Indiana Water Operator Training Manual

Lesson Six – WT2 operators

Contents

WT2 systems and operators

Both water systems and water system operators receive classifications from IDEM. As discussed in Lesson one, a class WT2 (Water Treatment 2) system includes systems with no population limitations that meet the following:

(A) Acquire water from one (1) of the following:
  (i) Ground water
  (ii) Purchase

(B) Utilize chemical feed to achieve one (1) of the following:
  (i) Disinfection
  (ii) Fluoride standardization, or
  (iii)Water stabilization

A grade WT2 operator is a certified operator qualified to operate a glass WT1 and WT2 water treatment plant after having fulfilled the following requirements:

(A) Possess a high school diploma or its equivalent

(B) Meet the qualifications of the certification rule

(C) Must be able to:
  (i) maintain inventories;
  (ii) order supplies and equipment; and
  (iii) interpret chemical and bacteriological sample reports

(D) Attain one (1) of the following acceptable work experience requirements:
  (i) One (1) year in the operation of a class WT2 water treatment plant
  (ii) Two (2) years in the operation of a class WT1 water treatment plant

Chemical feed devices

Dealing with devices that feed chemicals into the water system is a fact of life for many water system operators. Chemicals fed include chlorine, fluoride, potassium permanganate, poly phosphates, lime and others. Most feeders differ from others because the characteristics of chemicals are different.

The design of chemical feeders may vary for the same chemical if that chemical comes in different forms. Chlorine is a good example.

Chemical form	Feeder design
Chlorine pellets	Pellet dropper drops pellets into well
Chlorine tablets	Tablet feeder installs inline and tablets dissolve
Chlorine gas	Tank-mounted feeder on 150 lb. cylinders
	Manifold wall-mounted feeder for 2,000 lb. cylinders

How to calculate chemical feeds

Pounds of Chemical required = Flow (in million gallons per day)
X 8.34 X desired dosage (in mg/l)
or
Pounds = MGD X 8.34 X mg/l

(8.34 is the weight of a gallon of water)

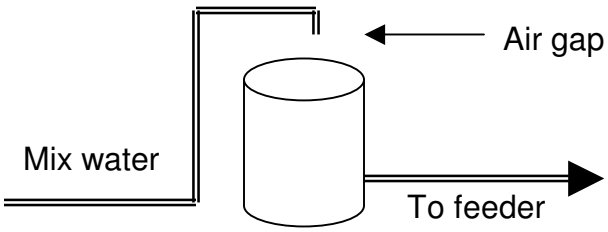
Don't forget to adjust for chemical concentration. If you use bleach that is five percent chlorine, then it will take 20 pounds of the bleach to get one pound of chlorine.

Let us look at an example:

Step 1	Step 2
You want to feed Fluoride at 1 ppm (mg/l) You pump 100,000 gallons per day You are using sodium fluoride (NaF), that is 44% available fluoride (the rest of the compound is sodium) Lbs. = MGD X 8.34 X mg/l Lbs. = .1 X 8.34 X 1 Lbs. = .834 We still need to factor in the available fluoride	To figure the availability factor, divide 1 by the percentage In this 44% fluoride example, 1/.44 = 2.273 Multiply the required pounds by the availability factor .834 X 2.273 = 1.896 pounds of fluoride solution needed to treat 100,000 gallons of water with a concentration of 1 ppm

Day tanks

A day tank is a tank that is filled with a chemical mixture that is fed into the water system over a period of time.



In the previous example, NaF was used. It is usually mixed at about 2%.

This day tank holds about 100 gallons

20 pounds into 100 gallons = 2.4%

Remember, 100 gallons of water weighs 834 lbs.

20÷834=.0239

With a NaF concentration of 2.4% and an availability of 44% F, there are .088 lbs. of F in each gallon of the day tank solution. (.024x.44x8.34=.088). 1.896 lbs. of F are needed to treat 1,000,000 gallons of water in a day. 1.896÷24= .079 lbs. per hour. If the feed pump is set at a rate of .015 gpm, it will deliver 21.6 pounds of solution per day. (.015x60x24=21.6). 21.6x.088=1.9 lbs.

Disinfection

Disinfection can reduce or eliminate many pathogens. It provides some protection from cross connections and may assist in filtration. Automatic disinfection can reduce the isolation area (sanitary setback) from 200 feet to 100 feet.

Generally, chlorine is the most practical method for disinfection. Choices for chlorine include gas, bleach, powder and tablets. Other common options for disinfection include ultra violet (UV), ozone and hydrogen peroxide.

Chlorine (Cl_2) characteristics

- Chlorine is a toxic, yellow-green gas
- Heaver than air (2 ½ times)
- Highly reactive
- Iron ignites when heated in a chlorine atmosphere
- When pressurized, Cl_2 is a liquid
- Used as a weapon in WWI, killing nearly 2,000 and injuring over 164,000
- People can smell Cl_2 at 0.02 ppm
- 1,000 ppm (0.1%) will kill you in a couple of deep breaths

In drinking water, chlorine is measured as free and total. Free chlorine is the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl) and/or hypochlorite ion (OCl-). Total chlorine is free chlorine plus combined chlorine. Combined chlorine is also known as chloramines and is often referred to as a spent bullet.

Always maintain a free chlorine residual at all points in the water system of at least .25 mg/l and no less than 1 mg/l total chlorine throughout the system. If .25 mg/l free chlorine cannot be obtained without going a lot over 1 mg/l total chlorine, say > 2 mg/l, look into possible problems such as iron bacteria, ammonia or other organics.

