

NANOBUBBLES; TINY BUBBLES, BIG IMPACT

25 Years of Excellence in Sustainable Solutions

Nanobubbles for clean water and
good plant health

Marco van Schaik



AQUAOX'S VISION

Sustainable Water Treatment & Disinfection Solutions

INNOVATION:

Investing in cutting-edge technology for efficiency and scalability.



ECOLOGICAL RESPONSIBILITY:

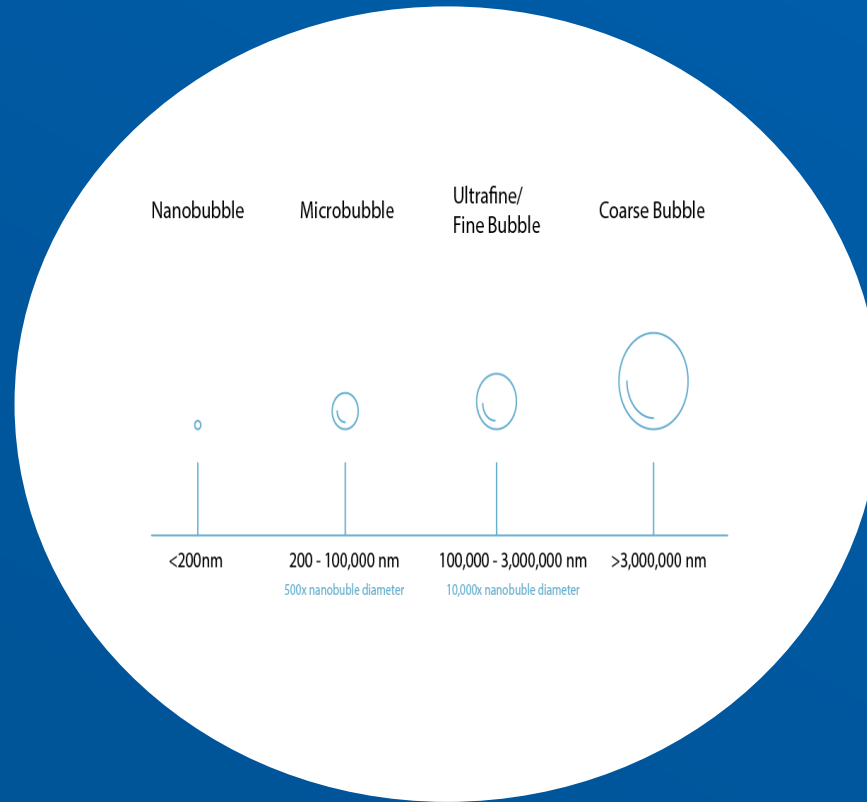
Prioritizing sustainability through responsible water management.

USER FRIENDLY TECHNOLOGY:

Ensuring accessibility and easy operation of systems.

WHAT ARE NANOBUBBLES?

The Key to Safer and More Efficient Water Treatment

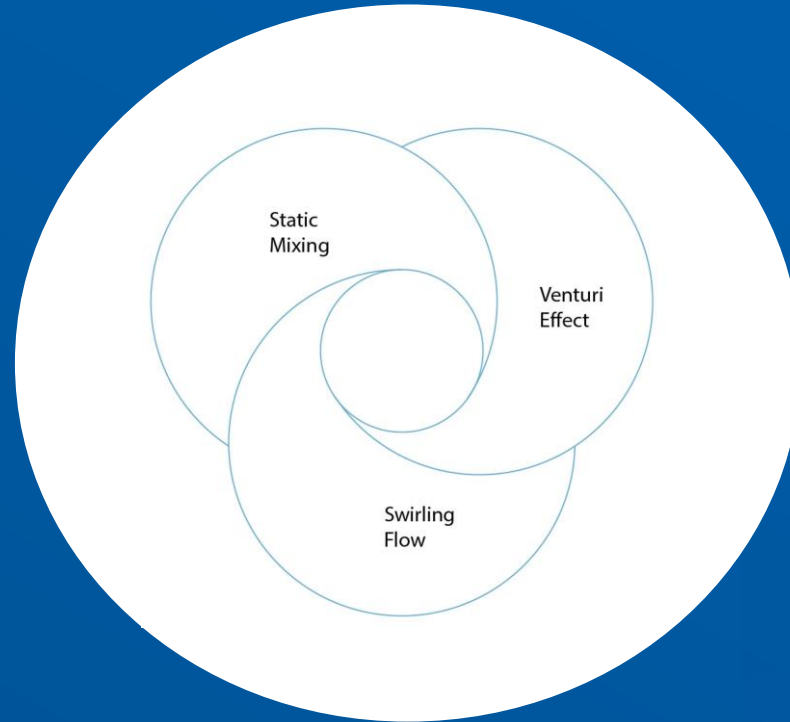


HOW ARE NANOBUBBLES PRODUCED?

