WV Town Faces Drought, Leakage, Iron and Manganese
Years of Planning Result in New Plant
by Jamie Knotts
On Tap Acting Editor

Sometimes it takes an act of nature to get people’s attention. For the residents of Terra Alta, West Virginia, it was a long summer drought and a dwindling water supply that forced them to start planning for their future water needs.

Now, nine years later, the 1,500 residents are about to enjoy the taste of clean, clear water again. A new $834,000 plant and two wells will open in October eliminating the early 1900-era plant, colored water, and inconsistent supply.

Bad Things Come in Threes

Residents of this small town nestled in the hills of northern West Virginia near the Maryland border always had great tasting water and a good water supply says Water Board President Jim Sypolt. But a drought in the summer of 1989 changed that.

Water levels in the city’s well started dropping and water had to be temporarily hauled in. Luckily, the city was able to buy water from Hopemont Hospital, a nearby long-term care state facility that had its own treatment plant and stable water supply.

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Ground was broken on the new Terra Alta plant this summer.

Oklahoma Begins Technical Assistance
by Kathy Jesperson
NDWC Staff Writer

With its oil fields and agriculture, Oklahoma had many challenges to consider when developing its drinking water technical assistance program. The state’s history has a direct relationship to its future. And what has made the state so rich has affected its water supplies.

On November 16, 1907, Oklahoma became the 46th state. Its teeming oil fields brought settlers from all over the world, and the state was promptly known as “the place to strike it rich.” Cities like Tulsa, Ponca City, Bartlesville, and Oklahoma City flourished. Soon after, railroads and cattle ranches boomed because of the demand for beef along the East Coast. The state remains one of the largest cattle producers, ranking fourth in the nation.

Oklahoma’s 69,919 square miles include four mountain ranges: the Ouachitas, Arbuckles, Wichitas, and the Kiamichis. Forests cover nearly 24 percent of the state, and it has more man-made lakes than any other state. Its more than 3 million inhabitants enjoy approximately one million lakes, which have 2,000 more miles of shoreline than the Atlantic and Gulf coasts combined.

To aid water systems, the state contracted Oklahoma Rural Water Association (ORWA) to run its drinking water technical assistance program. According to Gene Whatley, director of ORWA, the association implemented three new programs to meet the state’s needs.

“These programs include capacity development, small system water treatment, and source water protection,” says Whatley. “The programs are funded through contracts with the Department of Continued on page 19
On Tap Covers a Little of This, That

As we go to press, the dog days of summer have settled in across much of the country making it sweltering and miserable. What better time for a cool, refreshing sip of safe drinking water?

Jamie Knotts, promotions editor for the National Drinking Water Clearinghouse (NDWC), stepped in briefly to edit this issue while our editor Harriet Emerson took a short break from On Tap to devote uninterrupted time to fiction writing.

Jamie got away from his computer and attended a water board meeting in Terra Alta, West Virginia, where he was amazed at the issues facing these dedicated public servants. His purpose was to gather background information for a case study about the town’s new treatment facility (see page 1), however he realized that the board meeting itself was worthy of a feature article. (See page 16.) Water board members and other decision makers across the country are sure to relate as this small community addresses drought, poor water quality, and leakage problems. Thanks to the kind folks of Terra Alta for sharing their story.

You’ll find a range of subjects covered in this issue including regulatory, operator, and general interest items. Staff Writer Kathy Jesperson examines another state’s technical assistance activities as part of our ongoing series. This time, her pen heads west to the sun-drenched state of Oklahoma. (See page 1.) She also continues her series on operator safety issues with a look at chlorine safety. (See page 10.)

Our thanks to Environmental Engineer Todd H. Dresser of the Burlington, Massachusetts, Board of Health, who alerts us to the possible risks associated with redeveloping former commercial and industrial sites. (See page 3.) Mohamed Lahlou, NDWC technical assistance specialist, examines another drinking water treatment issue in our ninth Tech Brief, which covers iron and manganese removal from groundwater supplies. (See center section.) NDWC Technical Assistance Specialist Babu Madabhushi focuses on how reverse osmosis is used in home water treatment in this Q&A. (See page 18.)

On a sad note, we say goodbye to longtime employee Diana Knott. You may remember her as On Tap’s first editor or from one of the many conferences she attended representing our organization. For the last few years, she has coordinated promotions and publications for the NDWC as well as the National Small Flows Clearinghouse and the National Environmental Training Center for Small Communities. Diana is leaving to pursue a doctoral degree in journalism at the University of North Carolina at Chapel Hill.

Sanjay Saxena
Director, National Drinking Water Clearinghouse

RUS Loan Rates Unchanged; Federal Poverty Level Changes

Interest rates for Rural Utilities Service (RUS) water and wastewater loans are unchanged.

A new poverty level, however, has been set. The rates for the fourth quarter of fiscal year 1998 apply to all loans issued from July 1 through September 30, 1998. These rates are:

- poverty line rate: 4.5 percent;
- intermediate rate: 4.75 percent;
- market rate: 5.125 percent.

To qualify for the poverty line rate, the median household income of the area served must be below 80 percent of the state’s nonmetropolitan median income or fall below the federal poverty level. Effective April 1, 1998, the new federal poverty level is $16,450, up from $16,050 for 1997. The other criterion for the poverty line rate is that the loan must primarily be used to meet health and sanitary standards.

RUS loans are administered through local or state Rural Development offices, which can provide specific information about RUS loans and applications.

For the phone number of your state Rural Development office, contact the National Drinking Water Clearinghouse at (800) 624-8301 or (304) 293-4191.
Redevelopment of Former Commercial/Industrial Sites

What are the risks?

by Todd H. Dresser, Environmental Engineer
Burlington Board of Health
Burlington, Massachusetts

As a municipal official responsible for monitoring site development proposals, I would like to alert developers, the consulting community, and regulators to increasingly common trends that could have a significant environmental and financial impact.

Since January 1997, I have reviewed 22 development proposals—11 of these involved the redevelopment of former commercial/industrial sites where contamination exists.

All communities welcome the revitalization of these properties, but we have noted a trend that, if not corrected, could cause serious consequences for the community and the developer. The original designs submitted for five contaminated sites contained one or more features that could have resulted in the uncontrolled release of contaminants or accelerated their migration.

The percentage of proposals containing potentially detrimental recommendations should serve as a warning that a comprehensive evaluation is required prior to initiating construction activities in an area where contamination exists.

Construction May Threaten Aquifers

Due to the historical use of these sites, we know that environmental contamination may or does exist at many of these locations. We have also learned that if the environmental conditions are not carefully evaluated as part of a coordinated development review process, then we run the risk of aggravating the contaminant problems and creating a number of public health concerns.

In light of the town’s role as a public drinking water producer, we place great emphasis on reviewing site plans with regard to stormwater management and aquifer protection. It was in this capacity that we noted four common construction and development activities that may threaten the local aquifer. These include:

- blasting,
- excavation and dewatering,
- stormwater management, and
- extraction wells.

In addition, we have noted that a portion of the development community considers their environmental concerns closed once an environmental Activity Use Limitation has been acquired for a site or a remedial system has been installed. This false sense of invulnerability has prompted a number of developers to propose site alterations that could have significantly enhanced contaminant migration and the degradation of the local aquifer.

What problems might arise?

The following is a general outline of some potential problems noted since the beginning of 1997 which, if not modified, could have altered contaminant migration and impacted the local water supply. This is not a complete list of potential construction problems and should only be used for educational and informational purposes. Furthermore, the intent of this discussion is to raise awareness and promote further evaluation.

