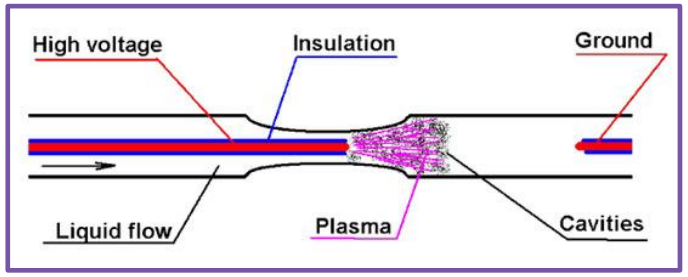
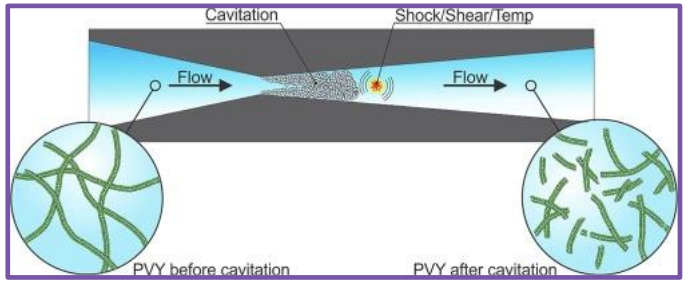
HydroPlasmaTech

PLASMA BASED CAVITATION FOR WATER PURIFICATION AND ADVANCED OXIDATION (OH)





We have developed a new plasma-cavitation reactor (PCR) system and have efficiently applied this hybrid technology to water disinfection. Conventional wastewater methods often do not remove complex organic contaminants. These challenges make finding new water-treatment technologies increasingly urgent.

Some types of another a dvanced oxidation proc esses based on mixing technologies, such as the use of hydrogen peroxide, persulfate and derivative compounds have limitations.

Ozonation is an expensive method for water disinfection. While ozone itself is a powerful oxidant that can directly oxidize unsaturated organic compounds, it is also spontaneously converted into a more reactive unselective species, OH, in water. However, ozone is difficult to disperse or dissolve into water, leading to lower gas–liquid mass transfer. For this reason, various mixing technologies must be used to enhance ozonation and increase efficiency, although this leads to the drawback of high costs.

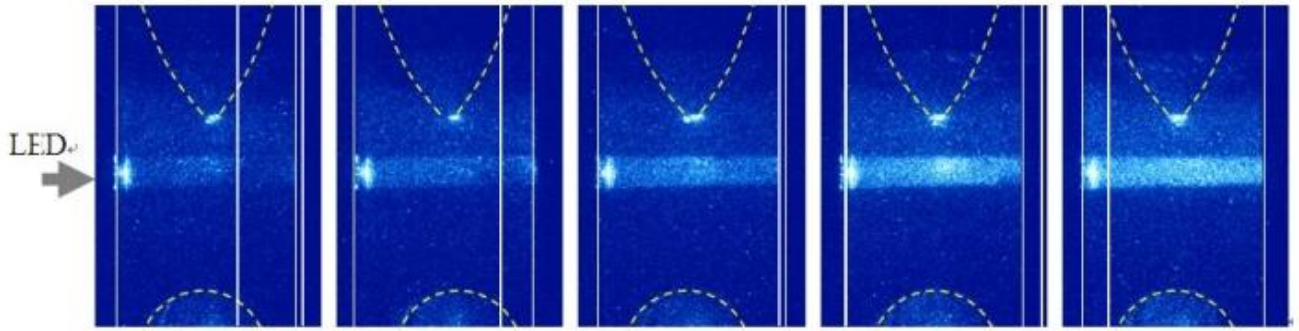
Hydrodynamic cavitation has also found important applications in the in-vitiation and enhancement of degradation and catalytic reactions in both homogeneous and heterogeneous systems.

Cavitation can be used in wastewater treatment for the activation of reagents (for example, one of the methods of water treatment based on the use of persulfate and peroxymonosulfate involves cavitation activation) for wastewater treatment, or to enhance ozonation or other types of advanced oxidation processes.

Hydrodynamic cavitation has been widely used in environmental remediation as it offers the advantages of process acceleration and higher energy efficiency.

PLASMA DISCHARGE IN THE CAVITATION ZONE, TOGETHER WITH THE GENERATION OF HYDROXYL RADICALS.

OH radicals have larger oxidation power than ozone and chlorine and therefore play important roles in plasma chemical science.



Treatment-time dependence of fluorescence intensity of OH radicals

In addition to proprietary cavitation reactors, we have developed a Plasma Cavitation Reactor (PCR) reactor to treat water in continuous flow with plasma discharge in a cavitation zone that is generated by the hydrodynamic unit. The main goals of our technology are: the disinfection of water and the removal of persistent organic pollutants (POPs) from wastewater and use of a PCR's activated water in agriculture.

