# The Modern Contractor's Well Rehab Toolbox

Photo courtesy Prowell Technologies Ltd.

**New innovations and improved standbys make well rehabilitation and cleaning jobs faster and more profitable.**

By Jill Ross

My dad always said that having the right tools makes the job easier. The same can be said for contractors who specialize in well rehabilitation work. They know that having the right tools for the job is the key to making work faster and more profitable. And manufacturers in the ground water industry have been more than eager to respond.

Here we'll take a look at some recent innovations in the well rehab market, and how they might help make those "problem well" jobs go more smoothly.

## Step One: Inspection and Testing

Before any work can be done on a faltering water well, the cause of the problem must be determined. Is the well clogged with bacteria or mineral scale? Is there a leak, or multiple leaks, in the well casing? Or perhaps sand infiltration is the problem?

The savvy well rehab contractor knows one of the most important tools for rehabilitation is not really a cleaning tool at all. It is the downhole video camera, which allows the contractor to get a look at what's going on below the surface and decide what the best course of action will be.

In short, a video survey will help the contractor:

- Find and view fractures, voids, water inflow, cross or inter-bed water flows, sand, gravel, grout, ground water pollution, or ground water contamination infiltration.
- View actual conditions and determine end of casing, well screen, or packer placement.
- Inspect casings, screens, and welds.

A video log is a useful tool in educating the customer about work needed on the well. Another video can be made after the well is cleaned, showing the improvements.

Before any cleaning work is begun, tests should be performed on the well to determine the well's specific capacity and the amount of yield that has been lost. A water quality test should also be conducted (see sidebar: "Steps to Take *Before* Successful Rehab").

## Step Two: Determine Course of Treatment

Successful well rehabilitation can involve chemical or nonchemical methods, or a combination of both. In this step, we'll review both the old "tried and true" methods plus some innovative new procedures.

### *Chemical Solutions*

Mineral scale and slime bacterial problems are often common problems that cause well clogging and decreased water yield over time. Following is a brief look at both.

**Mineral scale** may be the problem if the well declines slowly and somewhat

**Jill Ross** is a former editor of *Water Well Journal* and worked for the National Ground Water Association from 1996 to 2004. Today, she does freelance work from home. She can be reached at jillross72@gmail.com.

consistently over several years. A hard scale will be noticed if the pump is pulled. The problem can be iron (red/brown color), sulfates (green/blue), manganese (black), or calcium (white/tan). Bubbling or nodules may be noticed on pumps or the pump column. In a video, the scale buildup will be present in sections of the screen where water velocity is the highest.

Acids are commonly used to dissolve these scale deposits and return a well yield. Different scale deposits react differently to acids. A new acid product was developed in the 1990s by Dave Hanson, owner of Design Water Technologies, as a safer alternative to muriatic and sulfamic acid.

**Bacterial problems** are the likely culprit if well yield declines suddenly and drastically. Wet, slimy debris may be present on the pump column or in the piping system. Slime can be any color, even clear. When dry, the slime may turn into a fine powder or hardened scale. A musty, fishy odor or an oily film may appear, indicating iron bacteria. A rotten egg odor may be present, indicating sulfate-reducing bacteria. Bubbling or corrosion may be noticed on pumps or the pump column. Videos of the well may show slimy or stringy growths on the inside of the casing or screen.

Specialized chemicals to combat bacterial problems in water wells are available from industry manufacturers including Cotey Chemical, Berry Systems, and Design Water Technologies.

Before using any acids or chemicals in the well, it makes sense to remove as much of the debris from the well as possible. Less product is then required and the chemicals can more easily penetrate the formation. Sonic jetting and high-energy air pressure are some methods used to remove hardened scale. An alternate, less expensive option is to use a wire brush to clean the well, such as those available from Cotey Chemical and Design Water Technologies. The brushes can attach to cable or pipe and agitate, surge, and scrub the well.

### *Chemical-Free (or Combination) Solutions*

Several innovations and improvements on existing processes have been made in recent years. Here, we'll take a look at some of these methods. Additional information and resources can be found by referring to the table, "Common Methods for Well Rehabilitation."

**Hydrofracturing.** Using packers, underperforming zones in the well are isolated and subjected to high-pressure water which opens and flushes out new and existing cracks and fissures in the surrounding rock formation, allowing increased water flow into the well. Several industry manufacturers have developed specialized equipment for this method of well rehabilitation and redevelopment including Flatwater Fleet (Saginaw, Minnesota), Kyle Equipment (Sterling, Massachusetts), and Pine Veau Water Well Fracturing (Sydenham, Ontario).

**Wire Charge Devices.** An example of this technique is the Sonar-Jet (Water Well Redevelopers, Anaheim, California), a patented process which uses a custom fabricated detonating cord that produces a slower burn rate and has a greater gas-producing capability than a standard detonating cord. It works by using a mild harmonic frequency of shock waves to disintegrate mineral and bacterial deposits. The detonating cord has a series of pressure compensators to produce a 100-millisecond delay at each compensator point, creating a "water pick" effect, while pulsing the water at a high velocity back and forth through perforations to deep-clean the productive aquifer. Similar devices are the EnerJet, developed by Welenco (Bakersfield, California) and the Shockblasting method, available in Europe and marketed by Berliner Wasserbetriebe (Germany).