Blasting Increases Fractures

We have reviewed several proposals recommending extensive blasting as a means of removing bedrock and assisting with leveling the site. The proponents had failed to consider that blasting would significantly increase the number of fractures present in the bedrock while also possibly altering groundwater migration. In each case, extensive groundwater contamination was present either at the site under review or at an adjacent site.

Prior to approving the blasting plan, applicants were requested to have their plans reviewed by a hydrogeologist knowledgeable in local contamination concerns. As a result, all blasting plans were either significantly reduced or abandoned. The primary reasons cited for this were the creation of new migration pathways, and potential negative impact on existing remedial systems. As a result of this action, the Board of Health has in several cases prevented the removal of natural barriers that inhibit the movement of contaminants to the local wellfield.

Excavation/Dewatering Cause Problems

Excavation and dewatering have also become increasingly problematic. Many developers are willing to disclose the fact that contamination is present at their site. Unfortunately, few routinely prepare contingency plans and funding to be used to test for and manage contaminated media encountered during construction activities. This increases the likelihood of occupational exposure, the accelerated migration of contaminants, and costly delays as financial and regulatory issues are resolved.

At the Burlington Board of Health, we routinely require applicants to assess this concern and prepare contingency plans. In several site plans, applicants have been able to alter their

Continued on page 4
What are the risks?

Continued from page 3

underground utility designs in order to minimize the disturbance of the contaminated material to be removed during construction. This significantly decreased their site development costs and prevented the uncontrolled migration of contaminants.

From an aquifer protection standpoint, we are primarily concerned about the proper collection and disposal of contaminated groundwater. On several occasions we have found contractors preparing to discharge contaminated groundwater directly into local water bodies or wetlands. This point re-emphasizes the need not only to develop but also to properly communicate and implement plans for managing contaminated media.

Stormwater Management Causes Concern

Stormwater management also poses a number of concerns with regard to aquifer protection. Most state and federal stormwater management guidance recommends that you maximize the onsite recharge of stormwater at each site.

This guidance has in many cases been codified verbatim as a requirement at the local level in the form of zoning ordinances or aquifer management bylaws. Unfortunately, we are finding more frequently that strict adherence to this practice could significantly harm many aquifers by actually promoting the migration of groundwater contaminants.

The types of problems we have noted related to stormwater management are the potential saturation of groundwater treatment systems or the acceleration of contaminant migration caused by the concentrated infiltration of stormwater.

In the first case, several designs have proposed the concentrated collection, storage and infiltration of a large volume of stormwater in the center of a contaminant plume. This design posed the following problems:

- the infiltration of water could create a hydraulic head and thereby enhance the migration of contaminants,
- the introduction of large volumes of relatively clean water could lower the efficiency of a treatment system and prolong remedial efforts, and
- at one location it would have reduced the ability of an extraction well to capture and contain the contaminants.

Another concern we have noted is related to the installation of drainage structures and underground utilities in areas where a high groundwater table and contamination exist. We are very concerned about creating a new conduit for contaminant migration.

We have addressed this concern by emphasizing the need to seal drainage structures to prevent groundwater intrusion while also requiring the installation of impervious check dams within the utility trenches to prevent contaminant migration.

Town Regulates Wells

Another concern has been the increasing interest in the installation and use of extraction wells for cooling and irrigation purposes. Many facilities managers consider these wells an inexpensive alternative to the public water supply. Their main concern is decreasing water and sewer bills. What many facilities managers frequently overlook is the need to consider whether groundwater contamination exists in the local area.

We have addressed this problem by regulating...
the installation and use of all wells in Burlington. As a result of this process, we have encountered a number of facilities that were so focused on obtaining an inexpensive source of water that they routinely ignored well known contamination issues present in Burlington.

Preventing the introduction of contaminants to property should be a primary concern for any facility, especially those located in a commercial/industrial setting or an area where septic systems and drywells have been historically used. Otherwise, the use of an extraction well could alter the movement of groundwater contaminants and result in a variety of regulatory and financial liability.

Further Discussion of Issues Is Needed

A final point of interest is that existing state and federal guidance does not provide a clear and concise discussion of these issues. This is a major concern because municipal agencies are responsible for reviewing and approving approximately 95 percent of the development activity in the Commonwealth of Massachusetts.

In addition, our research has determined that most municipal review boards in Massachusetts are either not prepared to review for these concerns or do not routinely do so. As a result, many municipal review boards are ill informed about these concerns and unprepared to evaluate the issues.

This problem appears to be compounded by a reluctance we have noted by developers to consider other environmental concerns in addition to site closure once an Activity Use Limitation has been acquired or a treatment system has been installed. This combination of factors raises the specter that these issues will not be reviewed until after a problem arises and an environmental impact has occurred.

Coordinated Approach Is Recommended

The intent of this discussion is to raise awareness and understanding of these potential problems. Unfortunately, due to the complexity of the issues it is not easy to draft quick and easy guidance for all circumstances. I recommend vigilance on your part and encourage you to discuss these issues thoroughly when considering the redevelopment of a parcel, as well as during the environmental site assessment and closure process.

We have noted with increasing frequency that many developers routinely overlook these issues. We strongly recommend that a coordinated approach involving both an environmental and civil engineering review be utilized when redeveloping a contaminated site. The onus is on the consulting community and developers to consider these issues in order to reduce their own financial and professional liability. Also consider the possibility that you may be put in a position that requires you to educate and inform the local reviewing authority that strict adherence to a local ordinance may be detrimental to their interests.

We recommend that everyone involved with the redevelopment of contaminated sites include these concerns with their standard review protocol. We also suggest that you discuss these issues with federal, state, and local regulators to ensure that the most environmentally viable design is adopted.

For further information, you may write to Dresser at the Burlington Board of Health, 29 Center St., Burlington, MA 01803 or call (781) 270-1956. You may also e-mail him at tdresser@burlmass.org.

In 1995, the U.S. had a population of about 267 million. Approximately 225 million people had their water delivered from a public-supply system.

U.S. Geological Survey

Newsletter Explores Small System Funding

Are you interested in learning about drinking water and wastewater funding sources, management options, and educational resources beneficial to small systems? Then you’ll want to receive Water Sense, a free quarterly publication from the National Drinking Water Clearinghouse (NDWC).

Recent editions feature articles about two often neglected groups. The Spring 1998 issue looks at funding for Indian Tribes and Alaska Native Villages, while the Summer 1998 issue explores funding for colonias along the U.S.–Mexico border.

In addition to these features, other topics examine funding for wellhead protection, and an update on the U.S. Environmental Protection Agency’s state drinking water revolving fund.

For a copy of the Spring or Summer issues of Water Sense, or to get a free subscription, call the NDWC at (800) 624-8301 or (304) 293-4191. The Spring issue is item #WSENSE14; the Summer issue is item #WSENSE15. To order by e-mail, send name, address, item number to ndwc_orders@estd.wvu.edu.

Water Sense may also be downloaded from the NDWC Web site located at http://www.ndwc.wvu.edu.
### Safe Drinking Water Act Regulatory Calendar

The following is a brief selection of key proposed and anticipated rule makings under the Safe Drinking Water Act.