The Key to Safer and More Efficient Water Treatment

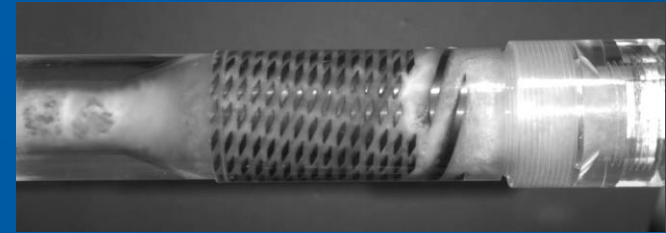
1) Combination of :

- Static Mixing
- Venturi effect
- Swirling flow



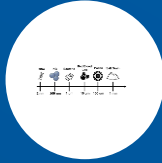
2) Other methods

- Membrane
- Electrolysis

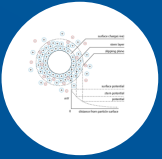


CHARACTERISTICS OF NANOUBUBBLES

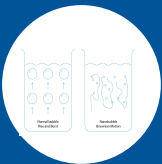
A Safer, Greener Alternative



SIZE



SURFACE CHARGE



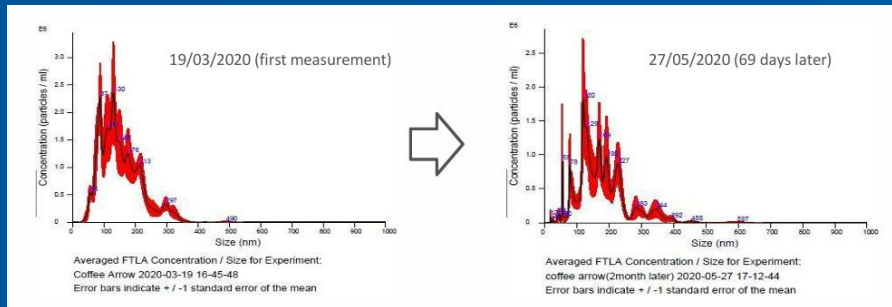
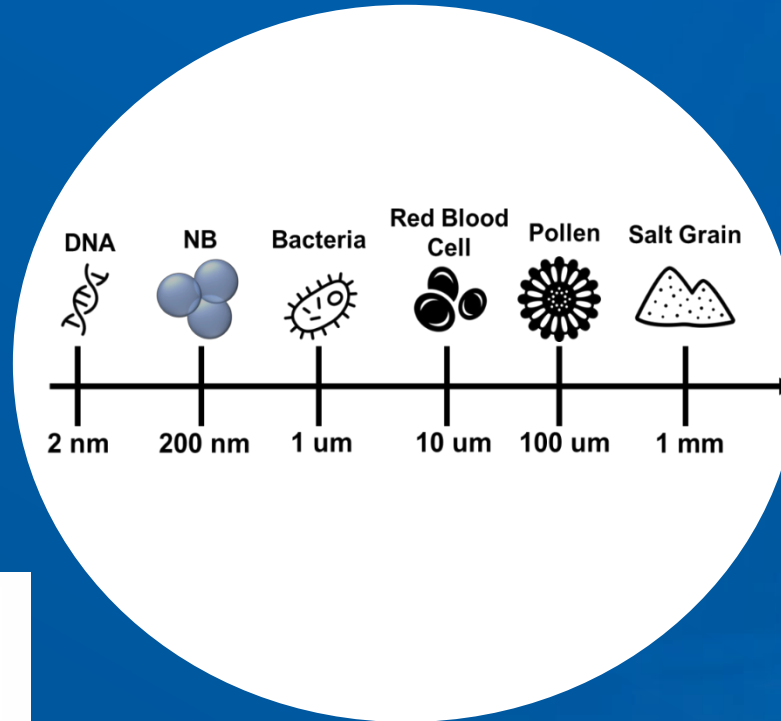
NEUTRALLY BUOYANT



