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Currently, there is a growing demand for water treatment technologies, considering global environmental challenges such as degradation and depletion of water resources.

MICRO-NANO BUBBLE (MNB) technology and its application for wastewater treatment has emerged as a problem-solving alternative for such challenges.

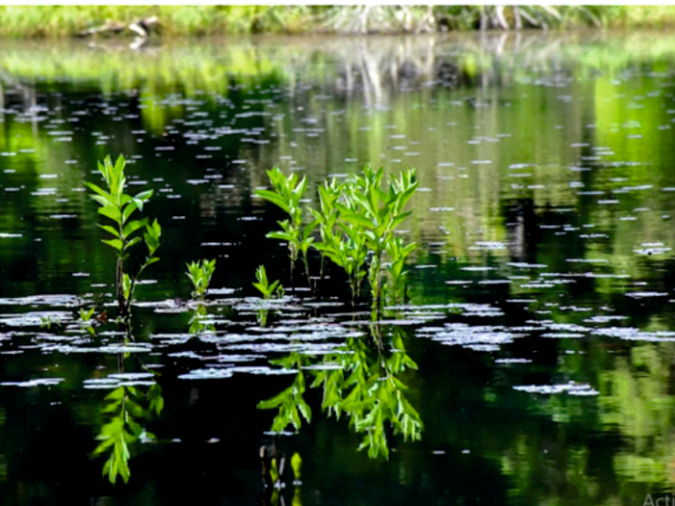
The studies about MNB's fundamental properties, such as tiny bubbles stability and various chemical and physical features, it is strongly felt that, the MNBs application in wastewater treatment, processes such as flotation, aeration, disinfection and due to its unique characteristics, its application can be extended in various fields including Agriculture, Aquaculture, Horticulture & Hydroponics, Cellular Biology, Medical, Industry and Domestic.



MICRO-NANO BUBBLE GENERATOR
For Proven Benefits

WASTE WATER TREATMENT:

Global economic development cannot be separated from water resources. Currently, in many developing countries, water resources are facing extreme challenges such as water scarcity, droughts, and other environmental problems.



Further, the increasing amount of wastewater caused by rapid urbanization and industrialization has significantly increased the challenges of both water availability and quality. Therefore, the treatment and recycling of wastewater are increasingly needed to ensure the sufficient availability of water.

Generally, biological methods, such as activated sludge, have been used to treat the pollutants from both industrial and domestic wastewater. However, such methods have disadvantages such as high energy costs and resulting in an abundant amount of solid waste creating an additional cost to dispose of the produced waste. Therefore, there is a dire need to develop a water treatment technology that can effectively address the increasing challenges of water scarcity sustainably.

In such a scenario, **MICRO NANO BUBBLES (MNBs)** has emerged as useful technology to be used in water treatment. MNBs are tiny

bubbles with diameters of nanometres and micrometers having several unique physical properties that make them useful for water treatments.



For instance, their unique property of having a large surface area enables an efficient mass transfer process between the liquid and gas phases, which helps to facilitate chemical reactions. Such processes lead to the collapse of the MNB, which produces shock waves in the water, generating OH (Hydroxyl) radicals as a result. The water treatment processes, such as electroflotation and dissolved air flotation, generally make use of MNBs. In recent years, the use of such methods has been widely adopted for the decontamination of domestic and industrial water treatment, due to the higher bioactivity of MNBs.

During recent years, research on MNBs for water-related applications has significantly increased, considering their feasibility as a sustainable technology for water treatment.

AGRICULTURE:

MNB-treated water in agriculture improves the soil's physiological and biological conditions by encouraging aerobic microorganisms, which improves soil particle structure, water absorption and oxygen dissolution, levels of the rhizosphere (the region of soil in the vicinity of plant roots in which the chemistry and microbiology are influenced by their growth, respiration, and nutrient exchange), microbial species and phosphate and urease (an enzyme that catalyzes the hydrolysis of urea, forming ammonia and carbon dioxide), which positively impact plant growth.

MNBs water reduces CH₄ (Methane) emission and arsenic dissolution through an oxidative shift of the redox conditions in the flooded soil.

MNBs accelerate metabolism in animal and plant species.

MNB application through a drip kills bacteria, removes harmful substances and odors from water, improves the freshness, taste and yields fruits and vegetables.

MNBs are used for biological and weed control i.e., facilitating Triopsidae (Self-propelled movement of a cell or organism from one location to another) growth, which stops weed growth in rice fields and also decreases chemical and fertilizer usage.

MNB water improves the rate of seed germination.

HORTICULTURE & HYDROPONICS:

Plants require oxygen to grow. Maintaining adequate dissolved oxygen (DO) levels in water is the easiest way to increase a plant's health. Elevated DO levels reduce disease and enhance root mass, which increases nutrient uptake and conversion efficiency. Micro nanobubble gas-injection technology is the ideal solution for horticulture applications by rapidly elevating and maintaining supersaturated DO levels in irrigation water to help push the genetic potential of plants. Supercharging a plant's metabolism with oxygen will increase yield while reducing the crop-turn cycle. Thereby, increasing profits to the farmers.

Plants absorb water and nutrients through root systems, which require oxygen for aerobic respiration. Higher DO levels in the root zone combined with the size, stability,



and surface charge of micro nano bubbles, result in higher root mass, allowing the plants to absorb nutrients and water more efficiently. An enhanced plant metabolism allows the conversion of these inputs into plant mass, resulting in increased fruiting and flowering yields.

