CHASTAIN-SKILLMAN, INC.

ENGINEERS • ARCHITECTS • SCIENTISTS • SURVEYORS

CONSULTANT'S UPDATE

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NEW STANDARD CONSTRUCTION CONTRACT FORMS

By Suzanne S. Hunnicutt, AIA

For many years, architects and engineers have encouraged the use of standard construction contract forms rather than custom drafted documents. Within the last year, three different construction industry associations have issued or reissued groups of standardized construction contract forms. These are: the American Institute of Architects (AIA), the Engineers Joint Contract Documents Committee (EJCDC) and a new organization called ConsensusDOCS, which is comprised of about 20 contractor and owner associations, the largest and most influential of which is the Associated General Contractors of America (AGC).

The AIA published their first standard agreement forms 120 years ago and today their group of over 100 contract and administrative forms are the most widely used throughout the construction industry. The AIA documents are updated every ten years. The most recent update was issued in November of 2007 and contained approximately 40 new or revised forms including the A201 "General Conditions of the Contract for Construction" which is the cornerstone for their most popular "family" of documents.

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CHLORINE RESIDUAL IN WATER SYSTEMS

By James R. Chastain, Jr., PhD, PE, MPH

The injection of chlorine in public water systems as a disinfectant has been one of the great public health advances in modern times. Because of its required use, relative to other parts of the world, the United States has all but eliminated the waterborne diseases which take such a toll on human life and productivity elsewhere. While chlorine is not the only disinfectant available for water purification, it is certainly the most widespread, as it is highly effective and generally the least expensive.

Chlorine is normally applied as part of the treatment process prior to pumping into the distribution system. As a multi-use treatment chemical, chlorine can be applied for oxidation of organic and inorganic contaminants, substitution reactions with certain chemicals and, of course, disinfection.

Beyond its use within the treatment plant, United States regulations have long considered it necessary to carry a chlorine residual into the distribution system in order to maintain the integrity of the water while being delivered to the customer. The putative objectives of carrying a chlorine residual are as follows:

- Inactivate microorganisms in the distribution system
- Indicate variance in distribution system water quality
- Control biofilm growth.

(Chlorine—Continued on page 6)

EOH NEWS

- ***US Court of Appeals Strikes Down EPA Clean Air Mercury Rule (2/8/08)***
  For more information, visit http://www.eponline.com/articles/58324
- ***OSHA's Construction Confined Space Standard Comment Period Ends 2/28/08, Construction Community Feedback; Critical and Negative***
  For more information, visit http://www.ohsonline.com/articles/58735

INFECTIOUS DISEASE

- ***CDC Panel Recommends Flu Shots for All Kids (ages 6 months to 18) in the 2009 – 2010 Season***
  For more information, visit http://abcnews.go.com/Health/ColdFlu/story?id=4353731
- ***Multi-drug Resistant (MDR) TB at Highest Level Ever in 20 Countries, Over 45 Countries with Reported Cases***
  For more information, visit http://www.ohsonline.com/articles/58919

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SURVEY DISCREPANCIES BETWEEN SURVEYORS & FIRMS

By J. Richard Noland, Jr., PSM

I wish I had a nickel for every time I heard someone say "you can't get two surveyors to agree." Usually the person making the statement had a bad experience with overlapping boundaries, or possibly elevation differences on a project site, and never received a reasonable explanation. There are reasons why this happens, and I will explain only two common ones.