INCREASE SURFACE AREA

CHARACTERISTICS OF NANOBUBBLES

- SIZE
 - < 200NM CALLED NANOBUBBLE
 - +/- 2500 TIME < SALT GRAIN
 - AVERAGE SIZE PRODUCED 75-150NM

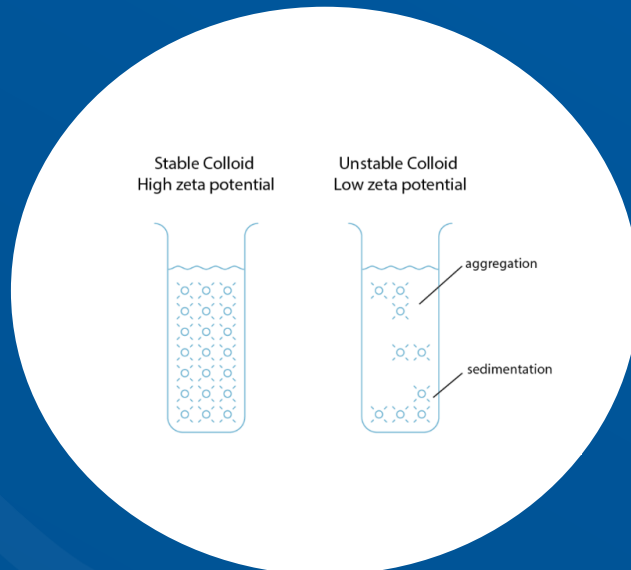
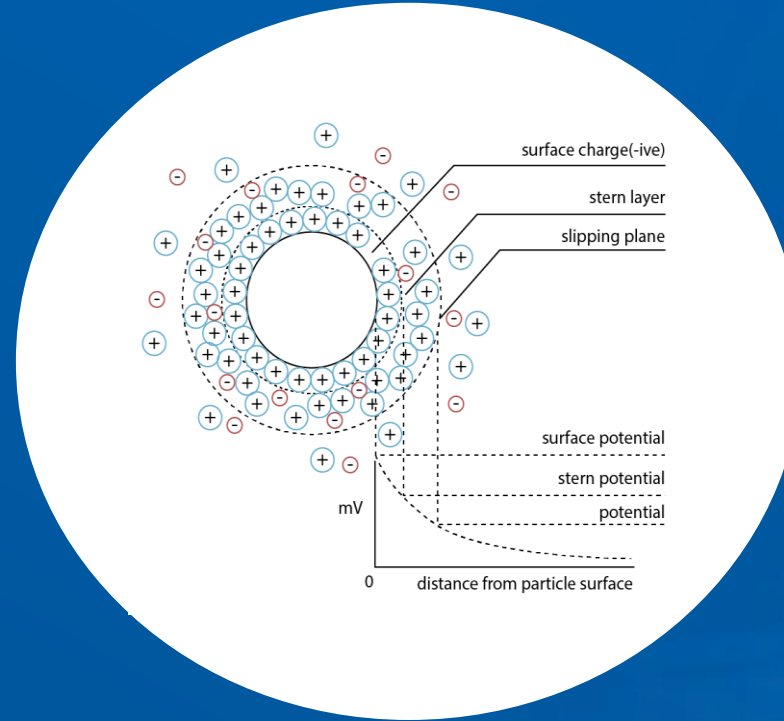


