Clean Water Innovations LLC
8310 S. Valley Hwy, Suite 285
Englewood, Colorado 80112
Phone: 303.219.2580

Wasterwater Treatment, Recycling, and Purification Through Ionic Electro-Flocculation with D.S.A. Type Electrodes

www.cwi-llc.com lsantiago@cwi-llc.com

We will never know the value of the water until the well is dry... **[Thomas Fuller].**

"Clean Water Innovations LLC has the technology to produce clean water for discharge or reuse in multiple applications and industries, including drinking water."

GRUP AWAINNOVA NGC

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Water is an imperative need in many areas of the world. This shortage is spreading due to the need for water to grow and process food, produce energy, provide the industry with it in order to satisfy an ever-growing population.

Clean, drinkable water is an essential component that allows for a healthy life; however, 1.2 billion people do not have access to it, according to serious and reliable international studies. By 2025, two thirds of the of the world's population could be facing water shortages, according to World Wildlife Federation (WWF). Fresh water supplies are continuously decreasing worldwide. By 2030, water demand is expected to increase by 40%. The estimation is that the world population will reach 9 billion individuals, which will put more pressure on fresh water supplies of appropriate quality for human consumption, as well as on the flora and fauna on this planet.

Concept

Wastewaters can be defined as that which, due to human use, pose danger and should be discarded, since they contain a great amount of foreign substances and/or harmful microorganisms.
Within this concept, waters with several origins have been included:

Domestic wastewater or sewage water: come from human feces and urine, as well as personal hygiene, household and kitchen cleaning. It often contains a great amount of organic matter and microorganisms, as well as soap residues, detergents, bleach, and grease.

Washing water: they can come from the atmosphere (as rain, snow or ice), from watering and cleaning on streets, parks and public places. In those places where atmospheric precipitation is heavy, this water can be disposed of separately so it does not saturate treatment systems.

Industrial wastewaters: come from procedures carried out in factories and industrial facilities; they contain oils, detergents, antibiotics, acids, greases and many other products and byproducts from mineral, chemical, vegetal or animal origins. The composition may vary depending on the industrial activity.

Agriculture wastewaters: they come from agriculture procedures on rural areas. These waters usually participate with regards to their origin, of urban wastewaters used in many places for agriculture irrigation, with or without previous treatment.

Ecological and Sanitary Impact

Wastewaters, due to the great amount of substances (some of them toxic) and microorganisms they carry, can be the cause and vehicle of pollution in those places where they are discharged without previous treatment. Water pollution can be defined as a modification, generally produced by human interaction, of its quality, rendering it unfit and dangerous for human, industrial or agricultural uses, fishing, recreation activities, as well as for domestic animals and wildlife consumption.

Main inconveniences of residual water

1

Foul tastes and odors.

These are consequence of the different substances they carry and, mostly, to their decomposing, especially in those processes, mainly anaerobic, where organic matter decomposes with gases as a by-product.

2

Microorganism proliferation.

Decomposition processes, aquatic vegetation presence, mold, fungus, etc., and the sulphate to sulphide reduction in anoxic conditions.
Toxic action
It is the effect and repercussion that some residues have on receiving water bodies, on their flora and fauna, as well as on their potential consumers of those waters, or those affected by the accumulation of these toxic substances in the food chain.

3

Toxic effects could be:

Lethal: they cause death by direct poisoning.
Sublethal: below lethal levels, but they can hinder growth, reproduction or any organic activity.
Acute: they have an effect (usually death) on a short term.
Chronic: they produce a lethal or sublethal effect on a long term.
Accumulative: the effect increases with subsequent doses.

Assessment of the problem

These problems are not only physical or aesthetic, but transcend onto health concerns, since human communities need to draw on several surface water sources in order to provide for their drinkable water supply, and if these are polluted with human or industrial waste products, they could allow for major epidemiologic issues. The fact that pollution is diminishing water quality in several places has become clear. With this progressive deterioration, the use of techniques and models in order to predict the behavior of water quality indicators has become a more important issue.

Thus, wastewaters, before being discharged on receiving water bodies, should receive an appropriate treatment according to their composition, a treatment that modifies their physical, chemical and microbiological characteristics, to the point of avoiding pollution issues for receiving water bodies that have been mentioned above. Wastewater elimination is not the only issue to be considered, since water is a scarce resource that is needed in greater amounts each day, making the reuse of available resources in order to satisfy human needs becomes more vital.

Solutions for Water Shortage

Solutions for Water Shortage. There are many available solutions to effectively address water shortage. These include water reuse, storage, management, preservation and a variety of technologies for water treatment, such as desalination. Generally, one or more solutions and approaches should be enforced to attain efficiency, depending on whether that solution is adopted by a corporation that depends on water availability or by a governmental entity. Adding water through reutilization or desalination is not a definitive solution. Without adequate management and strategies to address the ever-growing demand, any solution will always be incomplete.