"The Survey" is what happens in the field, and the end product is generally the "Map of Survey." The client usually only sees the "Map of Survey," and not the effort it takes to produce the "Map of Survey." Prior to sending a field crew to the project site to perform "The Survey," there is research that must be done. This is one area that causes a lot of discrepancies. Research, for some surveyors, is obtaining a copy of the tax map if performing a Boundary Survey. The more research a surveyor does in the geographical area he is working in, the better historical understanding he will have of that area. If your property description begins with a phrase similar to "Commence at the Northeast corner of the Southwest ¼ of Section 11, Township 28 South, Range 25 East," the surveyor who only has a copy of a tax map sends his crew in the field to survey your description, and the crew may return with a location of a railroad spike they found at the centerline of a paved road. The spike happens to be in the vicinity of the Northeast corner of the Southwest ¼, and the surveyor uses this spike in his calculations for your boundary, not knowing that the spike was set 10 years earlier by the County survey crews, and was never intended to mark the Northeast corner of the Southwest ¼. The spike was set to monument the centerline of the road right-of-way only, not the Northeast corner of the Southwest ¼. However, the surveyor who performs proper research prior to sending his crews to the field may know there is a railroad spike set approximately 6' west of where the true land corner should be. Thus, he can instruct his crews of this and, when they look 6' east of the spike, they find a 4"x4" concrete monument that was set prior to the road being paved. This example could lead to a 6' discrepancy in where the boundary would be marked by the two surveyors.

Another common discrepancy is vertical (or elevation) differences. Elevation basis as shown on "Maps of Survey" should reference the benchmarks used to perform the survey and the corresponding vertical datum to which it is referenced. There are two basic vertical datums: National Geodetic Vertical Datum of 1929 (NGVD29), and North American Vertical Datum of 1988 (NAVD88). The most common in Polk County is NGVD29, due to the frequency of benchmarks with this datum. Benchmarks are permanent markers set in the ground which have a fixed elevation set on it by a level network and adjusted to the referenced vertical datum. Benchmarks are generally set by government agencies, and the data is available to the public. The government agencies vary greatly in accuracy standards and level of care when setting their benchmarks, so it is fairly common to have a benchmark from one agency that does not work with a benchmark from another agency. Compounding these issues are surveyors who find one benchmark and begin working. Two benchmarks are needed to verify that one has not been disturbed. We had an instance where an agency called to ask why our elevations differed from the adjoining parcel elevations surveyed by another firm. Both sites were being reviewed by this agency at or near the same time. We reviewed our quality control measures taken on our project and found nothing lacking. We had run a level loop between two well-established benchmarks that were established by the Florida Department of Transportation. We then investigated the adjoining surveyor's one benchmark reference and found that it had been established in 1980 on a fire hydrant. When we visited that benchmark, we found that the fire hydrant had a dated stamp of 1997 on the side. Thus, the other surveyor had used an elevation on a fire hydrant that was not there anymore; it had been replaced. Had that surveyor checked into a second benchmark, he would have caught this discrepancy prior to producing a "Map of Survey."

There are many different instances were discrepancies can arise. Proactive quality control measures are important in preventing such discrepancies.

Richard Noland serves as Senior Project Manager in Chastain-Skillman's Lakeland office and has over 21 years experience in the survey profession. He can be reached at (863) 646-1402 or Rnoland@chastainskillman.com.

PLEASE JOIN US AS WE WELCOME OUR NEW ASSOCIATES

In Lakeland

Stephen D. McConn, PE, comes to us from the Atlanta area. From our **Lakeland** location, he will serve our clients as a Sr. Engineering Consultant/Civil Department Assistant Manager. Steve received his Bachelor of Science Degree in Civil Engineering from Georgia Tech University and has experience working at engineering design firms and directly for land development firms.

In Tampa

We also welcome Deanna L. Ives to our **Tampa** office staff. A Pasco County native, Deanna is a St. Leo College graduate, having earned her Bachelor of Science degree in Environmental Science. Deanna will fill the role of Industrial Hygienist.

IS YOUR PETROLEUM CLEANUP PROGRAM SITE ALREADY ELIGIBLE FOR STATE OF FLORIDA FUNDED CLEAN UP?

By Tom E. Lewis, PG, MBA

In 1986, The Inland Protection Trust Fund (IPTF) was created by the State of Florida (State) legislature to enable the Florida Department of Environmental Protection (FDEP) to respond to incidents of petroleum contamination without delay. The IPTF is derived from a tax on every barrel of petroleum or petroleum product produced in, or imported into, the State. This tax revenue is the source of the majority of the FDEP's petroleum cleanup funding programs, generally known as "the Petroleum Cleanup Program."