<table>
<thead>
<tr>
<th>Scope</th>
<th>Schedule</th>
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</thead>
<tbody>
<tr>
<td><strong>Analytical Methods Update</strong></td>
<td>Approve new analytical methods, eliminate older methods.</td>
</tr>
<tr>
<td><strong>Chemical Monitoring Revisions</strong></td>
<td>Streamline monitoring requirements for 64 chemicals.</td>
</tr>
<tr>
<td><strong>CCRs</strong></td>
<td>Issue regulations for community water systems to issue CCRs at least annually.</td>
</tr>
<tr>
<td><strong>DWCCCL</strong></td>
<td>Development of candidate contaminants for possible regulation under the SDWA.</td>
</tr>
<tr>
<td><strong>Lead and Copper Rule Revisions</strong></td>
<td>Revisions to the Lead and Copper Rule.</td>
</tr>
<tr>
<td><strong>Radionuclides (other than Radon)</strong></td>
<td>EPA must decide what action to take regarding the proposed regulation for radium-226, radium-228, uranium, alpha emitters, and beta and photon emitters.</td>
</tr>
<tr>
<td><strong>Reformatting of Drinking Water Regulations</strong></td>
<td>To reformat the existing drinking water regulations in the CFR to make them easier to understand.</td>
</tr>
<tr>
<td><strong>Shallow Injection Well (Class V) UIC</strong></td>
<td>Minor revisions made to UIC regulations. New regulations covering Class V injection wells to be developed.</td>
</tr>
<tr>
<td><strong>Sulfate</strong></td>
<td>Regulate sulfate as authorized by the 1996 SDWA Amendments.</td>
</tr>
<tr>
<td><strong>Variances and Exemptions</strong></td>
<td>Revise variance and exception requirements to conform to 1996 SDWA Amendments.</td>
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Year 2000: Is your computer system ready?
by Kathy Jesperson
NDWC Staff Writer

Are you ready for the next millennium? If you’re asking, “Millennium. What millennium?” then maybe you won’t be surprised to learn that your computer system may not know that it’s coming either.

How can this be? Well, after December 31, 1999, many computer systems aren’t going to know what year it is. This happens because certain systems only store the last two digits of a given year. This problem is often referred to as Year 2000 (Y2K). And it could affect billing and even automated drinking water and wastewater system operations.

“In the past five to 10 years, there has been an increase in the use of computer systems in the water and wastewater industry,” noted James A. Bell, associate with Smith & Loveless, Inc., a water and wastewater treatment equipment supplier.

Besides being used for many office functions, such as billing, computers are now being used in numerous other areas. “In the pump station market, programmable logic controllers (PLCs) are often being used in place of conventional control systems,” Bell continued. “Also, many water and wastewater plants have automated their operations with central computerized monitoring systems.

Two Digits Are Missing

“The key problem concerning the impending millennial change is whether or not the PLC or computer monitoring system contains what is referred to as a ‘real-time clock’ function,” he said. “It’s this function that tells the computer when to activate certain drinking water and wastewater system operations.”

How can a simple function like the date cause a computer system to fail? “In the year 2000, a real-time clock functioning with a two-digit data field may treat ‘00’ data as the year 1900 and not 2000, causing possible system malfunctions,” said Bell. Not knowing what year it is can affect whether or not bills are sent out on time and due dates are properly calculated. And many monitoring systems within drinking water and wastewater plants that alert operators to equipment malfunctions and breakdowns may fail. Computers are also used to record and transmit data from remote locations, which could cause date-sensitive problems to arise.

It All Started a Few Years Ago

So how did we get in this mess? Would you believe that we did it on purpose? “Back in the 1960s and 1970s when computers first entered the business world, they were extremely expensive,” noted Peter de Jager an industry consultant in his article “You’ve Got To Be Kidding.”

“Most of this expense was tied directly to two aspects of computing: how much data a computer could store and how fast it could process that data,” de Jager wrote. “One way to store data was on a stiff piece of cardboard known as a Hollerith card. Each of these cards had enough space to hold only 80 characters of information, which is not a lot of information.

“Since these cards were not big enough to store all the data they needed to store, programmers had to compromise,” de Jager continued. “Rather than writing dates like 28/09/1958, they wrote 280958, saving themselves four precious characters. Unfortunately, two of those characters were the now crucial ‘19.’

Now, some 30 years later, even though computers changed, the standard didn’t, de Jager said. And the problem isn’t that easy to fix. “When someone says, ‘Put the dates back in,’ they’re making an assumption,” he continued. “They’re assuming that we know where the dates are within the programming.”

Can we find solutions?

What can you do to prepare for the 21st Century? First, you need to be aware that the problem exists. Don’t panic, but do become aware that there are solutions. Then start working on them immediately. Also find out what your suppliers are doing to address their Y2K problems. If they don’t have a plan, you may be at risk.

The Small Business Administration (SBA) recommends a checklist prepared by the Federal Reserve Board. “No single checklist fits everyone’s needs since businesses have a wide variety of services and technologies,” notes the SBA Web site. But you can use these steps to help you prepare:

• Awareness—Educate and involve all levels of your organization in solving the problem.
• Inventory—Identify and list all the different computer-based systems, components, service providers, and hardware that contain microchips supporting your business.
• Assessment—Examine how severe and widespread the problem is in your business and determine what needs to be fixed.
• Correction and testing—Implement the readiness strategy you have chosen and test what’s been fixed.
• Implementation—Use your repaired or replaced system.

Continued on page 17
Books Offer Management Information

Noted water consultant Ellen Miller has produced a series of books to help municipalities and rural water districts “get the job done.” Whether it be bond issues or construction projects, these books—known as the Water Board Bible series—help water and wastewater utilities understand the challenges that confront them.

The first edition in the series was published in 1995. Since that time, a total of five volumes have been released. The latest in the series, Getting Results From Your Experts: Engineers, Attorneys & More by Miller and Elmer Ronnebaum, was unveiled earlier this year. A wide variety of topics related to construction projects are covered in this latest volume. The emphasis is on detailing what managers must know in order to plan and implement a successful project.

Chapters deal with topics, such as “Keeping It Legal,” “Choosing the Right Expert,” and “Project Management That Gets Results.” Several useful appendices, such as a “Price Planning Checklist” and a “Sample Request for Proposals,” are also included.

The Water Board Bible series is published by the Kansas Rural Water Association and includes the following titles:


The books range in price from $9.00 to $13.80, plus shipping and handling. To order any of the books in this series, write to the Kansas Rural Water Association, P.O. Box 226, Seneca, KS 66538. They may also be reached by phone at (785) 336-3760, by fax at (785) 336-2751, or on the Web at http://www/krwa.net.

The first two books may be ordered from the National Drinking Water Clearinghouse (NDWC). Call the NDWC at (800) 624-8301 or (304) 293-4191 and request by title and item number. To order by e-mail, send name, address, item numbers, quantities you wish to order, and your phone number to ndwc_orders@estd.wvu.edu. Postage and handling charges are added to orders.

Access RESULTS Database Online Soon

The National Drinking Water Clearinghouse (NDWC) is set to release the latest version of its drinking water treatment technologies database. Version 3.0 of the Registry of Equipment Suppliers of Treatment Technologies for Small Systems or “RESULTS” will be available through the NDWC’s Web site in late September.

The database offers small communities and regulators information about technologies successfully used in other areas of the U.S., providing a valuable tool for evaluating different technologies for replacement or upgrades to current treatment systems. Equipment suppliers will also find RESULTS an effective marketing tool for reaching potential customers.

The new RESULTS version includes information from more than 1,000 sites in all 50 states and some systems in Canadian provinces. The database also includes up to 250 vendors who manufacture and supply drinking water technologies.

Searches of the database’s information can be made directly from the NDWC’s Internet Web site. NDWC technical assistants will perform personalized searches at no charge for those without Internet access. Disk copies of the database will also be available for purchase.

A number of technologies will be represented including filtration, corrosion control, ion exchange and demineralization, aeration, disinfection and oxidation, and organic and inorganic removal.

Searching the database will be easy. Searches may be conducted to learn about a location where a particular system is in place, vendors or manufacturers of various technologies, a specific technology used by other systems, and the type of drinking water contaminant removed.

The new version RESULTS, a project of the NDWC funded by the U.S. Environmental Protection Agency, will be available in late September.

