**Ultrafine Bubble Agriculture**

ISO 20480-1:2017 Bubble size definition

- Microbubbles: Greater than 1 and Less than 100 μm
- Fine bubble: Less than 100 μm
- Ultrafine bubbles: Less than 1 μm, normally between 100 and 200 nm
- Nanobubble is old term for Ultrafine bubbles

www.vestflow.no
Ultrafine Bubbles

Ultrafine bubbles are nano-size bubbles that display unique properties in water.

- 100nm = 2000x surface area of microbubbles
- No Buoyancy near perfect gas transfer
- Can remain suspended in water for months
- Increases water’s gas holding capacity
- Excellent mixing aerates entire water column
- Maximum utilization potential of every mole of oxygen

PPO2 values (1,053.3 mmHg) in water containing UFBs of 0.5m, were approximately 38.6% higher than the theoretical maximum volume of oxygen saturation (760 mmHg) with microbubbles.

Figure 3: Potency of oxygen partial pressure increase in ultrapure water by oxygen macrobubbles or oxygen fine micro/nanobubbles.
Product Overview

**FEATURES**
- Available in 6, 12 and 36 m³/h
- 90% Oxygen
- ~1 billion nanobubbles per ml
- Available with or without pump
- Plug and play installation
- Quiet operation

**APPLICATIONS**
- Tank Oxygenation
- Easy Integration
- Phatogen Suppression
- Algae Prevention
- Supersaturation

**Key advantages:**
- Tank oxygenation
- Water quality improvement
- Evenly oxygenates the entire water column
- Highest oxygen utilization when compared to all alternatives
- Stable dissolved oxygen levels
- Increased nutrition absorption
- Superior water quality and disease prevention
- Biofilm control
- Increased plant growth rate
- Increased storage time
Nanobubbles, (200 nm in diameter) have several unique properties such as long lifetime in liquid owing to its negatively charged surface, and its high gas solubility into the liquid owing to its high internal pressure. They are used in variety of fields including diagnostic aids and drug delivery, while there are no reports assessing their effects on the growth of lives. Nanobubbles of air or oxygen gas were generated using a nanobubble aerator (BUVITAS; Ligarc Company Limited, Osaka, Japan). Brassica campestris were cultured hydroponically for 4 weeks within air-nanobubble water or within normal water. Oxygen-nanobubble significantly increased the dissolved oxygen concentration of water as well as concentration/size of nanobubbles which were relatively stable for 70 days. Air-nanobubble water significantly promoted the height (19.1 vs. 16.7 cm; P,0.05), length of leaves (24.4 vs. 22.4 cm; P,0.01), and aerial fresh weight (27.3 vs. 20.3 g; P,0.01) of Brassica campestris compared to normal water.

✓ Producers of the highest liquid flow, highest nanobubble concentrations, most scalable nanobubble technology systems on the market to date.

✓ Commercially proven with over 450 installations, in >20 different countries.