

Nanobubbles

Tiny Fighters of Your Biggest Cost and Energy Wasters

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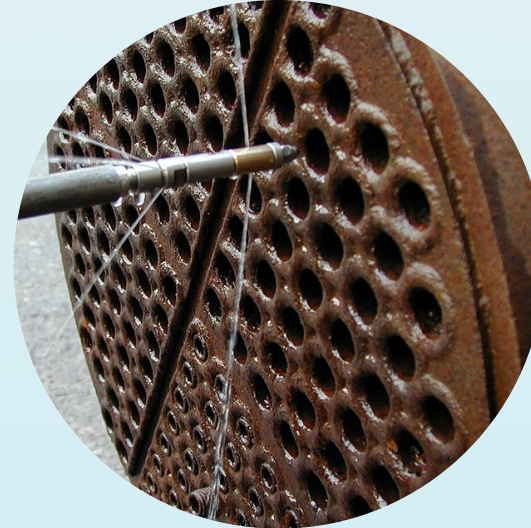
Who is Rapid Water Technologies?

- + Developer of industry-leading Nanobubble Generators since 2015
- + Engineer and manufacturer of Nanobubble Systems
- + Headquartered in Grand Rapids, MI



Where can Nanobubbles improve water use in your facilities?

- + Domestic Hot Water
- + Hot Water Heating
- + Chilled Water
- + Cooling Towers
- + Washdown & Cleaning
- + Process Water



What can Nanobubbles Do?

Nanobubbles improve your...



Water Use

- + Reduced water consumption
- + Improved chemical efficacy
- + Decreased chemical use



Processes

- + Less maintenance
- + Decreased downtime
- + Improved heat transfer

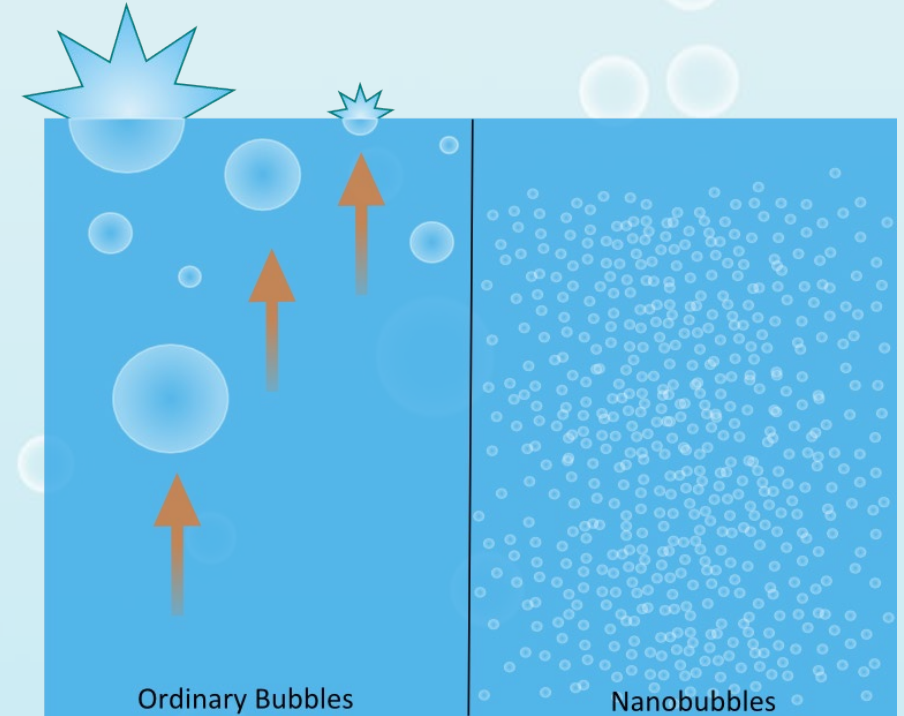


Bottom Line

- + Energy savings
- + Chemical savings
- + Labor savings

What are Nanobubbles?

- + Ordinary bubbles are larger and float out of suspension
- + Nanobubbles are microcavities that are less than 600 nm in diameter – 2500 times smaller than a grain of salt!
- + Because of their size, Nanobubbles:
 - + Experience Brownian motion and stay in solution indefinitely
 - + Excellent distribution of nanobubbles through entire water column
 - + Are negatively charged
 - + Significantly increase surface area and surface tension
- + **These properties allow Nanobubbles to naturally remove biofilm and other deposits and prevent future buildup**



Do these problems look familiar?

- + Equipment Fouling
- + Loss of Energy Efficiency
- + High Chemical Costs
- + Maintenance Calls/Complaints
- + Odor in Standing Water

What do they all have in common?

Biofilm and other deposits plague systems where water is used. Nanobubbles can remove and prevent it.