Though the State no longer provides assistance for newly reported discharges, there are six possible ways a site can obtain State funding assistance and a site may qualify for more than one. The first four ways to obtain State funding is by already being enrolled and determined eligible in one of the four Petroleum Cleanup Programs, only one of which can apply to a specific discharge:

Early Detection Incentive Program (EDI)(1986)

This was the first State assisted cleanup program and provides for 100% State funding for cleanup if the property owners report releases. The application period ended in late 1988.

Petroleum Liability & Restoration Insurance Program (PLRIP) (1989)

This was intended for active facilities. The State underwrote the restoration of insurance coverage for new discharges and subject to various caps and deductibles depending on the date the discharge occurred. The State coverage ended on December 31, 1998.

Abandoned Tank Restoration Program (ATRP) (1990)

This program was created to address contaminated facilities that were out of business as of March, 1990, and provides for 100% State funding. Although the ATRP application period ended in June 1996, the window is open indefinitely for property owners who are unable to pay for closure of abandoned tanks.

Petroleum Cleanup Participation Program (PCPP) (1996)

This was created to include sites that were excluded from all previous opportunities for State assistance. The program is only for discharges reported prior to 1995, and the application deadline was the end of 1998. The responsible party must pay a percentage of cleanup costs and prepare a limited assessment at their own expense.

Generally, once cleanup program funding eligibility is assigned to a site for a discharge, it remains with the site regardless of changes in real property or storage tank ownership. However, the FDEP looks first to the current property owner for payment of any required deductible or co-payments.

In addition to these four Petroleum Cleanup Programs, a fifth way to obtain State funding assistance is if a Consent Order provides for some level of State funding assistance based on ability to pay. Lastly, Preapproved Advanced Cleanup (PAC), though not a separate eligibility program, provides a mechanism for obtaining funding assistance for an already eligible site in advance of the site's priority score.

A common aspect of the initial four eligibility programs is the order in which petroleum contamination assessments and remedial cleanups are performed. They are based on each site's ***priority score***. The priority score for each petroleum site was established in accordance with criteria set forth in Chapter 62 771, FAC, "Petroleum Contamination Site Priority Ranking Rule." This rule awards points based upon the site's potential threat to human health, public welfare and the environment. The priority score is therefore a number that represents the relative threat the site poses to potential receptors, with a higher score representing a greater threat. On July 1, 1995, the ***priority score funding threshold*** was set at 70 points, meaning that only eligible petroleum cleanup sites with a priority score of 70 points or more were entered into state funded assessment and remediation. Over the last 13 years, this priority score funding threshold has been lowered (and raised) to accommodate more and more sites as cleanup on many of the initially funded sites was completed. Currently, the priority score funding threshold is 37. Because of this funding system, a facility with an incorrect score may be excluded from state funded assessment and remediation that would otherwise increase the facility's property value.

So, how is this priority score derived? Surprisingly, the magnitude and extent of contamination has relatively little impact on the score, and it is quite possible to have a large and/or highly contaminated site with a low priority score. Because the priority score represents the relative threat posed to potential receptors, the most important criterion is the site's location in relation to public and private drinking water wells. A low priority score indicates that there are no known receptors for that contamination, so its relative threat is less than that of a site that may be less contaminated but is closer to receptors.

All program sites were assigned a priority score when they initially became eligible for funding assistance. Potable well survey data from the Florida Department of Health (DOH) was used in support of priority score. There are two common scoring mistakes that occurred for some sites. The first common error is an improper site location (latitude/longitude) that causes the site to be farther from a receptor. The second common mistake is the omission of nearby residential potable well receptors that are not in the DOH well survey data.