**Fluid Percussive Methods.** These methods use downhole tools that generate rapid and high-energy pulses using high-pressure air or other gas. Two that are available in North America are the AirBurst method (Frazier Industries, Muskego, Wisconsin) and the Airshock Impulse Generator (ProWell Technologies, Israel). Advantages of this method include a highly efficient shock wave and surging without using explosives, and it can be used in conjunction with new and traditional nonhazardous well treatment products to enhance the effectiveness of the overall process. The whole system is compact and portable—no rig needed.

**Carbon Dioxide Injection.** The Aqua-Freed procedure (Subsurface Technologies, Rock Tavern, New York) uses cryogenic $CO_2$ in a controlled manner to rehabilitate wells. This process is described as acting on the formation and encrustants in the well through gas expansion and freezing and thawing, which dislodges deposits, and also through the formation of carbonic acid acting under pressure. The carbonic acid acts as a mild acid, which can attack deposits. The thermal shock on bacteria and their biofilm networks also helps dislodge biofouling. No other chemicals are necessary, although some service providers will add a chemical rehab step and additional redevelopment.

**Suction Flow Control.** One development in recent years is the refinement of the controlled-inflow pump tailpipe, referred to as a suction flow control device. The device design available in the United States is the Aquastream, produced by Sand Control Technologies

TOOLBOX/ continues on page 22

#### Possible Causes for Failing Wells

1. Biofouling/bacterial contamination
2. Screen encrustation
3. Sand pumping
4. Casing/screen damage
5. Surface water infiltration
6. Changes in the aquifer or the geological area around the well site

#### Steps to Take *Before* Successful Rehab

1. Document the well construction.
2. Evaluate the change in well yield or specific capacity over time.
3. Evaluate the change in water quality over time.
4. Document prior rehabilitation treatment.
5. Sample the well water (at different depths, both static and pumping) and scale deposits for biological and chemical analyses.
6. Video log the casing and screen.
7. Pump the well to establish a baseline prior to treatment.

Source: Ulrick and Associates, *www.ulrick.com*

TOOLBOX/ from page 21

**Common Methods for Well Rehabilitation**

| Treatment | How It Works | Trade Names | Additional Information | For More Information |
|---|---|---|---|---|
| **Brushing** | A wire brush dislodges debris from the inside of the well casing | WireHog™ | Effective for cleaning well screen and casing; no effect on the surrounding formation | • Cotey Chemical *www.coteychemical.com*<br>• Design Water Technologies *www.designwater.com* |
| **Surging** | Agitation of the well with a pumping device called a surge block | n/a | Somewhat effective in reaching the surrounding aquifer; works for low-open area screens, high-open area screens, or open boreholes | Gossco Manufacturing Inc. *www.gosscomfg.com* |
| **Jetting/ Hydrofracturing** | Shooting jets of water (or other fluids) through the screen and into the formation while simultaneously pumping dislodged materials out of the well | • WFT-Well Frac™<br>• Frac-Packer™<br>• Jetting-Device™<br>• Hydro-Frac® | Packers can be used to isolate zones in the well, opening and flushing out new and existing cracks in the surrounding rock formation, allowing increased water flow | • Flatwater Fleet *www.flatwaterfleet.com*<br>• Kyle Equipment *www.hydro-frac.com*<br>• Pine Veau *www.waterwellfracturing.com* |
| **Chemicals and Acids** | Chemical solutions are available to treat specific types of biological deposits and mineral scale | • Unicid™<br>• Bioshield™ | Available in dry or liquid, mineral or organic; best when used in combination with a physical cleaning method; proper disposal is essential | • Cotey Chemical *www.coteychemical.com*<br>• Design Water Technologies *www.designwater.com*<br>• Berry Systems *www.berrysystemsinc.com* |
| **Wire Charge Devices** | A shaped or charged wire is detonated inside the well, loosening hardened deposits; gas-pressured jets move fluid back and forth through the perforations to deep-clean | • Sonar-Jet®<br>• EnerJet®<br>• Shockblasting® | Different strengths or grain sizes of detonating cord are used depending on diameter, condition, and amount of encrustation; can be followed with a chemical treatment | • Water Well Redevelopers *www.sonar-jet.com*<br>• Welenco *www.welenco.com/ener_jet.htm*<br>• Berliner Wasserbetriebe *www.bwb.de* |
| **Fluid Percussive Methods** | Downhole tools generate rapid and high-energy pulses using high-pressure air or other gas | • AirBurst®<br>• Airshock™ Impulse Generator | May be used in conjunction with chemical treatment; no chemicals required; portable (no rig needed) | • Frazier Industries *www.airburst.net*<br>• ProWell Technologies *www.air-shock.com* |
| **Carbon Dioxide Injection** | Gas expansion and freezing and thawing dislodges deposits; forms carbonic acid, which provides pressure and acts as a mild acid | • Aqua-Freed®<br>• Aqua-Gard® (for maintenance) | Injectant does not react with organic molecules; $CO_2$ is relatively safe to handle; provides a choice where chemicals may be forbidden | Subsurface Technologies *www.subsurfacetech.com* |
| **Heat** | Heat is applied to the wellbore | n/a | Best when used with a blended chemical heat treatment method | Droycon Bioconcepts *www.dbi.ca* |
| **Sand Pumping** | A suction-flow control device modifies the path of water entering the pump, forcing flow to enter the well in a more cylindrical fashion, and reduces the tendency of clogs to concentrate near the pump | Aquastream™ | Can be installed after cleaning using one of the previous methods; helps new wells maintain efficiency and can help bring back production of older wells | Sand Control Technologies (Aquastream) *www.aquastream.com* |

