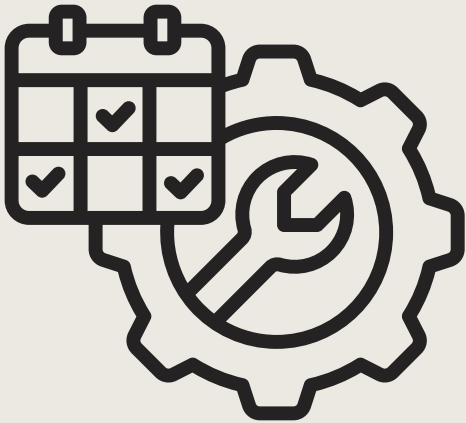




CRS
CHEMICAL REDUCTION SOLUTIONS

Nanobubble **water conditioning** for Industrial Reverse Osmosis Machines.

More Throughput. Less Fouling. Lower Operating Costs



RO Feed Water Is Working Against You

Mineral scaling, particulate fouling, and unstable water chemistry limit RO performance and accelerate membrane degradation

The result: reduced permeate output, inconsistent spot-free quality, increased chemical cleaning, shorter membrane life, and unplanned maintenance—all of which constrain throughput and drive up operating costs



CRS Solution

CRS installs a patent-pending, nanobubble generator inline before the pre-filter. Using hydrodynamic cavitation, the system continuously conditions water before it reaches RO membranes

Key Benefits



- Improves pretreatment effectiveness
- Increases permeate quality and stability
- Reduces scaling and membrane fouling
- Extends membrane and equipment life
- Increases system uptime and reliability
- Reduces biological fouling

Why CRS is Different

- No pressure drop
- Independent of system flow
- Continuous conditioning via recirculation loop
- No consumables or ongoing inputs

Connect with CRS
www.chemicalreduction.com

BETTER WATER. BETTER EQUIPMENT. BETTER ECONOMICS.



CRS

CHEMICAL REDUCTION SOLUTIONS

WHAT IS A NANOBUBBLE?



Tiny. Stable. Game Changing.

2500 times smaller than a grain of sand, nanobubbles are so small that they have a lower buoyancy and will remain suspended in water for a long time

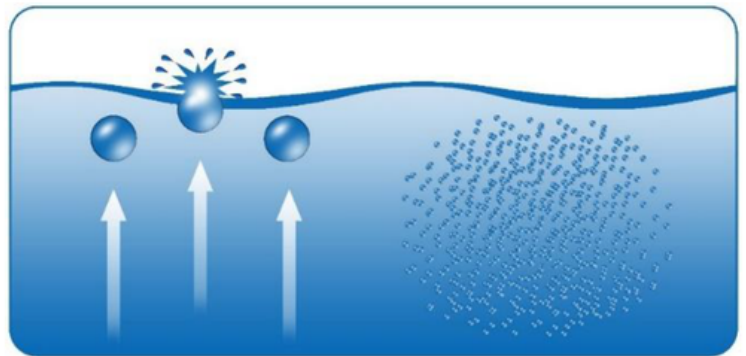


Improves RO Performance

- Stabilizes membrane flux
- Reduces rate of differential pressure increase
- Extends cleaning intervals
- Improves pretreatment efficiency
- Reduces fouling across system

Engineered for RO Performance

CRS is on a mission to use economical and simple nanobubble generators to improve profitability and reliability of water systems



nanobubbles remain suspended in water

575+

CRS SYSTEMS
DEPLOYED IN 2025

15+ years

OF EXPERIENCE

500+ million

GALLONS OF WATER
TREATED BY CRS PER MONTH



Connect with CRS

www.chemicalreduction.com

BETTER WATER. BETTER EQUIPMENT. BETTER ECONOMICS.



CRS

CHEMICAL REDUCTION SOLUTIONS

HOW DO NANOBUBBLES INHIBIT SCALE AND BIOFILM?