CHARACTERISTICS OF NANOBUBBLES

- SURFACE CHARGE

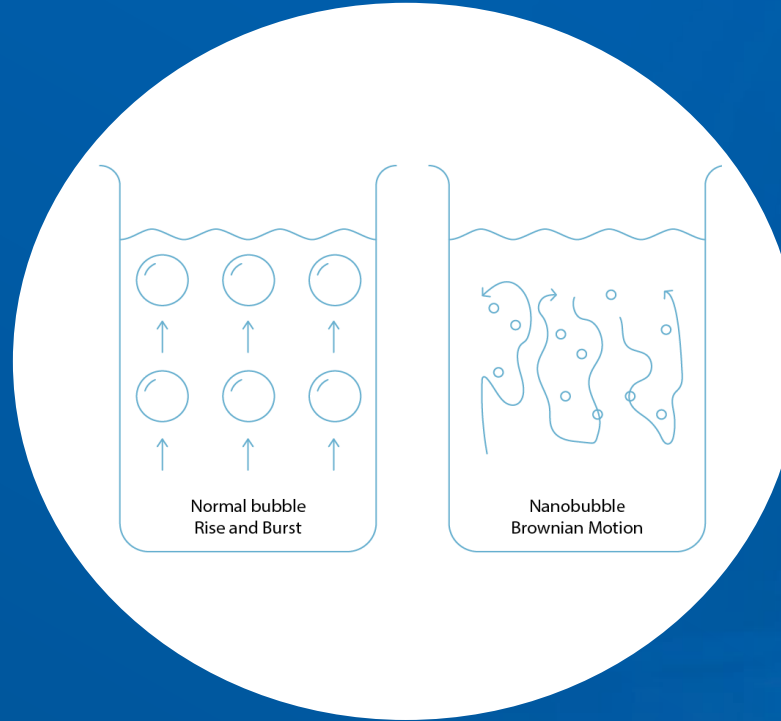
- STRONG NEGATIVE SURFACE CHARGE
 - IMPACT ON BIOFILM FORMATION
 - INCREASE STABILITY OF NANOBUBBLES IN SOLUTION

- ZETA POTENTIAL



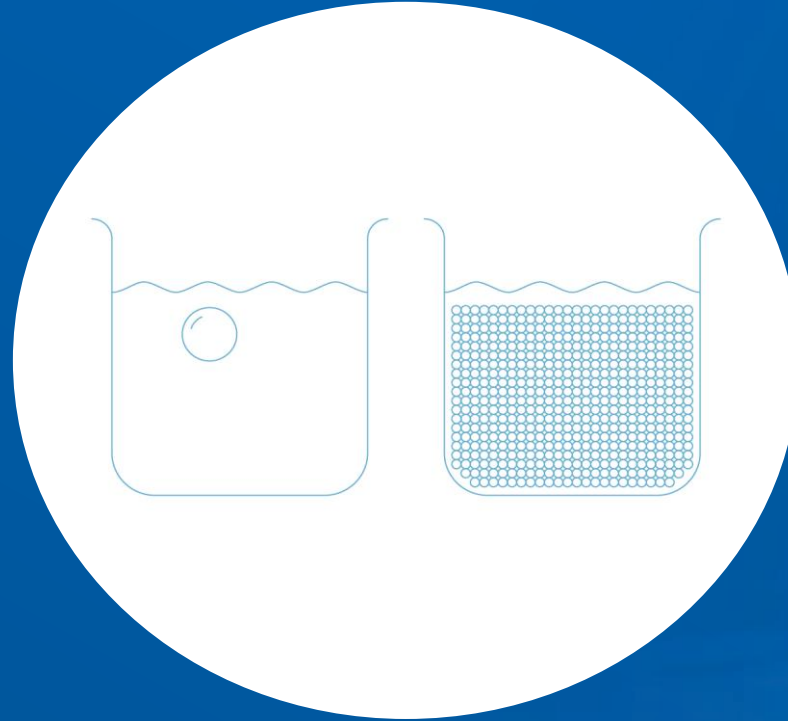
CHARACTERISTICS OF NANOBUBBLES

- NEUTRALY BOUYANT
 - NANOBUBBLE CAN REMAIN IN LIQUIDS FOR WEEKS.
- BROWNIAN MOTION
 - RANDOM, ERRATIC MOVEMENT OF TINY PARTICLES (LIKE MOLECULES OR NANOBUBBLES) SUSPENDED IN A FLUID.



CHARACTERISTICS OF NANOBUBBLES

- INCREASED SURFACE AREA
 - IMPROVED OXYGEN SUPPLY
 - SCOURING
 - OXIDATION
 - ENHANCES THE EFFICIENCY OF SUPPLIED GAS (E.G O₂, Co₂,N)



One ml of 100 nm diameter nanobubbles has 1000 times more surface area than one ml of 0.1 mm diameter bubbles