**(continued on next page)**

| Common Methods for Well Rehabilitation (continued) | | | | |
|---|---|---|---|---|
| **Treatment** | **How It Works** | **Trade Names** | **Additional Information** | **For More Information** |
| **Oscillating Fluid** | Creates pulsating pressure waves within the wellbore and formation fluids; these waves break up any type of near-wellbore damage and help restore the permeability | Downhole Fluidics© Oscillator | The tool is run into the well via coiled tubing, conventional tubing, wash pipe or drill pipe; the desired treatment fluid (e.g., acid) is pumped down the tubing through the tool | Downhole Fluidics *www.dhfluidics.com* |
| **Sealing Leaks** | Repairs holes, cracks, and corrosion damage that cause water leaks | High Pressure Filter-Sleeve™ | Minimum diameter loss in the casing; fits a wide range of casing diameters | Link-Pipe *www.linkpipe.com/wells.htm* |
| **Video Surveys** | Provides a look down the well; tool for diagnosing well problems and deciding treatment | • R-CAM 1000™<br>• R-2000 Dual Cam™<br>• GeoVISION™<br>• Well-Vu™ | Available in color or—black and white; 1-inch to mineshaft | • Laval Underground Surveys *www.lavalunderground.com*<br>• Marks Products *www.geovision.org*<br>• Nature Vision *www.wellvu.com* |
| **Sources:**<br>"Cleaning Wells and Pipelines," Dave Hanson, Design Water Technologies, *www.designwater.com*<br>"Recent Innovations in Well Rehabilitation," Stuart A. Smith, *www.groundwaterscience.com*<br>"Traditional Well Development and Rehabilitation," Northwest Hydro-Fracturing, *http://nohydrofracturin.qwestoffice.net*<br>Various manufacturers' Web sites | | | | |

(Pittsburgh, Pennsylvania). The suction flow control device normalizes flow across the intake stream, reducing the tendency of clogs to concentrate near the pump, controlling sand pumping and lengthening the time needed between well cleanings.

Many of these recently refined methods are not widely known or used yet. As with any new technology, education and specific training are needed. For more information on personal experience with these various methods, read Stuart Smith's article, "Recent Innovations in Well Rehabilitation" available at *www.groundwaterscience.com*.

"The costs of adapting these new methods are not insignificant, but are absolutely less costly than the effects of uncontrolled deterioration of wells and water systems," says Smith, a consulting hydrogeologist and partner at Ground Water Science Inc., Upper Sandusky, Ohio. "Besides, these costs become budgeted, regular maintenance costs instead of emergency costs. Companies that provide these services for wells may find profitable new opportunities."

## Step Three: Make Necessary Repairs to Seal Leaks and/or Seal Off Undesirable Zones

The corrosion of well casings or screens can cause holes to develop in a casing and cause the screen slot size to increase, allowing sand, fines, and gravel pack to enter the well. Traditionally, when this happens, the common fix is to install a new screen inside the damaged one, and place a new gravel pack between the two. However, this in effect reduces the size of the inner diameter of the well, dropping the capacity.

Link-Pipe, a Canadian company specializing in no-dig pipe repair products, recently developed the High-Pressure Filter-Sleeve, a ratcheting stainless steel "sleeve," to avoid this very problem. Here's how it works. A large inflatable balloon is placed inside the sleeve, and a sealant is applied to the outside of the sleeve. The sleeve is lowered into the well to the desired depth, at which time air is forced into the balloon until the sleeve expands and the sealant is pressed against the inner surface of the casing. After 30 minutes, the balloon is deflated and pulled out of the well. (For a case study of the sleeve's use in a Wisconsin water supply well, visit *www.linkpipe.com*).

## Step Four: Perform Final Video Survey and Tests

Whatever method is used to clean the well, generally a final video survey is performed, showing the visible improvement. Also, within two weeks of the procedure, a pumping test should be performed to determine the new well yield. All of this data should be presented (along with your bill, of course!) to your now completely satisfied customer. *WWJ*