Nanobubble Technology is the Answer to these problems

- + Improved heat transfer
- + Lower energy costs
- + Reduced CIPs frequency
- + Extended equipment life and lower maintenance costs
- + More efficient chemical use

AND it's a simpler, more elegant solution



BEFORE Nanobubble Treatment



AFTER Nanobubble Treatment

Effects of Biofilm on Heat Transfer in Heat Exchangers

Biofilm Thickness		Percent of Reduction in Heat Transfer		
Micron	(mm)	Carbon Steel Tubes	Stainless Steel Tubes	Copper Tubes
1	.001	2.79	4.34	29.46
2	.002	5.42	8.31	45.45
3	.003	7.92	11.97	55.56
4	.004	10.29	15.35	62.50
5	.005	12.54	18.48	67.57
6	.006	14.68	21.38	71.43

Removing biofilm will result in energy savings



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*Work in collaboration with
universities and research
foundations to validate and
advance Nanobubble Technology*

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How does Rapid Water Technologies Create Nanobubbles?

- + Water flows through a series of precisely designed chambers that create vortices and pressure drops, creating Nanobubbles from gases in solution.
- + The RWT Nanobubble Generator can be installed sidestream or inline with no moving parts or required maintenance
- + No additional gas input, electrical or chemicals





Case Study: Process Cooling

- + **\$180,000+ annual savings** in cleaning and chemical costs
- + Plus:
 - + Reduced downtime (less overheating of water baths)
 - + Cleaner production lines
 - + Extended equipment life
 - + Increased quality and higher production volume
 - + Reduced scaling
 - + Energy savings

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Case Study: Heat Exchanger

- + Tube bundles stayed clean since installation instead of fouling within 10 days
- + Softer water with reduced calcium
- + **\$17,000 annual savings** in cleaning costs for ONE piece of equipment



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The bundle would plug to the point of failure if we didn't clean it every 10 days or so. Whenever we pulled the head off for cleaning, the diameter of the tubes would be [down to] 3/8" or less [versus new at 3/4"].



Case Study: Open Loop Cooling Water

- + 15° F (ΔT) performance improvement in condenser water temperature
- + Visible deposits began breaking up in 24 hrs
- + Fewer equipment breakdowns
- + More consistent water chemistry

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Where could your facility benefit from Nanobubble Technology?

- + Cooling Towers
- + Domestic Hot and Cold Water
- + Process Water



System Benefits

- + Energy savings
- + Reduced equipment maintenance
- + System longevity
- + Less downtime
- + Sustainable and reduces chemical use

Bottom Line: Saves Time and Money!

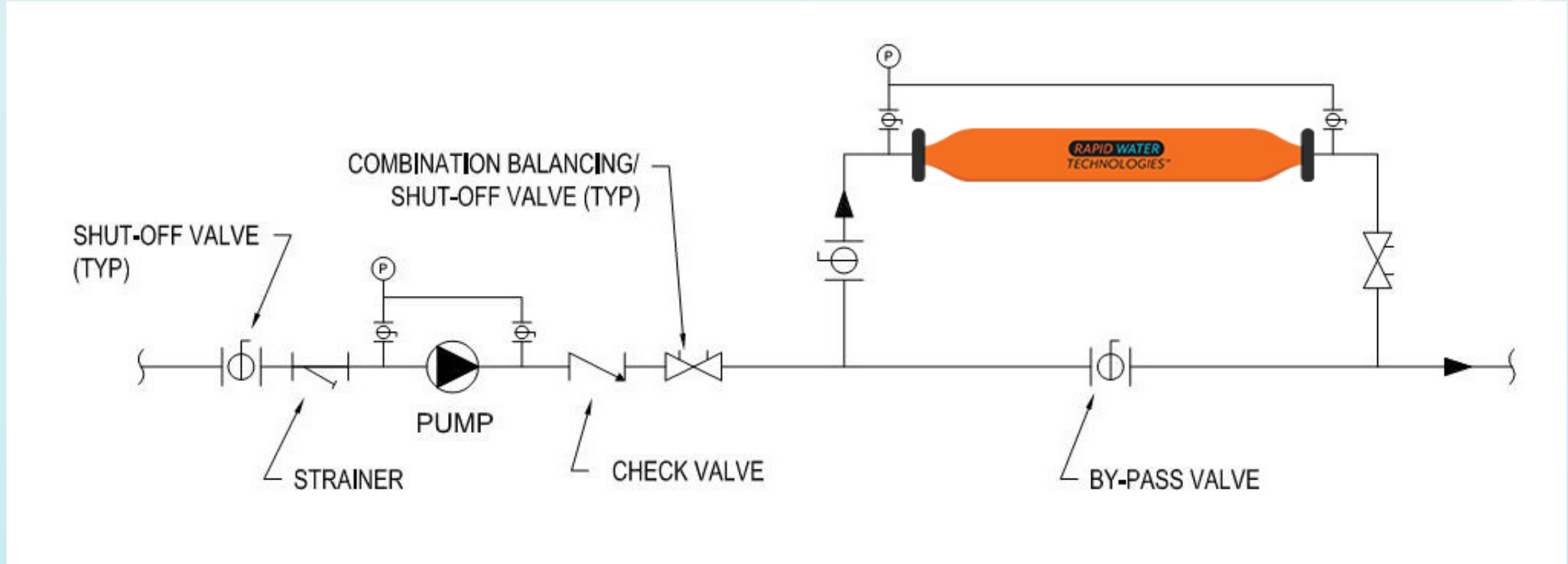


Before Nanobubble Treatment



After Nanobubble Treatment

Standard Installation



Questions?

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