**Section 370.1200 Phosphorus Removal by Chemical Treatment**

a) General

1) Method

 Addition of lime or the salts of aluminum or iron may be used for the chemical removal of soluble phosphorus. The phosphorus reacts with the calcium, aluminum or iron ions to form insoluble compounds. These insoluble compounds may be flocculated with or without the addition of a coagulant aid such as a polyelectrolyte to facilitate separation by sedimentation.

2) Design Basis

A) Preliminary Testing

 Laboratory, pilot or full-scale trial of various chemical feed systems and treatment processes are recommended to determine the achievable performance level, cost-effective design criteria, and ranges of required chemical dosages.

B) System Flexibility

 Systems shall be designed with sufficient flexibility to allow for several operational adjustments in chemical feed location, chemical feed rates, and for feeding alternate chemical compounds.

b) Process Requirements

1) Dosage

 The required chemical dosage shall include the amount needed to react with the phosphorus in the wastewater, the amount required to drive the chemical reaction to the desired state of completion, and the amount required due to inefficiencies in mixing or dispersion. Excessive chemical dosage should be avoided.

2) Chemical Selection

A) The choice of lime or the salts of aluminum or iron should be based on the wastewater characteristics and the economics of the total system.

B) When lime is used it may be necessary to neutralize the high pH prior to subsequent treatment in secondary biological systems or prior to discharge in those flow schemes where lime treatment is the final step in the treatment process.

3) Chemical Feed Points

 Selection of chemical feed points shall include consideration of the chemicals used in the process, necessary reaction times between chemical and polyelectrolyte additions, and the wastewater treatment processes and components utilized. Considerable flexibility in feed location should be provided, and multiple feed points are recommended.

4) Flash Mixing

 Each chemical must be mixed rapidly and uniformly with the flow stream. Where separate mixing basins are provided, they should be equipped with mechanical mixing devices. The detention period should be at least 30 seconds.

5) Flocculation

 The particle size of the precipitate formed by chemical treatment may be very small. Consideration should be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment should be adjustable in order to obtain optimum floc growth, control deposition of solids, and prevent floc destruction.

6) Liquid - Solids Separation

A) The velocity through pipes or conduits from flocculation basins to settling basins should not exceed 1,5 feet per second in order to minimize floc destruction. Entrance works to settling basins should also be designed to minimize floc shear.

B) Settling basin design shall be accordance with criteria outlined in Subpart G. For design of the sludge handling system, special consideration should be given to the type and volume of sludge generated in the phosphorus removal process.

7) Filtration

 Effluent filtration shall be considered where effluent phosphorus concentrations of less than 1 mg/1 must be achieved.

c) Feed Systems

1) Location

A) All liquid chemical mixing and feed installations should be installed on corrosion-resistant pedestals and elevated above the highest liquid level anticipated during emergency conditions. Refer to Section 370.147(b)(2)(A).

B) Lime feed equipment should be located so as to minimize the length of slurry conduits. All slurry conduits shall be accessible for cleaning.

2) Liquid Chemical Feed Pumps

A) Liquid chemical feed pumps should be of the positive displacement type with variable feed rate. Pumps shall be selected to feed the full range of chemical quantities required for the phosphorus mass loading conditions anticipated with the largest unit out of service.

B) Screens and valves shall be provided on the chemical feed pump suction lines.

C) An air break or anti-siphon device shall be provided where the chemical solution stream discharges to the transport water stream to prevent an induction effect resulting in overfeed.

D) Consideration shall be given to providing pacing equipment to optimize chemical feed rates.

3) Dry Chemical Feed System

A) Each dry chemical feeder shall be equipped with a dissolver which is capable of providing a minimum 5-minute retention at the maximum feed rate.

B) Polyelectrolyte feed installations should be equipped with two solution vessels and transfer piping for solution make-up and daily operation.

C) Make-up tanks shall be provided with an eductor funnel or other appropriate arrangement for wetting the polymer during the preparation of the stock feed solution. Adequate mixing should be provided by a large-diameter low-speed mixer.

d) Storage Facilities

1) Size

 Storage facilities shall be sufficient to insure that an adequate supply of the chemical is available at all times. Exact size required will depend on size of shipment, length of delivery time, and process requirements. Storage for a minimum of a 10-day supply should be provided.

2) Location

A) The liquid chemical storage tanks and tank fill connections shall be located within a containment structure having a capacity exceeding the total volume of all storage vessels. Valves on discharge lines shall be located adjacent to the storage tank and within the containment structure.

B) Auxiliary facilities, including pumps and controls, within the containment area shall be located above the highest anticipated liquid level. Containment areas shall be sloped to a sump area and shall not contain floor drains.

C) Bag storage should be located near the solution make-up point to avoid unnecessary transportation and housekeeping problems.

3) Accessories

A) Platforms, stairways, and railings should be provided as necessary to afford convenient and safe access to all filling connections, storage tank entries, and measuring devices.

B) Storage tanks shall have reasonable access provided to facilitate cleaning.

e) Other Requirements

1) Materials All chemical feed equipment and storage facilities shall be constructed of materials resistant to chemical attack by all chemicals normally used for phosphorus treatment.

2) Temperature, Humidity and Dust Control

 Precautions shall be taken to prevent chemical storage tanks and feed lines from reaching temperatures likely to result in freezing or chemical crystallization at the concentrations employed. Enclosure heating or insulation may be required. Consideration must be given to temperature, humidity and dust control in all chemical feed room areas.

3) Cleaning

 Consideration shall be given to the accessibility of piping. Piping should be installed with plugged wyes, tees or crosses at changes in direction to facilitate cleaning.

4) Drains and Drawoff

 Above-bottom drawoff from chemical storage or feed tanks shall be provided to avoid withdrawal of settled solids into the feed system. A bottom drain shall also be installed for periodic removal of accumulated settled solids.

f) Hazardous Chemical Handling

 The requirements of Section 370.147(b), Hazardous Chemical Handling, shall be met.

g) Sludge Handling

1) General

 Consideration shall be given to the type and additional capacity of the sludge handling facilities needed when chemicals are added.

2) Dewatering

 Design of dewatering systems should be based, where possible, on an analysis of the characteristics of the sludge to be handled. Consideration should be given to the ease of operation, effect of recycle streams generated, production rate, moisture content, dewaterability, final disposal, and operating cost.