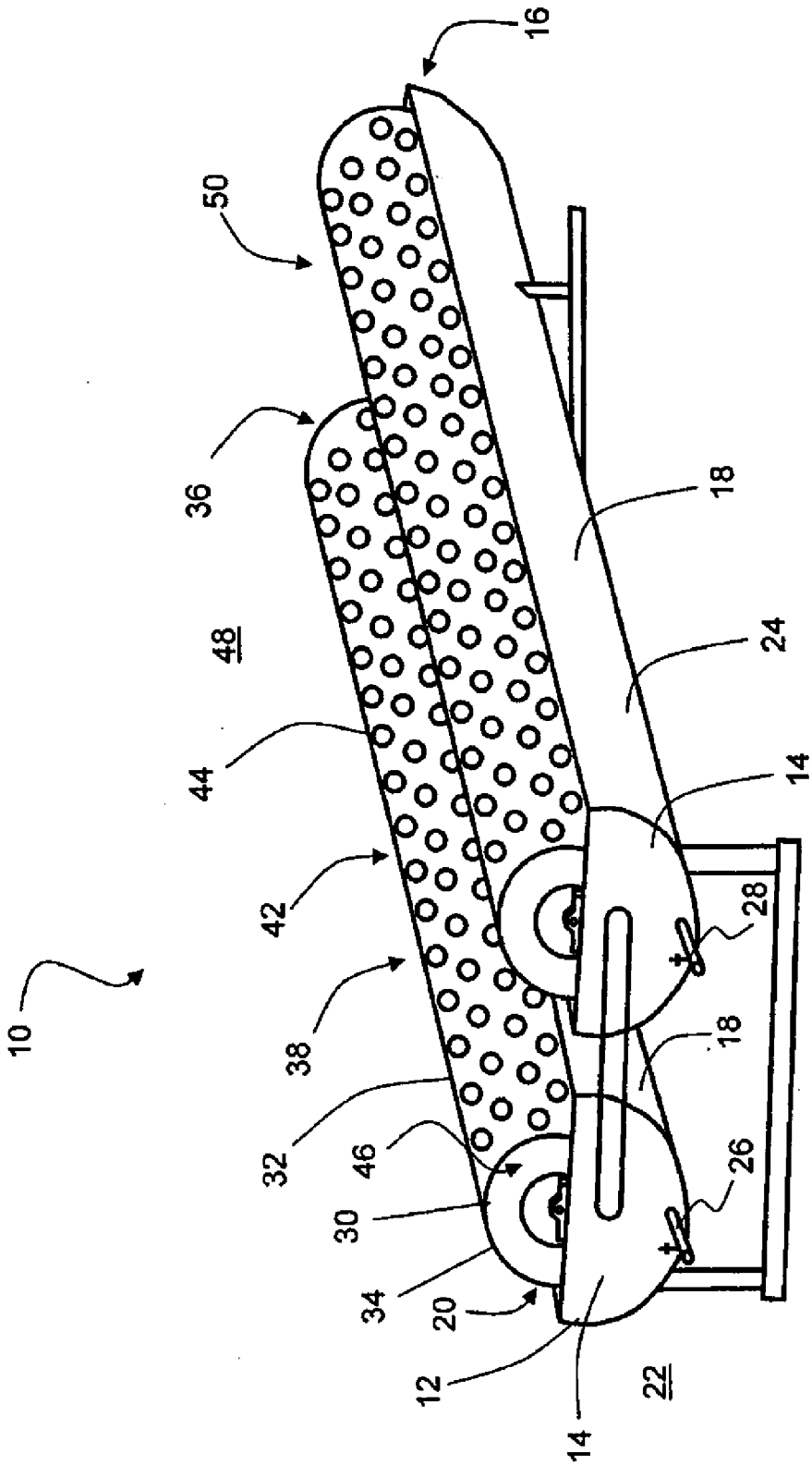


FIG. 1

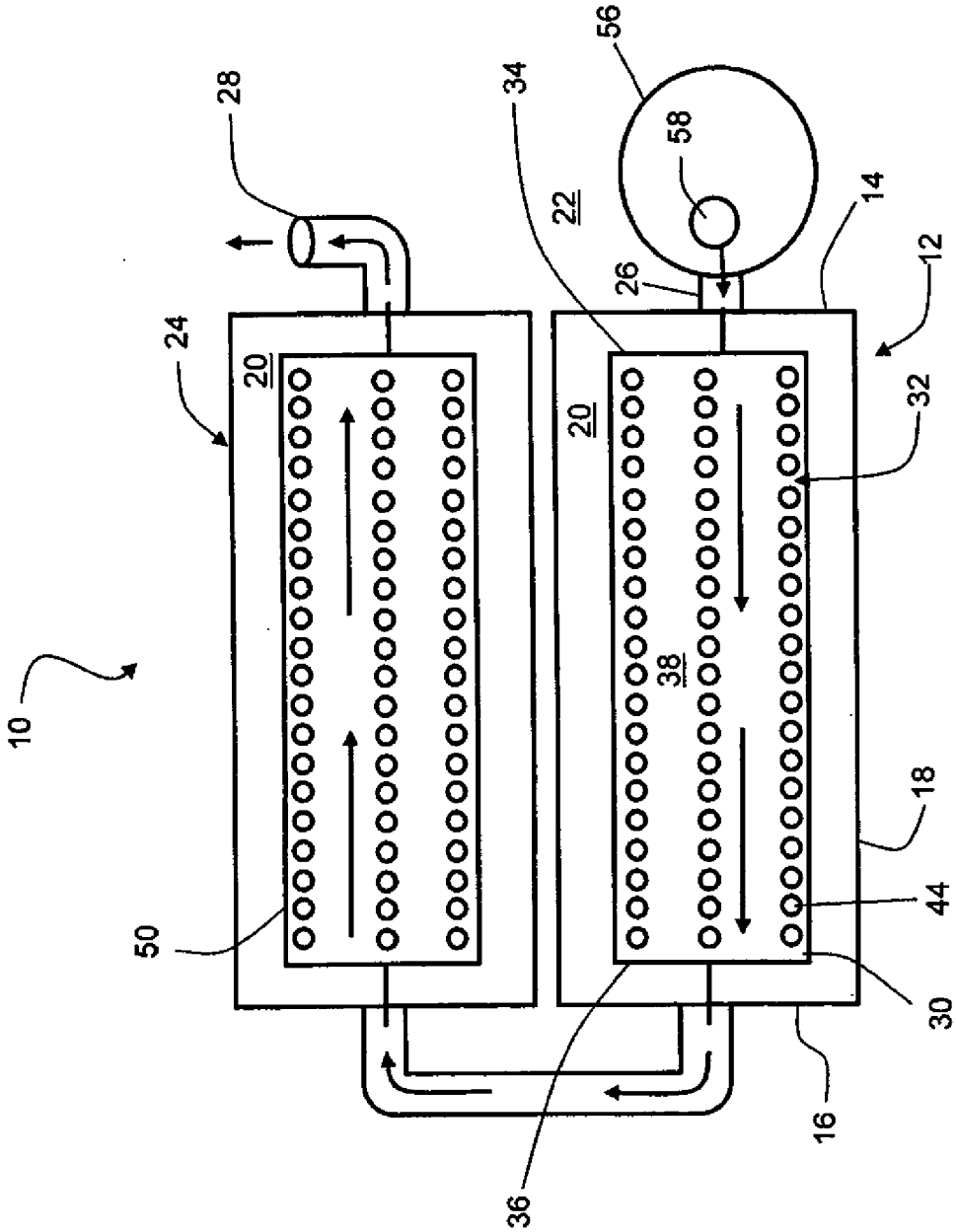


FIG. 2

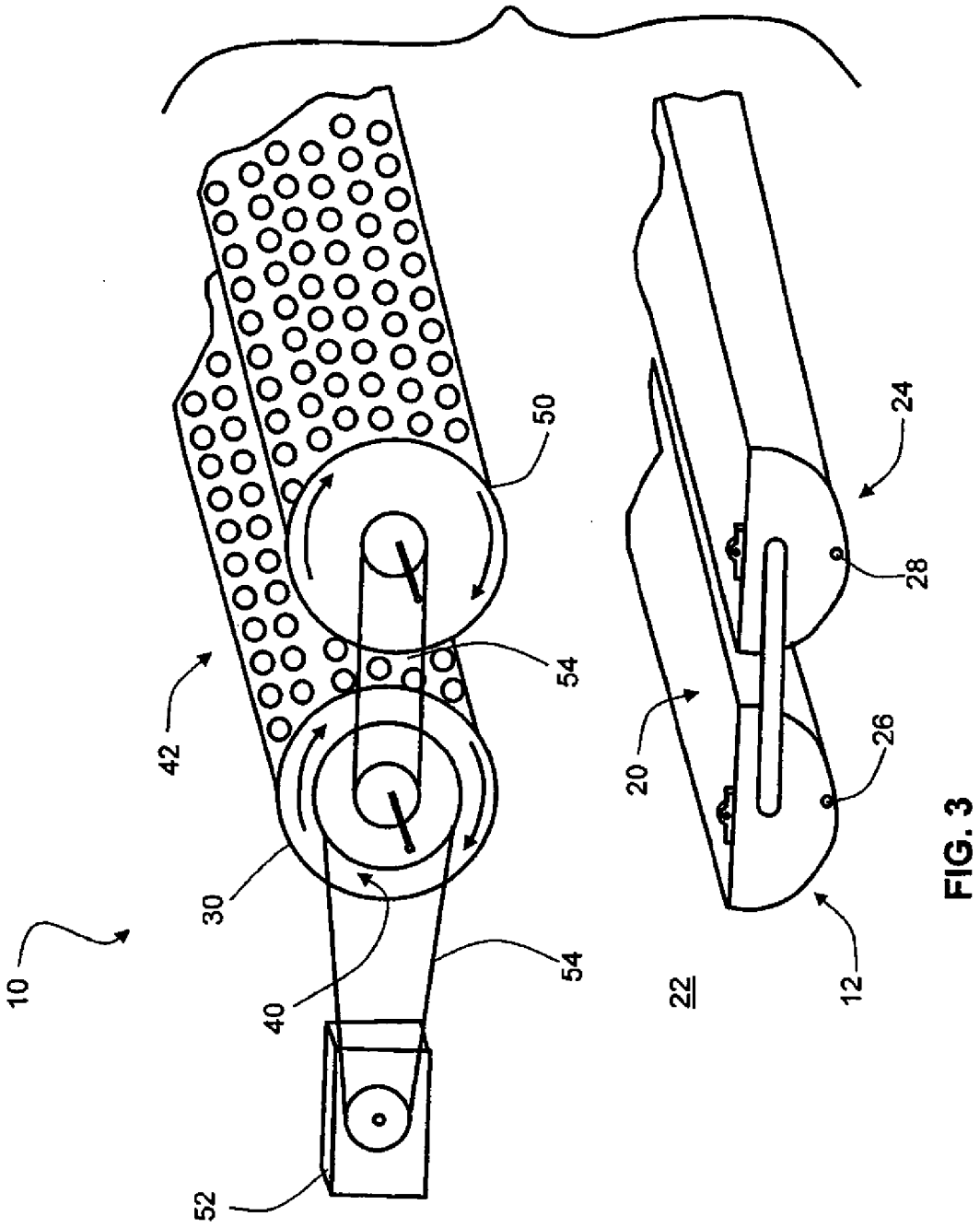


FIG. 3

ROTATING PERFORATED CYLINDER TREATMENT SYSTEM

PRIORITY CLAIM

This application claims priority to Provisional Patent Application No. 60/395,262 filed with the United States Patent and Trademark Office on Jul. 11, 2002.

BACKGROUND

The present disclosure relates to treatment systems, specifically to a low-energy treatment system for low-flow acid and alkaline drainage located in remote areas.

The precipitation of heavy metals from acidic or alkaline metal-laden water requires large amounts of dissolved oxygen to complete chemical reactions at certain pH plateaus. Complete oxidation of the heavy metal precipitant is key to producing a stable metal precipitant, thereby producing a stable filtered or decanted water for discharge after treatment. Reduced environments (dissolved oxygen deficient) remain unstable and the final pH and or residual metal content of the discharge water is unpredictable.