To access RESULTS, log on to the NDWC’s Web site located at http://www.ndwc.wvu.edu.
**SCOPe Pilot Program Helps Communities**

Small communities may soon have key concerns and potential areas of conflict addressed earlier in the regulatory process thanks to the Small Communities Outreach Project for Environmental Issues (SCOPe) pilot program.

Because small communities are often at a disadvantage in terms of resources, information, and ability to participate in the regulatory process, the National Association of Schools of Public Affairs and Administration (NASPAA) started this program that allows small communities to actively participate in rulemaking.

According to SCOPe consultants, if small communities were better informed and participated in early regulatory development stages, regulators could find solutions earlier in the rulemaking process and avoid costly changes. In time, SCOPe hopes the quality of life in small communities will improve as a result of its efforts.

Through a network of NASPAA schools, information will flow between small communities, the U.S. Environmental Protection Agency (EPA), and other interested parties. Three graduate schools will choose approximately 12 to 20 communities to participate in SCOPe. The project will track regulatory developments for the communities and explain EPA rules and regulations in an understandable manner. Information will be gathered from the communities and relayed back to SCOPe for evaluation.

At this time, SCOPe is a pilot project limited to communities in the southeastern U.S. with the expectation that the program will expand to other regions. No time frame has been established for implementing SCOPe nationally.

An advisory council has been selected to provide direction and contacts for the project and includes Richard Phalunas, Ed.D., who represents the National Drinking Water Clearinghouse and its sister organizations, the National Environmental Training Center for Small Communities and the National Small Flows Clearinghouse.

For more information about SCOPe, visit their Web site at http://www.naspaa.org or call (202) 628-8965.

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**West Virginia Forms Drinking Water Coalition**

West Virginia has established a new coalition with the goal of providing educational and training opportunities for those responsible for the day-to-day operation of public water systems. Following the lead of similar efforts across the nation, the coalition brings together several groups to tackle issues that each may be unable to address individually.

Founding members of the West Virginia Drinking Water Education and Training Coalition include the West Virginia Section of the American Water Works Association (AWWA), West Virginia University’s National Drinking Water Clearinghouse (NDWC), West Virginia Environmental Training Center, West Virginia Rural Water Association, West Virginia Rural Community Assistance Program, West Virginia Public Service Commission, and the West Virginia Bureau for Public Health.

“The formation of this Coalition represents the first formal, cooperative effort that addresses the common goal of improved drinking water in West Virginia,” said Sanjay Saxena, the Coalition’s chairman and director of the NDWC.

In addition to developing and coordinating training programs, Coalition members will explore the establishment of a hands-on training facility. The Coalition’s work will strive to help drinking water system personnel meet the latest state and federal requirements.

West Virginia’s coalition is modeled on national efforts that began in 1990 with the formation of the National Training Coalition made up of representatives from the U.S. Environmental Protection Agency, AWWA, Association of State Drinking Water Administrators (ASDWA), National Environmental Training Association, National Rural Water Association, and Rural Community Assistance Program.

For more information about forming a coalition in your state, the National Training Coalition offers a State Training Coalition Starter-Kit for $85. This large package offers a number of tips for organizing a coalition. Place your order by contacting ASWDA at 1120 Connecticut Ave., N.W., Suite 1060, Washington, DC 20036. They may be reached by phone at (202) 293-7655 or by fax at (202) 293-7656.
Chlorine Safety: Know What You’re Doing

by Kathy Jesperson
NDWC Staff Writer

Editor’s Note: This article continues our look at safety issues facing operators. It provides an overview of chlorine handling, transportation, and storage.

For more than 90 years, chlorine has been the most prevalent disinfectant in the U.S. for drinking water supplies and municipal wastewater. Its use has virtually eliminated waterborne diseases, such as cholera, typhoid, dysentery, and hepatitis A, according to the Chlorine Chemistry Council (CCC).

“Chlorine belongs to a group of elements known as halogens and is found naturally in combined states only—chiefly as sodium chloride or ordinary table salt,” explained the Pure Water Solutions Web site. “It is manufactured commercially by running an electric current through salt water. This process produces free chlorine, hydrogen, and sodium hydroxide.”

According to the Occupational Health and Safety Administration (OSHA), because chlorine is considered an extremely reactive element and its accidental release could be harmful or even fatal, it must be handled with extreme care. Therefore, its handling, storage, and transport are federally regulated.

Exposure Can Be Fatal

Accidental exposure to chlorine can pose some serious health risks. According to the U.S. Environmental Protection Agency’s (EPA) Technology Transfer Network (TNNWeb), acute exposure to chlorine at high levels greater than 30 parts per million (ppm), results in chest pain, vomiting, toxic pneumonitis, pulmonary edema, and even death. At lower levels (less than 3 ppm), chlorine is a potent irritant to the eyes, the upper respiratory tract, and lungs.

Chronic health effects of chlorine exposure include weight loss, eye and nose irritation, respiratory tract inflammation, and kidney and liver damage. Chlorine may also corrode teeth as well as increasing a person’s susceptibility to tuberculosis.

EPA’s TNNWeb further noted that no information is available about the carcinogenic effects of inhaling chlorine. Most of the studies available were designed to investigate the relationship between chlorination byproducts found in drinking water, such as trihalomethanes, and cancer in humans. These studies show an association between bladder and rectal cancer and chlorination byproducts.

Because of these health threats, whether immediate or long-term, OSHA urges all employees to be familiar with emergency procedures, the location and proper use of emergency equipment, and the methods of protecting themselves during rescue operations. Workers should also familiarize themselves with regulations regarding any hazardous material with which they must work. And there’s more than one organization regulating chlorine.

Know the Regulations

The U.S. Department of Transportation (DOT), EPA, and OSHA regulate chlorine. DOT and OSHA require that chlorine be labeled as a poisonous gas. DOT also requires diamond-shaped DOT warning signs, which must be visibly posted on vehicles carrying 1,000 pounds or more of chlorine. Manifests—or records—must be kept when any quantity of chlorine is transported.

When chlorine is delivered by truck, the truck should never be allowed to keep its motor running during unloading. If a chlorine cylinder should develop a leak, the combination of chlorine and carbon monoxide from the vehicle’s exhaust forms phosgene, which is a deadly gas that prevents oxygen uptake into the bloodstream.

Storing chlorine also poses some risks. Since chlorine gas expands rapidly, the May 1988 edition of the Uniform Fire Code requires chlorine storage rooms to be equipped with exhaust ventilation systems large enough to handle the entire contents of the single largest氯.
tank or cylinder of chlorine.

“If you rupture a cylinder, it won’t explode,” explained Ken Dennis, president, Dennis Chlorination Service. “But the liquid contents will almost immediately turn to gas. One cup of compressed chlorine gas in a liquid form will expand approximately 460 times. It is two and one-half times heavier than air and will fall into low-lying areas.”

Since exposure may be fatal, OSHA’s Hazard Communication Standard [29 CFR 1910.1200] requires an emergency procedure plan. If 10 or more pounds of chlorine are accidentally released into the atmosphere within a 24-hour period, employers are required to notify the National Response Center as well as state and local authorities.

In addition to these codes, EPA requirements under the Clean Air Act (CAA), rule 61, effective August 19, 1996, make it necessary for all utilities storing 2,500 pounds of chlorine or more onsite to develop Risk Management Plans (RMP). These plans must include hazard assessment, accident prevention, and emergency response programs, including worst-case scenarios. Programs must be in place and RMPs submitted to EPA by June 21, 1999.