These errors can have a big impact on a site's priority score, especially when given that the current priority score funding threshold is 37 points. For example,

(Petroleum—Continued on page 5)

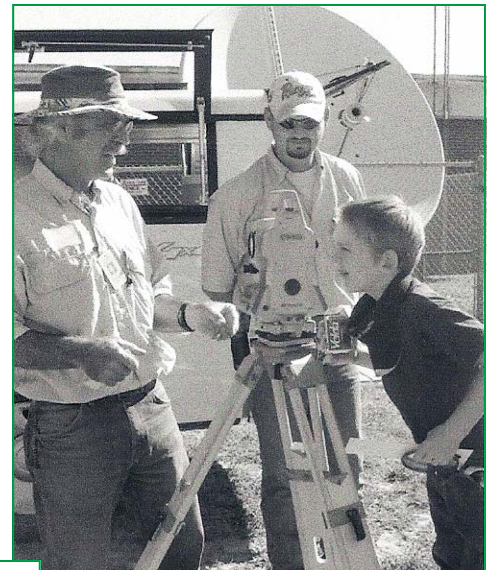
Great American Teach-In

By H. Everette Richards, Jr.& Michael H. Saites

On November 14, 2007 Chastain-Skillman sent my survey crew to participate in the great American Teach-In at Lena Vista Elementary, in Auburndale.

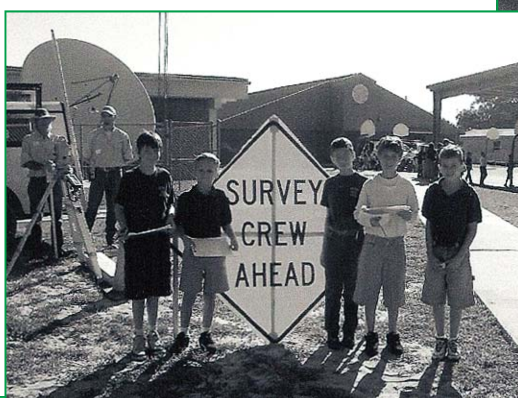
We were able to educate several grades throughout the school about our profession, the kind of work we perform on a daily basis and the type of equipment we use. The students were allowed to interact with the equipment as we informed them on what each piece of equipment was used for, and why. They really liked the total station and data collector. We let them look though the total station and showed them how it measured angles and distances. We then answered their questions about the equipment and procedures.

The Teach-In was a wonderful educational experience for the students, teachers, as well as us. I enjoyed attending the teach-in and would encourage others to get involved, as it prepares the kids of today for tomorrow.



Everette Richards serves as Survey Crew Chief in Chastain-Skillman's Lakeland office and has 10 years experience in the survey profession.

Mike Saites serves as Survey Instrument Man in Chastain-Skillman's Lakeland office and has 18 years experience in the survey profession.



Announcements

Paul Bizier, P.E., BCEE, has been selected by the Water Environment Federation (WEF) to serve as an author in a major update of the WEF/ASCE manual "Design of Municipal Wastewater Treatment Plants." This manual serves as an important design guideline for environmental engineers nationwide. Paul directs the Environmental Engineering design group for Chastain-Skillman, and has been with the firm for 23 years.

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an uncontaminated municipal or community well field with greater than 100,000 gallons per day permitted capacity having just one well located within ½ mile of a site could increase that site's priority score by 30 points (if previously no such wells were found within ½ mile of the site). In addition, if just one private well (constructed prior to the date of contamination discovery) is located within ¼ mile of a site, it could increase that site's priority score by 20 points (if previously no such wells were found within ¼ mile of the site). Other factors that can increase the score are wells being located downgradient of a site, or if a well field's 1 foot draw down contour is shown to encompass the site (regardless of the well field's distance from the site).

Because errors can reduce a site's priority score below the funding threshold, significant delays to the State funded cleanup can occur as a result. Eliminating known contamination issues often increases a site's property value and it is important for the property owner or the confirmed responsible party to take action should they suspect the priority score for a site is too low. The site score can be re-evaluated, if requested in writing to the FDEP by the property owner or the confirmed responsible party. This request must include supporting documentation such as maps, photos, and/or well permits. Chastain-Skillman, Inc. can assist the property owner or the confirmed responsible party with this process if they choose Chastain-Skillman, Inc. as the designated cleanup contractor for the respective site(s). This can be accomplished by signing FDEP's *Contractor Designation Form & Real Property Owner/Responsible Party Affidavit* (CDF), which Chastain-Skillman, Inc. can prepare and submit for the property owner or the confirmed responsible party.

