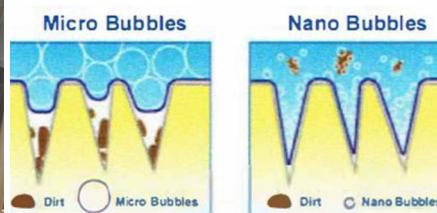
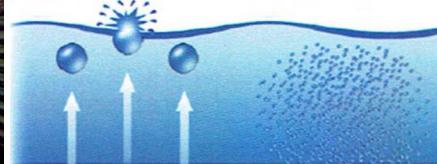




# Vortex UFB unit

The Vortex UFB unit has been designed to release ultra-fine oxygen bubbles into a storage tank and other forms of water holding systems. The unit consists of a pump, filter, check valve, venturi, pre-mixer, cone-vortex combination, in-line Dissolved Oxygen (DO) sensor, pressure sensor, oxygen concentrator and a control box. This all mounted on a frame.



The Vortex unit scrubs the air for oxygen. Through the patent-pending vortex technology it applies force to the oxygen, pulverizing the O<sub>2</sub> into the irrigation water, and creating Nano Bubbles. By doing this the O<sub>2</sub> stays in suspension even when going through several process of an irrigation system.

## WHAT ARE NANO-BUBBLES?

Nano bubbles are tiny spherical cap-shaped bubbles with diameters less than 100 nm that have the ability to change the normal characteristics of water. They have several unique physical and mechanical features, including stability, high internal pressure, extremely large surface/volume ratio, high oxygen dissolution rate, and generation of free radicals. The peculiar attributes of nanobubbles has led to their wide application and utilization in various agricultural applications which are proven to be with high economic potential.

## THE SCIENCE BEHIND NANO BUBBLES

An ordinary bubble (1 mm diameter) will quickly rise to the waters surface and collapse. Based on the Brownian Motion Particle Theory, nano bubbles will randomly drift and remain in liquids for an extended period of time without being affected by buoyancy.

Nano Bubbles produce Reactive Oxygen Species (ROS). These oxygen radicals and hydroxyl radicals help to eliminate hard to kill pathogens.

At 1-billionth of a meter, nano bubbles can delve deep into surface imperfections that even micrometer size bubbles cannot reach. Nano bubbles dig out and remove dirt and odors, leaving a clean surface behind.

## THE VORTEX UNIT:

- Nano Bubbles help organisms absorb oxygen and become more active.
- Oxygen Nano Bubbles promote the growth of micro-organisms and expedite the breakdown of organic matter.
- By improving the efficiencies of water treatment growers can increase the nutrient uptake in plants, see improved plant health and root quality, and reduced chemical usage.



Untreated RO water

 Treated with O<sub>2</sub> nano bubbles 48 hours ago

## OXYGENATION OF IRRIGATION WATER WITH NANOBUBBLES

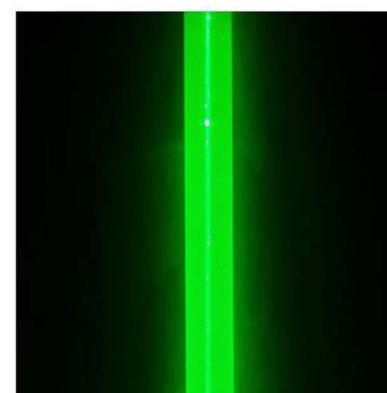
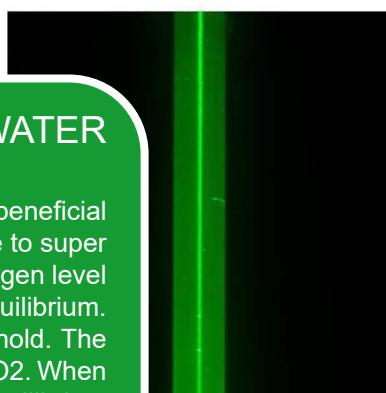
A high oxygen level in the irrigation water is very beneficial for the plants if it reaches the rootzone. It is possible to super saturate the water with oxygen gas up to 300%. Oxygen level and temperature of the water have a certain equilibrium. The colder the water the more oxygen (O<sub>2</sub>) it can hold. The equilibrium level for water of 20 C (68 F) is 9 mg/liter O<sub>2</sub>. When the O<sub>2</sub> concentration in the water is lower than the equilibrium level and it is exposed to air it will take O<sub>2</sub> however if the O<sub>2</sub> concentration is higher than the equilibrium level it will lose O<sub>2</sub>. Through the movement of the irrigation water in pumps, tanks, pipes and sprinklers the O<sub>2</sub> above the equilibrium level will be lost before it reaches the root zone.

### NANOBUBBLES

Nanobubbles are bubbles one billion times smaller than a meter. They are so small you cannot see them with the naked eye only with laser equipment. Nanobubbles are produced with special generators. A nanobubble has a negative zeta potential and the pressure inside the bubble is high. Normal gas bubbles will rise to the surface and collapse. Nanobubbles will not rise to the surface and will be suspended in the water for a long time and will be getting smaller over time and release there O<sub>2</sub> mostly in the water. Also, movement of the water will not nearly effect O<sub>2</sub> in nanobubbles as O<sub>2</sub> gas dissolved in water.

### NANOBUBBLES IN IRRIGATION

With a nanobubble generator in combination with a O<sub>2</sub> concentrator it is possible to super saturate the irrigation water to > 250% O<sub>2</sub> and keep that concentration stable for a long time because the O<sub>2</sub> nanobubbles will dissolve slowly in the irrigation water what gives a constant production of Reactive Oxygen Radicals (ROS). It will reach the root zone of the plants at a level between 150 and 200% saturation.



### MAIN ADVANTAGES OF O<sub>2</sub> NANOBUBBLES:

- Stable enhancement of Dissolved Oxygen (DO)
- Bubbles have a negative charge and promote cation-exchange
- Bubbles become a substrate (the water becomes an aerated foam)
- Free radicals increase metabolism
- Cell membrane permeability of larger molecules
- Fights disease through exclusion (healthier plants) instead of disinfection

