# Nalco Stays Cool Against the Heat of Biofouling

## High-Speed Protection Against Biofouling Starts with High-Speed Powder Injection

As the economy recovers and business heats-up, cooling towers across the country will remain a prime target for cutting costs and improving efficiency. Facility managers and plant engineers in commercial and industrial facilities captured a welcomed savings during the recession with automated systems that manage cooling water quality. Designed to monitor bioactivity and water chemistry, these systems automatically detect imbalances and respond to prevent biofouling, scaling and corrosion. Looking forward in a business environment that allows companies to see beyond the P&L, these systems will be considered indispensable not just for the cost-savings they deliver, but also for their ability to conserve precious resources.

The dye container rests on a scale, which enables the operator to monitor powder injection and prepare an accurate solution. The injection cycle in this application typically requires about eight minutes.

In a recent collaboration, industry leader Nalco teamed with Dow and demonstrated what an optimized cooling water system can really accomplish. At Dow's Freeport, Texas, production site, Nalco 3D TRASAR® technology was applied to 80 process and comfort cooling towers. By optimizing cooling water monitoring and management, the overall system generated an annual $4 million savings by reducing maintenance costs, energy consumption, water use and greenhouse gas emissions. In fact, the system in this plant saves one billion gallons of water annually — enough to supply nearly 40,000 people in the U.S. for one year.

### Fast Detection, Decisive Action

"Success in cooling water management requires sensitivity and speed," says Y Fred Lu, 3D TRASAR brand manager. "The system must detect increased bioactivity or unbalanced chemistry quickly, and take decisive action immediately to restore optimal conditions."

The prevention of biofouling is especially challenging, and fast intervention is vital. Once a biofilm has formed, it quickly degrades heat transfer. Acids secreted by the bacteria can cause microbiologically influenced corrosion (MIC). The bacteria can also promote the formation of scales such as calcium carbonate.

The stainless steel wand is equipped with a stand-off that prevents suction against the sides of the bulk container and helps to break up clumps of solid material.

As a biofilm becomes well-established, it also becomes extremely resistant to biocides. Bacterial colonies are well protected in their shell of exopolysaccharide (EPS). In fact, bacteria beneath an EPS shield are up to 1,000 times more resistant to biocides than when they are in a free-swimming, planktonic state.

"The bottom line in biofouling," says Lu, "is that the best strategy is to move fast, kill microbes before they can form a biofilm, or at least destroy the biofilm while it is still in a nascent stage and highly vulnerable to the microbicide."

The Nalco 3D TRASAR system detects bioactivity by injecting the cooling water with a bioreactive dye, which the company calls a BioReporter™.

"The BioReporter dye is a deep blue until it is exposed to the enzyme released during microbial respiration," says Nalco scientist Mita Chattoraj, a co-inventor

As seen in Processing September 2010


In this application of SLIM powder injection technology, a wand is used to minimize "dusting." The powder is drawn from within the bulk container, through the wand and flexible tube to the mixer, where it is injected into the liquid stream and dispersed instantly. It then recirculates through this 1,000-gal vessel until discharge..

of the process. "It is then reduced to a 'reacted BioReporter,' which is pink and highly red fluorescent.

"The dye disperses in the cooling water and travels throughout the system, reacting to all bacteria present, whether they are free-floating or encased in a biofilm. Bioactivity is monitored continuously by comparing the fluorescence of the blue and red dyes.

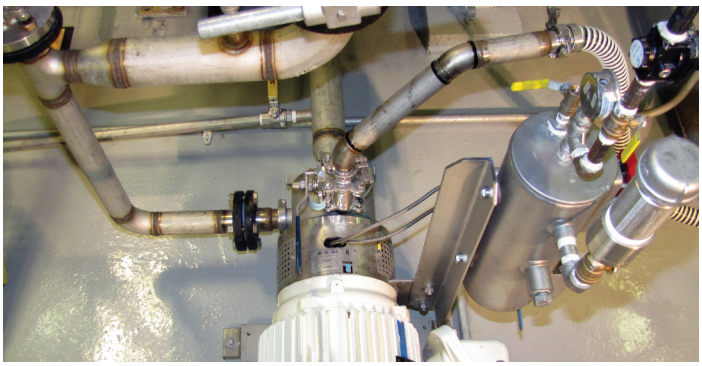
"When the system detects an increase in bioactivity, it triggers an immediate release of biocide. By reacting immediately, we prevent runaway fouling and reduce the amount of biocide needed for control. Perhaps even more important, when the system determines that bioactivity has been suppressed, it immediately stops releasing biocide. By preventing an overdose of oxidizing biocide, we can dramatically reduce corrosion, while we also reduce waste and prevent a release of excess biocide into the atmosphere."

