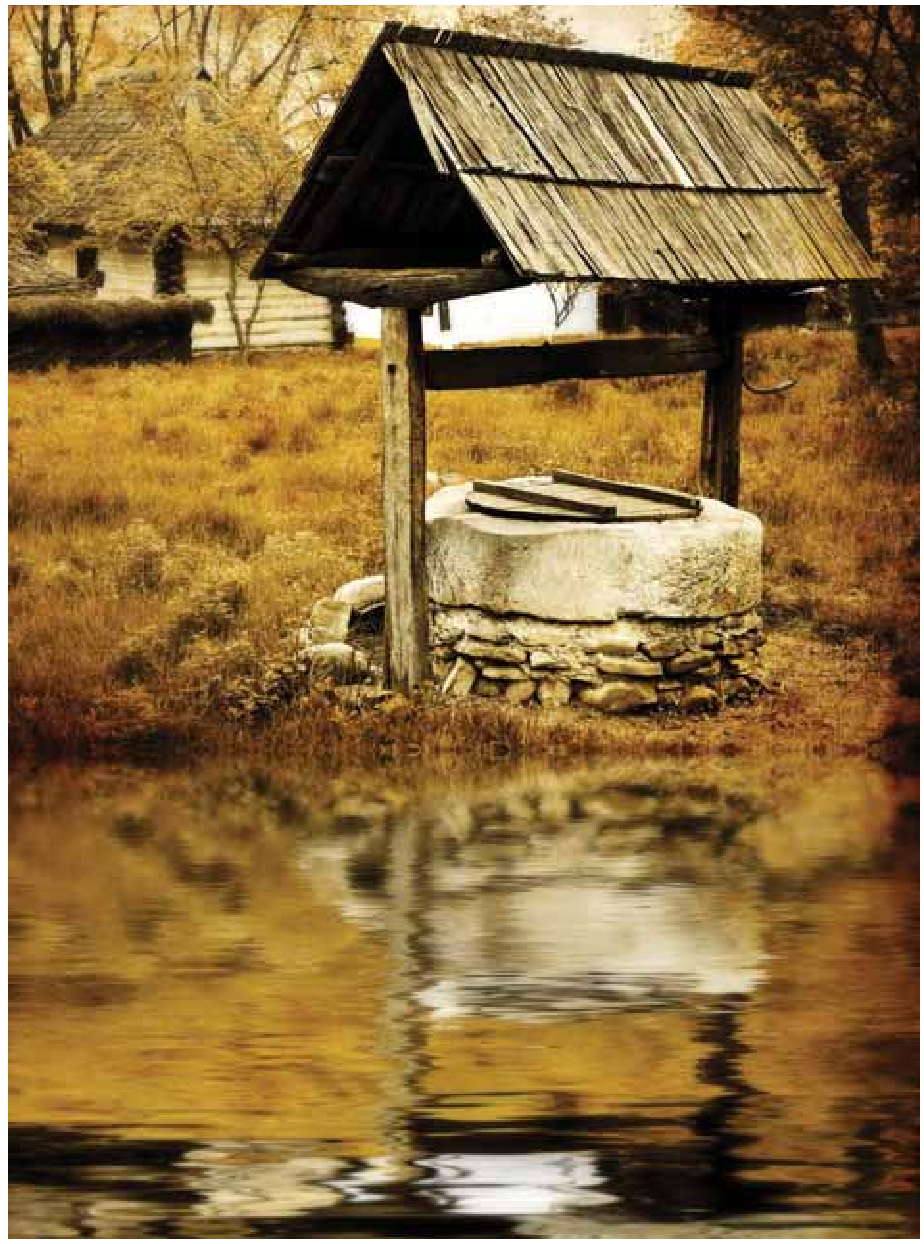
Well-Timed Maintenance



By Neil Mansuy

Time-based approach to effective well maintenance

Most wells experience some type of operational problem during the normal process of aging. The rate at which a well will experience such problems can be influenced by many factors, including water chemistry, aquifer characteristics, operational schedules and well construction details, just to name a few.

There are many types of wells across the globe, including water supply, injection, aquifer storage recovery, extraction, monitoring and dewatering, and most deteriorate as they age. These wells can be constructed in unconsolidated, consolidated or semi-consolidated geological environments with open-hole rock; screened with or without filter packs; and be vertical, horizontal or at a slant (angle wells).

