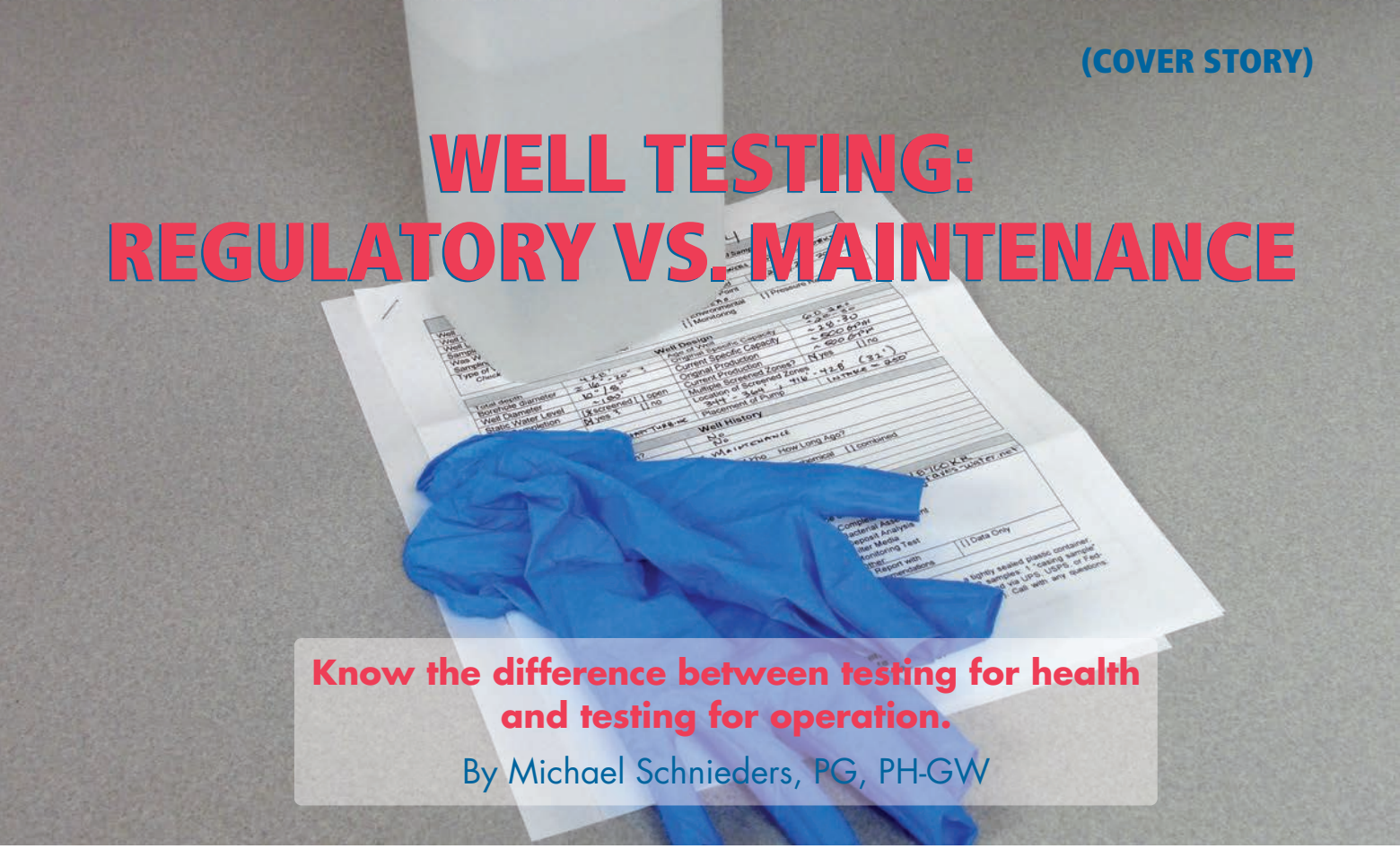
WELL TESTING: REGULATORY VS. MAINTENANCE



Know the difference between testing for health and testing for operation.

By Michael Schnieders, PG, PH-GW

Over the course of a well's life, it is generally evaluated multiple times.

A test well is often drilled initially and sampled to evaluate the viability of the location as a water source. After completion of construction and development, a new well is usually subjected to a full battery of tests per state regulations. Once in active use, periodic testing is then required to monitor for the presence of coliform organisms.

