BULLETIN ON CHEMICAL FEEDERS

OPERATION OF POSITIVE DISPLACEMENT TYPE CHEMICAL FEEDERS FOR DOMESTIC APPLICATION

I. Common chemicals that may be fed singly or in combination:

A. Chlorine compounds - common laundry bleach. Used to kill bacteria and/or oxidize iron, hydrogen sulfide.
B. Soda Ash - used to correct low pH conditions. Reacts with acidity to form a bicarbonate, thus neutralizing it.

II. Factors limiting and affecting installation and adjustment of positive displacement chemical feeders:

A. Type of bacteria or chemical compound to be treated.
B. Concentration of bacteria or chemical compounds per given volume of water.
C. Volume of water per minute to be pumped.
D. Pressure range of the pump and its characteristics at different pressure settings.

III. General Installation Principles:

A. Chemical feeder volume and pressure range - The general design of the feeder selected must be such that it can provide sufficient volume to treat any amount of water that the pump can deliver over an extended period of time. Since the chemical feeder is generally wired in parallel with the pump, the feeder must also be able to pump against the maximum shut-off pressure for which the pump controls are set.

The pump operating pressure range should be reasonably narrow, particularly on centrifugal or jet type pumps, so as to prevent the constant speed and delivery feeder from over-treating the relatively small volume of water delivered by the pump at high pressures.

B. Sufficient chemical feed rate as evidenced by chlorine residual and/or pH change.

1. Chlorine residual - Chlorine residual, when sufficient retention time for the chlorine to combine with the treatable elements in the water is present, indicates that all possible chemical reaction has taken place and that a slight excess of chlorine exists to take care of temporary excesses of undesirable elements that may be present. If no chlorine residual exists, the installer should assume that some untreated elements are still present in the water. Chlorine residual may be checked with standard test kits that are readily available. Residual tests cannot be made on water that has gone through a carbon or color, taste and odor filter since all excess chlorine is adsorbed by the carbon contained in these filters.
2. pH - When soda ash is used to bring low pH waters up to neutral, standard pH tests may be used to check effectiveness of the chemical feeder.
3. When both oxidation of iron and low pH correction is intended, pH correction should be established first. Oxidation of iron can be difficult in low pH waters, and pH change will affect the rate of oxidation and result in chlorine residual changes.

C. Installation and adjustment.

1. Contact or retention time - Contact time can be defined as the time during which the chlorine is in contact with the water to be treated. A contact time of at least 20 minutes between the point where chemicals are injected into the water and the point where water is drawn from the tap must be maintained to enable chlorine to purify the water. Contact time may also be needed for high levels of hydrogen sulfide or to oxidize iron. Use of a static-in-line mixer (MM2 Motionless Mixer) is recommended to provide a better mix of chemicals and water.
2. Adjustment - Adjustment of the amount of chemical feed can be made both by varying the intensity of mix and by varying the length of each individual stroke that the feeder makes. Generally speaking, the approximate mix of chemicals to water in the solution container should first be calculated and made. The feeder is then set at 50% of maximum stroke, and residual or pH tests made. The length of stroke can then be varied to make minor correction in the rate of feed. If the stroke should have to be moved near either extreme of minimum or maximum length, the mix should be discarded and a new mix with more correct proportions made. In the case of multiple chemicals such as chlorine and soda ash, the soda ash must be calculated and corrected first. Once the correct proportion and feed of soda ash is determined, the chlorine may be added and the residual checked. When adding chlorine, do not change the feed rate or add any extra water since this would throw the soda ash mix out of balance.
3. Proportions for various common complaints.
   a) Bacteria - Generally, 1 ppm chlorine feed is sufficient to correct most contamination complaints. This requires 6 ounces of bleach multiplied by each 100 gallons per hour pump capacity to be added to the 10 gallons of water in the solution tank. Residual should be from .2 ppm to .5 ppm.
   b) Iron - Chlorine will both oxidize iron in solution as well as kill any iron bacteria present. The pH of the water must first be raised to 7 or above to enable chlorine to effectively oxidize iron. 1 ppm chlorine will oxidize 1 ppm of iron. This requires 6 ounces of bleach multiplied by each 100 gallons per hour pump capacity, again multiplied by the number of ppm iron in the water to arrive at the approximate amount of chlorine needed per 10 gallons of water in the solution tank. Residual should be .2 ppm to .5 ppm.
   c) Sulfur and sulfur compounds - Chlorine will oxidize and precipitate various sulfur compounds. Start with 2 ppm chlorine and increase the feed until the sulfur odor disappears and .5 ppm residual is present.
   d) Low pH - Soda Ash will neutralize low pH waters and add little, if any, hardness. Initial mix is 20 ppm (8oz. soda ash times each 100 gph pump capacity per 10 gallons of water in solution tank) for water having a pH of 6.0 or above. For water having a pH below 6.0, the initial mix should be 30 ppm (12 oz. soda ash times each 100 gph pump capacity per 10 gallons of water in solution tank). 10 pounds of soda ash is the maximum amount that will dissolve in 10 gallons of water. Check pH and adjust feed rate of mix concentration as needed to achieve pH of 7.2 to 7.5.