Tom Lewis is a Senior Hydrogeologist in Chastain-Skillman's Tallahassee Office. His work focuses on environmental site assessment, environmental site rehabilitation and geologic/hydrogeologic projects. Tom received a Bachelor of Science Degree in Geology from The College of William and Mary in 1994, and a Master of Business Administration from Bellevue University in 2000. He can be reached at (850) 942-9883 or tlewis@chastainskillman.com.

(Forms—Continued from page 1)

The EJCDC was formed in 1975 for the purpose of developing documents for projects involving professional engineering services. Therefore, their group of over 60 documents are geared toward and most frequently used for infrastructure projects such as transportation and utility construction. In March 2007, the EJCDC released a new edition of over 20 of their documents including their own cornerstone document, C-700, entitled "Standard General Conditions of the Construction Contract."

ConsensusDOCS published their first set of documents in September of 2007. Their documents are based on standard forms previously developed by the AGC and another influential member of the organization, the Construction Owners Association of America. This group of over 70 documents also contains a general conditions document, ConsensusDOCS 200.

Each of the three associations claims that their documents are the most "fair and balanced." In reality, they each bear the mark of the organizations that created them and have some significant philosophical differences. Each group of documents also has some unique aspects as well. The AIA documents have the distinct advantage of having been tested and refined in court over a long period of time. The EJCDC documents include a number of specialized forms dealing with issues specific to engineering projects. The ConsensusDOCS group has developed a unique new three-way agreement between owner, designer, and contractor called ConsensusDOCS 300 "Standard Form of Tri-Party Agreement for Collaborative Project Delivery."

Although the three groups differ on which standard documents are the best, they all are in agreement on one thing. Standard documents are highly preferable to custom documents that always favor the drafting party, require more careful legal review, contain language not standard to the construction industry, and are untested in court.

Suzanne Hunnicutt is Vice-President of Architecture, and works out of Chastain-Skillman's Sebring office. Her work focuses on the design of office, institutional and industrial buildings for both public and private clients. Suzanne received a Bachelor of Design degree in 1975 and a Master of Architecture degree in 1980 from the University of Florida. She can be reached at (863) 382-4160 or shunnicutt@chastainskillman.com.

RECENT PROJECTS AND CONTRACTS OF INTEREST

Chastain-Skillman is again assisting two long standing clients with design of much needed wastewater treatment plant capacity. Our Environmental group is designing expansions to double the size of both the Auburndale Regional WWTP (from 2 MGD to 4 MGD) and the Doug Allen WWTP in Bartow (from 4 MGD to 8 MGD). You can learn more details about each of these projects on our website at www.chastainskillman.com. The combined construction cost for these two expansions, which will include considerable off-site transmission expansions as well, totals approximately $40 million.

(Chlorine—Continued from page 1)

There are perennial professional debates about how and whether these objectives are achieved, but regulations are clear that the residual is to be maintained.

Types of Chlorine Residual

Actually, chlorine residual is a generic term which covers a number of different forms of chlorine that remain in the water. It is important to carefully define these different forms, because they have different germicidal properties. Because chlorine is a chemical in aqueous solution, in order to discuss these different forms, it is necessary to briefly sketch the primary chemical reactions.

