AP1.5 ANY WATER PLASMA TREATMENT SYSTEM

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Case Study

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Waste to Energy, Recycling, Water Treatment, Renewable Energy
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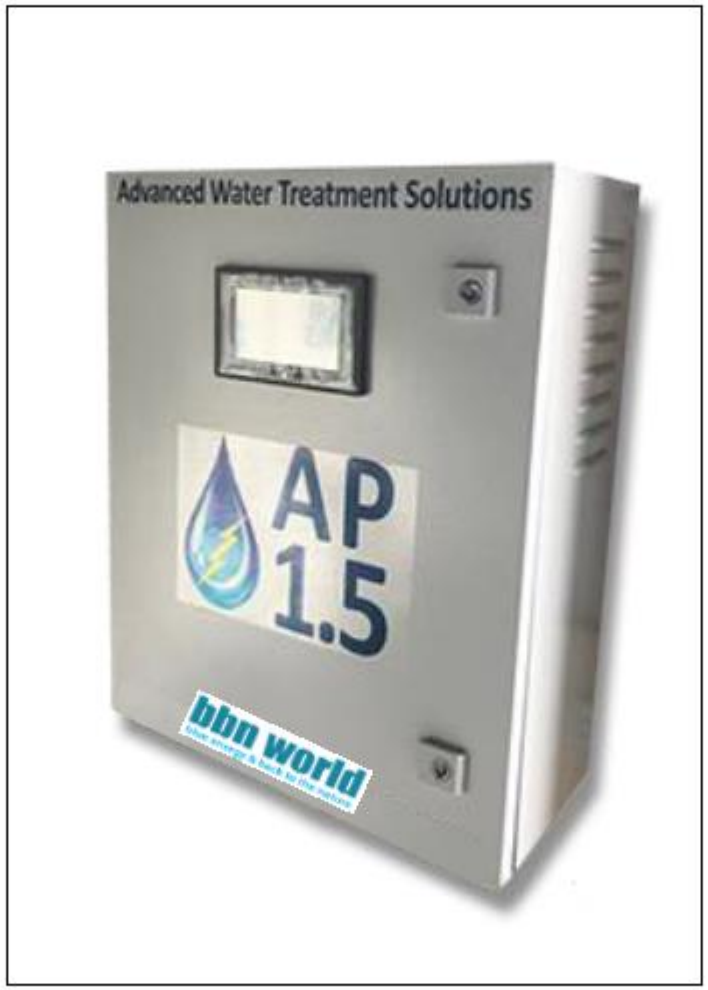
AP 1.5 TREATMENT SYSTEM

Product Specifications

- Dimensions: 15.75”(L) X 7.25”(W) X 19.75”(H)
- Weight: 30 Lbs.
- Inlet Pipe: ¾”
- Flow Rate: 5~10 GPM
- Rated Pressure: 10-40 psi
- Rated Input Power Supply: Single Phase,100-240V,
- 50-60Hz, 1-2Amps



AP1.5

Electro-Oxidation System

Self-Cleaning, Hyper Oxidation System
Designed and tested for bacteria disinfection, precipitation of scale causing minerals and oxidation of organic and inorganic contaminants.

Electro-Oxidation Technology AP 1.5

AWP Electro-oxidation technology in which oxidation reactions occur by applying an electric field between Non-sacrificial electrodes, generating multiple oxidants directly in the effluent for oxidation of organic and inorganic contaminants.

Applications

- Elimination of bacteria, viruses and parasites
- Improves Color and eliminates odor
- Eliminates Volatile / semi-volatile Hydrocarbons

Benefits

Advanced Water Treatment Engineering
Consistent, & Reliable operation
Quick installation, fully automatic operation with HMI Screen & inbuilt Safety flow switch.

Specifications

Dimensions :(L) 15.75" x (W) 7.25" x (H) 19.75"
Weight: 30 Lbs.
Inlet Pipe: ¾ "
Flow Rate: 5~10 GPM
Rated Pressure: 10~40 Psi
Rated Input Power Supply:
Single Phase,100 V ~240 V, 50 ~60 Hz, 1~2 Amps

Features

MICROBIOLOGICAL CONTROL

Multiple oxidants generatd in AP 1.5 are used to oxidize organics including bacteria and viruses without use of chemicals.

SCALE CONTROL

Scaling salts in the water are precipitated in terms of carbonates or sulfates without use of chemicals

HEAVY METAL OXIDATION

Heavy metals e.g Iron(Fe) is oxidised by multiple oxidants generated during electro-oxidation process.

