# pH Measurement in Industrial Waste Neutralization

## Process

Raw industrial waste streams, especially those low in pH, can damage sewage system piping and harm the micro-organisms used in municipal sewage treatment plants. Therefore, local environmental authorities often require that acidic or alkali industrial waste be neutralized before being discharged into the municipal sewage system. This neutralization may be done in a batch or a continuous process. But in either case, pH is the key measurement used to control the addition of neutralizing reagents..

## Batch Neutralization of Industrial Waste

For the small industrial user, a simple batch neutralization system can effectively treat low-volume, variable-strength spent acid or alkali. Figure 1 shows a typical batch neutralization system for spent acid. A level controller opens the inlet valve of the empty reaction tank to admit acid waste and closes the valve when the tank is full. pH is measured in the tank, usually using a submersion mounted sensor, and alkaline is added whenever the pH falls below a threshold value. The level controller and the pH transmitter are interlocked, so the discharge valve of the tank does not open until the tank is full and the proper pH has been achieved.

A common problem in batch neutralization processes is overshoot. A small addition of acid or alkaline reagent can cause a large change in pH, particularly for solutions near pH 7, due to the logarithmic nature of the pH scale. If the tank is large and the sensor is located far from the point where the reagent enters, the sensor may continue to call for reagent even after enough has been added to achieve neutralization. To prevent overshoot, a timer is often used to limit the reagent additions to short time intervals with delays in between to allow for mixing and chemical reaction to occur before more reagent is added.

## Continuous Neutralization of Industrial Waste

Continuous neutralization of acid or alkaline industrial wastes is preferable to batch neutralization in three situations:

1. When there is a high volume of waste (typically more than 190 l/min (50 gpm))
2. When the hold-up time in the reaction tank is short (typically less than five minutes)
3. When there are wide swings in the pH value of the incoming waste (typically 3 pH units or more)

***Figure 1 - Batch Neutralization System***

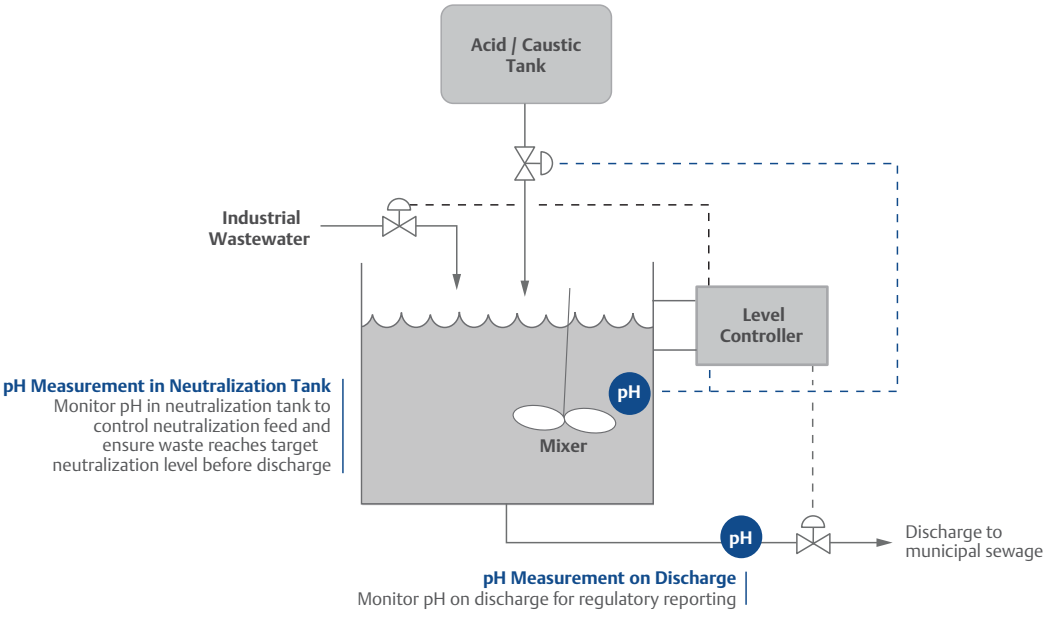


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*Figure 2 - Continuous Neutralization Process*

