Figure 1: Mobile Lab Moves among Four Treatment Plants to Conduct Research

Innovative pH Monitoring System Design Saves Costs at Water Utility

The potable water utility in Birmingham, Alabama has experienced significant savings in annual costs for pH monitoring by switching to a new system from ABB.

By **Rob Mapleston**

CASE STUDY

The Birmingham Water Works Board oversees four treatment plants for potable water. Incoming water comes from lakes, rivers, and reservoirs. Some blending takes place, depending on the seasonal changes in water depth and available flow. All four plants incorporate traditional treatment steps–rapid mix, coagulation, flocculation, sedimentation, filtration, and disinfection. BWWB treats and distributes about 100 million gallons of water per day.

Since 2004, BWWB has been conducting extensive research and development with the aid of a mobile pilot plant installed in a trailer. The pilot plant contains two water treatment trains that simulate the operation of the full-scale plants within the BWWB system. During tests, one train mimics treatments for the full-scale plant under study while the second train serves for experiments with different treatments.

The Challenge: High Maintenance Costs

In the past, online monitoring of pH proved to be expensive. BWWB was spending about $7200 a year on replacement of six pH probes. Additionally, the accuracy of online pH measurements often deteriorated, requiring additional bench-top tests. The new ABB pH7653 monitors have been in place two years without need of replacement; pH values measured always match those of bench-top tests.

According to Senior Engineer Jeff Cochran, "We do a lot of pilot testing of treatment conditions, using different chemicals and states of alkalinity and acidity. The pilot plant runs 24/7. Our goal is to optimize operation of the full-scale plants. The pilot plant allows us to conduct this research without adversely affecting water actually distributed to customers," he says.

The pilot plant moves among the full-scale plants in a rotation, making sure they're properly operating. The pilot treatment trains see the same incoming water as the full-scale plants. "Originally three online probes for each treatment train in the pilot plant monitored pH values," says Cochran. "Monitoring took place at raw water tanks, immediately after addition of coagulants, and before the filters."

Treatment chemicals include aluminum and ferric sulfates. "The chemicals contain sulfuric acid, which lower the pH of the incoming water," says Cochran. "An optimum pH facilitates proper removal of turbidity and total organic carbon in later treatment stages. A high TOC," he explains, "makes it more difficult to disinfect the water with chlorine."

Monitoring pH before and after the filters is also important. Says Cochran: "The pH value prior to the filters affects their run times before the necessity of backwashing. We also want a sufficiently high pH following the filters to avoid corrosion issues out in our distribution system."

The original six pH monitors required replacement every six months, amounting to $7200 in annual costs. Requirements of additional bench-top testing caused by pH probe contamination and inaccuracies further increased costs by about $800. www.abb.com/measurement

Figure 2: The Pilot Plant Contains Two Treatment Trains-One Mimics Full-Scale Plant and the Other is for Tests

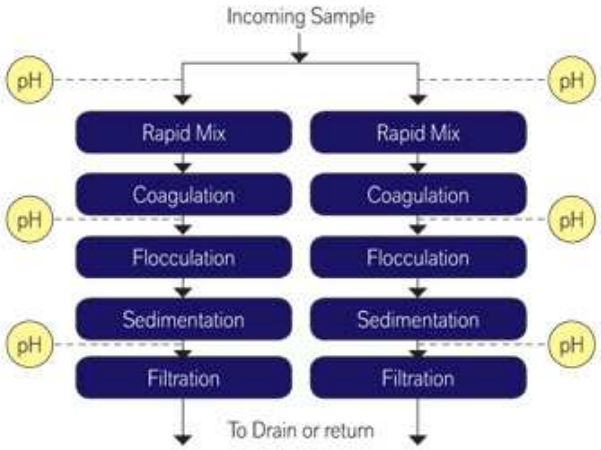

Figure 3: In the Original Pilot Plant Configuration, Monitors Measure pH of the Raw Water, the Coagulation Stage, and Before the Filters. One Train is for Research and the Other Mimics the Full-Scale Plant

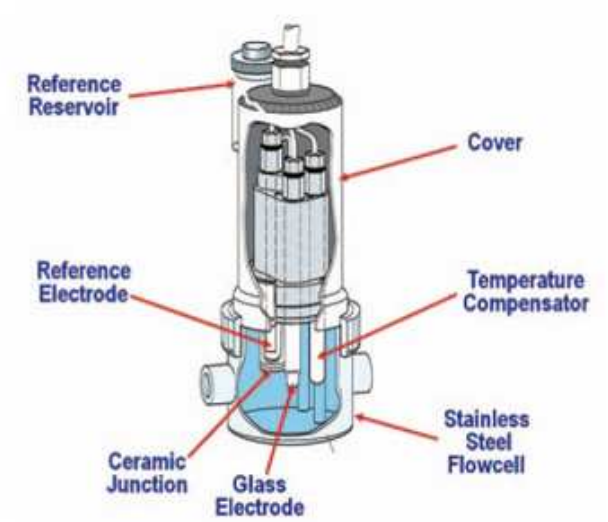

Figure 4: ABB Monitor Design Includes a Reference Reservoir and Individually Detachable and Replaceable Electrodes

The Solution: Innovative pH Monitors

Engineers at BWWB started looking at pH probes by various manufacturers to decrease costs and improve accuracy. "With the exception of the ABB pH monitors, most were similar in their construction," says Cochran. "Despite the fact they cost a little more, the ABB pH7653 monitors have two immediate benefits that tipped the decision in their favor," he says. "One is the elevated KCL reference reservoir. It continuously feeds reagent over the tip of the reference electrode, keeping possible contamination out. Previously, contamination was a constant issue because of particulates and all the different treatment conditions and chemicals."

Figure 5: An Inexpensive, Replaceable Reference Junction Overcomes Problems of Blockages at Very Low Cost Two of the Eight New ABB pH 7653 Monitors Installed in the Pilot Plant

Cochran notes that the second benefit is their modularity. "The three components inside the monitor, pH electrode, reference electrode, and temperature probe, are all individually replaceable if necessary," he says. "We don't have to replace the entire monitor. The ABB monitors have been in place for two years without need for replacement, and paid for themselves in less than that time."

He adds that it's hard to put a dollar value on the fact that the ABB monitors always match bench-top pH tests. "Knowing the online pH values are accurate allows us to do 'flow pacing' in the pilot plant," he says. "We can adjust rate of the chemical additions based on the direction of changing pH values and their predicted effects on turbidity and TOC. Delays involved with bench-top testing preclude use in flow pacing."

The Results: Lower Maintenance Costs

Based on the success of this pH project, BWWB has added another ABB pH7653 monitor to each of the pilot plant treatment trains. The pilot plant includes three filters in each train. Now two ABB monitors measure pH on two of the individual filters for each train. This halves the time for research on finding optimum pH values across filters. Additionally, the utility plans to add ABB pH7653 monitors to one of the full-scale plants soon. ■

About the Author
Rob Mapleston *is working with ABB Measurement Products.*

ABB *is a leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact. The ABB Group of companies operates in around 100 countries and employs about 145,000 people.*

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