AWP'S ADVANCED OXIDATION TECHNOLOGY

AWP's Electro-oxidation is an electrochemical process in which oxidation reactions occur by applying an electric field between Non-sacrificial electrodes, generating multiple oxidants directly in the effluent for oxidation of organic and inorganic contaminants.

Advancement and research in electronics and materials have enabled AWP to offer an Electro-Oxidation process with significantly improved performance, safety and cost effective technology. When special electrodes are used for electrolysis of water, OH-radicals (OH•), ozone (O3), hydrogen peroxide (H2O2) etc. develop in addition to chlorine (Cl) when salt (NaCl) is contained in the water.

The electro-oxidation occurs through 1) Direct and 2) Indirect Oxidation mechanism. Direct oxidation occurs over the electrode whereas indirect oxidation occurs in the solution. Multiple chemical reactions occur on the surface of the electrodes and in the solution that end up in formation of hydrogen peroxide and Free chlorine in the solution without adding any chemicals. By controlling factors such as geometry of the electrodes, arrangement of electrodes, electrode material, coatings on the electrodes, current density, distance between electrodes, flow rate, pH, nature of the electrolyte solution, temperature etc the performance of the electrochemical cell can be controlled as needed.

$$H2O \leftrightarrow H^+_{(aq)} + OH^-_{(aq)}$$

$$NaCl_{(aq)} \leftrightarrow Na^+_{(aq)} + Cl^-_{(aq)}$$

At Cathode: $2\ H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$

At Anode: $2\ Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$

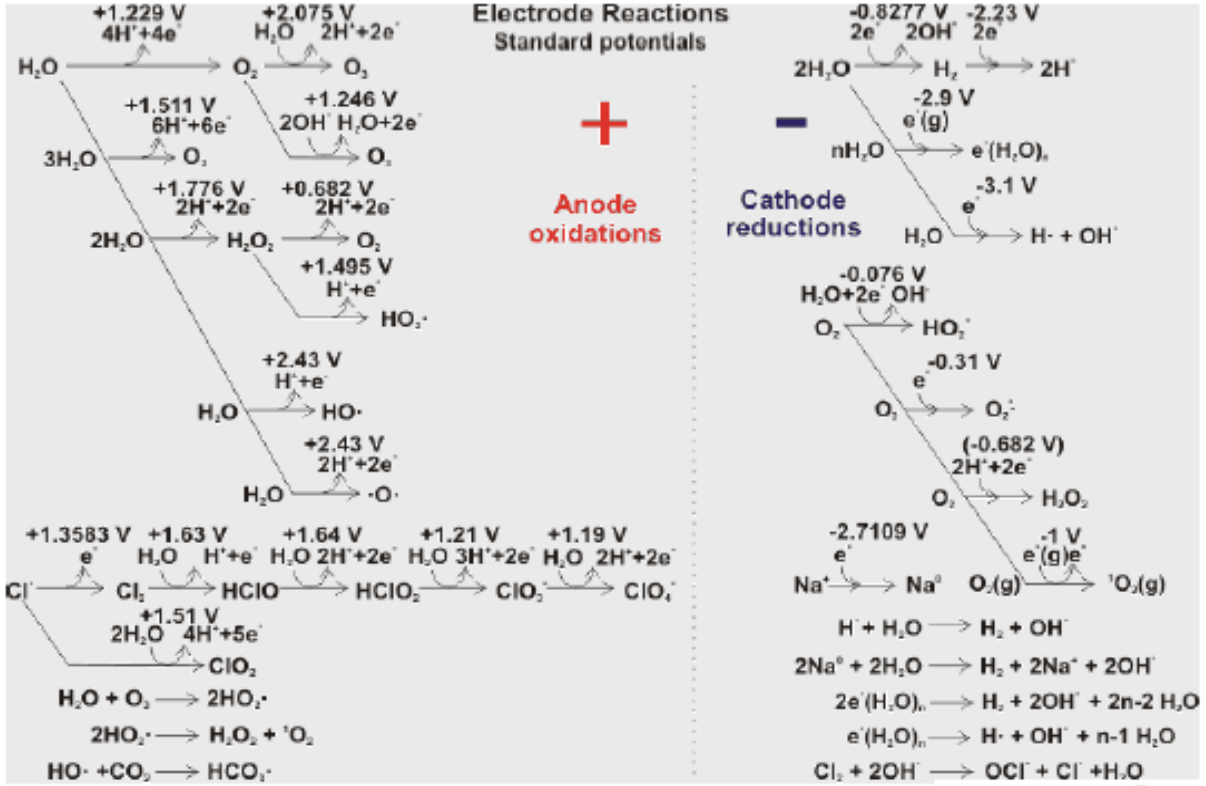
$$4\ OH^-_{(aq)} \rightarrow O_{2(g)} + 2\ H_2O_{(l)} + 4e^-$$

