

THE ORP STANDARD

A better method of assuring water sanitization?

Oxidation-reduction potential (ORP) — a mandatory standard for measuring water quality in West Germany's public pools and spas — ought to become a public-health requirement in the United States, aquatics consultant Jim Brown of Beaverton, Ore., told sanitarians at this year's National Environmental Health Association annual meeting.

Brown, who recently completed a study of chemical and microbiological water-quality constituents for 30 public spas in the area of Portland, Ore., told his listeners that he found little correlation between free-chlorine-residual readings and the bacteriological quality of the spas he surveyed. He plans to publish his findings in the *Journal of Environmental Health* and the *Archives of Environmental Health*.

"Normally," he says, "it is presumed that if you are maintaining a free chlorine residual of 2 milligrams, you have good water quality, but we did not find this to be true. The only parameter that seemed to take into consideration all the constituents — including oil and grease concentration — was ORP. We found that whenever the ORP residual was equal to or greater than 650 millivolts, the water was bacteriologically acceptable."

Brown, a member of the National Sanitation Foundation (NSF) task committee that is currently reviewing pool and spa equipment standards, says that ORP is a well-known measurement in the field of sewage waste-water treatment. "People who are knowledgeable in that area are frankly surprised that we don't use it for pools and spas," he says. Public spas in particular are a prime target for ORP, because "organic loading makes potential disease transmission far more significant for public spas than for pools."

"Brown's report suggests that bather loading, ORP and chlorine's effectiveness are directly related," says Jack Moorehead of Fairchild Filter Corp., La Jolla, Calif. The OTO chlorine test kit

routinely sold in pool stores is unreliable because it fails to distinguish between free and combined chlorine,

By Sylvia Tiersten

Moorehead says. The parts-per-million reading could reflect combined chloramine, which won't protect bathers from bacteria and viruses.

Because organic and chemical loading drastically reduce the ability of free chlorine to overcome bacteria, DPD

"Free chlorine is a quantitative measure, and ppm is a ratio. ORP measures the qualitative result."

free chlorine test kits also are of questionable value unless the exact level of organic contaminant in the spa water can be determined, Moorehead says.

Citing West Germany's public-health standards, Moorehead says that "pool and spa water quality in that country meets or exceeds Environmental Protection Agency drinking water standards in the United States." In Germany, he explains, free chlorine levels of .2 to .4 ppm are considered more than adequate as long as the ORP is at an acceptable level of 650 millivolts or higher.

Jacques Steininger of Santa Barbara Control Systems, Chertrol Division, Santa Barbara, Calif., defines ORP as "the oxidation-reduction potential of a sanitizer such as chlorine, bromine or ozone. These oxidizers 'burn off' impurities in the water, including body wastes, algae and bacteria."

The ORP sensor measures the

potential generated by the active form of the sanitizer, and not the inactive forms, such as combined chlorine. Unlike OTO or DPD "eyeball" testing, ORP is an ongoing electronic process that requires no test chemicals or reagents and constantly monitors sanitation levels.

Persuading pool and spa industry people and public health officials to rely on ORP is a question of education, Brown says. He predicts the eventual adoption of an ORP standard for public and semi-public pool and spa facilities. ORP probes priced in the \$200-to-\$300 range are available and monitor water on a continuous basis. However, Brown says that the cost of the probes would basically rule out the home market during the next few years.

Currently, a handful of manufacturers produce ORP probes, usually as a component of an automated chemical feeder system. Ironically, even managers of pools and spas who swear by chemical automation usually are unaware that ORP metering is built into these systems; the acronym is anything but a household word.

Peter Poirier of Ofuro Hot Tubs, San Diego, Calif., is a case in point. His commercial hot tub facility is controlled by a chlorine monitor, which he says is "a sheer necessity for any and all spas that demand constant maintenance because of large or fluctuating bather loads." Although the system contains an ORP probe, Poirier says that he was totally unfamiliar with the concept or term ORP.

Pressure from health departments will push public pool and spa operators over to automation and, indirectly, to reliance on ORP, Pablo Navarro of Chertrol says. "Put four to six people in a 300-to-700-gallon body of water," he says, "and you are immediately taking out a lot of the chlorine. By noon, the sanitizer could be gone." He says that ORP is "probably the truest

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measurement of water cleanliness."

Navarro tells prospective buyers that "if you automate, you will save on chemical consumption. It is the wave of the future." He likens it to use of a thermostat on a heater. "If you tried to control it by hand, the temperature would keep swinging up and down," he says.