Precautions Must Be Observed

According to the Water Environment Federation’s (WEF) textbook, Wastewater Disinfection, the following precautions should be observed by operators when connecting cylinders to the manifold:

- Flexible connectors should always be replaced if they are discolored, become crimped, or emit a crackling or screeching noise because connectors may rupture without warning.
- A chlorine respirator should always be worn when changing cylinders, and all valves must be closed before breaking connections in the pressure lines.
- Use the buddy system when changing cylinders and performing maintenance on pressure components.
- A system should never be operated when a leak exists or a component is not working.
- Equipment should be operated first on manual control to determine that the hydraulic, vacuum, and pressure systems are all working properly.

Follow the Rules

These recommendations should be considered when handling chlorine gas:

- Do not expose cylinders to heat.
- Never tamper with the valve.
- Never lift the cylinder by the protective hood that covers the valve.
- Do not drop cylinders or knock them over.
- Always chain cylinders to a wall. Cylinders should be chained to the hand cart as well.
- Do not connect two or more cylinders to a common manifold because of the possibility of rupture.
- Do not store cylinders near elevators, stairwells, or air intakes, or anyplace where fumes can spread and contaminate other places.
- Store cylinders separately from other chemicals, and make certain that they are properly labeled.
- All facilities using chlorine should keep a leak repair kit on hand. The kit should contain clamps, drift pins, hammers, wrenches, and other tools necessary to stop the leak.

Source: Dennis Chlorination Service

Plan Risk Management Programs

“Prevention is the emerging aspect of the CAA requirement for RMP,” said Julie Vanden-Bosch, EPA communication team member. “EPA believes that this regulation will lead to the reduction of risk in surrounding communities.

“All facilities must submit a plan for the worst-case scenario, and those facilities that are a part of Program 2—where we expect many wastewater and drinking facilities to be—must submit an ‘alternative’ or more realistic scenario,” Vanden-Bosch continued. “They must also talk to communities about what this means. A worst-case scenario takes into account what would happen if the uncontrolled release of all of the chlorine onsite should occur over a ten minute period within a five-mile radius.

“In general, the risk of worst case scenarios is very low,” Vanden-Bosch continued. “Combining them with worst case weather conditions make it even less likely. It could still happen, but it is unlikely. Alternative, or more realistic scenarios, generally have smaller quantities and lower release rates than worst-case scenarios.

“They also allow you to take into account your active and passive mitigation systems. That means most facilities have prevention valves that can stop chlorine leaks before they hit the air,” Vanden-Bosch said. “They also have trained personnel to help clean up leaks, and this includes local fire departments. The thing we want to

Continued from previous page
**Chlorine Safety: Know What You’re Doing**

Continued from page 11

stress is that planning for accidents and taking steps to prevent them is necessary. “These plans will eventually be publicly available via the Internet,” Vanden-Bosch continued. “We have two model plans in development that will help when utilities are ready to develop their plans. These will also be available on the Internet.”

**Setting up a Safety Program**

An RMP is only part of a good safety program. According to the WEF’s textbook, “the first step toward the safe design and operation of a disinfection facility is the understanding of the properties of various disinfectants.”

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**What to do in an Emergency**

OSHA requires that certain emergency procedures be followed in the event that an accidental release of chlorine should occur. These include:

- Notifying safety personnel;
- Removing all sources of heat and ignition;
- Keeping all combustibles away from the leak;
- Ventilating potentially explosive atmospheres;
- Evacuating the spill area for at least 50 feet in all directions;
- Finding and stopping the leak without risk; if this cannot be done the cylinder must be isolated until all gas has dispersed; and
- Using water to reduce vapors; but not pouring water onto the spill or leak area.

Source: Occupational Health and Safety Administration

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There are three commonly used forms of chlorine: solid calcium hypochlorite, liquid sodium hypochlorite, and chlorine gas. “Where a large amount of chlorine is required, chlorine gas is preferred over sodium hypochlorite because of its cost effectiveness,” noted the CCC.

The DOT classifies calcium hypochlorite as a corrosive and rapid oxidant. Sodium hypochlorite is classified as a corrosive agent and chlorine gas as a nonflammable corrosive gas under pressure.

**Calcium Hypochlorite**

Calcium hypochlorite is considered unstable and combustible, and it may react unpredictably when combined with many common substances, such as petroleum products, oils, fats, grease, acids (even mild ones), and sugars. The reaction when combined with one of these substances may be termed as explosive.

Also, chlorine gas may spontaneously emit from powdered chlorine in storage, especially under high temperatures. Therefore, calcium hypochlorite should be kept in a cool, dry, well-ventilated storage area. Containers should not be stored with other chemicals or in an area where it can be exposed to direct sunlight.

Operators who work with calcium hypochlorite should always wear eye protection and dust masks. They also should always have immediate access to an eye wash and shower facility.

Calcium hypochlorite is typically used in strengths of 60 to 65 percent.

**Sodium Hypochlorite**

Sodium hypochlorite is a liquid form of chlorine and comes in a variety of strengths. It is considered unstable and corrosive with a shelf life of approximately 90 days. Large amounts of chlorine gas can be liberated spontaneously from liquid chlorine upon contact with oxygen.

Eye protection and access to emergency eye wash stations and shower facilities are recommended for operators handling sodium hypochlorite. This chemical may also cause severe burns to skin and clothing, so protective clothing is recommended as well.

Sodium hypochlorite is typically used in strengths of 5.25 to 15 percent.

**Chlorine Gas**

Chlorine gas should always be treated as if it were moist chlorine, which is very corrosive. “It is an irritant, a suffocant, and a vesicant (a substance that causes blistering). It will support combustion of iron and steel at approximately 200 degrees C (400 degrees F),” according to WEF’s textbook.

“Chlorine gas is detectable by smell at low levels, and has a green-yellow color at higher levels of concentration in the atmosphere,” noted WEF’s textbook. “At levels below one ppm, it is undetectable unless instrumentation is used.

OSHA has set the maximum contaminant level (MCL) at one ppm over an eight-hour period.”

“Chlorine gas is its own best warning system,” said Dennis. “It has a distinct smell and irritates the eyes and throat. When you mix chlorine with water you get hypochlorous acid.

“Acid in your lungs will not come out,” Dennis continued. “Your body tries to produce fluid to dilute the chlorine, and your lungs will fill with fluid—basically you will drown yourself.”

**Handling Leaks**

“Most leaks happen when you’re changing cylinders,” said Dennis. “Never change a cylinder by yourself. Be careful of how much force you use... Continued on next page
EPA Survey Looks at Water System Trends

The survey results are in, and they help present a picture of the nation’s water systems. In 1995, the U.S. Environmental Protection Agency (EPA) conducted a Community Water System Survey to collect information to support its regulatory development initiatives. Earlier surveys were conducted in 1976, 1982, and 1986. Results of the latest survey show that:

- The percentage of systems that do not treat their water steadily declined from 1976 to 1995.
- In spite of the decrease in systems not providing treatment, only 19.5 percent of the capital investment made by community water systems is for water quality improvements.
- Standard financial ratios indicate that many small community water systems are not financially healthy.
- More than one-third of all community water systems participate in some type of source water protection effort.

Chlorine Safety: Know What You’re Doing

Continued from previous page

when you’re opening a valve. If the valve will not open, do not force it. Send it back to the manufacturer you bought it from, or have someone from the company come and open it for you.

“If you suspect a leak, use an ammonia solution to help you find out where it’s coming from,” said Dennis. “Attach a small cloth or swab soaked with ammonia water to one end of a stick, and apply it to the suspected area. If there is a leak, a white, smoky cloud will form around the area.”

Some leaks aren’t always obvious. “Valves that are discolored are a good indication of a leak,” Dennis explained. “You should always have access to a capping kit because a minor leak mixed with humid air creates an even bigger leak due to the corrosive action.”

Dennis also recommends conducting monthly safety drills so workers will be familiar with emergency procedures.

Where Can I find More Information?