Electrolytic medium: $Cl_2 + H2O \leftrightarrow HOCl_{(aq)} + H^+_{(aq)} + Cl^-_{(aq)}$

$$HOCl_{(aq)} \leftrightarrow H^+_{(aq)} + OCl^-_{(aq)}$$

$$O_2 + 2H^+ + 2e^- \leftrightarrow H_2O_{2(aq)}$$

In addition to the above said overall reactions, several other side reactions occur in the electrochemical cell which produce a plethora of oxidizing agents in the water. Additionally, other ionic chemical reactions such as sulfate, carbonates and hydroxide (Barium sulfate, Strontium sulfate, calcium carbonate, Iron Hydroxide etc.) precipitation reactions are occurring which also settle down with them any other reduced heavy metals in the solution.

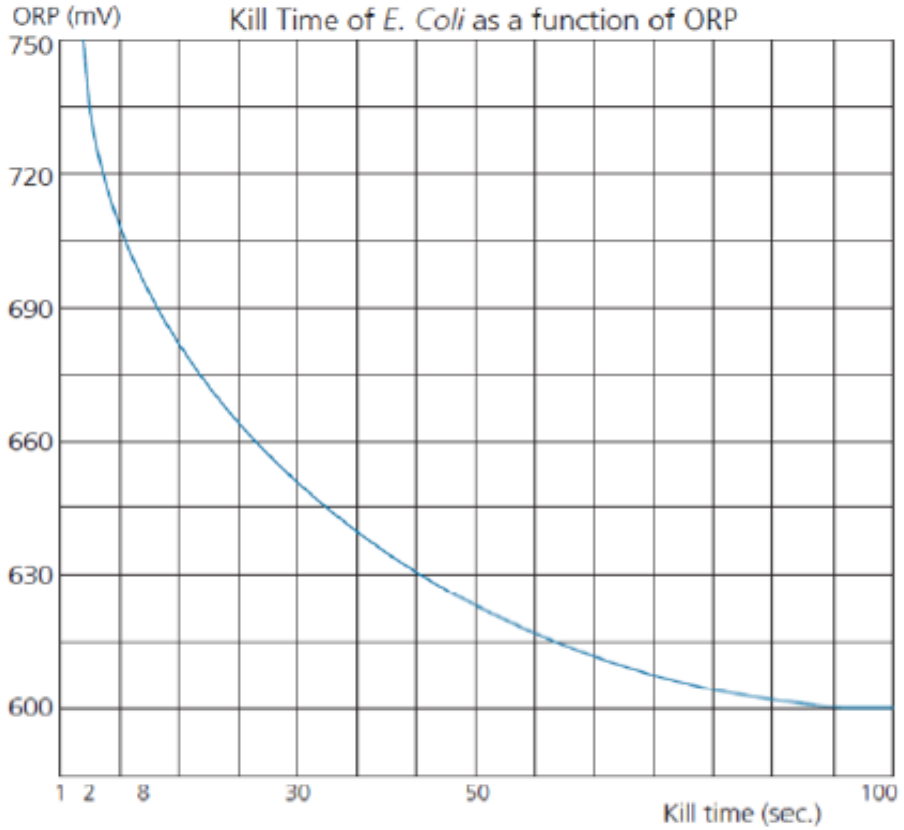


Oxidation Reduction Potential (ORP) of the solution in the electrochemical cell represents the combinative oxidizing power of all these oxidizing species including HOCl, H2O2, Cl2, OH•. The ORP of the solution can be measured using specially designed sensors in mv with respect to a reference electrode.

The ORP is the potential of a solution to do its work of inactivating micro-organisms and oxidizing organic and inorganic materials. The higher the ORP millivolt reading, the more powerfully the water can oxidize and disinfect.