Fluoride standardization

Fluoride is a naturally occurring element found to be beneficial in reducing tooth decay. According to the Indiana State Department of Health, people who drink optimally fluoridated water from birth will experience approximately 20-40 percent less tooth decay in their lifetime. A desirable concentration of fluoride is .8 to 1 mg/l. Some water systems already have some fluoride in their water, so be sure to determine your water supply's natural fluoride concentration before starting a fluoride program.

The U.S. EPA has set a maximum primary standard of 4 mg/l, above which fluoride may cause some bone diseases. There is a secondary standard of 2 mg/l, above which there may be a brown staining and/or pitting of the permanent teeth. Children under 9 should not drink water with a concentration greater than 2 mg/l fluoride.

<u>Types of fluoride</u>

- Sodium Fluoride (NaF)
  - Dry
  - Fairly easy to mix
  - Most expensive
  - Breathing hazard
- Sodium Silicofluoride (Na_2SiF_6)
  - Dry
  - Harder to mix
  - Less expensive than NaF
  - Breathing hazard
- Hydrofluosilicic acid (H_2SiF_6)
  - Liquid
  - Easiest to mix
  - Lowest cost
  - Very reactive (never mix with bleach)

Know the naturally occurring concentration of fluoride in your water supply before starting a fluoride program. Be sure to factor in the availability of fluoride in your fluoride compound when calculating dosages.

Water stabilization

Water stabilization is the addition of chemicals to a water system to inhibit the precipitation (dropping out of solution) of minerals. Stabilization chemicals can keep minerals such as iron and manganese in solution to prevent “red water.”

Water treatment chemicals can control build of scales within pipes by distorting crystalline formations so minerals do not stick to the inside of the pipes. This is sometimes called deflocculation.

Corrosion can sometimes be controlled through water stabilization. Chemicals can reduce the migration of metal ions into the water from surrounding pipes. This can assist in resolving copper and lead problems.

Some companies may claim their products will cure all water problems. Protect yourself and customers by performing laboratory testing with product samples on your water (jar testing). Discuss the problem with multiple suppliers and order only small amounts of the product for initial trial before committing to full-scale implementation. Ask your IDEM inspector for advice before commencing a water stabilization program.

Monthly Report of Operations

All community public water supplies that add chemicals to their water are required to make daily entries onto a monthly report of operations (MRO). The certified operator-in-charge must sign the report and submit the MRO to IDEM within 10 days following the end of each month.

In addition to reporting amounts of chemicals added, the operator must record the results of routine testing for Turbidity, Chlorine residuals (both plant and distribution system) and other common water characteristics.

Filter runs and backwash water used should be recorded, as should total plant production and minimum, maximum and average daily pumpage.

All water systems should record total well production and minimum, maximum and average daily pumpage, even if not required to submit MROs.

This practice can provide documentation for fixed-radius Wellhead Protection Plans and significant withdrawal reports to the Indiana Department of Natural Resources (DNR).

Congratulations. You have completed lesson six of the Indiana Water Operator Training Manual.

To test your comprehension of the material included in lesson six, a self-graded examination has been prepared for your use. The examination begins on the next page. There are 10 questions that will take a total of about 10-15 minutes to complete. Do not over analyze the questions. Just look for the best answer.

Good luck with the test. You will find the answers in Appendix G-6 of this manual.

There is a Microsoft PowerPoint® slideshow associated with these lessons. The slideshow is located on the compact disc included with this manual.

If you do not have the disc, or would like to view the slideshow on the Internet, you may find it at http://www.Indianawateroperatortraining.org.

Indiana Water Operator Training
Self-graded examination

Lesson 6

Check one best answer per question

Question1.
A pellet dropper is designed to drop chlorine pellets into:
___A. Wells
___B. Day tanks
___C. Elevated storage tanks
___D. Ground level storage tanks

Question 2.
Liquid chlorine is often shipped in:
___A. 1 ton cylinders
___B. 2,000 pound cylinders
___C. 150 pound tanks
___D. All of the above

Question 3.
You have bleach solution that is 5% chlorine. How many pounds of the bleach solution do you need to get 1 pound of chlorine?
___A. 2 pounds
___B. 12 pounds
___C. 20 pounds
___D. 22 pounds

Question 4.
A day tank is used for:
___A. Premixing chemicals for feeding into the water system
___B. Storage of non-water treatment chemicals within an isolation area
___C. Testing water stabilizers in a laboratory
___D. None of the above

Question 5.
You should maintain a free chlorine level of at least what in your water system:
___A. 1 mg/l
___B. .25 mg/l
___C. 1.25 mg/l
___D. 2.5 mg/l

Question 6.
If you suspect a chlorine leak, you should drop to the floor and crawl away from the area.

___A. True
___B. False

Question 7.
Fluoridation of public water supplies serving more than 50,000 persons is required by the Indiana State Department of Health.

___A. True
___B. False

Question 8.
Children under 9 years of age should not drink water with a fluoride concentration greater than:

___A. .5 mg/l
___B. 1 mg/l
___C. 1.5 mg/l
___D. 2 mg/l

Question 9.
What mineral in a water supply may cause red water?

___A. Copper
___B. Lead
___C. Calcium Carbonate
___D. Iron

Question 10.
Corrosion is:

___A. The buildup of crystalline mineral formations
___B. The accumulation of copper and lead in a water heater
___C. The migration of metal ions into water from surrounding pipes
___D. The primary cause of mud balls in a pressure filter