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Solutions for Water Shortage

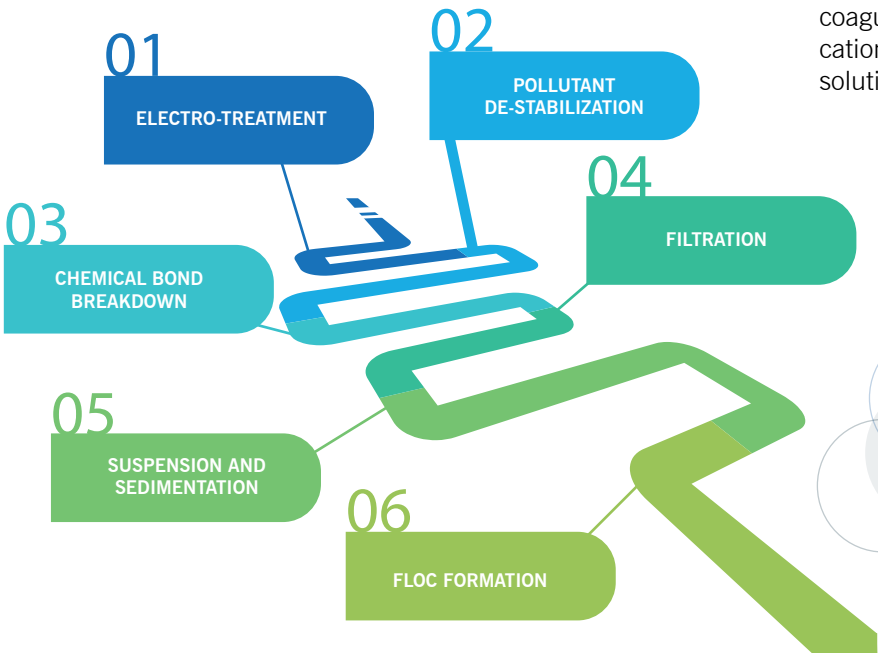
Many strategies and approaches that, intertwined, work for water reuse are also able to alleviate water shortages for industries and municipalities. These include water recycling and reutilization as well as the use of systems with a zero liquid discharge. When an industrial facility uses water with a closed circuit system (water at the facility is constantly used and treated, to be used once again without being released or discharged into the sewage), it is generally addressed as a zero discharge facility.

Recycled or reclaimed water can be used for various purposes at a facility, both inside the building as well as with the community. Typical uses for recycled water include surface irrigation for crops and vineyards, golf courses, landscape areas and for food crops. Other uses include underground water body replenishment, conservation or development for ecosystems such as marshes or marine habitats, as well as industrial processes. Non-drinkable water can be used for toilet cleansing, garden watering, to wash vehicles, clean streets and similar purposes.

These systems allow for residual water, usually seen as useless and expendable, to become a valuable resource. Grupo Awainnova NGC, with its Ionic Low-Voltage Electro-flocculation Technology and D.C. with D.S.A. electrodes and extensive experience in the advanced treatment of process and residual water in order to reuse it, has designed systems for water reutilization through various industrial, agriculture and municipal processes. Its water treatment technology is able to produce pure and ultra-pure water that can be reused in several applications, including recirculation as drinkable water.

Grupo Awainnova NGC, has the Ionic Low-Voltage Electro-flocculation Technology and D.C. with D.S.A. electrodes, which offers an excellent, absolutely effective as well as highly efficient and feasible option.

The Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes includes many stages



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Description of the Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes for wastewater treatment

The Electro-Flocculation with D.S.A. Electrodes technology applies electrochemistry, the branch that studies interaction and correlation of chemical and electric processes through the oxidation-reduction reactions. Some of the main electrochemical techniques are: electrocoagulation, electrochemical oxidation, electro-incineration and electro-Fenton processes.

In this type of reaction an exchange occurs between the electrons from the polluting atoms and the ions or molecules from the solution, through the application of a potential difference, which triggers a strong, effective and efficient electrical current where electrons flow through the most negative to the most positive point.

This technique has a great potential for eliminating the disadvantages of the classic and/or modern treatments for residual water of any kind and implicates the generation of physical and chemical phenomena; it uses electrodes in order to provide ions to the residual water that is to be treated.
The main goal is to reduce the concentration of pollutant components in wastewater –physical, chemical, and biological- that are in the effluent, through a coagulant generated in situ by an oxidation reaction and interchange from the anodes.

When a potential is applied to electrodes made out of different metals and special alloys which metals such as titanium, tungsten, nickel, molybdenum, iron, and aluminum, as well as mineral carbon, the following process takes place: metal from the anode is dissolved, producing metal ions, immediately hydrolyzed in order to form hydroxides and poly-hydroxides, which are excellent coagulant agents. Coagulation is achieved when these cations are attracted by negative particles present on the solution.

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Design components of an Electro-flocculation with D.S.A electrodes wastewater treatment facility.

01.- Residual water container structure.

02.- Innocuous sludge container.

03.- Treated water container.

04.- Residual water conduction infrastructure.

05.- Treated water conduction infrastructure.

06.- Electric power transformation-generation.