Air compressors and paddle type agitators used in prior art heavy metal treatment systems consume large amounts of energy during the oxidation and agitation phases of heavy metal precipitation. The efficiency of compressed air bubblers, used in aerating metal laden waters, depend on bubble size and the distribution of these bubbles in the water during the treatment phases. Agitation of the heavy metal laden waters with paddle type or propeller type blades require large amounts of energy, as they operate within tanks and move large amounts of water, in order to assure adequate introduction and mixing of oxygen enriched waters and pH adjusting reagents during treatment of heavy metal laden waters.

The prior art treatment systems rely on air compressors to add atmosphere to the heavy metal laden waters in order to raise the dissolved oxygen content of the water during treatment phases. Efficiency of the compressed air and the absorption of oxygen by the heavy metal laden water during treatment, depends on bubble size and the distribution of these bubbles within the prior art deep tanks. Excess amounts of compressed atmosphere must be added to insure that adequate oxygen is absorbed by the heavy metal laden water during the treatment and formation of the precipitants. This requires large amounts of energy to be expended in order to insure adequate oxidation takes place. Additionally, the remote nature of many impacted sites that require treatment systems often lack commercial electrical power.

Paddle type agitators used in prior art treatment systems move slowly within deep tanks and are largely unable to liberate the coated and un-reacted alkalinity providing reagent, thereby requiring the additional addition of reagent, to compensate for the un-reacted reagent previously added. The efficiency of the ionic exchange is also compromised as the large sized particle is not as efficient as a small particle during the formation of the precipitant. Prior art paddle type agitators also require and consume large amounts of energy as they have to move large amounts of water within deep tanks.