A plant's roots need beneficial bacteria, which flourish in an oxygen-rich environment. Pathogens thrive in an environment that does not contain or is severely lacking oxygen. Increasing the DO levels in the root zone promotes good bacteria, helping the roots become stronger. Conversely, harmful bacteria and diseases, such as Pythium, can take hold when the environment around the plant's roots becomes anaerobic or depleted of oxygen. Elevated DO levels combined with the oxidation potential of oxygen-enriched micro nano bubbles prevent root-borne disease and reduce the need for costly chemicals, such as fungicides.

Healthy roots with a steady oxygen supply have better respiration and the capability to absorb more ions in solution, such as potassium, nitrogen, and phosphorus. This efficient absorption enables plants to mature more quickly and begin their fruiting and flowering cycles faster. The rapid and healthy maturation of the plants allows farmers and cultivators to reduce their growth cycle time, enabling more crop turns per year and increasing revenue.

This MNB generator can be used in roof gardens.

AQUACULTURE AND FISHERIES:

MNBs can be applied for purification of sludge at the lake bottom (the air is supplied to sludge in the form of micro-nano bubbles, which can recover the poor oxygen condition at the lake bottom).

MNBs improve the blood flow and branchial respiration of fish.

MNB-treated water application on aquatic plants and fisheries significantly increases growth by improving nutrient uptake.

Over half of the fish and shellfish directly consumed by humans are produced through aquaculture, also known as fish farming. As fish farmers look to produce more fish to keep up with global demand, they run into severe problems with a lack of dissolved oxygen (DO) in the water. Fish and shellfish need oxygen to breathe. When fish population is huge, a shortage of DO is inevitable because the fish and shellfish consume more oxygen from the water. Additionally, waste byproduct accumulates on the floor of the fish farm, damaging or eliminating bottom-dwelling plants and animals. Our advanced gas-to-liquid injection technology can alleviate these problems by rapidly elevating and maintaining higher levels of DO levels in the fish farm and effectively oxygenating lake floors due to the micro nano bubbles lack of buoyancy.

- **Stocking Density**

The metabolic rates of fish can be severely affected by the concentration of oxygen in the farm. Low DO levels lead to decreased respiration and feeding activity that slows fish growth rates. An oxygen saturation level of 85% and above is ideal for aquaculture; lower levels have varying effects on the fish and mollusks (snails, slugs, mussels & octopuses), ranging from reduced appetite to massive mortality rates. Oxygen aeration using the micro nano bubble generator ensures that fish farmers can achieve the highest possible stocking densities while ensuring high survival rates to boost yields and profits.



• Disease Prevention

Low DO levels in the water of an aquaculture farm can also lead to disease and fungal infections. Lack of DO can lead to a build-up of fish and mollusks waste on the lake floor, creating conditions that are ideal for bacteria and fungus to thrive. Farmers have traditionally turned to vaccination, antibiotics, or additive chemicals to deal with these issues. However, these methods are costly and cause great stress to the fish, making them less healthy for human consumption. The micro nano bubble technology uses the power of clean and natural oxygen delivered through neutrally buoyant micro nano bubbles to prevent disease, providing a much healthier, more efficient, and cost-effective solution for aquaculture.

• Efficient Oxygen Transfer

Aquaculture farmers need large amounts of oxygen to maintain a healthy fish and mollusks population. Failure to add any additional oxygen to the water will lead to poor growing conditions and is not a feasible option. Traditional aeration methods are very inefficient, leading to high costs to achieve proper DO levels. The micro nano bubble generator is the ideal technology to maximize oxygen utilization for the aquaculture industry by delivering the highest oxygen-transfer efficiency, over 90%, of any aeration method in the market today.

• Functional Benefits:-

- Rapid enhancement of Dissolved Oxygen.
- Improves Standard Oxygen Transfer Efficiency (SOTE).
- Controls Ammonia, Nitrate, Nitrite & Hydrogen Sulphide.
- The high retention time of Oxygen Saturated Water.
- Increases pH, Controls Algae, and reduces Bad Odours.
- Enhances rapid growth in Shrimp, Fish, and Plants.

CELLULAR BIOLOGICAL:

MNBs are used in fermentation.

DOMESTIC USES:

The functions of MNB Generator (at domestic) are, water and air will collide and enormous amounts of negative ions (anions) are generated.

The Negatively charged MNBs are used in showers, bathtubs for strong anti-oxidant effects which will have subsequent health benefits such as slowing down of aging skin, removal of deep-rooted dust particles and grease, bacteria, viruses and chemical residue. With MNBs the hair roots will be activated and become energized. MNBs keep your skin moisturized and accelerate your skin metabolism and blood circulation.

MNBs are also used to wash vegetables, fruits, cloths, tableware, kitchenware and even floor tiles.

Experiments on bacterial deactivation showed that the small-sized bubbles' when collapsed, determined the efficiency of water disinfection in swimming pools.

Pathogens, viruses and chemical residues can pose major health risks. Chemical treatments are not desirable and can affect the taste and quality of products. MNBs have been demonstrated to be highly effective in eliminating these pathogens while simultaneously enhancing shelf life.



MICRO NANO BUBBLE TECHNOLOGY

For Proven Benefits.

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