Some common problems include loss of production, discoloration on startup, water quality changes, bacteriological failure, increased cost of operation, shorter life expectancy and increased life-cycle cost.

The causes of well deterioration are often categorized into the following:

- Biological: This results from naturally occurring bacteria that filter both organic and inorganic constituents from the water.
- Mineral encrustation: This results when minerals are mostly oxidized by oxygen penetrating down the well column during operation, creating an oxidized zone around an operating well. This zone enhances biological growth and a significant volume of plugging deposits from biologically filtered minerals trapped in the biofilm growth for protective purposes. The most commonly encountered minerals include various species of iron, manganese, calcium, magnesium and silicate.
- Formation damage: This results when the near well environment is invaded by fines (sand, silt or clay) from the formation and some of the pore spaces surrounding the well collapse.

Keeping It Clean

Rehabilitation and maintenance are some of the most significant costs of operating water supply wells and environmental recovery systems. The historical method of operating wells was to "run to failure," until loss of production had occurred, water quality had deteriorated, the cost of pumping water had become much higher and the system was no longer in regulatory compliance.

Much of the reliance on the run-to-failure method was due to a dependency on feedback monitoring of a well (specific capacity, water quality, bacterial testing, etc.). In the past, I often recommended that well rehabilitation and maintenance be performed prior to a well losing 15% to 20% of its original specific capacity (production rate divided by unit drawdown).

During the mid-1990s, however, after much experience, I realized that specific capacity is not a good indicator of early losses of pore volume in and around a well. Significant plugging can occur prior to losing any specific capacity. This is because a lot of excess pore volume exists in and around a well, and plugging some of the pore volume does not immediately impact the specific capacity. There also is excess production capacity with depth in an operating well. Losses can occur in some zones, and other zones can either make more water or take more water, depending on the intended operation. Losses in specific capacity occur when the remaining open pore volume transitions from laminar to turbulent flow and then turbulent flow losses occur.

Run to failure means that by the time any cleaning is initiated, the deposits plugging the well have become more extensive, and more hardened or mineralized. The traditional approach to this problem was to try to prevent deposits from building up in an operating well. Some prevention techniques included heat treatments to eliminate bacteria from the subsurface environment, shock chlorination to keep bacteria under control or anoxic block to prevent oxygen from penetrating down the well column.

I often describe these approaches as trying to "hunt, count and kill bacteria." The key to successful well maintenance, however, is not effectiveness at killing bacteria—rather, it is effective removal of biological deposits and the associated minerals. This requires using different types of energy to remove deposits from the surfaces within the water well environment.

Time-Based Approach

More than 15 years ago, I made the transition from trying to prevent deposits from building up in water well environments to a time-based maintenance approach, after recognizing that deposition occurs from the first day a well is placed into operation. This approach has been successful, because the deposits are removed when they are less extensive and softer in nature. Removal of these deposits on a timely basis helps keep wells clean, so that the deposits never get to the point at which they are significant and hardened. The time interval between maintenance is usually annual, but some wells require more frequent service. Many systems have successfully made the transition from rehabilitation after they have noticeable deterioration to the proactive preventive maintenance approach.

The key to cost-effective well maintenance is cleaning without removing any pumping or injection equipment. The injection of energy must reach all zones of an operating well with the pump in place. This means overcoming the energy delivery limitations that often occur in the lower zones of a well. One method of delivering this effective energy into a well with pumping and injection equipment in place is using gaseous and liquid carbon dioxide. Aqua Gard is one such product; it involves equipping the well with hardware to be able to deliver energy into it in a sealed environment with the pumping or injection equipment in place.

The time-based approach is crucial to well health, because waiting until problems occur often means it is too late for a maintenance cleaning to be effective, and more costly rehabilitation will need to take place. Rehabilitation most often requires removing pumping or injection equipment, along with aggressive cleaning treatments to remove deposits. The analogy I often use is: "You do not wait until your engine starts knocking before you change your oil."

The benefits of keeping a well clean include:

- Maintaining peak efficiency;
- Maintaining the lowest cost of pumping water;
- Maintaining the maximum production rate;
- Minimizing failure of total coliform positive samples and elevated heterotrophic plate counts;
- Preventing discoloration on startup;
- Preventing many taste and odor issues; and
- Maintaining the original water quality by maintaining the original production profile. *wqp*

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