Cherntrol manufactures chemical automation controllers for small pools and spas with an ORP probe for chlorine or bromine sensing but no pH control. The firm also makes systems using both ORP and pH sensors for medium and large commercial pools. Meters provide direct readout in terms of pH and ppm; the millivolt reading for ORP is converted into ppm so the average user can understand it.

The less expensive controllers rely on the ORP probe to sense the chlorine or bromine level and omit pH controlling altogether. Usually, Navarro says, ORP falls whenever pH drops off in either direction. This type of controlling is most appropriate when the more neutral types of sanitizers are used, such as dichloro or bromine; it is less applicable when liquid sodium hypochlorite or chlorine gas sanitizers are present.

The greatest barrier to acceptance of automated chemical feeders is cost, Navarro says. Controls retail at \$625 for smaller installations and up to \$6,900 for larger commercial pools with automatic weekly superchlorination cycles. But prices will come down as the market grows and large-scale fabrication becomes feasible, he predicts.

In some places, chemical automation already is mandatory. In Warren County, Ohio, for example, the General Health District requires installation of an electronic water-control device on all public spas and hot tubs to monitor and control free chlorine and pH. The same is true in Anchorage, Alaska, where an automatic chlorinator with a sensor is required to insure proper levels of chlorine.

When Poirier tried to open a public hot tub facility in San Diego in 1979, he found the local health department "very strict and not very flexible. I checked around in other places such as Oregon and found that there had been problems," he says.

Poirier has become a proponent of strict regulations "for the good of our industry." Locally, he says, commercial spas did not fare well in a 1984 study

in San Diego that included health club and condominium spas (See PS/N, April 1, 1985, pg. 8). The survey was carried out by members of the San Diego Public Health Laboratory and the San Diego State University Graduate School of Public Health, who reported the results at the American Society of Microbiology meeting in Las Vegas earlier this year.

Out of 50 public spas surveyed, the researchers found that 24 percent of them were a source of parasitic infection and that more than 50 percent of them were under-chlorinated and had unhealthful bacteria.

One of the reasons that ORP won wide acceptance in Germany several years ago was that the pioneer work in ORP was performed by German scientists, says Steininger. The European-born executive, who has looked into the use of ORP in Germany, Denmark and Switzerland, says that German health officials specify the need for both ORP and free-chlorine-level measurement, "and the other countries are more-or-less following Germany's lead. They complement each other," he says of the two tests. He expresses doubt that ORP will ever replace ppm measurement of free chlorine as the sole standard for pool and spa sanitation in this country.

Bob Crandall, an independent consultant in Sacramento, Calif., sees the ORP question as one aspect of a larger problem. "Brown's study, and others, suggest the need to look closely at alternative methods of sanitizing," he says. Crandall has done extensive work with ozone, ultraviolet and hydrogen-peroxide water treatments in lieu of chlorine or bromine.

"There is a fair body of literature on pool sanitizing, but there is not a lot on spas," Crandall says. Based on the indications so far, he adds, "I would seriously question free chlorine as a good indicator of water cleanliness."

As for monitoring ORP instead of free chlorine, he says, "You would want to do both at first — on an experimental basis. Then, if the ORP reading turns out to be an excellent indicator, you might phase out the free-chlorine testing."

One tub manufacturer with a more-than-passing knowledge of ORP is Blair Osborn, president of Olympic Hot Tub Co. in Seattle, Wash. "I have been beating on the health departments for

years saying that free chlorine is a useless standard," he says. As far as an automated system with an ORP probe,

"I would never sell a commercial system without it."

However, he adds that "ORP is not the great panacea. One of the problems you have if you're using stabilized chlorine is that if cyanurates spill, the voltage drops." Commenting on Brown's recent NEHA talk, Osborn says, "I think what Jim Brown is implying is that sanitizing power is proportional to voltage."

Osborn also takes a dim view of "health departments that say you have to provide an automated sanitation system. It's too vague. All it means is that you must install a robot feeder and walk away from it."

To be effective in a health-club situation, he says, a system would have to include a controller. An erosion feeder system he dismisses as "a joke in a health-club setting. You can see chlorine go from five ppm to zero in less than five minutes," he says. "All you have to do is take four sweaty runners, stick them in a 500-gallon pool and bingo — all the free chlorine goes to combined."

In addition to chemical automation systems for commercial spas, Osborn has sold a few for backyard use, including one for \$800 to a local bank official who frequently is on the road for two weeks at a time and likes the spa to stay clean in his absence.

Despite the high cost of and disagreements about electronic monitoring and controlling, chemical automation and ORP testing look like an idea whose time has come. The real impetus for improved sanitizing is coming from the operators, Steininger says. "They, along with the health departments, are pushing the pool and spa dealers to come up with better methods," he says.

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