Plasma is a physical process leading to OH formation in water when plasma is in contact with water. Plasma is a source of high electric fields, energetic charged particles, ultrasound, UV light, and now shockwaves and cavitation.

The decomposition of liquid water by plasma and cavitation produces Hydroxide Radicals (OH) and hydrogen. The OH production leads to longer-lived hydrogen peroxide. Plasma is produced inside of a cavitation bubbles, in this case no outside source of gas is needed and the cavitation bubbles serve as mass transporters of reactive oxygen species.

The presence of an electric field can lead to cavitation bubbles becoming lined up in strings. In this case, the discharge develops inside the bubbles and also jumps from bubble to bubble.

Also
called microchannel is formed between the electrodes, a dynamic effect that continuously forms and disappears in the cavitation and electric fields.

The free radicals formed can lead to microorganism inactivation and therefore to water disinfection. OH radicals can penetrate bacteria cell walls and membranes, and cause severe damage. This process is based on chemical oxidation, meaning that microorganisms and viruses cannot develop resistance.

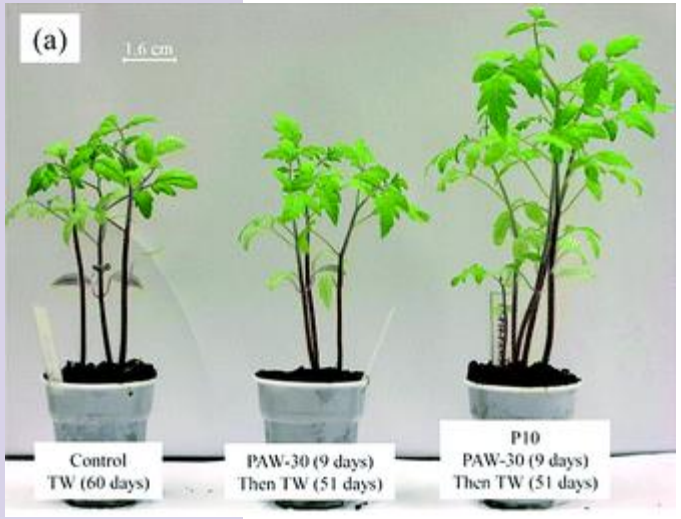
PLASMA/CAVITATION ACTIVATED WATER IN AGRICULTURE

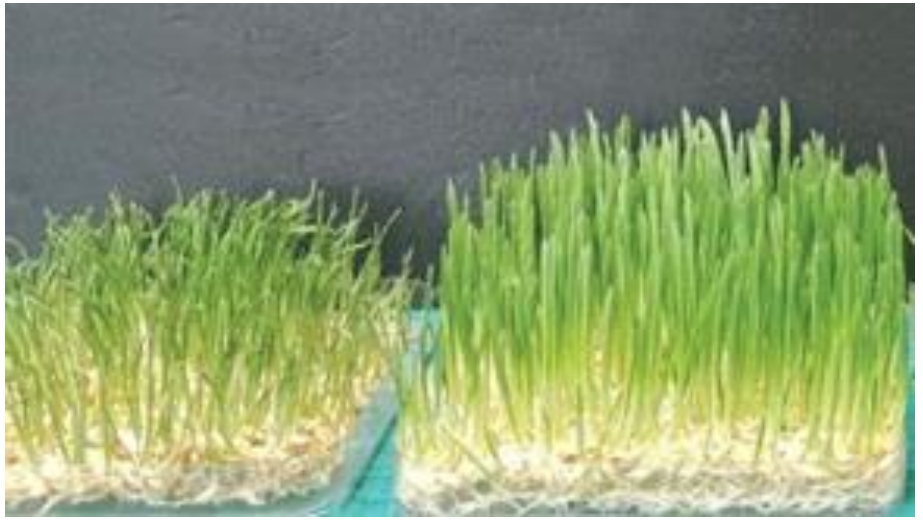
Plasma Activated Water appears in nature, when lightning gets in contact with the rain. This water demonstrates special capabilities to enhance plant growth and vigor, due to the presence of Reactive Oxygen Species (ROS).

HydroPlasma breakthrough technology transforms any water into plasma, in continuous flow, generating a unique type of plasma activated water.

Plasma can be used in the entire life cycle of fresh produce, from soil to fork: Sterilize seeds while in storage. Enhance seed germination. Sterilization, and removal of volatile organic compounds in greenhouse facilities. The plasma activated water is stable for at least three weeks.

