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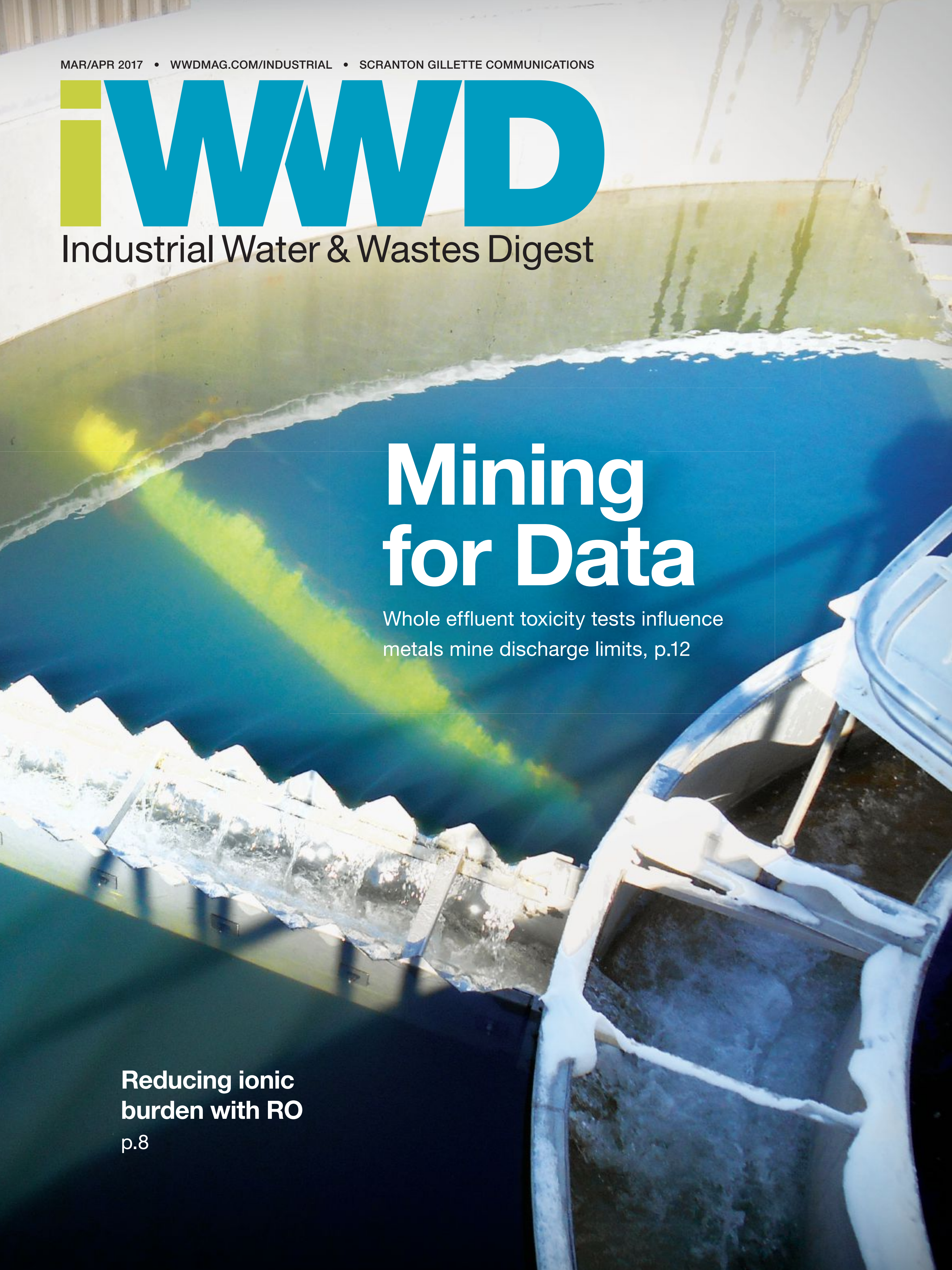
Industrial Water & Wastes Digest



Mining for Data

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Reducing ionic burden with RO
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Optimize With Ozone

SWITCH TO OZONE IMPROVES CIP PROCESS PERFORMANCE

By Jim Jackson

Ozone is primarily known as a respiratory irritant created by sun irradiation of ground level pollutants, but it also is a powerful disinfectant used by municipal water facilities, bottled water plants, and the food and beverage industries. In a disinfecting system, manmade ozone, which is created in ozone generators by passing pure oxygen through a controlled electric arc, is dissolved in water to rapidly remove micro-organisms. Then the ozone breaks down to its parent molecule, oxygen.

The purifying power of ozone gas was recognized in the early 1980s by the bottled water industry, and in November 1982, the U.S. Food and Drug Administration (FDA) approved ozone as generally recognized as safe for the treatment of bottled water. The use of ozone for bottled water sanitization eventually led the food and beverage industry to expand ozone's use to include disinfection of their process water systems with some plants incorporating ozone into their Clean-In-Place (CIP) cycles.

The typical CIP process begins at the end of a product run and uses a timed sequence of events, utilizing three stainless steel storage vessels: one for hot water rinse, one for cold water rinse and one for the detergent solution. The rinse and detergent solutions are pumped through a specific CIP circuit to clean and disinfect lines, storage tanks and bottle fillers that have been taken out of service for cleaning. An automated chemical feed station delivers the required chemical concentrate during the cleaning processes (see Table 1).