With AWP's patented special geometry electrodes, proprietary coatings on the electrodes and reactor design, the technology allows to treat any water regardless of its salinity. AWP has demonstrated the efficacy and reliability of their commercial units on several types of field applications.

Graph 6.1: Kill Time for a log 3 Reduction of *E. coli* as a function of ORP

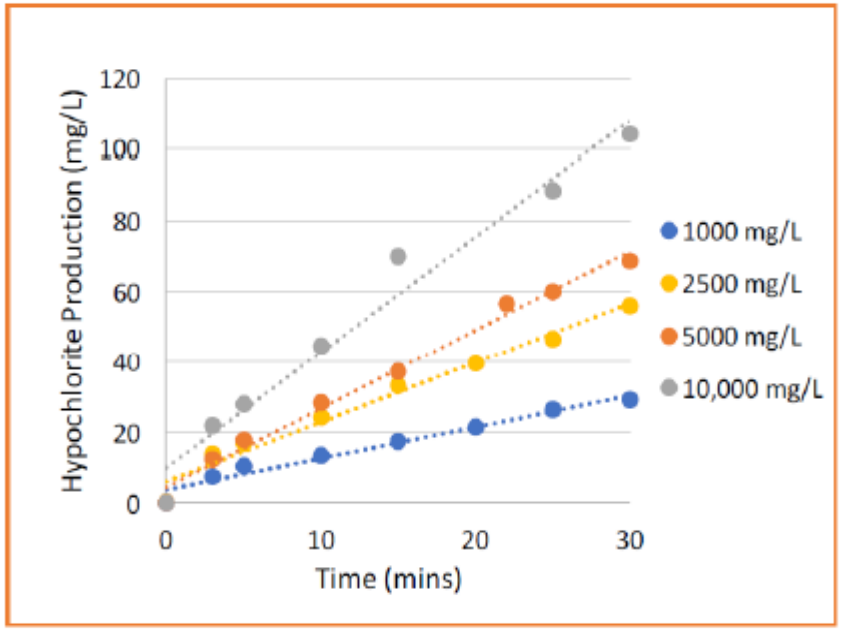


Source: Eutech Instruments Pty Ltd - NSW Health AU

AWP's technology offers an Advanced Oxidation Platform to address issues like bacteria disinfection, precipitation of scale causing minerals (Making water soft) and oxidizing organic and inorganic contaminants. AWP's treatment technology can be used as a pre-treatment before filtration process to reduce the load on final polishing techniques such as UV or RO to increase their performance. AWP's unique periodic charge reversal technology allows for self-cleaning of the electrodes which increase the lifetime of the electrodes as well as increase the current efficiency of the electrodes.

Performance data of AWP's technology as evaluated by University of Illinois is as shown below.

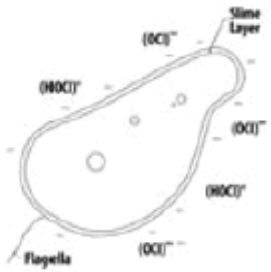
Figure 3: Hypochlorite production with varying salt concentrations.



Very high concentrations of hypochlorite are observed within a very short time depending upon the salinity of water. HOCl and OH• are the main oxidants responsible for killing bacteria in water. It is presumed that viral infectivity is suppressed, due to the denaturing and break down of the viral protein necessary for infection, through a reaction of that protein with two types of active oxygen present in the Water:

1.Electrolyzed Hypochlorous Acid (HOCL)

2.Hydroxyl radicals (OH)



It is widely believed that the bactericidal effect of Electrolyzed Water (HOCL-solution) against various strains of bacteria is due to the combined action of hydrogen ion concentration, oxidation-reduction-potential (ORP-reactions) and dissolved chlorine (HOCL). First ORP-reactions at the cell membrane damage the outer and inner membrane and inactivate the microbes defense mechanism. Then HOCL can penetrate the cell and oxidize it.

Typical Acid Producing Bacteria Treatment Results in Produced Water (six bottles represent different dilutions)

Table 2: Acid Producing Bacteria Results

Sample	7th Day Result (cfu/mL)	Growth
CWP0317000A	NMG	No Measurable Growth
CWP0317000B	10^2-10^3	Low

cfu/mL = Colony Forming Unit/mL

Figure 2: Acid Producing Bacteria

CWP0317000A - AFTER TREATMENT

CWP0317000B - BEFORE TREATMENT

Table 3: Sulfate Reducing Bacteria Results

Sample	7th Day Result (cfu/mL)	Growth
CWP0317000A	NMG	No Measurable Growth
CWP0317000B	10^4-10^5	High

cfu/mL = Colony Forming Unit/mL

Figure 3: Sulfate Reducing Bacteria

CWP0317000A - AFTER TREATMENT

CWP0317000B - BEFORE TREATMENT

Typical Sulfate Reducing Bacteria Treatment Results in Produced Water (six bottles represent different dilutions)

Advantages

Cost Effective Treatment Process

No additional chemicals needed for treatment

Compact Installation/ Operation on Demand.

