METTLER TOLEDO APPLICATION NOTE

Coagulation And Flocculation

BACKGROUND

Water is clarified using the processes of coagulation and flocculation, which remove suspended solids (turbidity) from water by causing the suspended particles to aggregate into a slime that settles out of the water. This technique is used in treating wastewater, both industrial and treated sewage, from municipal wastewater treatment plants. It is also used, as a first step, in treating raw water for industrial use, and in food and beverage production.

THE PROCESS

Coagulation uses salts such as aluminum sulfate (alum), or ferrous or ferric (iron) salts, which bond to the suspended particles, making them less stable in suspension, i.e., more likely to settle out. Figure 1 depicts the coagulation process in the resident tank by the diagonal lines.

Flocculation is the binding or physical enmeshment of these destabilized particles and results in a slime that is heavier than water, which settles out in a clarifier. Flocculation agents are natural synthetic polymers and synthetic organic polymers used to form the flocculant. Figure 1 demonstrates the flocculation process in the clarifier by the merging horizontal lines.

pH Effects

The salts used for coagulation form certain ions in solution that are responsible for the coagulation action taking place. However, the actual ions produced by these salts depend upon the pH of the water sample.

At varying sample pH values, the coagulation process may suffer from less than optimum ion formation in solution. pH that is too low may not allow the coagulation process to proceed, while too high pH can cause a coagulated particle to redisperse. The size of the coagulated particles is also affected by pH, which in turn determines the density of the flocculated slime and its tendency and rate of settling out.

The optimum pH for the coagulation and flocculation process must be determined experimentally. It is specific to each application and is dependent upon the sample, the coagulation and flocculation agents used, the desired clarity of the water, and the water's end use.

INSTRUMENTATION

pH control of the sample prior to clarification will also vary from application to application. An industrial waste sample, for instance, may be subject to wider pH variations, requiring stepwise pH control, while a raw water sample for beverage production may need only small adjustments for minor variations in pH and alkalinity.

Clarification is typically either the first step in treating raw water, often river water or even city (potable) water, or the last step prior to discharge of a wastewater sample. As a result, the demands on the pH sensor in terms of temperature, pressure, and corrosion resistance are minimal.

In certain cases, a pH measurement may be required in the clarifier itself or after the clarifier for subsequent pH adjustment. The pH sensor may be exposed to the flocculant (flocculating polymer and slime), which can form a tenacious coating on the pH sensor. Since the polymer coating is organic in nature, it can be readily cleaned off using a solvent suitable for the polymer which does not attack the sensor's materials of construction. The InPro® 4500 pH Sensor, featuring our patented Xerolyt® solid polymer reference system, resists the effects of coating and clogging and can maximize the time between required cleanings and reduce maintenance costs. The 2050 pH analyzer is also recommended for this application.

PRODUCTS

2050 pH Analyzer

- Economically priced, full featured transmitter
- Large, easy-to-read LCD allows quick view of information
- Two relays as limit contacts with delay timer to minimize false alarms and one relay as alarm or wash contact

InPro® 4500 Solid Polymer pH Electrode

- Patented Xerolyt® solid polymer reference system maintains a stable potential for accurate and repeatable pH measurement and low maintenance
- Open junction eliminates reference clogging and extends sensor life
- High pressure resistance eliminates requirement for pressurizable housing
- Xerolyt solid polymer is particularly suitable for use in emulsions, suspensions, heavily contaminated or sulfide-containing media, and solutions with a high concentration of suspended solids

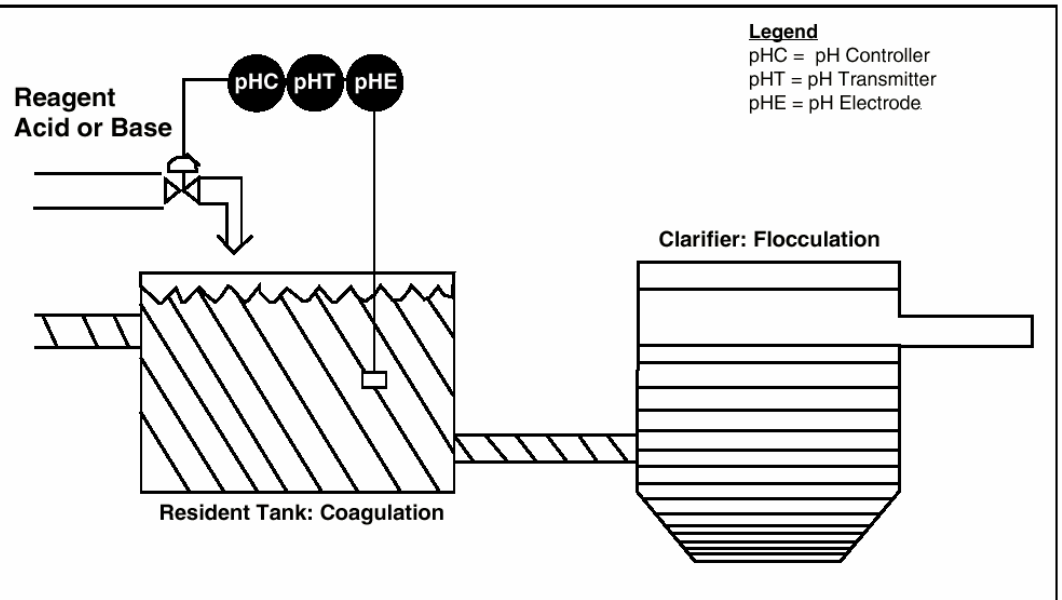

FIGURE 1. Coagulation and Flocculation

Ref: RA ADS 2800-03