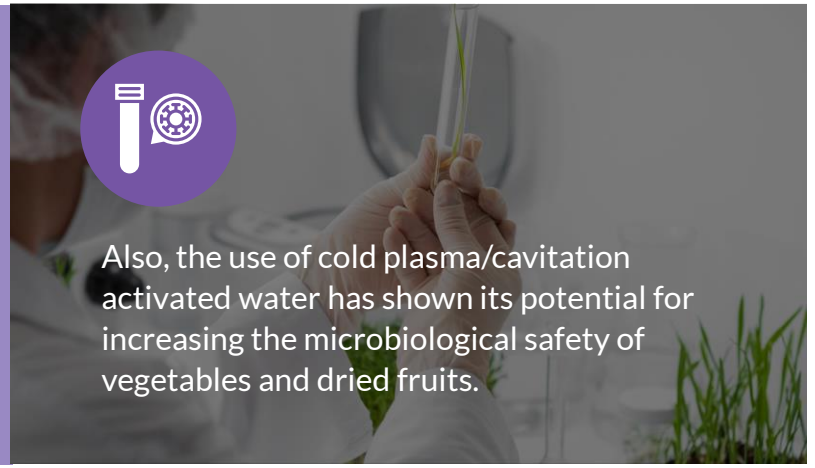
PLANT GROWTH PROMOTION EFFECT OF PLASMA ACTIVATED WATER (PAW).





Plasma activated water (PAW) can represent an alternative to chemical fertilizers in agriculture.

The use of cold plasma in agricultural systems for controlling microorganisms' development in storage areas or for a safe packaging of foodstuff to determine the reduction of pesticides in fruit and vegetables for hygienic decontamination or drought stress. From a physiological standpoint, the use of plasma in agriculture is better known for the positive effects on seed germination or on early growth plants.



Also, the use of cold plasma/cavitation activated water has shown its potential for increasing the microbiological safety of vegetables and dried fruits.

Cold plasma contains energetic reactive species, such as ultraviolet (UV) photons, electrons, positive and negative ions, free radicals and excited or non-excited molecules and atoms.

Plasma/cavitation activated water induces growth of vegetables. PAW irrigation enhanced endogenous H_2O_2 and NO_x levels in seedlings.

Additionally, PAW treatment altered the growth and development of specific tissues (cotyledon stem, root, and flower) inincreases their biomass. PAW accelerates vegetative and root growth at an early developmental stage. It enhances the overall plant height seedlings, resulting in increased growth and biomass. The use of PAW in the cultivation of leafy vegetables, stem thickness, and total fruit weight.

Use of PAW for increase in primary nutrient contents in fruits and leaves in an orchard, as well as to assess the scion survival rate and vegetative growth of young grafts in a nursery. The application of PAW influenced the fruitset, yield, leaf nitrogen (N) and potassium (K), fruit phosphorus (P), calcium (Ca) ascorbic acid (AA) and titratable acidity (TA).

PLASMA-ACTIVATED WATER (PAW)

PLASMA CAVITATION REACTOR (PCR) TECHNOLOGY IS AN ECO-FRIENDLY AND ECONOMICALLY VIABLE TECHNOLOGY THAT UTILIZES PLASMA, CAVITATION AND WATER AS PRELIMINARY INGREDIENTS.

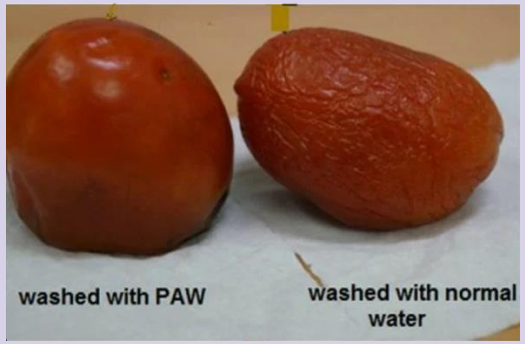
Physical properties of water change due to plasma activation, which could lead to potential industrial applications.

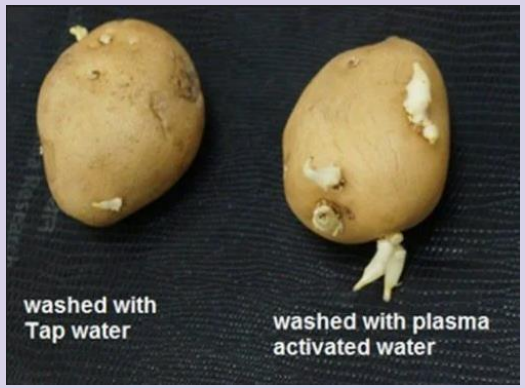
Non-thermal plasmas generated in cavitation bubbles, produce a variety of reactive oxygen and nitrogen species (RONS), e.g., ozone, hydroxyl radicals, hydrogen peroxide, superoxide, and nitrogen oxides.

The interaction of plasma with liquid media leads to the transport of RONS into the liquid and the formation of secondary active species.

In water, the main reactive species formed by plasma activation are OH radicals, ozone, hydrogen peroxide, nitrites, nitrates, peroxynitrites, and peroxynitrates; water activated in this way with non-thermal plasma is called plasma-activated water (PAW).

‘Wonder Water’ That Can Keep Veggies Fresh For 40 Days!





PAW CURRENTLY HAS NUMEROUS APPLICATIONS, INCLUDING BUT NOT LIMITED TO;

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