Applications

AWP's Electro-oxidation technology can be used for removal of:

- Active pharmaceutical compounds: estrogen, cortisone, antibiotics, EDCs
- Elimination of bacteria, viruses and parasites
- Soluble organic matter
- Color and odor
- Nitrogen compounds (nitrate, ammonia)
- Specific toxins: CN, pesticides, herbicides, PCBs, phenols, fungicides.
- BTEX and PAHs
- Sulfides, thiols and amines
- Free cyanide and inorganic cyanohydrins
- Volatile or semi-volatile Hydrocarbons
- Many of persistent organic compounds
- Bacteria disinfection
- BTEX and PAHs

Proposal for AP1.5 Electro-Oxidation Reactor Cabinet Unit

We are pleased to provide with a quotation as follows:

Scope of Work:
AWP to provide the following hardware:
1) AP 1.5 Vertical Electrolytic Reactor configured with ONE Anode assembly housed in a Cabinet Unit

Equipment Specifications:
• Configuration: Single reactor module, cabinet mounted.
• Throughput: Hydraulic capacity up to 5–10 gallons per min. (3/4" Pipe)
• ONE Paddle Electrodes Assembly coated with mixed metal oxide coating connected to DC Power supply.

DC Power Supply unit:
• **Features:**
o High Current DC Power Supply.
o OUTPUT: Adjust 24 V DC. 0– 100 Amps.
o INPUT: 1 Phase, 110 V AC Single phase 10 Amps.
o Reversing Output Polarity at rate from 10 min to 3 Hr.
o Digital Readout of Output Current and Voltage.

Pricing for AP1.5 Electro-Oxidation unit:
AP1.5 Electro–Oxidation Unit, $30,000/unit

This quotation assumes that the customer will provide onsite assistance for the installation of the skid at the required position and the effluent is pumped into the reactor at a specified flow rate. Once the installation is complete, AWP will provide start–up assistance and training to the customer's personnel. If the start–up and training is required on site at a location different than place of installation, the daily charge is $1000/day plus travel expenses.