BENEFITS OF NANOBUBBLES IN HORTICULTURE

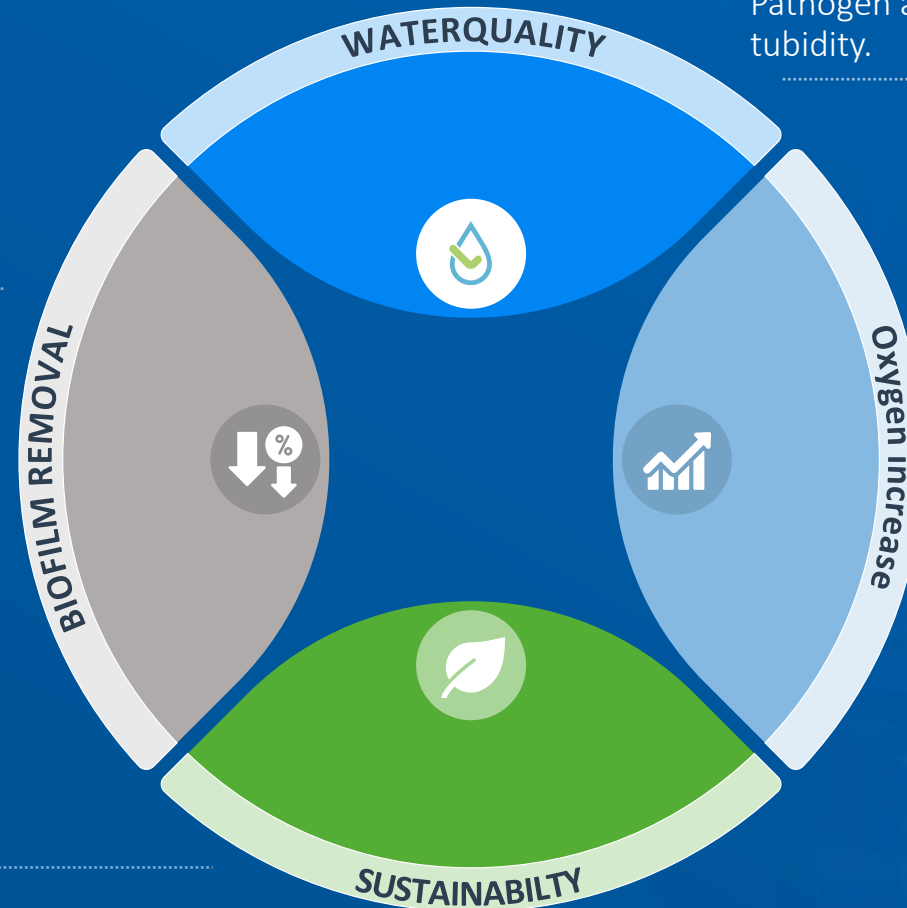
A Brighter Future for Water Treatment

EFFICACY ON BIOFILM

Effective on biofilm, reducing harmful pathogens and algae

SUSTAINABLE AND COST EFFECTIVE

Reduced quantity of traditional chemicals, healthier crop -> increased growth



WATER QUALITY IMPROVEMENT

Pathogen and algae removal, improved sediment removal, lowered turbidity.

Oxygen increase

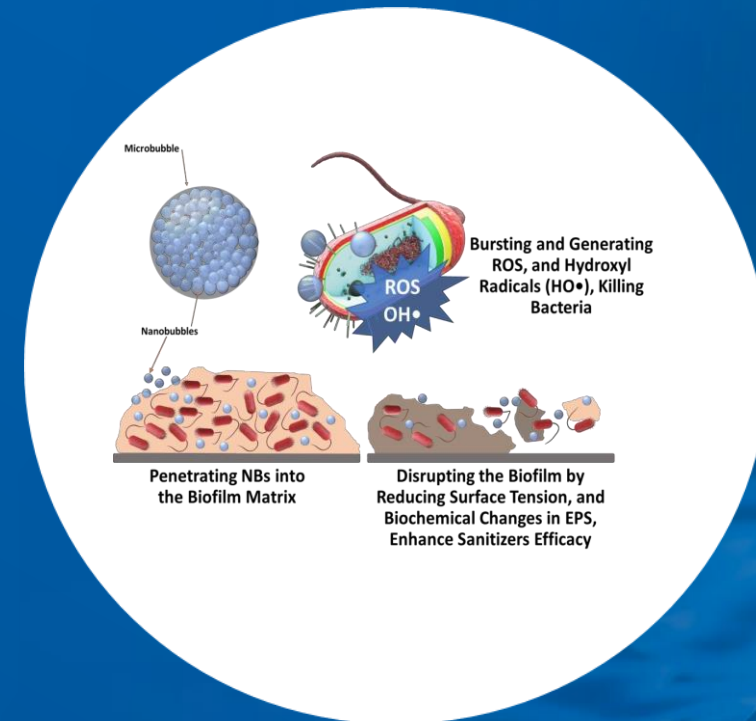
Elevated oxygen levels promote better root development and nutrient absorption, fostering healthier plant growth