More information about chlorine safety may be obtained by contacting the following government agencies:

- **Occupational Health and Safety Administration**

- **U.S. Environmental Protection Agency**

- **National Institute of Occupational Safety and Health**
  For information about workplace safety, call (800) 35-NIOSH. Visit their Web site at http://www.cdc.gov/niosh/homepage.html.

- **U.S. Department of Transportation**
  Information about highway safety may be obtained by calling (202) 366-1153. Transit safety may be obtained by calling (202) 366-1398. And railroad safety may be obtained by calling (202) 493-6300. Visit their Web site at http://www.dot.gov.

- A Tech Brief about disinfection is available through the National Drinking Water Clearinghouse (NDWC). This four-page fact sheet may be obtained free of charge by calling the NDWC at (800) 624-8301 or (304) 293-4191. Ask for item #DWBLPE47.

- A fact sheet about chlorine will be available in September 1998 as part of the Environmental Technology Initiative (ETI). This fact sheet may be obtained by calling the National Small Flows Clearinghouse at (800) 624-8301 or (304) 293-4191. To notify the National Response Center of a leak, call (202) 426-2675.
Years of Planning Result in New Water Plant

Continued from page 1

When the rains came and well levels returned to normal, a new problem emerged. Leak detection tests showed that only 30 to 40 percent of potable water was getting to the 640 customers—much lower than the state-recommended 85 percent. Up to 60 percent of treated water was being lost due to antiquated lines, some installed as early as 1910.

On top of these problems, iron and manganese began leaching into the wells, giving customers either black or orange water (see Tech Brief in the center section for more information about iron and manganese removal). Clearly, something needed to be done.

New Pipe Is Laid

The problems Terra Alta faced spurred the community to look for help. With a loan and a grant from the Rural Utilities Service (RUS), along with a Small Cities Block Grant, nearly 90 percent of the town’s distribution lines were replaced in 1991. More than 80,500 linear feet or 15.25 miles of lines were installed, coupled with 60 new fire hydrants and 110 new gate valves.

The town drilled two new wells, abandoned four inefficient wells, and reconditioned their 200,000 gallon storage tank. Total cost for the project came in at slightly more than $2.62 million.

Iron and Manganese Problems Remain

The new distribution system and wells addressed the supply problem, but the poor water quality issues remained. Residents complained that the city’s colored water was staining their clothes and sinks. They also worried if their water was safe.

Chief Water Treatment Operator Ted Nice ultimately answered residents’ complaints. He and his co-workers Randy Sigley and Ken Barnard found themselves not only treating the water and maintaining the plant, but educating the public.

“Once we explained that the iron and manganese weren’t harmful and described what we were doing to help the problem, the residents seemed to understand,” Nice says.

Flushing hydrants in low areas where the iron and manganese settle seems to help the situation. A schedule calls for flushing every two months, but when the complaint calls come in, the lines get flushed more often.

But flushing hydrants would never be the solution to the problem, Nice says. Filtration would be the answer if only the city had the space to install it at the treatment plant—space they didn’t have.

And then there was the more pressing problem—three of six wells were directly under the influence of surface water contamination. However, the remaining three wells could not consistently provide enough water to meet customer demands if the contaminated wells were abandoned. They also needed to address violations for having wells close to a stream and a sewage plant.

More than a general rehabilitation of the current treatment facility was necessary. New wells that offered greater capacity and a plant that could offer filtration were needed.

Town Learns the Hard Way

In the mid-1990s, local leaders set out to find funding for the new project. With the assistance and advice of an environmental consulting firm, they contacted—and later secured—sources to fund the project.

Gary Powell, an eight-year water board member, says numerous letters were mailed to government agencies and state and local elected officials seeking support. (See story on page 16 about Terra Alta’s Water Board.)

“We kind of learned as we went along,” says Powell. “The engineering firm had worked with two other small towns in the county, so they were able to put us in contact with sources to get the project moving.”

A $520,000 loan and a $150,500 grant came from the West Virginia Infrastructure and Jobs Development Council. An additional $163,500 was left over from the 1991 RUS grant used for line replacement.

Continued on next page
Powell says the water board wanted to keep the loans low enough so they could make payments using current income generated from customers. Their goal was to avoid increasing rates because a proposed new sewer facility would likely force customers to pay higher sewer rates.

To the Drawing Board

With funds secured, Thrasher Engineering began designing the new plant that is set to open in October 1998. A site was chosen just outside town that provided more space and room to grow if needed. Design plans call for a 50x32 foot building, an antral/sand filtration unit, turbidity monitors, an automatic backwasher, settling tank, laboratory section, and two new wells.

Nice, one of eight Class II operators in the local community, says the new plant will be in a different category, a Class II Plant. He says workers will regularly test for turbidity, something they currently are not required to do. Workers also will need to monitor the plant 24 hours a day, seven days a week—a change from their current 8 a.m. to 5 p.m. schedule.

Upon the recommendation of West Virginia University Geology Professor Henry Rauch, two new well sites were located 75 feet apart. Each will be able to produce 175 gallons a minute and about 350,000 gallons a day. A six-inch pipe will connect the wells located some 700 feet from the plant.

Both wells tap water from a different location, so iron and manganese will be less of a problem. The new treatment technologies being installed should take care of any problems that could occur over time.

Town Looks to the Future

Capacity was an issue with the old plant, but the new facility should meet the needs of the community. Along with serving Terra Alta and Hopemont hospital, which abandoned its plant and now uses Terra Alta’s water, the new plant will be large enough to serve two nearby communities—Alpine Lake and Corinth.

Board Member Powell says the plant could also handle the needs of a proposed prison that may be built in the area.

“If a business of that stature moves into the area, we’ve got the capacity at the plant,” he says. “We may need to drill another well, though.” He says the prison could employ as many as 1,000 people, a massive boost to the local economy.

Powell is pleased that since the first problems appeared in 1991, the project will soon be completed.

“We’ve had water problems for the last few years,” he says. “Wells have caved in and we’ve rebored them and dealt with the colored water too. The new plant and good water will be another selling pitch for people to move into town.”

Nice and his two fellow treatment workers are looking forward to the move. The new, larger facility will be a big change from the current cramped, noisy, and run-down treatment plant.

Their only apprehension is that the new plant sits approximately 50 feet from an active railroad track. A derailment a few years earlier in downtown Terra Alta sent a rail car careening through the basement of City Hall. “We’re not too happy being that close to the tracks, but we’ll be glad to get out of here [the current plant],” Nice says.

If there’s a message other small communities facing water quality or supply problems can take from Terra Alta’s example, it is that patience, hard work, and persistence pay off when a community works together for a solution.

A companion article to this piece appears in the Summer issue of Water Sense, a sister publication to On Tap. The Water Sense article addresses the financial planning needed to secure the town’s new water system.

For a free copy of Water Sense, call us at (800) 624-8301 or (304) 293-4191 or download it from our Web site located at www.ndwc.wvu.edu.
“If the Residents Only Knew What We Do…”

Water Board Tackles Town’s Problems

by Jamie Knotts
On Tap Acting Editor

It’s Thursday evening—cool for early June—as Terra Alta’s Water Board members, one-by-one, enter city hall for their monthly meeting. All but one have already put in eight hours at their regular jobs. And with numerous town water issues ahead of them tonight, they won’t be getting home until the sun has long set.

The Mayor, Charlie Feather—or “Fez” as the name tag on his light brown work uniform says—is the first to arrive and unlock City Hall. “You mean your wife let you out for the evening?” quips Rus McConnell as he follows behind into the darkened, red brick building.

Rus and Charlie have a few more years of experience on them than the others at tonight’s meeting. The 60-something year olds are separated by only a couple of years. Rus is a retired school teacher having put in 42 years in the local school system, but Charlie still works for a local heating and cooling dealer.