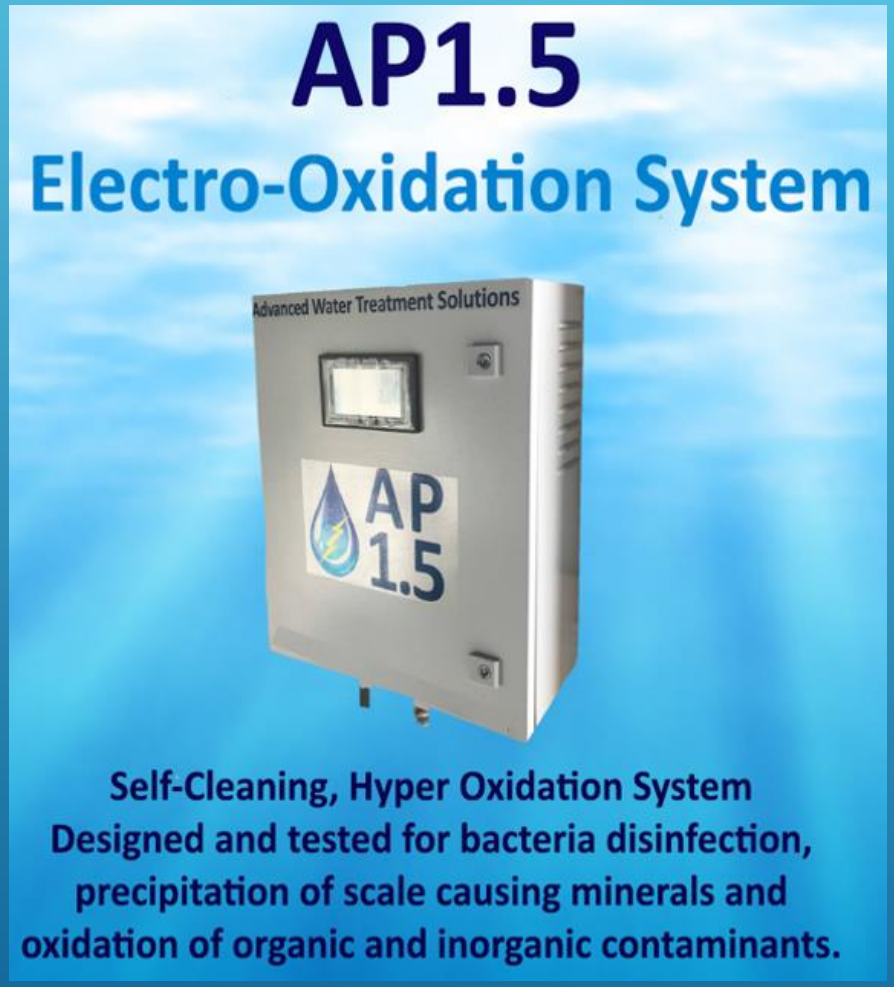
Delivery: 10 Weeks

Warranty: Standard 6 months' parts and labor on all non–wear components. Electrodes are not under warranty.

Thank you for giving the opportunity to provide you with this quotation. We are confident that our system meets and exceeds your requirements.

AP1.5 Electro-Oxidation System

Installation Operation & Maintenance



INTRODUCTION

Electro-Oxidation Technology: AP Series

Clear Water Plasma draws upon wealth of knowledge from years of integrated research, experimentation, advancement of Material science and electronics to produce a unique, patented & state of the art water processing technology

With the dedication & clear vision to establish business practices and technologies with a positive social impact Clear Water Plasma has come up with cost effective technology which addresses Water Treatment issues without using Chemicals.

Clear Water Plasma's AP Series Electro-oxidation technology is ideal for disinfection and water treatment by oxidation of micro-organisms, biofilm, organic and inorganic contaminants and micro precipitation of scale causing minerals.

With which oxidation reactions occur by applying an electric field between Non-sacrificial electrodes, generating multiple oxidants directly in the effluent for oxidation of organic and inorganic contaminants

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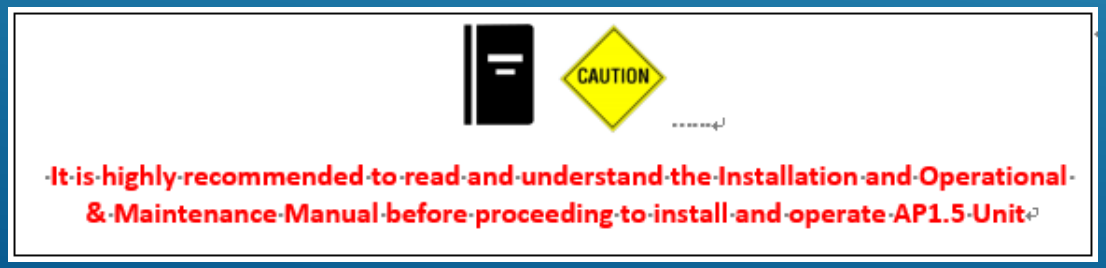


Specifications

Unit Dimensions (Inches): (H)19.75 (W) 15.75 (D) 7.25

Weight: 30 Lbs.

Inlet Pipe: ¾ Inches

Flow Rate: 5~10 GPM

Rated Pressure: 10~40 Psi

Rated Input Power Supply: 100 V ~240 V, 50 ~60 Hz

Important Instructions

This manual has been written to include number of safety instructions to ensure safe installation of the AP1.5 Unit and operate the way it is designed and operate.

Instructions in this manual are in the form CAUTION, WARNING & DANGER and the user of this unit take note of all the precautionary measure to comply with the instructions.

It is highly recommended to read and understand the Installation and Operational Manual before proceeding to install and operate AP1.5 Unit.

Do not alter AP1.5 product without written consent from the manufacturer. Any alteration or modification without careful management of change could have serious consequences including bodily harm or death.

Use only COMPONENTS from original Equipment Manufacturer for replacement of defective components.

Before servicing AP1.5 Unit should be Electrically isolated and proved to be electrically isolated as AP1.5 starts & stops automatically.

Personnel operating or servicing AP1.5 Unit should wear required Personnel Protective Gear before working on the Unit.

