Magnetic units: Views are still poles apart

Though the studies done so far have not been kind to magnetic water treatment, the jury is still out on whether the concept works and on how it achieves its alleged descaling effects. A favorable verdict could pave the way for widespread use in the CPI.

□ Does magnetic water treatment (MWT) work? Does it—as is claimed by the U.S. manufacturers of more than 100 models of MWT equipment (see box)—remove and prevent scaling, minimize corrosion, inhibit bacterial growth, reduce blowdown and cut water consumption? For years, the answers have eluded researchers and given rise to controversy.

Now, however, several studies under way promise to clear up some of these points, possibly before the end of this year. And the chemical process industries (CPI) are anxiously awaiting the outcome, mainly because MWT units, so far used only in households and light industrial applications, could save millions in water-treatment costs.

The magnetic devices cost anywhere from $30 to $200,000, depending on size and sophistication. A typical installation (e.g., upstream of a heat exchanger), says manufacturers, can eliminate all of a plant's requirements for water-treatment chemicals, which can cost $85-$260/million lb of treated water. (Removing those chemicals from plant effluents, of course, entails further expenses.) Further, the tag for chemicals is increasing, as CPI firms consume larger amounts to run boilers and cooling towers at higher efficiency.

Many experts on water treatment, however, have always had serious reservations about MWT. They contend that there is no technical basis for any of the MWT claims, and that most of the tests conducted so far prove that the devices don't work at all. But this is because those experiments have not been properly done, say MWT vendors, adding that, until recently, chemical water-treatment methods, too, were not well understood scientifically. And that has not prevented makers of chemical additives from racking up impressive sales figures—more than $1.6 billion to all U.S. industry last year, including over $600 million to their primary customer group, the CPI.

HELP ON THE WAY—In order to dispel the myths surrounding MWT, the Committee for Refinery Environmental Control (a subgroup of the Washington-based American Petroleum Institute) is funding a study by researchers at Baylor University, Waco, Texas (Chem. Eng., Sept. 5, 1983, p. 17). The group's goals, emphasizes team leader Kenneth Busch, a chemistry department professor, are to put MWT technology on firm scientific footing and to understand the operational mechanisms behind MWT's claims. Results are expected by yearend.

The Baylor team's laboratory setup, consisting of an off-the-shelf magnetic-treatment device, piping and pumping, is designed to simulate real-life conditions. Last September, at a committee meeting, Busch reported that the team had obtained some tentative, encouraging qualitative results. However, he is unwilling to divulge additional details, except to say that the group "noticed some effect on the water" after it had passed through the MWT unit.

Another current study is being sponsored by the Water Quality Assn. (Lisle, Ill.). The group, whose previous MWT-related work (done in 1981) was highly critical of the concept, is now funding James Alleen—a civil engineering professor at Purdue University (West Lafayette, Ind.)—who is evaluating several commercial permanent-magnet designs. To eliminate bias, says WQA's technical director Lucius Cole, manufacturers' recommendations will be followed throughout the appraisals.*

Worried by declining water quality and the prospect of future water shortages, the U.S. Dept. of Energy (DOE) also has jumped on the investigational bandwagon. Its Office of Industrial Programs has been the major backer, since October 1982, of a $48,000 MWT-literature survey being put together at the Dept. of Environmental Health Sciences of Tulane University (New Orleans).

Scheduled for publication in March, the study will also be reporting current and previously unpublished research, says Robert Massey, who is administering the program for DOE. Massey adds that after reviewing the data DOE will make suggestions as to what kinds of MWT research ought to be done to help settle the controversy.

INDUSTRY TRIALS—Meanwhile, the CPI are doing some tests on their own. One that is being closely watched started last year, and involves five MWT units: four have been installed by Amoco Oil Co. at its refinery in Texas City, Texas; the fifth is at an Amoco biochemical facility at Hutchinson, Minn.

According to James Grutsch, the firm's director of environmental technology, preliminary results are positive. Chemical treatment costs have been s units to tre
Magnetic treatment of water has been slashed by 90% since two of the units at Texas City were put online to treat water for the refinery's air-conditioning system. Industry, however, is more interested in the performance of the two other units, said to be the first magnetic devices used to treat water going to process equipment in a petroleum refinery. In operation since last July, they are hooked in parallel to a reformer and can treat a combined 30,000 gal/min. According to an Amoco spokesman, this test could conclusively demonstrate whether MWT can be used with CPI equipment, since the temperature differences in the reformer's heat exchangers are 30-40°F, vs. 6-12 deg for such applications as air conditioning.

"During a two-month period [July and August]," adds the source, "we increased the cycles of concentration in the system from 6 to 15 without experiencing any significant scaling or corrosion. After that, we encountered increased scaling. We attribute that to decreased flow through the MWT system because of plugging introduced into the refinery's water system by Hurricane Alicia [which hit Texas in late August]."