## Lightweight Dye Presents Heavyweight Mixing Challenges

Nalco prepares its BioReporter dye solution in its Ellwood City, Penn., plant. In solid form, the dye is a lightweight powder with a bulk consistency similar to talc. Poured into a liquid with turbine agitation – even with a vigorous vortex — it forms agglomerates that resist wetting out. When poured from one open vessel into another, the powder could become airborne. For Nalco's production team, airborne dye presents a significant housekeeping mixing challenge.

"This is quite a strong dye," says Plant Engineer Rich Pike. "A little goes a long way, which is why the BioReporter solution contains such a low concentration of the dye."

"When the dye is actually injected into cooling water, it is diluted even further," says Fred Lu. "In fact, its concentration in cooling water is on the parts-per-billion level. It's actually invisible to the naked eye. The water looks completely clear, though we can measure the dye concentration fluorometrically."



The inline SLIM Solid/Liquid Injection Manifold instantly disperses powders in a liquid stream. A specially designed rotor/stator generator develops an intense vacuum, which draws the powder through the powder injection inlet to the high shear zone, where it is dispersed instantly. An auxiliary pump and eductor are not required.

"Because the dye is a fine, lightweight powder, it can cause real problems in the plant," says Pike. "With ordinary handling and mixing in an open vessel, it could drift into the air, and even small amounts can require a great deal of time for clean-up and waste disposal."

The team considered a variety of mixing technologies, including vacuum transfer and a pump/eductor to disperse the powder in an aqueous solution. They sought a safe, cost-efficient balance between fast mixing, high throughput, low maintenance and minimal risk of downtime caused by dye-clogged lines and filters.

"We were also looking for a design we could implement very quickly, since our timetable was tight – and so was our budget. We needed a fast turnaround, a comparatively simple installation and a reasonable price. We keep this plant extremely clean to promote safety and efficiency on the plant floor," says Pike. "So, a double

**"With our dye solution, we're contributing to environmentally-responsible business and sustainability that's making a real difference worldwide."**

After the mixer has been started, the powder injection valve is opened. A powerful vacuum then begins to draw powder directly into the high shear mix chamber.

mechanical seal was a must. And of course, the system would also have to be closed to prevent powder from escaping into the plant atmosphere."

The team selected a high-speed powder injection device comprised of a high-shear rotor/stator mixer that does not require an additional pump or eductor. Called a SLIM Solids/Liquid Injection Manifold, the mixer was provided by Charles Ross & Son Company in Hauppauge, N.Y.

"The rotor in this mixer is specially modified to generate an intense vacuum and draw solids into the mixer without assistance from a pump or eductor," says Ross Technical Director Ken Langhorn. "The solids are injected directly into the mix chamber, where they are instantly subjected to intense shear, fully wetted out, and dispersed into the fluid stream. Clumps have no chance to form."

The in-line mixer, which is normally mounted on a rolling cart to serve multiple mix tanks, was permanently attached with hard piping to a 1,000-gallon vessel equipped with a four-blade turbine agitator.

Using a Variable Frequency Drive, the operator slows the mixer to continue recirculation under lower shear conditions.

## High-Speed Powder Injection

"To start the process, we make up an aqueous solution in the tank and begin agitation," says Pike. "We then begin recirculating the fluid through the rotor/stator mixer at about half speed, and the solution is discharged subsurface in the tank. This minimizes splashing and air entrainment."

The SLIM system is equipped with either a powder injection wand or an overhead hopper. In this case, a wand was used to minimize the risk of "dusting."

"As the mixer is increased to full speed, the vacuum it generates increases as well, and the operator inserts the wand directly into the dye container. For a typical batch, the mixer sucks all the dye from the container in about eight minutes."

The dye container rests on a scale alongside the mixer, and the mix proportions are monitored closely to guarantee the accuracy of the final solution.

"When the transfer has been completed," says Pike, "the inlet valve on the wand is closed, and the SLIM continues to recirculate the batch until QA approval."

## The Big Picture — Sustainable Business

Dispersed BioReporter dye solution prepared here is used to prevent biofouling in cooling water systems throughout the United States.

"This is a manufacturing plant, and we're certainly focused on producing a perfect dispersion with every batch," says Pike. "But our mission is a lot bigger than that. With our dye solution we're contributing to environmentally-responsible business and sustainability that's making a real difference worldwide."

**Charles Ross and Son Company**
**800-243-ROSS, www.mixers.com**
Write In 575