Preparation prior installation of AP1.5 Unit

- ✓ AP1.5 Unit is wall mounted Type and should be protected from Water splash, Rain water and should be properly supported.
- ✓ Electrically supply Single Phase 100~220 V, 50~60Hz with Isolation Switch.
- ✓ Water Supply line pipe ¾" diameter with Isolation Valve to regulate the Flow and Isolation during maintenance
- ✓ It is mandatory to install fine mesh filter (250-500 micron) on the water supply line to protect Electrodes in the reaction chamber
- ✓ Pressure regulator to maintain the water supply pressure in the range 10~40 psi
- ✓ Water outlet from the AP1.5 Unit should not be restricted and there should be no back pressure otherwise Reaction chamber will be subjected to excessive pressure leading to failure of Reaction chamber
- ✓ AP1.5 Unit installation must comply with local and state Laws and regulation

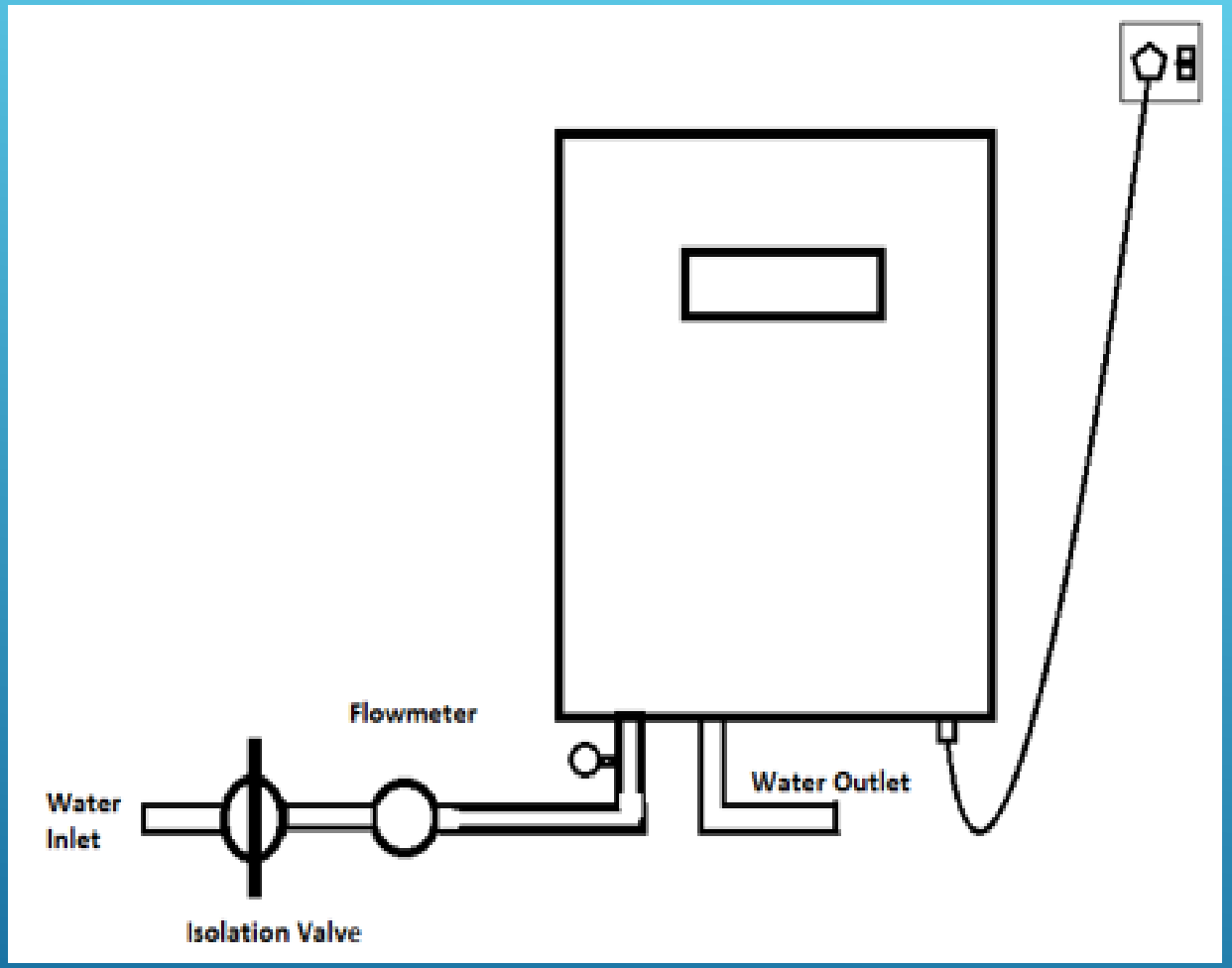
Installation Procedures

It is recommended to install the Unit on Vertical wall and should be easily accessible for operation.