What is needed in the art is a treatment system designed to improve the efficiency of the oxidation and agitation phases of heavy metal precipitation during treatment, while utilizing a low-energy consumption power source.

SUMMARY

The disclosed device is directed toward a treatment system. The treatment system comprises a first container comprising a first end and a second end opposite the first end, a first container wall disposed between the first end and the second end. The first end, the container wall and the second end define a first interior and a first exterior. The first end, the container wall and the second end define a first container opening. A second container is fluidly coupled to the first container. The second container comprises a first end and a second end opposite the first end, a second container wall disposed between the first end and the second end. The first end, the container wall and the second end define a second interior and a second exterior. The first end, the container wall and the second end define a second container opening. A first aerator is partially disposed in the first interior through the first container opening. The first aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a first aerator interior and a first aerator exterior. The first aerator configured to partially rotatably dispose in a liquid contained in the interior of the first container. The first aerator is configured to aerate the liquid both at the first aerator interior and the first aerator exterior. A second aerator is partially disposed in the second interior through the second container opening. The second aerator comprises a body having a first end and a second end opposite the first end. The body comprises an aerator wall disposed between the first end and the second end. The aerator wall includes a plurality of perforations through the aerator wall. The first end, the second end and the aerator wall define a second aerator interior and a second aerator exterior. The second aerator is configured to partially rotatably dispose in a liquid contained in the interior of the second container. The second aerator is configured to aerate the liquid both at the second aerator interior and the second aerator exterior. A rotary motive force element is operatively coupled to the first aerator and the second aerator. The rotary motive force element is configured to rotate the first aerator and the second aerator.

Another embodiment of the disclosed device is directed toward a rotary water treatment system comprises at least one open channel cell configured to contain a liquid. A cylinder partially disposed in the open channel cell. The cylinder having a first end and a second end opposite the first end, and a cylinder wall coupled between the first end and the second end. The cylinder wall including a plurality of perforations formed in the cylinder wall. A motive force element is coupled to the cylinder configured to impart rotary motion to the cylinder. At least one influent supply is coupled to at least one open cell. At least one effluent discharge is coupled to the at least one open cell. A pump is fluidly coupled to the at least one influent supply.

A method of treating a liquid is disclosed. The method of treating a liquid comprises flowing the liquid through an influent supply into at least one open channel cell. The method includes rotating a cylinder through the liquid. The cylinder is partially disposed in at least one open channel cell. The cylinder comprises a first end and a second end opposite the first end and a perforated cylinder wall coupled between the first end and the second end. The first end, the perforated cylinder wall and the second end define an interior and an exterior of the cylinder. The method includes

lifting the liquid from at least one open channel cell onto the perforated cylinder wall at an interior surface and an exterior surface of the perforated cylinder wall. The method includes exposing the liquid to air from the exterior of the cylinder and the interior of the cylinder. The method includes flowing a treated liquid out of at least one open channel cell through an effluent discharge.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the figures, wherein like elements are numbered the same.

FIG. **1** is a perspective view of an exemplary treatment system.

FIG. **2** is a plan view of an exemplary treatment system.

FIG. **3** is a partial perspective view of an exemplary treatment system.

DETAILED DESCRIPTION

Persons of ordinary skill in the art will realize that the following description of the present disclosure is illustrative only and not in any way limiting. Other embodiments of the invention will readily suggest themselves to such skilled persons having the benefit of this disclosure.

The present disclosure describes a water treatment system for treating contaminated water, such as a heavy metal-laden water supply. In order to efficiently add dissolved oxygen from the atmosphere into a reduced environment of heavy metal laden waters (oxygen deficient) the surface of the water must be exposed to the atmosphere. An exemplary treatment system disclosed herein includes perforated rotating cylinders in order to exploit the surface tension properties of water, by lifting a thin film of the water from the cells and carrying the water on both the inside and outside surfaces of the rotating perforated cylinders. The perforations of the cylinders are "bridged" by a thin film of water as they rotate. This thin film of water absorbs oxygen from the atmosphere and effectively and efficiently raises the dissolved oxygen content of the heavy metal laden water.

One exemplary system operates with a flow rate of about 5 gpm of heavy metal laden water, with the perforated cylinders rotating at about 60 rpm, effectively distributes the influent over a total surface area of about 50,868 square feet.