Most water plants introduce chlorine through a chlorinator which safely transfers chlorine gas into the water. Because chlorine gas is highly toxic, most chlorinators limit the chlorine injection rate to approximately 3500 mg/L so that the probability of chlorine degassing is very low. The hydrolysis reactions of chlorine gas into aqueous solution proceeds according to the following simplified equations:

$Cl_2 + H_2O \rightleftharpoons HOCl + H^+ + Cl^-$ where HOCl: Hypochlorous acid

$HOCl \rightleftharpoons H^+ + OCl^-$ where OCl^-: Hypochlorite ion

As might be expected from equations of this form, chlorine functions as a weak acid in water. The speciation can be estimated using the equations:

$$\frac{[H^+]\,[Cl^-]\,[HOCl]}{[Cl_2]} = 4 \times 10^{-4}$$

$$\frac{[H^+]\,[OCl^-]}{[HOCl]} = 2.7 \times 10^{-8}$$

It can then be seen that these dissociation equations are in dynamic equilibrium. The proportion of the chlorine which exists as HOCl versus OCl^- in pure water is dependant on the temperature and pH of the water. Of course, any background demand or reactions will be satisfied before the residual is established. In other words, when chlorine is applied to the water it will immediately react with other substances in the water which are amendable to oxidation, such as manganese or sulfides, and thus be removed. After those reactions occur, the chlorine that remains will be available as a residual.

Some Chlorine Reactions of Interest

Because chlorine is such a strong oxidizer, it reacts with a wide range of chemicals. Some of these initial reactions involve organic materials which, when reacting with chlorine, may form compounds that are potentially carcinogenic. These compounds are generally classified as Disinfection By-Products (DBP). State and federal regulations limit the levels to which they can exist in drinking water. The regulations focus on trihalomethanes (THM) or haloacetic acids (HAA5) as primary indicators of this occurrence. The specific chemicals forming these groups are:

a) Total THM: chloroform, bromodichloromethane, dibromochloromethane, and bromoform and

b) Haloacetic acids – 5: monochloroacetic acid, dichloroacetic acid, trichloroacetic acid monobromoacetic acid and dibromoacetic acid

The reason that DBPs have become a topic of concern is that some toxicological and epidemiologic studies have identified a number of these parameters as being carcinogenic in animals or associated with cancer (primarily bladder cancer) in epidemiological meta-analyses.

Another reaction of interest is the one between chlorine and ammonia. This is highlighted for several reasons. First, ammonia is an indicator of contamination, as well as a contaminant itself, at sufficient doses. Therefore, any time that ammonia is found, the source and concentration distribution should quickly be traced. Chlorine is an effective means of dealing with ammonia in limited concentrations.

Second, somewhat paradoxically, ammonia is sometimes mixed with chlorine to form chloramines, which are in turn used as another form of disinfection residual. This is because chloramines are more stable in distribution systems and are desirable because of the tendency to form fewer disinfection byproducts. Chloramines exist in three forms given by the equations below. These reactions typically proceed in stepwise fashion depending on the available hypochlorous acid. Monochloramines are the preferred form of use in water systems due the potential for taste and odor problems associated with dichloramine and nitrogen trichloride.

$NH_3 + HOCl \rightleftharpoons NH_2Cl + H_2O$ (monochloramine)

$NH_2Cl + HOCl \rightleftharpoons NHCl_2 + H_2O$ (dichloramine)

$NHCl_2 + HOCl \rightleftharpoons NCl_3 + H_2O$ (nitrogen trichloride)

Nomenclature for Chlorine Residual

As mentioned, chlorine is active and exists in a number of different forms which have different disinfection potentials. This is further complicated by the fact that chlorine residuals can be developed using chlorine dioxide and sodium hypochlorite. Therefore, it is necessary to develop a nomenclature for classifying these forms to assure that appropriate disinfection occurs. The most common forms of chlorine residual referenced in technical literature and in environmental regulations are listed below.

Free Available Chlorine Residual: concentration of hypochlorous acid and hypochlorite ions existing in chlorinated water.

Free Chlorine Residual: refers to a chlorinated water in which at least 85% of the total measured chlorine residual is hypochlorous acid.

(Chlorine—Continued on page 7)

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Combined Chlorine Residual: refers to the chlorine residual that consists of chloramines.

Total Chlorine Residual (or Total Available Chlorine) is the sum of Free Available Chlorine Residual and Combined Chlorine Residual.

