

# 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 ions being formed in solution. pH that is too low may not allow the coagulation process to proceed, while 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.

## pH MONITORING AND CONTROL

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 only need 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 that is 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, but which does not attack the sensor's materials of construction. The 396P TUpH™ Sensor, which resists the effects of coating, can be used to maximize the time between required cleanings.

<sup>™</sup> TUpH is a registered trademark of Rosemount Analytical, Uniloc Division.

## INSTRUMENTATION

### Model 1056 Dual Input Intelligent Analyzer

- Dual configurable inputs and outputs enable cation conductivity measurement with a single analyzer
- Large, bright LCD display can be customized to show straight and cation conductivity simultaneously
- Intuitive menus with advanced diagnostics
- 4 alarm relays with timers
- Optional HART or Profibus DP

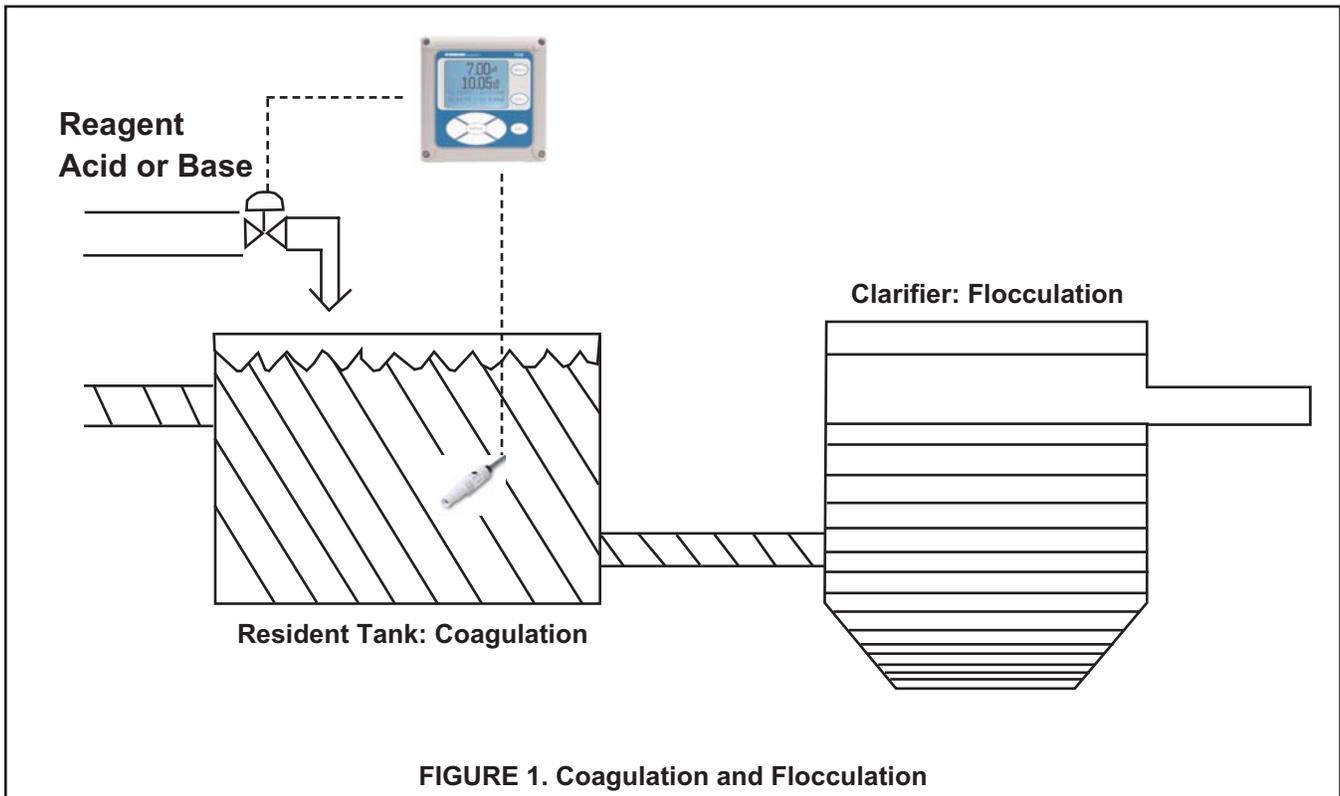


### Model 396P pH/ORP TU<sub>pH</sub> Sensor

- Patented<sup>1</sup> polypropylene reference junction and patented helical pathway mean longer sensor life in process solutions containing heavy solids.
- Disposable, one-piece construction is convenient and economical, where minimal troubleshooting and maintenance downtime are of prime importance.
- Versatile. Can be used in numerous loop configurations with all Rosemount Analytical and other manufacturers' instruments.



<sup>1</sup> U.S. Patent No. 5,152,882, Foreign Patent Pending.



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