The leading edge of the perforated cylinders, while rotating, also creates a cascading bubbling waterfall type action or, turbulent flow as the excess water that is lifted by the perforations is drained off of the cylinders. This cascading action also effectively and efficiently adds dissolved oxygen to the reduced environment (oxygen deficient) waters contained within the cells. The rotating action of the cylinders within the cells effectively and efficiently add large amounts of dissolved oxygen from the atmosphere, to the contained water in the cell, while thoroughly mixing the reduced and oxygen rich waters together, thereby raising the dissolved oxygen content of the contained waters.

Referring to FIGS. **1**, **2** and **3** a perspective view, a top view and a partial perspective view of an exemplary treatment system are illustrated. The treatment system **10** is shown in part without some of the subcomponents. The treatment system **10** includes at least one container (a first container or in an exemplary embodiment, an open channel cell) **12** preferably in a semi-cylinder shape. The container **12** includes a first end **14** and a second end **16** opposite the first end **14**. A container wall **18** is disposed between the first end **14** and the second end **16** to define an interior **20** and an exterior **22**. In an exemplary embodiment, the container **12** is an open-topped semi-circular cell having about a ten foot length and about an eighteen inch diameter. The total depth of the container **12** can be about nine inches and have a capacity of about sixty-six gallons. When the exemplary treatment system **10** is in operation, the depth of a liquid contained in the container **12** can be about five inches equaling a volume of about thirty-five gallons. The container **12** can be made of PVC or non-reactive corrosive resistant material. The container **12** is configured to contain liquid. The liquid is to be treated in the treatment system **10** and can comprise one of an acidic metal-laden water and an alkaline metal-laden water.

In an exemplary embodiment, the treatment system **10** includes another or second container **24** fluidly coupled (plumbed) to the first container **12**. The second container **24** includes the same physical features as the first container **12**. The first container **12** and second container are plumbed together to allow liquid to flow from an influent supply **26** through the first container to the second container **24** and to an effluent discharge **28** (See flow arrows in FIG. **2**). In an exemplary embodiment, the effluent discharge can be a sediment bag. The liquid can flow along the length of each cell **12**, **24**. In an exemplary embodiment, the containers **12**, **24** are plumbed to allow for influent and effluent to flow at various elevations or depths in the containers **12**, **24**.

An aerator (or first aerator) **30** is configured to be disposed in the container **12**. The aerator **30** includes a body **32** having a first end **34** and a second end **36** opposite the first end **34**. An aerator wall **38** is disposed between the first end **34** and the second end **36**. The aerator wall **38** includes an interior surface **40** and an exterior surface **42** opposite the interior surface **40**. The aerator wall **38** includes a plurality of perforations **44** formed in the aerator wall **38**. The perforations **44** allow fluid communication between the interior surface **40** and the exterior surface **46**. In a preferred embodiment, the perforations are one-half inch diameter holes formed in the aerator wall **38**. The first end **34**, aerator wall **38** and second end **36** define an aerator interior **46** and an aerator exterior **48**. The aerator **30** is configured to be partially disposed in the liquid contained in the interior **20** of the container **12**. The aerator **30** is only partially immersed in the liquid in the container **12**. The aerator **30** is configured to rotate about a longitudinal axis of the body **32** (See rotational arrows at FIG. **3**). The aerator **30** rotates through the liquid in the container **12**. As the liquid penetrates the perforations **44**, the liquid wets both the interior surface **40** of the aerator **30** and the exterior surface of the aerator **30**. While the aerator **30** rotates through the liquid, the liquid is aerated, (i.e., exposed to air).

A second aerator **50** having similar features to the first aerator **30** is disposed in the second container **24**. The second aerator **50** is also rotatably partially disposed in the interior **20** of the second container **24**. In an exemplary embodiment, the aerator **30**, **50** is a PVC cylinder **30** having a first end **34** and second end **36** coupled to a cylinder wall **38** similar to the aerator wall **38**. The cylinder **30** has a fifteen inch diameter and a nine foot length. The cylinder **30** has about 4,200 one-half inch diameter holes **44** through the cylinder wall **38**.

As illustrated in FIG. **3**, a motive force element **52** is operatively coupled to the first aerator **30** and in exemplary embodiments, also coupled to the second aerator **50**. The motive force element **52** is configured to rotate the aerator(s) **30**, **50**. In an exemplary embodiment, the motive force element **52** imparts rotary motion to the cylinder(s) **30**, **50**. A drive belt **54** and drive pulley arrangement can be employed to rotate the cylinder(s) **30**, **50**. In an exemplary

embodiment, the motive force element is a 110 volt, 1.7 amp gear reduced ac motor rotating the cylinder(s) **30**, **50** at about 60 rpm.

A tank or reservoir **56** can be coupled to the influent supply **26** to provide a source of liquid to the treatment system **10**. In an exemplary embodiment, the tank **56** can be a flash reaction tank. A pump **58** can be employed to pump the liquid to the influent supply **26** from the tank **56**. In an exemplary embodiment, the pump can be a 5 gpm, 15 amp, 110 watt pump.