Preventing Scale Nucleation

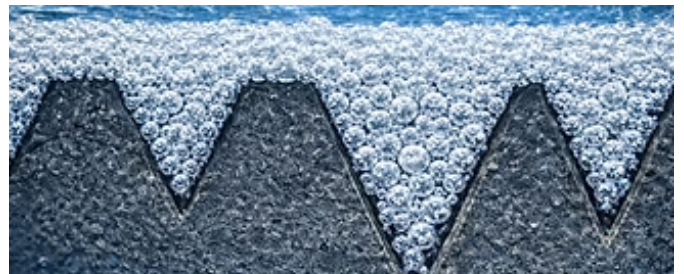
Nanobubbles inhibit scale by disrupting nucleation, keeping minerals dispersed, and preventing crystal adhesion to surfaces



Reduces Biological Fouling

Nanobubbles carry a negative surface charge (zeta potential), which can increase electrostatic repulsion between bacteria and surfaces, making initial attachment more difficult

Engineered for RO Performance



Due to their small size and surface charge, nanobubbles penetrate microscopic surface features and improve water-surface interaction. This enhanced contact helps lift and disperse deposits, particles, and biofilm, allowing them to be removed by normal system flow. The result is cleaner surfaces, improved system efficiency, and reduced fouling over time

575+

CRS SYSTEMS
DEPLOYED IN 2025

15+ years

OF EXPERIENCE

500+ million

GALLONS OF WATER
TREATED BY CRS PER MONTH



Connect with CRS

www.chemicalreduction.com

BETTER WATER. BETTER EQUIPMENT. BETTER ECONOMICS.



CRS

CHEMICAL REDUCTION SOLUTIONS



HOW ARE NANO BUBBLES FORMED?



Hydrodynamic Cavitation

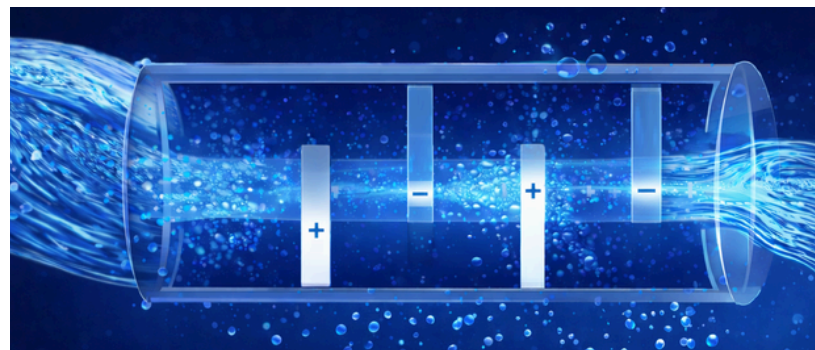
As water flows through the device, the internal geometry creates localized pressure differentials and high shear zones. Under appropriate flow conditions, these effects induce controlled hydrodynamic cavitation



Ionization of Entrained Gas

Nanobubbles are formed under more lenient flow conditions when the gases that are entrained in water are ionized or charged by the CRS proprietary metal alloy baffles

Hydrodynamic cavitation **plus** entrained gas ionization



Hydrodynamic cavitation is a well-documented physical phenomenon in which microscopic vapor- or gas-filled cavities form and collapse due to transient pressure reductions in a moving liquid. In CRS equipment, this process also results in the formation of stable micro- and nanobubbles

575+

CRS SYSTEMS
DEPLOYED IN 2025

15+ years

OF EXPERIENCE

500+ million

GALLONS OF WATER
TREATED BY THE SHAFT PER
MONTH



Connect with CRS

www.chemicalreduction.com

BETTER WATER. BETTER EQUIPMENT. BETTER ECONOMICS.