Contaminants include many harmful substances as well as many harmless constituents.

The Safe Drinking Water Act was passed by the U.S. Congress in 1974 following growing concerns about the contamination of our nation's water supplies. Under the SDWA, the U.S. Environmental Protection Agency sets "health-based standards" for drinking water supplies to protect against both introduced and naturally occurring contaminants that may be found in drinking water.

States and Indian Tribes can adopt federal water quality standards or approve ones more stringent. The EPA and state agencies then oversee the implementation and enforcement of the standards, with the states and Indian Tribes holding primary enforcement responsibility. This is why new well testing is conducted through and reported to your state.

When originally enacted, the SDWA focused primarily on water treatment and produced water quality as the means of providing safe drinking water. But a 1996 amendment significantly expanded the existing law to include source water protection, including groundwater supply wells.

Over the 40-year history of the law, the SDWA has served to greatly improve the quality of our nation's water resources and ensure public health. In the course of reviewing water quality standards, the EPA looks at many substances as potential contaminants.

Unfortunately, there remains a great misunderstanding in the role of water testing and the definition of a contaminant. Contaminants include many harmful substances as well as many harmless constituents.

> Always check with your laboratory to ensure you are using the correct sampling method, container, and preservative if necessary for the desired tests.

Low levels of trace minerals, metals, and salts are all naturally present in groundwater. At low concentrations, these contaminants are harmless; some may even be desirable—such as a preference for hard, "mineralized" water. Other contaminants are the result of industrial spills or improper disposal, and undesirable at any concentration.

It is important to differentiate the need for required testing for health and the role of testing for maintenance and operation. For example, understanding the absence of hexachlorocyclopentadiene or pentachorophenol in a water sample is important for classifying a new well as being free of industrial contamination. But it does not help in contributing to the understanding of lost capacity, or premature pump failure.

The confusion in testing needs spans the entire industry—from the well owner to the contractor to the engineer and even the regulator. From a labora-

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Multiple biological testing methods are advised to better understand problems occurring downhole.

Comparing deposit samples with water analysis can help determine the extent of a problem occurring downhole.

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tory standpoint, analytical terminology, advances in testing capabilities, and a lack of clear understanding of wells aids in this confusion. All too often the problems stem from poor communication.

Following guidelines

With regards to maintenance and operational issues, water testing is generally targeted at identifying the potential for mineral scale formation, the likelihood of corrosion, and an evaluation of the microbial community. While the focus and parameters are different for regulatory purposes, regulatory and maintenance testing generally use the same methods for analyses of a water sample.

Laboratory testing procedures for water samples are performed according to the guidelines set forth in *Standard Methods for the Examination of Water and Wastewater* as established by the American Public Health Association, the American Water Works Association, and the Water Environment Federation. In general, these methods are approved by both the EPA and AWWA for the reporting of water and wastewater data.

Regulatory testing requires specific collection methods, the use of special containers and preservatives, and has strict limits with regard to holding times prior to testing. Maintenance testing generally has different procedures for sample collection and submittal, partially reflective of the well or problems being encountered.

In evaluating the water chemistry from a well for maintenance, the primary concern is for scale formation or corrosion. Useful parameters for evaluation include pH, alkalinity, total dissolved solids, hardness level, calcium, magnesium, iron, manganese, and the oxidation-reduction potential.

Calculation of the Langelier Saturation Index and the Ryznar Stability Index incorporate many of these parameters and are valuable indicators of the potential for scale development or corrosion.

In evaluating a water sample for maintenance, the biological testing is conducted in an effort to understand the biofouling potential. Our industry uses the term "bacteria test" to account for a wide range of tests, but generally it is used to indicate the required total coliform occurrence test. Coliform tests are a means of evaluating for the presence or absence of coliform organisms, a large group of bacteria generally used as an indication of contamination. A well can be heavily biofouled and still remain coliform free.

When conducting biological analyses, it is advised you first quantify the population. This is done to see whether or not the microbial community falls within a normal range. Traditionally, the heterotrophic plate count (HPC) has been used. However, studies now indicate this method is not as useful, as less than 5% of the known bacterial species are culturalable on the media used. The adenosine triphosphate (ATP) test is a more accurate assessment, quantifying all living species—both aerobic and anaerobic—within a sample.