It is recommended that bottom of the cabinet be at height of 4 ft from the floor level.

Water pipe of ¾" size and pressure rating of minimum 50 psi is used to supply the water to the unit and is connected to ¾" Female pipe marked as "IN" on the bottom left corner.

Treated water outlet is of ¾" size located at bottom of the panel and is marked as "OUT".



Operation of AP1.5

Switch "ON" the Power

HMI Screen comes on Power and Main Menu is displayed.

HMI Screen is Touch Screen where all the operation of the unit is carried out.

Main menu basically consists of following information and Controls

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STOPPED

Running Time ..... Hrs ..... Min

Output Current ..... A

Output Voltage V

POWER

DOWN ⏬ ..... ⏮ .....%..... ⏭ ..... ⏻

Touching "⏬" will open second page of menu.

Power of the Electrolysis is decreased by touching "⏮" and increased by touching "⏭"

Touching "⏻" will Start & Stop AP1.5 Unit

Touching "⏬" will open the second page of Menu which appears as follows.

Change Frequency ..... min

Total Run Time ..... Hrs ..... Mins

UP ⏏ ..... Flow Sensor "DISABLE"

Frequency of Self-cleaning of electrodes can be changed ..... by touching which will open KEY PAD

where you can select time in minutes whereby self-cleaning takes place at set interval of time

AP1.5 Unit is provided with Flow Sensor at water inlet side which will STOP the unit if there is no flow of water in the System and starts automatically when water starts flowing through the AP1.5 Unit.

However, in case of malfunctioning of flow switch Flow Sensor can be Disabled by touching "DISABLE" and AP1.5 Unit can be used.

Flow sensor can be enabled by touching "DISABLE" again.

Maintenance of AP1.5

AP1.5 Unit does not have Customer serviceable part and the defective components can be replaced by COMPONENTS from Original Equipment Manufacturer.

Electrical Isolation of AP1.5 Unit should be done before carrying out any Component replacement work and replacement work should be done by Qualified & Professional Personnel.

.....

Warning :- AP1.5 Cabinet Door should not be opened while the system is running or when connected to power.

Recently one of our clients used our AP1.5 system to treat a mixture of Gray and Black waste water (Sewage Waste Water) and was fascinated with the results they got.

Sewage Water Treatment Case Study
BOD & E. Coli reduction

AWP has successfully treated sewage waste water from a leading service provider in western Texas.

The customer was constantly facing non-compliance issues with the existing aerobic activated sludge process.
The state regulations required the BOD to be less than 80mg/L and E. Coli & Total Coliforms to be less than 8 CFU/ml. The regulations also required the pH to be in the range of 6.0-9.0 and residual chlorine to be 2-3 mg/L over 7 days. The customer approached CWP with these stringent demands and AWP delivered on its promise.

The customer used AWP's AP-1.5 electrocatalytic oxidation unit as a pretreatment for its aerobic activated sludge process. The AP-1.5 unit achieved over log 3 reduction in total coliforms and Escherichia Coliforms (E. Coli). The BOD5 reduced by over 76% which reduced the load on the aerobic treatment and brought the overall treatment into compliance with the state regulations.

The pH of the water came down to 8.3 after the AWP treatment. The residual free chlorine in the water after the AWP treatment was about 14.5 mg/l which allowed the customer to add more untreated water and bring it down to 2-3 mg/L as required by the state regulations.

Thus, increasing the capacity of their system. The customer was very happy with the results of the pretreatment. It allowed the customer to increase the capacity of its aerobic treatment unit while maintaining compliance with the regulations.

Parameter	Performance
BOD, mg/l	76.87% degradation
pH	8.31
Temperature	21.3
Total Coliform, MPN/100 ml	< 1.0
E.Coli, MPN/100 ml	< 1.0
Chlorine, Residual, mg/L	14.5

The customer now wants to buy more of these portable units for its other locations. The electrocatalytic oxidation unit only consumes electricity and requires minimal maintenance and labor. It's a compact plug-n-play cabinet sized modular unit.

THANK YOU

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