The others file in shortly thereafter. Ted Nice and Randy Sigley—both full-time water treatment workers in their twenties—take their places along side the others at the long, brown conference table. Someone says that Gary Powell can’t make it tonight and that Board President Jim Sypolt is running a little late. Jim soon walks in, his arms filled with a stack of papers. The meeting begins.

Line Extensions and Bad Water Woes

A concern from Claudette Frantz is first on the agenda. She lives one-half mile beyond the last tap on her country road and hopes the board can extend lines to her house. Lightening took out her pump several years ago around the time the well went dry. A hand-dug cistern now feeds her pump several years ago around the time the well went dry. A hand-dug cistern now feeds her family’s needs.

News reports of Terra Alta receiving funding for a new treatment plant that will eliminate the alternating black or orange water has brought her to the meeting. (See the cover story on page 1.) “If it doesn’t rain,” she says, “I don’t have water. I have three teenage boys…. It’s getting real frustrating. When it rains, I wash clothes and we take a bath. And sometimes the bath water is brown, but we’re happy to have it,” she says.

Discussion turns to how far the lines would extend on her country road and hopes the board can extend lines to her house. Lightening took out her pump several years ago around the time the well went dry. A hand-dug cistern now feeds her family’s needs.

News reports of Terra Alta receiving funding for a new treatment plant that will eliminate the alternating black or orange water has brought her to the meeting. (See the cover story on page 1.) “If it doesn’t rain,” she says, “I don’t have water.

“Tread the Baths boy…. It’s getting real frustrating. When it rains, I wash clothes and we take a bath. And sometimes the bath water is brown, but we’re happy to have it,” she says.

Discussion turns to how far the lines would need to be extended and the number of households that could share in the cost of the extension.

Someone mentions that a housing development was proposed nearby and that would have been helpful in the cost sharing if only the bank loan had gone through.

All agree that Ted will measure the distance for the line extension and calculate the costs. Help might be available for the line extension if the rumored new local Public Service District pans out.

In the meantime, Claudette says she’ll make do with the higher than average rainfall this season and then pay the local fire company $35 for each load of water they deliver in the dry season. “I don’t care if its the old system or the new one (alluding to the poor water quality of current system). I just want water,” she says as she exits the meeting.

Next on the agenda is a petition from residents of Corinth, a small community located a mile from city limits. With iron and manganese in their well water leaching from old coal mines, residents want to be connected to Terra Alta’s system. (See Tech Brief: Iron and Manganese Removal in the center section.)

A look at the signatures shows that some of the 100 or so appear to be those of children, which will likely have to be disallowed. After discussion, the board recommends studying the request and bringing it up again at the next board meeting. Community leaders and a representative from the West Virginia Public Service Commission (PSC) will be asked to attend.

Why do I have to pay if I didn’t use it?

The subject of water leaks and water bill adjustments is raised. A resident’s letter is read asking that his bill be adjusted because an in-ground leak just outside his house led to a higher-than-normal bill.

Ted, the chief water treatment worker, offers his advice. He explains that he tried to verify that the leak was outside the home but couldn’t—the owner hadn’t dug a hole and he couldn’t tell. Instead of following the city’s procedure for leak verification, the homeowner had supposedly repaired the leak himself and now wanted the rate adjustment.

Board members briefly talk among themselves and decide to draft a memo to the man explaining what had happened—he hadn’t followed proper procedures and couldn’t be reimbursed for the higher bill. Several roll their eyes suggesting this wasn’t the first time—or last—they had faced a similar situation.

Payment Is Due the First of the Month

Delving deeper into testy financial issues, Jim almost reluctantly brings up the issue of an...
overdue bill. A customer wrote a letter asking the board to hold a check until a certain date and not shut off water service in the meantime. The check would cover a portion of the man’s bill while the remainder—nearly $400—would be paid in full at the end of the month. Doubt appears to be the collective look on their faces. Perhaps they’ve heard this story before.

Someone suggests that Ted speak to the man and explain that he must sign a written agreement to pay his outstanding bill. Another disagrees saying the PSC likely wouldn’t allow the board to force the customer to pay an arbitrarily set amount. All expect that Ted will have to walk a fine line between asking and telling the man how much should be paid.

Outstanding Bills Keep Piling Higher

Further discussion explores the stack of outstanding bills that has come before them. The number and total amount come as a bit of a surprise.

“Jiminy Crickets!” Jim blurts out as he sees the $15,000 in outstanding debts for last month.

“We’ve got payments coming up on this new plant,” he says. “I’ve got feelings for these customers, but what if I have to choose between making a payment and paying my workers? What am I going to do? Lay off my workers?”

There’s talk about the community’s relatively low income and how it is difficult for some on a fixed income to make ends meet. A proposed prison for the area would provide a great economic shot in the arm if it goes through, but some aren’t sure it will happen.

“Residents asked us not to raise rates for a new plant and we didn’t,” Jim says. “But how can we go on with over $15,000 on the books?”

“Heck, Ted, the politicians don’t want to raise taxes and we don’t either,” Rus says with a smile.

“Did I mention to you that I’m going to resign next month,” Rus says with a grin on his face.

“I didn’t ask for these problems or this job.”

Even the Little Issues Must Be Addressed

There’s a brief exchange about insurance issues. After researching different coverages and rates, Jim says he has found a provider that will save the water board $2,000 per year. Coverage will be $2 million instead of the current $1 million, but with a higher deductible.

The new water plant’s color scheme must be chosen. Jim mentions they need to select colors for the roof, gable ends, gutters, and walls. Of the options—green, red, Santa Fe, and brown—no one seems to have a preference and elect to have Jim make the choice.

Someone jokes, “Just make sure it’s a good color so when the politicians stand in front it makes them look good.” Everyone laughs.

Sensing the meeting is winding down, Ted brings up the issue of pay raises. Ted, Randy, and Ken Barnard—the part-time operator who shares time with the sewer department—are paid hourly. Jim wonders aloud whether the city’s other workers will be getting in raises this year.

The mayor, Charlie, isn’t sure how much the increase will be, but mentions that some of the workers are unhappy with the wide disparity in pay among the nine employees. He says that he would like to bring them all to an equal level. Across the board increases and proportionate raises based on skills also come up. They agree to discuss it later.

It’s now two and half hours since they began. Time to go home. As they gather their things to go, Jim mentions each board member is paid $40 per month to tackle the city’s water issues.

“After taxes,” Jim says, “I get $34.60. If the residents only knew the time and work we put in all month long for that check.” His words drift off as they all exit the building into the cool evening air.
How is RO used in home water treatment?

For the last 10 years, reverse osmosis (RO) has been used for point-of-use treatment in households. These can be either countertop or undersink systems, but many different household RO systems are available. Generally RO, a pressure driven process, operates at a pressure of 100 pounds per square inch (psi) for household use. Low pressure unit production ranges from 5-15 gallons per day, with purity of approximately 95 percent. These units may cost from $200 to $500, with maintenance costs ranging from $50 to $120 per year. But these systems may not be economical for producing water for daily use except for drinking and cooking.

What is reverse osmosis?

RO is a process that separates contaminants from water by forcing water through a semipermeable membrane. This membrane is selective about what it allows to pass through, and what it stops from passing through.

Osmosis is a natural phenomenon where two solutions of different concentrations, on two sides of a semipermeable membrane, try to attain equilibrium. The only possible way of reaching a state of equilibrium is for the solution of lesser concentration to pass to the other side by penetrating the membrane and diluting the solution with the higher concentration. This is caused by the natural osmotic pressure.