Once you've identified the size of the bacterial population, it is recommended you have the lab assess the anaerobic population. Anaerobic bacteria are a collective group of bacteria that do not require oxygen for survival. Testing for anaerobic growth is useful in identifying areas of heavy fouling as well as the development of environments for more problematic organisms such as sulfate-reducing bacteria (SRBs).

SRBs are the easiest to identify from a water sample, as a very distinctive hydrogen-sulfide gas is produced by the bacteria. Hydrogen sulfide gas has a distinctive rotten-egg odor, which diminishes the aesthetic quality of produced well water. Sulfate-reducing bacteria are common inhabitants in groundwater systems, often noticeable after prolonged periods of inactivity or in severely fouled wells suffering production problems.

In addition to the evaluation of anaerobic growth and the presence of SRBs, testing for the presence of iron bacteria is recommended. Iron-oxidizing bacteria are common problems in wells, especially those in alluvial aquifer settings or wells with low carbon steel completions. Often misidentified as iron-reducing bacteria, iron oxidizers are more readily identifiable by the iron-laden stalks they shed during their life cycle. Simple microscopic evaluation is useful in identifying the presence of iron bacteria and assessing their relative rate of occurrence within a sample.

Biology lessons

If you suspect a coliform problem, in addition to the aforementioned tests, it is advised you confirm the coliform occurrence and also rule out the presence of E. coli–specific coliforms. In addition, quantifying the coliform presence and having the dominant species identified can help further understand the problem and identify whether the issue is a fouled well or contamination.

Biological testing is unique in that often the timing of the test is due more to the bacteria's behavior and response to the testing media than a set time reference. Slow-growing cultures may require additional time before identification and assessment can be made. The allowable time frame may dictate what method, and accordingly, what information you can learn.

Procedures such as the ATP method may provide you a quantitative assessment in a matter of a few minutes as opposed to a traditional HPC test which typically requires a growth period of several days for representative growth.

If a sample shows signs of turbidity, sediment, or settling solids, it is advised the sample be evaluated microscopically. Microscopic evaluation of a sample under low power (20 to 400 times magnification) can help in identifying the influence of clay, silt, and fine grain size sediment on a well system. The evaluation can also be used to identify corrosion byproducts and surface water influence.

Capacity and production loss, corrosion, foul odors, discolored water, and water treatment concerns can be caused by natural water chemistry and microbial populations found within a well system. Knowing the reason for these changes and understanding the problems that can occur is important in maintaining an efficient well. Assessing the biological activity and water chemistry within a well system helps determine the well's overall cleanliness and assess system operation.

The benefits to testing are often limited by the understanding of the tests being run. Testing should be conducted following a discussion between all parties involved to identify what the reason is for the testing, what tests will be conducted, and how the samples should be collected. By discussing your project with the laboratory beforehand, you should be able to get a good idea of the lab's capabilities, sample collection requirements, and the time required for testing.

Evaluating laboratory testing data in conjunction with annual pump tests, a video survey, and a well site inspection is an important part of well maintenance. As with medical testing, the more information you know, the better you can respond.

Testing can help identify the early onset of fouling problems, typically in advance of the need for complete rehabilitation. For the municipal well owner, proactive periodic biological and chemical monitoring can help lower treatment costs, such as maintaining chlorine residuals in distribution lines, and reducing costly unscheduled maintenance. WWJ

DACUM Codes

To help meet your professional needs, this article covers skills and competencies found in DACUM charts for drillers and pump installers. DO refers to the drilling chart and PI represents the pumps chart. The letter and number immediately following is the skill on the chart covered by the article. This article covers:

DOF-2, DOG-9, DOK-8, PIC-1, PIE-21, PIF-8, PIG-2, PIG-7

More information on DACUM and the charts are available at *www.NGWA.org*.

Follow Best Suggested Practices at Well Sites

The National Ground Water Association's best suggested practices are designed to aid groundwater professionals at industry job sites. They are not standards, but practices that have been demonstrated to show superior results. Go to *www.NGWA.org* and find practices on combatting arsenic, boron, hydrogen sulfide, iron, methane, microorganisms, and more.

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