That experience has helped Amoco to identify several important operating parameters. For example, water...
velocity through the MWT devices should be at least 6 m/s; the magnetic field about 1.700 gauss. At these conditions, says Grutsch, "we think that sufficient magnetohydrodynamic energy is generated to reduce scaling. However, we still have no inkling of what the exact operating parameters should be, or whether our results are really due to MWT or some other phenomenon."

DIFFICULT TO GAUGE—It is this kind of uncertainty, made worse by a lack of operating data, that is most confusing to potential users of MWT. Indeed, some CPI experts discount most of the claims of successful applications made by makers of MWT units because those claims are not supported by performance data.

And the data itself may be hard to obtain because it is often difficult to tell whether the MWT unit is responsible for a decline in fouling. Usually, when an MWT device goes onstream, treatment with nonchromates—which protects against corrosion but causes fouling—is suspended, so the system automatically cleans itself out. "When this happens," notes Carl Boone, a consultant with Energy Systems Consultants (Houston), "it's MWT that gets the credit." Unfortunately, he adds, all these installations will show signs of corrosion sooner or later because they are being run without corrosion inhibitors.

An example of this may be the MWT unit installed more than four years ago on a 2,900-gal/min cooling tower at a Mobay Chemical dyes and metal plant in Charlotte, S.C. The $11,000 device was credited by a Mobay engineer with removing a 0.25-in.-thick scale from pipelines within two months of its debut. The same engineer, however, later agreed there was no sure proof of the unit's success because the tower never did operate with just untreated water—i.e., nobody bothered to check whether a suspension of chemical treatment would suffice to clean up the pipes naturally.

This and other similar experiences have given rise to general skepticism among CPI firms. Some contacted by CE have not wanted to admit they are testing the units, for fear that it "would lend credibility to MWT." Industry trade-groups seem to share this feeling about MWT. Says Norman Hamner, of the National Assn. of Corrosion Engineers: "We're inclined to be cynical. The bulk of information we have says that the devices don't work." Jack Matson, chairman of a Cooling Water Institute taskforce that's studying the technology, notes: "Any reasonable engineer has to be wary . . . but we shouldn't have a closed mind because if it did work, it would cause a revolution in the water-treatment industry."

UNDER THE GUN—Skepticism might not seem so bad to some MWT vendors in the light of other problems they face. Hydromag Ltd. (Pella, Iowa), for instance, has been sued by its home state on behalf of over a dozen presumably unhappy customers. It was their written complaints, says Jim Peters, assistant attorney general for consumer protection (Des Moines), that prompted Iowa to file in civil court. The users complain that the Hydromag units, which, according to Hydromag president Donald Van Gorp, reduce chemical use by 50% and replace water-softening units entirely, have failed to meet these claims.

Hydromag, meanwhile, plans to sue the state—for incorrectly testing its equipment. Van Gorp claims that researchers at Iowa State University pumped water through the units in the wrong direction—i.e., from outlet to inlet—and caused malfunctioning.

Customer dissatisfaction with commercial MWT equipment is apparently not confined to the Hydromag case. According to industry sources, attorneys general in various states—e.g., South Dakota—were investigating MWT units some years ago. Some vendors are even willing to admit that there are black sheep in the MWT business family. "Some guys out here give the whole industry a bad name," says a vendor.

FRIENDLY PERSUASION?—Possible pressure from vendors eager to influence the results of its just-completed evaluation of MWT units was "definitely a concern" for the U.S. Army Corps of Engineers (Champaign, Ill.), says Frank Karney, chief of the metallurgy and quality assurance section at the Corps' Construction Engineering Research Laboratories.

That was why, in order to make those results "irrefutable," he adds, the Corps took special care to make sure that both the manufacturers and the Illinois State Water Survey were involved in deciding correct laboratory and field setups for the tests.

Nevertheless, the final report concludes that the MWT devices don't work—i.e., they did not reduce or prevent pipe scaling in lab and field tests. In fact, says the study, corrosion increased and there was a greater need for fungicides when the units were used. "We did not match our hard technical data with their [vendors'] anecdotal ones," asserts Karney.

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Progress sparks interest in conductive plastics

Although their widespread use in commercial products is still some years away, inherently conductive materials have made important gains. Meanwhile, markets for the filled variety continue to expand.

Both kinds of electrically conductive polymers—filled, and inherently conductive ones (see box)—are in the news. U.S. demand for the filled variety is expected to grow to at least ten times its present level (1.5 million lb in 1983) by 1995, and companies everywhere are rushing to expand their product lines. As for the inherently conductive ones, researchers all over the world are making progress in solving some of the problems—e.g.,