Cause for Concern

A chemical firm specializing in food and beverage sanitization systems evaluated the CIP process used by a bottling plant in Mexico. Equipment inspections and a review of the current CIP system highlighted several deficiencies and concerns, including:

- Non-wetted surfaces within vessels (shadowing) following CIP spray;
- Stagnant dead legs in pipeline system;
- Non-turbulent flow within pipelines;
- High-energy costs from the use of hot caustic solution and rinse water;
- Programming issues with the CIP central PLC controller; and
- Safety concerns on the handling and storage of peracetic acid to disinfect syrup lines and storage vessels.

The issues of shadowing, dead legs in the process pipeline, and non-turbulent flow within the process piping were of serious concern, because some internal surfaces that came in contact with the bottled beverages were not being adequately cleaned and sanitized during the CIP procedure. Piping changes, along with the installation of additional vessel spray heads, eliminated these problems by ensuring all surfaces would be wetted and adequately cleaned by the CIP cleaning and sanitization solutions.

To reduce energy costs and address the safety concern of the exposure of plant personnel to peracetic acid, the chemical firm recommended changing the CIP

Table 1. Automated Chemical Feed Delivery Rates

Sequence	Description	LPM	Minutes	°C	Notes
1	Preheat detergent and rinse water		36		Steam heating
2	Water rinse to drain	150	10	30	Ambient water
3	Hot detergent	150	30	86	
4	Hot water rinse	150	10	86	Until < 750 µs
5	Hot water disinfection	150	30	86	To drain
6	Ambient water rinse	150	≥ 5	30	To drain until < 750 µs and < 40 °C

Table 2. Pilot Results for Microbial Testing

Filler No. 3	Total Aerobic Count (CFU/ml)						Fungus (CFU/20 ml·100 ml)					Yeast (CFU/20 ml·100 ml)				
Sampling Sites	Target	24 hrs	48 hrs	72 hrs	96 hrs	120 hrs	Target	48 hrs	72 hrs	96 hrs	120 hrs	Target	48 hrs	72 hrs	96 hrs	120 hrs
CIP Rinse Water	< 25	1	1	1	1	1	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Syrup	< 25	zero	zero	zero	zero	zero	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Carbo Cooler	< 25	zero	zero	zero	zero	zero	< 5	zero	1	1	1	< 10	zero	zero	zero	zero
Filler V-11	< 25	zero	zero	zero	zero	zero	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Filler V-32	< 25	1	1	1	1	1	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Filler V-57	< 25	1	1	1	1	1	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Frotis Valve No. 6	<10	1	3	5	5	5	< 5	zero	1	1	1	< 10	zero	1	1	1
Frotis Valve No. 6	<10	zero	zero	zero	zero	zero	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero
Cane #62	<10	zero	zero	zero	zero	zero	< 5	zero	1	1	1	< 10	zero	zero	zero	zero
Cane #63	<10	zero	zero	zero	zero	zero	< 5	zero	zero	zero	zero	< 10	zero	zero	zero	zero

process from hot caustic soda and peracetic acid to an ambient temperature detergent and ozone rinse. Validation of the surfactant and ozone process would be accomplished through a pilot test in a limited plant area.

Piloting Priorities

Mazzei Injector Co. was selected to design and provide the ozone disinfection system, which consisted of a 30 gram per hour ozone generator, an oxygen concentrator, and a GDT ozone injection and degasification skid. The ozone system was integrated into the CIP process through modification of the PLC that controlled the CIP sequenced events.

The pilot test found the colony forming units (CFU) on all systems tested were well within the plant's microbiological control targets for bacteria, fungus and yeast. Most systems showed zero CFU's on post ozone rinse samples held for up to 120 hours. Surfaces not exposed to the CIP solutions had a high CFU count and needed to undergo a second manual cleaning. (A portion of the pilot's microbiological testing results is shown in Table 2, page 10).

The ozone system was then modified to divert the ozone rinse water from the drain to the former hot water storage vessel. The diversion allowed the plant to recycle the water for use in the pre- and post-detergent rinse cycles, saving more than 7,500 gal per day.

More Than Monetary

The switch from a hot detergent and hot water system to an ambient temperature surfactant detergent and ozone process saved more than 47 million btu per day.

The final and most significant saving was the recovery in lost production time. When utilizing the hot detergent and hot water CIP process, the plant had to wait 36 minutes for the caustic detergent and hot water tanks to reach the 86°C application temperature. At a plant average of 5 CIP cycles per day, the switch to an ambient temperature system added an additional 180 minutes of bottling time per production day. The monetary value of this recovered time is considered confidential and has not been released; however, the plant typically produces 14,000 bottles per hour, which would result in an additional 2.5 million units of bottled beverage made in a typical production day.

Ozone Optimization

Ozone, once known only as an air pollutant, is recognized today as a powerful disinfectant. When combined with ambient temperature detergents, an ozone process can optimize a plant's production by reducing the duration of the CIP process, and improve plant safety by eliminating the need for hazardous chemicals like peracetic acid. iWWD

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