Exemplary Treatment System Test Results

Test results from an exemplary treatment system using acidic heavy metal laden water from a mine site in northeastern Nevada are as follows:

Dissolved oxygen contents of samples drawn from the mine site are consistently one (1) milligram per liter (mg) or less. A single pass of the acidic heavy metal laden water through the system, at a flow rate of 5 gpm, raised the dissolved oxygen content 800 to 900 percent. Dissolved oxygen levels rose from less than 1 mg/l to 8.5 mg/l or higher. The acidic metal laden waters were circulated through the system for as long as 3 hours, with no apparent improvement over the single pass, which takes approximately 15 minutes.

The removal of heavy metals from acidic, reduced environment water requires raising the pH of the impacted waters with an alkalinity providing reagent (e.g., lime slurry (CaOH2) or Sodium Hydroxide (NAOH) to remove (precipitate) the heavy metals from the impacted water. Either of these reagents are commonly the used in the treatment of heavy metal contaminated water. These tests were conducted using lime slurry (CaOH2) as the alkalinity providing reagent for the precipitation of the heavy metals from the impacted waters.

Test results showed that when the treated water and aerated water had a final dissolved oxygen content of less than 6 mg/l, the treated solution had an unstable and unpredictable final pH and residual heavy metal content after treatment. Tests results also showed that when the treated and aerated water had a final dissolved oxygen content of 6 mg/l or higher a stable pH and residual metal content after treatment was achieved. Following treatment the oxidized solution had a drop in pH of approximately 1 to 1.5 standard units (s.u.) after 12 hours. The dissolved oxygen content also dropped 1 mg/l to 3 mg/l while the chemical reactions were completed. Samples measured at up to five days after treatment have shown that the final pH and dissolved oxygen content remain stable after the preliminary drop.

Test results have shown that dissolved oxygen requirements and consumption for completing chemical reactions at certain pH plateaus are evident and predictable during treatment, reflecting the heavy iron content of the waters used during the tests. The pH plateau from 2.5 s.u. to 5.0 is relatively easy to achieve while remaining in an oxidized environment (dissolved oxygen content greater than 6 mg/l). The bulk of the heavy metal contaminates in the test waters are precipitated out of solution at a pH range between 5.0 s.u. and 8.0 s.u. in this series of tests. The pH plateau of 5.0 to 8.0 requires large amounts of dissolved oxygen in order to remain in an oxidized environment. The treatment system performed well in maintaining an "oxidized environment" during precipitation and sludge generation during treatment. The pH plateau of 8.0 to 10.0 was easily achieved while remaining in a oxidized environment as the remaining heavy metal concentration in the water was relatively low after the initial precipitation at pH 8.0 s.u. The testing of the prototype treatment system produced stable precipitants (heavy metal sludge) and clear discharge waters meeting or exceeding Federal EPA standards for secondary drinking water quality from heavily metal laden acidic mine waters in all of the tests performed.

The prototype treatment system was constructed and based on a flow rate of approximately 5 gpm of influent for testing purposes only. The final dimensions of the rotating perforated cylinder treatment system would be susceptible to several factors. Dissolved oxygen requirements at each site would vary, as the concentration of heavy metal contaminates in the impacted waters are different at each site. Dissolved oxygen requirements for precipitant formation will vary, depending upon the water chemistry and heavy metals removed by the treatment system. Flow rates of acid rock drainage and or alkaline rock drainage at each site are different and would require different sized rotating cylinders and cells and/or a series of cells required. Testing and optimization of the treatment system will be a determining factor on the physical size of the treatment system.

The rotating perforated cylinders and shallow cells used in this treatment system add large amounts of dissolved oxygen from the atmosphere with minimal energy expenditure and maximum efficiency.

Alkalinity providing reagents used in the treatment of heavy metal laden acidic waters are also efficiently and effectively agitated by the rotating perforated cylinders. The ionic exchange during precipitation of the heavy metals is also optimized by the rotating perforated cylinders action. The initial introduction of alkalinity providing reagents, into the heavy metal laden reduced environment, (flash reaction phase) produces a large sized particle precipitant. This large sized particle is mainly coated and un-reacted reagent. The rotating perforated cylinders agitate and pick this particle up and liberate the un-reacted reagent for an efficient ionic exchange during metal precipitation. While the ionic exchange is enhanced by the rotating perforated cylinders action, the oxidation process necessary for stable formation of precipitants, during the ionic exchange, is optimized by the particles being effectively exposed to the atmosphere in a thin film, thereby assuring complete oxidation of the precipitant during formation of the precipitant.