RO is the reversal of osmosis. By applying pressure (ranging from 300 to 1500 psi) against the osmotic pressure, the solution with the higher concentration can be forced to pass through the membrane leaving behind the contaminants on the other side of the membrane. The solution that is passed through the membrane is called permeate and the solution containing the contaminants is known as concentrate. The same principle can be applied in drinking water treatment. The contaminated water can be forced through the semipermeable membrane, leaving the contaminants on the other side of the membrane.

The typical semipermeable membrane consists of several thin layers of cellulose acetate or thin film polyamides that are bonded together. The pore size of the membrane is 0.0006 microns (the size of a smallest known bacteria is 0.02 microns). The selection of a membrane for any application is critical as each type has significant chemical limitations.

What can be removed by reverse osmosis?

RO can remove a wide variety of contaminants from water. If effectively designed, RO equipment can remove contaminants that cause unpleasant taste, color, and odor problems, such as a salty or soda taste caused by chlorides or sulfates. RO removes colloids, organics, and salts. It can substantially reduce dissolved metals, such as calcium, magnesium, sodium, and manganese. RO is also effective in removing contaminants such as arsenic, asbestos, atrazine (herbicides/pesticides), fluoride, lead, mercury, nitrate, and radium.

It can remove bacteria and viruses, and in some cases, RO is capable of removing biological contaminants, such as Cryptosporidium. But RO may not remove any dissolved gases and certain organic chemicals like chloroform.

To enhance the life of the membranes, pretreatment of the influent water is required. With proper pretreatment, such as carbon filtering, volatile contaminants including benzene, trichloroethylene, trihalomethanes, and radon can be removed.

What is the treatment efficiency?

RO can remove most dissolved mineral salts, particulate matter, and dissolved organic compounds. Literature suggests that total dissolved solids removal can range from 80 to 95 percent. Removal percentages are dependent upon pressure, pH, and prefiltration.

If not properly pretreated, the suspended particle deposit on the membrane surface can result in “membrane fouling.” Membrane fouling increases the resistance to the flow of water through the membrane. It also causes lower productivity at constant pressure or requires higher pressure for constant productivity.

The approximate removal percentages for some of the contaminants are listed below. The percentage removal varies with the type of membrane, the pressure applied, and the concentration of untreated water.

What are the advantages of RO?

The advantages of the process include:

• higher purity of treated water,
• ease of installation and operation, and
• substantial savings in operation costs. The reduced operating cost is due to fewer chemical requirements when compared to ion exchange system’s regeneration and waste neutralization. Lack of proper pretreatment may negate the savings of the process due to the need for frequent chemical cleaning or membrane replacement.

Conclusion

RO is an innovative, relatively new, cost effective, modified application of a well-established natural process than can now be used in...
Oklahoma Begins Technical Assistance

Continued from page 1

Environmental Quality (DEQ) from set-aside monies under the Safe Drinking Water Act (SDWA)."

Capacity Development Aids Systems

Whatley says that the capacity development program aids systems that have applied for drinking water state revolving fund (DWSRF) loans. “We perform evaluations and try to help the system improve its operational and managerial ability to meet the requirements of the SDWA,” he says. Objectives of the capacity development program include improved:

• compliance with drinking water standards,
• compliance with monitoring and reporting requirements,
• quality of service to customers,
• quality of water system management, and
• board member knowledge about efficient water system operations.

Small Surface Water Systems Get Help

The small system water treatment program provides these systems with operational improvements of their treatment plants and helps them maintain compliance with expanding U.S. Environmental Protection Agency (EPA) requirements mandated by the enhanced surface water treatment rule and the disinfection byproducts rule. Program services include evaluation of intake and raw water quality, coagulates and dosages, settling efficiencies, filtration practices and efficiency, and disinfectants and disinfection practices.

“The biggest problem we see is turbidity,” says Jesse Vaughn, small system treatment technical assistant. “We help systems understand what chemical dosages they should be using. We also help them order equipment they may need,” he continues. “We help them with laboratory analysis and just basically try to help them become better operators.”

Vaughn recognizes that good operator training is vital to helping a water system run as smoothly as possible. “We provide a four-hour certification renewal program for operators who need to be recertified to continue working,” he says. “We also provide certification classes for operators to become certified or upgraded to a higher level of certification. Operator certification has been mandatory in Oklahoma for years.

“Our laboratory certification exam includes a hands-on portion as well as a written test,” Vaughn explains. “This ensures that the operator knows exactly what to do in the plant. Oklahoma requires that water systems have a certified lab technician on staff to run water tests. That’s a separate certification process, so training is really important here.”

Source Water Protection Begins

The last program is the source water protection program, which is aimed at helping small water systems comply with EPA requirements for source water assessments. The program will assist water systems in local efforts to assemble teams, locate potential sources of pollution, develop contingency plans, and implement management practices and controls that protect drinking water sources through an approved source water protection plan.

For more information about Oklahoma’s technical assistance program, call Gene Whatley at (405) 672-8925.

Jesse Vaughn, small system treatment technical assistant

How is RO used in home water treatment?

Continued from previous page

homes. With continual advances in system and membrane design that enhance efficiency, dependability, and reliability, RO is expected to be used extensively in water treatment in the years to come.

References


For more information, call the National Drinking Water Clearinghouse (NDWC) at (800) 624-8301 or (304) 293-4191 and ask a technical assistance specialist to search the NDWC’s bibliographic database for more articles on the subject.

The NDWC also offers a product that examines the use of reverse osmosis as a city’s water treatment method. The case study, “City of Cape Coral Reverse Osmosis Water Treatment Facility,” costs $2.05. You may order this product at the numbers above or via e-mail at ndwc_orders@ndwc.wvu.edu.

“We help them [small systems] with laboratory analysis and just basically try to help them become better operators.”

Jesse Vaughn, small system treatment technical assistant
NDWC Offers Help for Small Systems

Note: The free items listed below are limited to one of each per order. Actual shipping charges are added to each order. Call (800) 624-8301 or (304) 293-4191 to order products. National Drinking Water Clearinghouse (NDWC) products also may be ordered via e-mail at ndwc_orders@ndwc.wvu.edu. Please allow three to four weeks for delivery.

- **Financing for Small Public Water Systems**  
  *Item #DWBFLN04*  
  This 20-page U.S. Environmental Protection Agency (EPA) report identifies the major potential funding sources for small communities and provides information on how to find funding.  
  *Cost: $2.90*

- **Office of Ground Water and Drinking Water Publications**  
  *Item #DWBKGN23*  
  This 65-page book contains a listing of more than 400 available drinking water publications distributed free. Included are such items as fact sheets, technical assistance documents, youth educational materials, and scientific reports.  
  *Cost: $0.00*

- **Improving the Viability of Existing Small Drinking Water Systems**  
  *Item #DWBKGN06*  
  This 48-page EPA document discusses ways others have successfully addressed problems common to small drinking water systems. Case studies, contacts, and suggestions for implementing state programs are included.  
  *Cost: $6.90*

- **Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities**  
  *Item #DWBKDM04*  
  This 209-page EPA document discusses various treatment technologies that can help systems when upgrading or designing new facilities. An overview of each technology, its performance, design considerations, costs, and operation and maintenance requirements are provided.  
  *Cost: $30.05*

- **Yes, You Can: Two Small Towns Show How To Save Money and Water**  
  *Item #DWBRPE08*  
  This brochure outlines how the communities of Lorena, Texas, and Bern, Kansas, saved money and water through public education about conservation.  
  *Cost: $0.00*

- **Methods for Assessing Small Water System Capability: A Review of Current Techniques and Approaches**  
  *Item #DWBLTR13*  
  This EPA manual was developed to help states understand and apply available methods for assessing water system capacity. It addresses small system capacity, provides examples of assessment methods, and explains system-level assessments for existing systems.  
  *Cost: $0.00*