The term "Available Chlorine" is sometimes used in technical literature and can be confused with the terms mentioned above. The term, rather than referring to a specific concentration in water, refers to the oxidizing power of the compound tested. It is possible that the term could be used in conjunction with a compound that doesn't contain chlorine at all in that it is computing the equivalent oxidizing power of the compound related to chlorine. White (1999) believes the term should be discontinued because it can be confused with the legitimate term "free available chlorine."

Causes of Chlorine Residual Decay

Once water has exited the treatment plant and entered the distribution system, it can not be assumed that the chlorine residual will remain constant. Water system operators know that, in reality, the level and form of the chlorine residual is variable throughout the distribution system. This loss of disinfectant residual can weaken the barrier against microbial contamination which can occur within the distribution system. Many people assume that because the distribution system remains under positive pressure that intrusion into the system isn't likely to occur. However, this is not necessarily true.

Contamination can enter the system by cross-connections or pipe line breaks. Cross-connection control programs are required by the State of Florida (Chapter 62-555.360 FAC), however, complete compliance is difficult to achieve. Pipe breaks or construction intrusion are usually followed quickly by line disinfection, but often times there is a lag between the initiation of the event and final disinfection of the system. These events can result in consumption of chlorine residual which serves as both an indicator of contamination and an agent to fight the results of contamination.

Chlorine residual will also decay "naturally" within the system as a result of reaction of chlorine with materials in or on the pipe wall. This can be either the pipe material itself or biofilms or sediment at the pipe surface. The ability to predict this chlorine loss is difficult due to the variable physical characteristics of pipes within the distribution system (e.g., age, construction material, diameters, encrustation, etc.) To simplify the process, most designers assume that the chlorine residual decays as a first order reaction. The fundamental characteristic of this assumption is that "contact time" is the primary variable driving the decay. Decay coefficients can be estimated by laboratory tests, but again there is variance within the system. What is observed, however, is that water age can be significantly correlated to chlorine residual decay. Recall that water age is the amount of time that water remains in the distribution system after it leaves the water plant. Knowledge of water age within various zones of the distribution system can be a useful tool in monitoring chlorine residual in the field.

Controlling and maintaining chlorine residual can be challenging. As mentioned above, a number of communities are switching to chloramines (combined chlorine) as a disinfectant rather than free chlorine. Combined chlorine is less reactive and therefore more stable within the system. While this means that it is a less powerful disinfectant, it does persist in the distribution system better and therefore can be a more reliable secondary disinfectant.

Communities with a progressive approach to maintaining a reliable in-system chlorine residual many times will undertake a program of pipe replacement and flushing. Florida water system rules require quarterly flushing of dead end lines, but a more proactive program looks for other areas too. An intelligent flushing program does not promote indiscriminant water use. Rather, the city's computer model (extended period simulation) is used to identify the locations and most efficient means of flushing. This activity should be done in conjunction with the community water conservation plan so that water is not unnecessarily wasted.

In conclusion, chlorination of drinking water has been a key factor in the dramatic reduction of waterborne disease in the United States. Secondary disinfection in the form of maintaining a chlorine residual within the distribution system is important. The chlorine residual can take several forms with have different disinfection (oxidation) potentials, decay rates and byproduct formation. Chlorine residuals vary from point to point within a distribution system as a result of chlorine decay. This occurs for a number of reasons and water system operators must monitor their system and take a proactive approach to maintaining an adequate residual while not over-chlorinating or over-flushing.

References:

White, G. C. (1999). Handbook of Chlorination and Alternative Disinfectants (4th ed.). John Wiley & Sons, Inc. New York, NY.

Mays, L.W. (2000). Water Distribution Systems Handbook. McGraw-Hill. New York, NY.

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This newsletter is provided solely for informational purposes and presents only highly condensed summaries relating to the topics presented. Therefore, it should not be relied upon as a complete record for purposes of regulatory compliance, nor is it intended to furnish advice adequate to any particular circumstances. For additional information on any of the topics in this newsletter, please contact the author, or Allan Duhm, (863) 646-1402, or e-mail us.

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