The rotating perforated cylinders and shallow cells used in the disclosed treatment system efficiently agitate and liberate the alkalinity providing reagent, while enhancing ionic exchange during the formation of the precipitant, with minimal energy expenditure and maximum efficiency.

In an exemplary treatment system, the power requirements have been tested and are extremely efficient compared to conventional treatments systems using air compressors and paddle or propeller type agitators. In the exemplary embodiment, the drive mechanism for the rotating perforated cylinders is a 110 volt ac gear reduced motor running at 1.7 full load amperes. The amperage consumption of the motor drops to approximately 1 ampere after the rotating cylinders reach an equilibrium turning at 60 rpm. A non-corrosive submersible pump rated at 5 gpm operating on 110 volts at 1.5 full load amps is used to circulate water through the cells. The operating amperage of the non-corrosive pump drops to approximately 1 ampere as the system is running. Operating energy consumption of the rotating perforated cylinder treatment system is approximately 2 amperes at 110 volts while in use.

A conventional treatment system, operating with an air compressor and paddle or propeller type agitator, at the same

flow rate of 5 gpm, will consume at least 10 times more energy than the rotating perforated cylinder treatment system.

The exemplary prototype treatment system constructed and tested has proven to be an efficient and effective system in the treatment of acidic heavy metal laden waters. The low energy consumption of the system, the efficiency of oxygen addition, as well as ionic exchange optimization and efficient alkalinity reagent consumption is evident in the testing results. The energy consumption of this treatment system is far less than the energy consumption of conventional systems. The efficiency of the rotating perforated cylinders operating with shallow cells has proven to be efficient and effective.

The rotating perforated cylinder treatment system has to date only been tested with acidic heavy metal laden waters. The treatment system has the capabilities to be applied to alkaline heavy metal laden waters also. The working theories are basically the same however reagents and pH plateaus are different when an alkaline environment is treated rather than an acidic environment.

It is contemplated that in addition to the disclosed treatment system being configured to treat liquids, such as heavy metal-laden water, other impacted waters having contaminants can be treated. The treatment system can remove volatile organic compounds, regular metals, or merely aerate the water for low dissolved oxygen environments. The treatment system disclosed can also be employed to bioremediate liquids, such as contaminated water supplies, and the like.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

What is claimed is:

1. A treatment system comprising:

a first container comprising a first end and a second end opposite said first end, a first container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a first interior and a first exterior, said first end, said container wall and said second end defining a first container opening;

a second container fluidly coupled to said first container, said second container comprising a first end and a second end opposite said first end, a second container wall disposed between said first end and said second end, said first end, said container wall and said second end defining a second interior and a second exterior, said first end, said container wall and said second end defining a second container opening;

a first aerator partially disposed in said first interior through said first container opening, said first aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a first aerator interior and a first aerator exterior, said first aerator configured to partially rotatably dispose in a liquid contained in said interior of said first container, said first aerator configured to aerate said liquid both at said first aerator interior and said first aerator exterior, wherein said plurality of perforations formed in the first aerator wall are configured to lift a thin film of said liquid from said first container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said first aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said first aerator wall, as well as said liquid contained in said first container;

a second aerator partially disposed in said second interior through said second container opening, said second aerator comprising a body having a first end and a second end opposite said first end, said body comprising an aerator wall disposed between said first end and said second end, said aerator wall including a plurality of perforations through said aerator wall, said first end, said second end and said aerator wall defining a second aerator interior and a second aerator exterior, said second aerator configured to partially rotatably dispose in a liquid contained in said interior of said second container, said second aerator configured to aerate said liquid both at said second aerator interior and said second aerator exterior, wherein said plurality of perforations formed in the second aerator wall are configured to lift a thin film of said liquid from said second container by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said second aerator is configured to create a cascading bubbling turbulent flow in said liquid flowing along said second aerator wall, as well as said liquid contained in said second container; and

a rotary motive force element operatively coupled to said first aerator and said second aerator, said rotary motive force element configured to rotate said first aerator and said second aerator.

2. The treatment system of claim 1 further comprising:

at least one influent supply fluidly coupled to one of said first container and said second container;

at least one effluent discharge fluidly coupled to one of said first container and said second container.

3. The treatment system of claim 2 wherein said at least one influent supply is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container, said at least one effluent discharge is fluidly coupled to one of said first container and said second container at a predetermined depth of said first container and said second container.

4. The treatment system of claim 1 wherein said first aerator and said second aerator are substantially cylinders configured for rotary motion about a longitudinal axis formed along said cylinder from said first ends of said first and second aerators to said second ends of said first and second aerators.