IV. Theoretical Problems - These conditions are some of the most commonly found in the field, all problems assume a pump capacity of 500 gallons per hour. Tank size should be 100 gallons minimum (5 gpm x 20=100 gallons total).

A. Water Analysis - Coliform bacteria present, Hardness 0, Iron 0, pH 7.0.

1 ppm chlorine feed desired.
6 oz. bleach
x 5 (500 gph)
30 oz. bleach per 10 gallons water in solution tank.
Check and adjust to get .2 to .5 ppm residual.

B. Water Analysis - No bacteria present, Hardness 0, Iron 5 ppm, pH 7.0.

5 ppm chlorine feed desired.
6 oz. bleach
x 5 (500 gph)
30
X 5 (ppm iron in water)
150 oz. bleach per 10 gallons water in solution tank.
Check and adjust to get .2 to .5 ppm residual.
A filter such as color, taste and odor filter is recommended to trap oxidized iron and remove chlorine taste.

C. Water Analysis - No bacteria present, Hardness 0, Iron 5 ppm, pH 6.2.

20 ppm soda ash feed desired.
8 oz. soda ash per 100 gph at 20 ppm rate
x 5 (500 gph)
40 oz. soda ash per 10 gallons water in solution tank.
Check pH and adjust to get pH from 7.2 to 7.5.
5 ppm chlorine feed desired.
6 oz. bleach
x 5 (500 gph)
30
X 5 (ppm iron in water)
150 oz. bleach to be added to solution already in tank.
Check residual and add or subtract chlorine to get residual of .2 ppm to .5 ppm. Do not change rate of feed as this will affect previously set soda ash feed. A filter such as color, taste and odor filter is recommended to trap oxidized iron and remove chlorine residual.

D. Water Analysis - Coliform bacteria present, Hardness 0, Iron 5 ppm, pH 5.6, complaint of sulfur odor and black stains.

30 ppm soda ash feed desired.
12 oz. soda ash feed desired.
x 5 (500 gph)
60 oz. soda ash per 10 gallons water in solution tank.
Check pH and adjust to get pH from 7.2 to 7.5.

8 (ppm) chlorine feed desired.
1 ppm bacteria
5 ppm iron
2 ppm for sulfur compounds
8 ppm total
6 oz. bleach
x 5 (500 gph)
30
x 8 (ppm total feed desired)
240 oz. bleach to be added to 10 gallons soda ash solution. Add or subtract bleach until sulfur odor disappears and residual is .5 ppm. A filter such as color, taste and odor filter is recommended to trap oxidized iron and remove chlorine residual.

NOTE: The above problems are based on the use of common laundry bleach and soda ash, since these compounds are readily available.

V. **Carbon (color, taste and odor) Filters -** Use of a carbon filter is recommended to remove chlorine residual, or where by-products of chlorination such as oxidized iron are present. The carbon filter will both remove the tastes such as chlorine, “swamp water”, etc. by adsorption, and mechanically filter solid material such as oxidized iron from the water. Due to the relative expense of replacing fill, it is generally more economical in the long run to install a large size pressure tank such as an 82 or 120 gallon size. A large tank that can provide adequate retention time and a moderate chlorine feed will require less frequent replacement of carbon fill than heavy chlorination of water used with a small tank.

VI. **Parting Shots -** As is the case with most mechanical installations, there is more than one application to accomplish every job. Many installers have arrived at solutions that are particularly designed to remedy some specific local conditions that may exist. The descriptive data that we have given is necessarily quite general in application and is intended as guide rather than as a specific instruction. Local plumbing codes should be consulted if there is any question as to how or by whom a particular installation should be made.

There are many applications for chemical feeders such as swimming pool water treatment, etc., that we make no attempt to cover in this booklet. Installation and testing procedures are generally similar in principle. In some instances, pH control that requires acid feed is used in conjunction with chlorination. **DO NOT** attempt to mix acid and chlorine compounds together so as to pump both through a single feeder from the same solution tank. Acid and chlorine, when combined in concentrated form, will react to form deadly chlorine gas.

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