Equipment of the wastewater treatment plant with the Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes:

01.- Main electro-flocculation reactors.

02.- Auxiliary electro-flocculation reactors (according to the expected treatment degree).

03.- Voltage and current rectifier power sources.

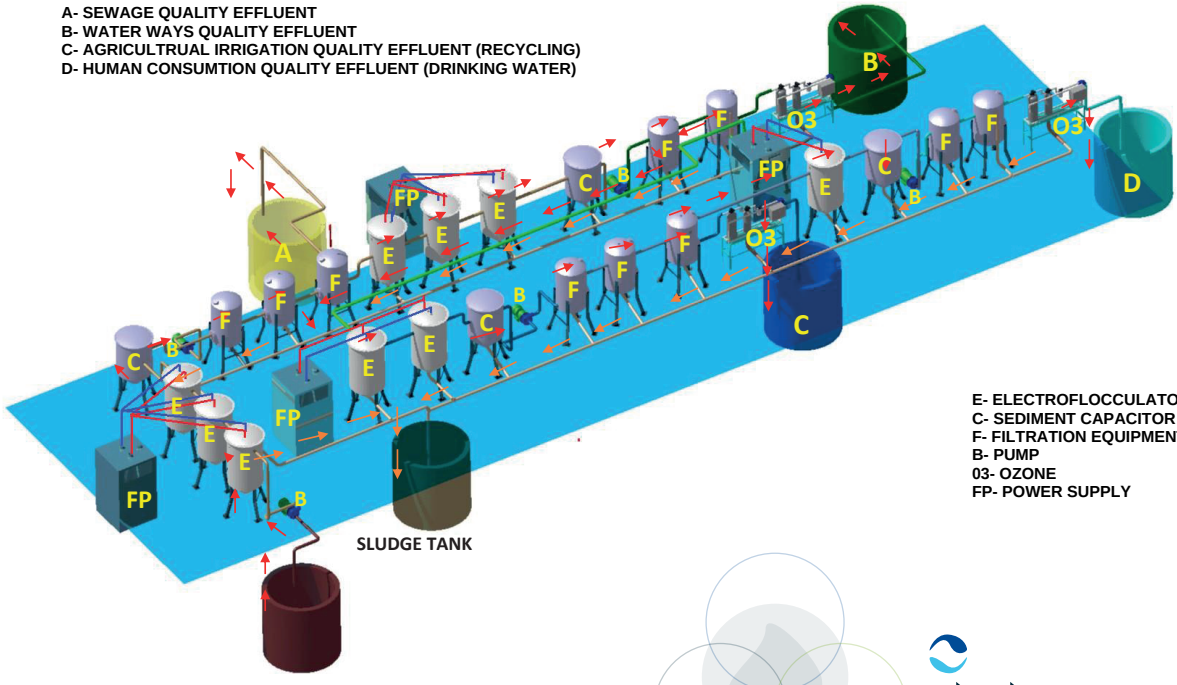
04.- Conventional filter equipment.

05.- Polishing filter equipment.

06.- Disinfection through UV lights and ozonization.

PROCESS FLOW DIAGRAM

A- SEWAGE QUALITY EFFLUENT
B- WATER WAYS QUALITY EFFLUENT
C- AGRICULTRUAL IRRIGATION QUALITY EFFLUENT (RECYCLING)
D- HUMAN CONSUMTION QUALITY EFFLUENT (DRINKING WATER)



E- ELECTROFLOCCULATOR REACTOR
C- SEDIMENT CAPACITOR
F- FILTRATION EQUIPMENT
B- PUMP
03- OZONE
FP- POWER SUPPLY

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Advantages

Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes advantages:

Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes has advantages over conventional, biological, evaporation, physical-chemical, reverse osmosis, and ultra-filter treatments (among other conventional or traditional treatments), applied to wastewater treatment; we can mention the following:

Two other important advantages, when comparing the Low voltage Ionic Electro-Flocculation Technology and D.C. with D.S.A. electrodes with traditional methods are:

It is more versatile, architecturally flexible, easily automatized, easier to the eye in an architectural sense and environmentally compatible.

It does not allow for mud generation, since the only auxiliary for the electro-treatment process is electricity. It only retrieves mud as a by-product of the extraction of solids that are contained in residual water; these retrieved muds are completely innocuous thus do not require additional drying or other treatment processes and, as a by-product of electro-treatment, comply with every non-hazardous residue regulation.

01

High effectiveness and efficiency in treatment, fully complying with ecology or health regulations to be applied.

02

Does not allow for foul odors, insect or vermin generation.

03

Does not generate process noise that exceeds permissible limits.

04

Requires much less processing or residence time in order to achieve the targeted treatment level.

05

Requires a very small surface due to its compact equipment.

06

Easily operated equipment.

07

Low operation costs.

08

Less energy consumption.

09

High volumetric water recovery efficiency, close to a 95%.

10

The only important input is electric power, so it does not produce secondary pollution.

11

It has modular growth characteristics in order to address the increasing the amount of water to be treated or its quality.