BENEFITS OF NANOBUBBLES

A Brighter Future for Water Treatment

EFFICACY ON BIOFILM

- **High Oxidative Potential**
ROS are highly reactive and can break down the biofilm matrix
- **Physical Disruption**
Generate microcurrents or localized turbulence when they collapse
- **Penetration into Biofilms**
Nanobubbles can penetrate the biofilm
- **Enhanced Cleaning and Disinfection**
Nanobubbles improve the efficacy of cleaning agents by disrupting the biofilm structure



BENEFITS OF NANOBUBBLES

A Brighter Future for Water Treatment

OXYGEN INCREASE

- **Enhanced Root Respiration**

Increased supply of dissolved oxygen improves root respiration, helping roots function more effectively.

- **Reduced Anaerobic Conditions**

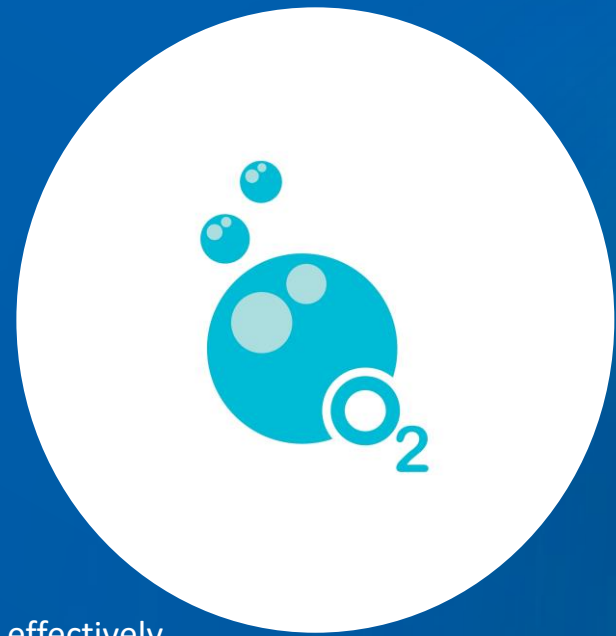
High oxygen levels prevent anaerobic conditions, keeping the root zone healthy

- **Improved Nutrient Uptake**

Oxygen-rich environments promote the activity of beneficial microorganisms in the root zone

- **Stronger and Longer Roots**

Oxygen stimulates root growth and branching, resulting in a larger root system



BENEFITS OF NANOBUBBLES

A Brighter Future for Water Treatment

WATER QUALITY IMPROVEMENT

- Pathogen and algae removal
Removal of algae and pathogen via Scouring, Oxynation
- Improved sediment removal
Nanobubbles promote aggregation of fine particles, easier to filter
- Lowered turbidity
Lowered oxygen consumption, reduced risk of pathogens