5. The treatment system of claim 1 wherein said first container and said second container are substantially semi-cylinders configured for containing liquid in said first interior and said second interior along a longitudinal axis of said semi-cylinders.

6. The treatment system of claim 1 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

7. The treatment system of claim 1 wherein said plurality of perforations comprises about one-half inch diameter holes defined in said aerator wall.

8. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to rotate through said liquid and lift said liquid on an interior surface and an exterior surface of said first aerator wall and said second aerator wall.

9. The treatment system of claim 1 wherein said plurality of perforations of said first aerator are configured to fluidly couple said first aerator interior with said first aerator exterior wetting an exterior surface and an interior surface of said first aerator wall with said liquid, and wherein said plurality of perforations of said second aerator are configured to fluidly couple said second aerator interior with said second aerator exterior wetting an exterior surface and an interior surface of said second aerator wall with said liquid.

10. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to increase dissolved oxygen content of the liquid contained in said first container and said second container respectively.

11. The treatment system of claim 1 wherein said first aerator is configured to mix reduced liquid and oxygen rich liquid in said first container, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said first container and said second aerator is configured to mix reduced liquid and oxygen rich liquid in said second container, and wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said second container.

12. The treatment system of claim 1 wherein said first container and said second container are configured to promote flow of said liquid through said first container to said second container.

13. The treatment system of claim 1 wherein said first aerator and said second aerator are configured to expose said liquid to air.

14. The treatment system of claim 1 wherein said first aerator is configured to immerse into said liquid contained in said first container a predetermined minimal depth, and said second aerator is configured to immerse into said liquid contained in said second container a predetermined minimal depth.

15. The treatment system of claim 1 wherein said first aerator is configured to agitate reagents in said liquid contained in said first container, and said second aerator is configured to agitate reagents in said liquid contained in said second container.

16. The treatment system of claim 1 wherein said first aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid and said second aerator is configured to increase the ionic exchange during precipitation of heavy metals in said liquid.

17. The treatment system of claim 16 wherein said first and second aerators are configured to agitate and lift coated un-reacted reagent particles in said liquid and liberate said un-reacted reagent thereby increasing ionic exchange during metal precipitation.

18. The treatment system of claim 17 wherein said first and second aerators are configured to expose said reagent particles to air in a thin liquid film, wherein said precipitant is completely oxidized during precipitant formation.

19. The treatment system of claim 1 further comprising:

a pump fluidly coupled to one of said first container and said second container, said pump configured to circulate said liquid through said first container and said second container.

20. A rotary water treatment system comprising:

at least one open channel cell configured to contain a liquid;

a cylinder partially disposed in said open channel cell, said cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall, wherein said cylinder is configured to rotate through said liquid and lift a thin film of said liquid on an interior surface and an exterior surface of said cylinder wall by exploiting the surface tension of said liquid, wherein said thin film bridges said plurality of perforations, and said cylinder is configured to create a cascading bubbling turbulent flow in said liquid flowing along said cylinder wall, as well as said liquid contained in said at least one open channel cell;

a motive force element coupled to said cylinder configured to impart rotary motion to said cylinder;

at least one influent supply coupled to said at least one open cell;

at least one effluent discharge coupled to said at least one open cell; and

a pump fluidly coupled to said at least one influent supply.

21. The rotary water treatment system of claim 20 further comprising:

another open channel cell fluidly coupled to said at least one open channel cell;

another cylinder partially disposed in said another open channel cell, said another cylinder having a first end and a second end opposite said first end, and a cylinder wall coupled between said first end and said second end, said cylinder wall including a plurality of perforations formed in said cylinder wall.

22. The rotary water treatment system of claim 21 wherein said motive force element comprises a gear reduced motor coupled to said cylinder and said another cylinder configured to rotate about a long axis of said cylinder and said another cylinder.

23. The rotary water treatment system of claim 20, wherein said cylinder wall is configured to aerate said liquid on both an outer surface and an inner surface of said cylinder wall.

24. The rotary water treatment system of claim 20 wherein said cylinder is partially disposed in said liquid contained in said open channel cell, and more than half of said cylinder longitudinal cross section extending beyond said open channel cell.

25. The rotary water treatment system of claim 20 wherein the rotary treatment system is configured to increase dissolved oxygen content of the liquid contained in said at least one open channel cell.

26. The rotary water treatment system of claim 20 wherein said cylinder is configured to mix reduced liquid and oxygen rich liquid in said at least one open channel cell, wherein the mixture of said reduced liquid with the oxygen rich liquid increases dissolved oxygen content of said liquid contained in said at least one open channel cell.

27. The rotary water treatment system of claim 20 wherein said liquid comprises one of an acidic metal-laden water and an alkaline metal-laden water.

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