CRS NANOBUBBLE GENERATOR

Industrial Reverse Osmosis Pre-Treatment



CRS
CHEMICAL REDUCTION SOLUTIONS

TECH ADVANCE

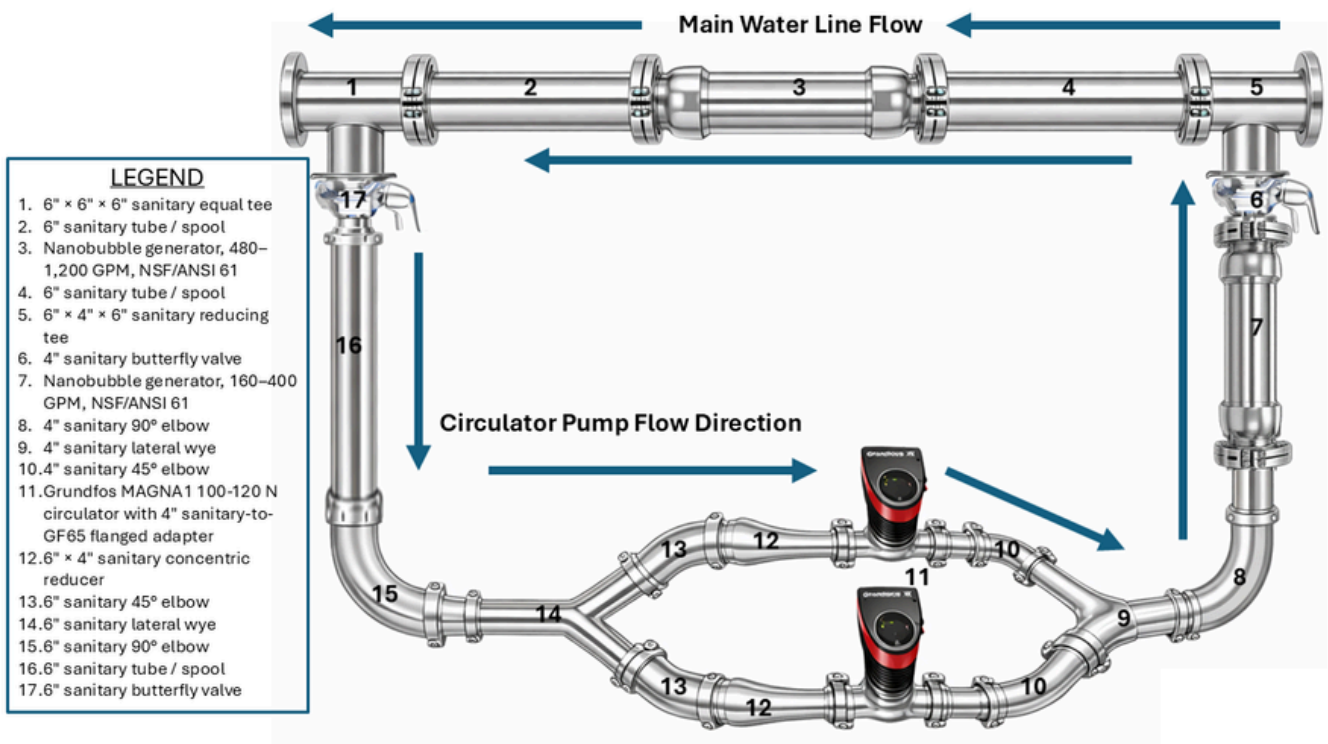
- CRS overcomes the limitations of hydrodynamic cavitation in high-flow, pressure-sensitive RO systems with a patent-pending design
- Systems do not require a minimum flow rate and can be designed with zero pressure drop

DESIGNED FOR INDUSTRIAL INTEGRATION



Scale and Biofilm Mitigation

Infusing RO feedwater with nanobubbles aids inhibiting scale and biofilm formation



TECH NOTES (FOR SERVICE MANAGERS)

- No impact on RO system pressure
- Fully compatible with existing pretreatment systems
- Simple operation with continuous circulation

INSTALLATION NOTES

Placement: Installed upstream of all pretreatment systems, including multimedia filters, cartridge filters, and carbon vessels

Operation: A dedicated recirculation loop ensures consistent nanobubble generation independent of system flow

Materials: Available with NSF/ANSI 61 and 372 compliant wetted components



BETTER WATER. BETTER EQUIPMENT. BETTER ECONOMICS.