BENEFITS OF NANOBUBBLES

A Brighter Future for Water Treatment

SUSTAINABLE AND COST EFFECTIVE

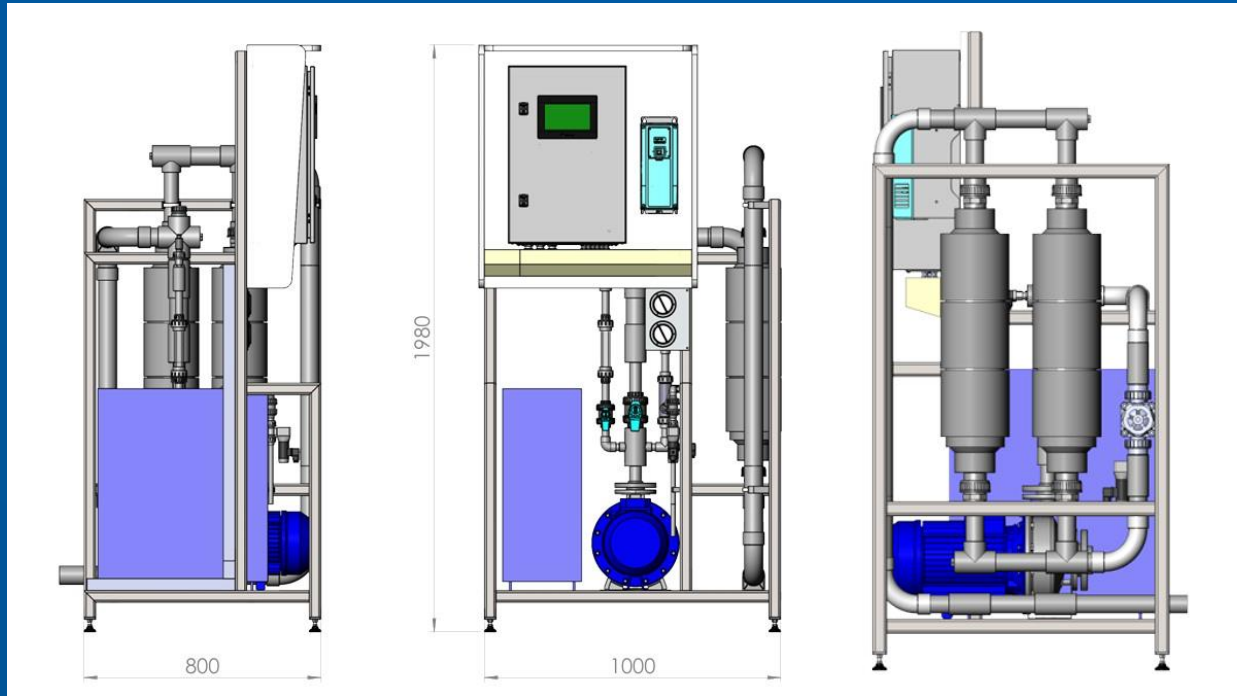
Reduced quantity of traditional chemicals
healthier crop -> increased growth

Non toxic treatment of water
Safe, no residues and or byproducts



AQUAOX NANOBUBBLES GENERATOR

EXAMPLE OF INSTALLATION



AQUAOX NANOBUBBLES GENERATOR

SOME EXAMPLES OF INSTALLATION



Casa Grandes Potplants and Flowers
Mexico



Luijck Hydroponics Salad
Breda, Netherlands



Sunnyside Surrey &
Delta, peppers, 2
systems +/- 10 ha, BC,
Canada

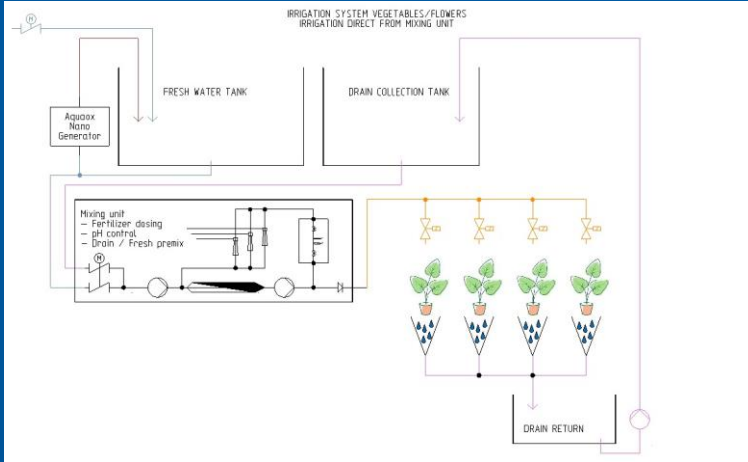


Minnaard Apples
Dronten , Netherlands

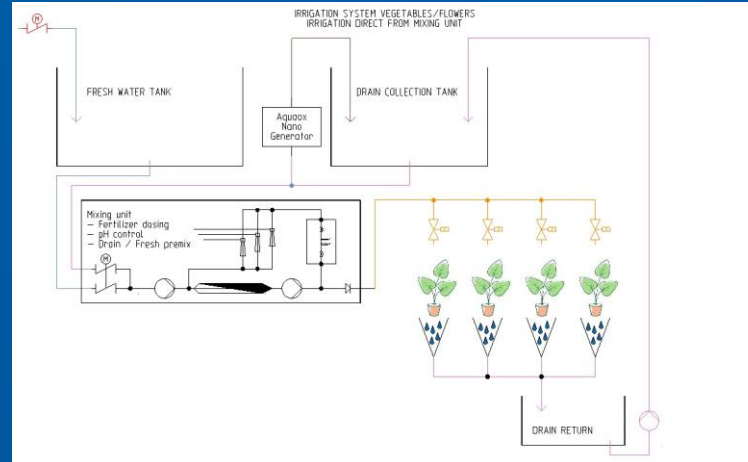
Over 25 succesfull horti/agricultural installations in USA,Canada, Mexico, Europe

AQUAOX NANOBUBBLES GENERATOR

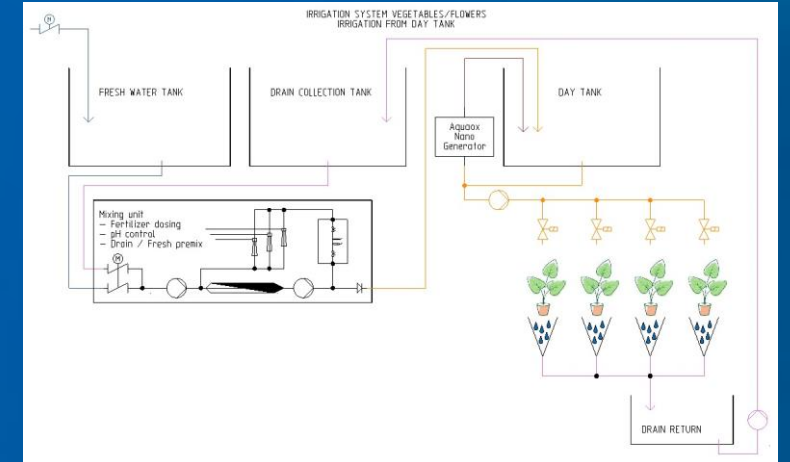
OVERVIEW OF TYPICAL INSTALLATION



Configuration A: Suitable for cultivation with high amount of fresh water water (e.g. >50%)

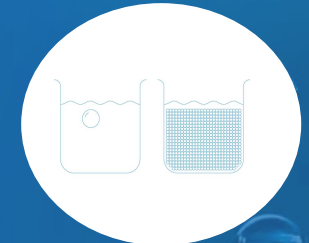
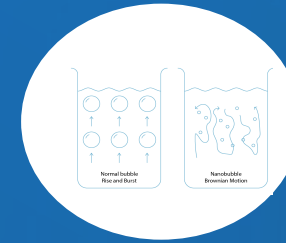
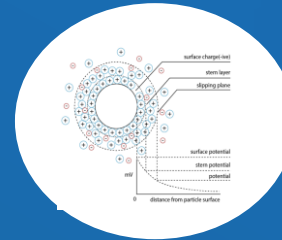
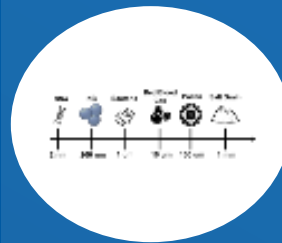
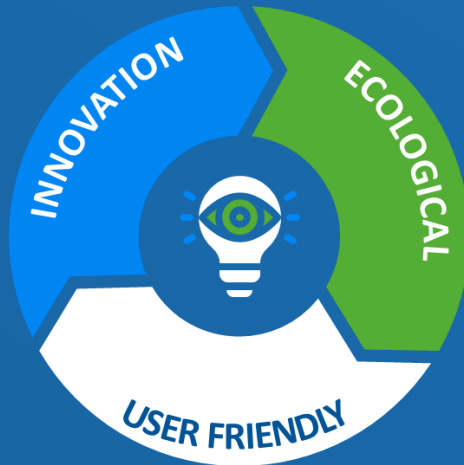


Configuration B: Suitable for cultivation with high amount of return/drain water (70-100%) e.g ebb-flood floor/table, salad-cultivation on floats or tables.



Configuration C: If Day tank is used

SHAPING THE FUTURE OF WATER TREATMENT



Over 25
succesfull
installations
in USA,
Canada,
Netherlands,

Different type
of installation
possible
depending on
local situation



ANY
QUESTIONS?

DISINFECTION REDEFINED

25 Years of Excellence in Sustainable Solutions

Thank you for your
presence and attention!



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