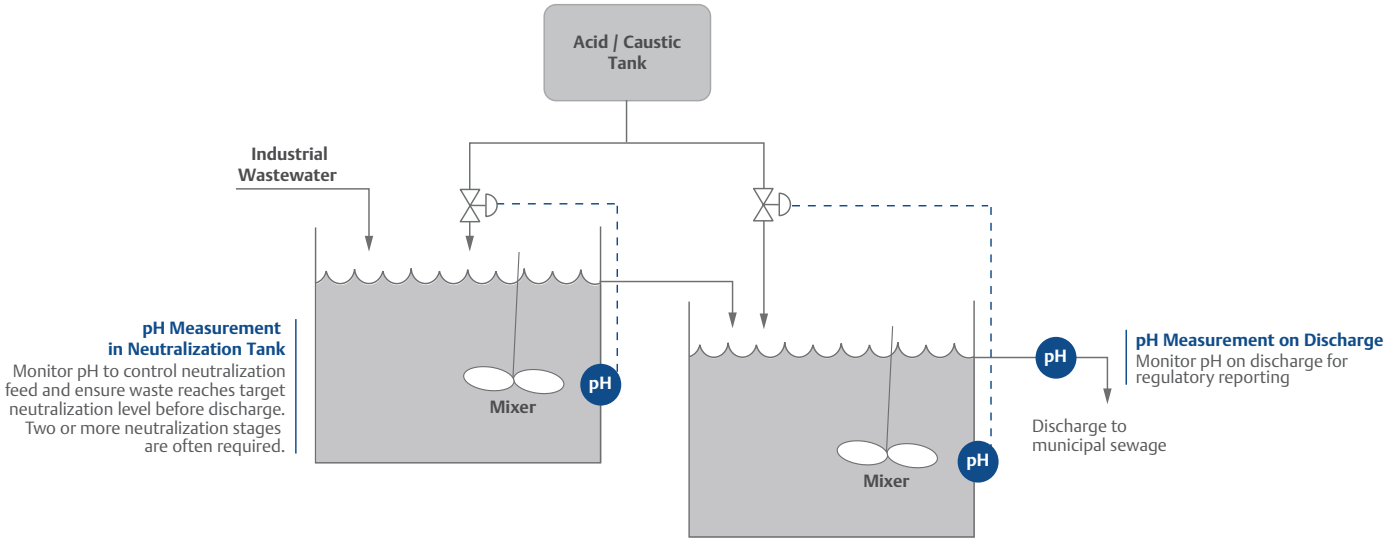


Figure 2 shows a typical continuous neutralization process. Spent acid continuously flows into a stirred reactor tank and treated waste is continually discharged at the same rate. pH is measured in the tank, usually using a submersion mounted sensor, and used to control the addition of alkaline reagent to maintain the target discharge pH level.

Multiple neutralization stages may be needed if pH of the incoming waste is much different than the target discharge pH. A one-tank system can provide good control if the pH change needed is less than 3 pH. Two tanks can provide good control for a pH change of up to 5 pH. Three tanks are needed if the required pH change is larger than 5 pH.

Other important considerations for controlling a continuous neutralization process are as follows:

1. Hold-up time in each tank should be at least 30 seconds, with one to three minutes being optimal.
2. Agitation is critical. The turnover time should be 5 to 10 percent of the hold-up time.
3. A proportional-plus-reset control of the reagent feed is preferred. However, if the hold-up time is 15 minutes or longer, then continuous on-off control should also be sufficient.

## The Emerson Solution

The most common pH measurement challenge in both batch and continuous waste neutralization is sensor coating. Industrial waste streams commonly contain some amount of undissolved materials that can coat the pH sensor reference junction, leading to lower sensor responsiveness and therefore poorer process control. The Rosemount™ 396P pH/ORP Sensor is ideally suited for this application because its large-area reference junction design resists the effects of coating.

The 396P is compatible with the full line of Rosemount liquid analysis transmitters, including the Rosemount 56 Dual Channel Transmitter which features a built in integral PID (proportional integral derivative) or TPC (time proportional control) controller which can be used to control the reagent addition without the need for a separate control system.

*Rosemount™ 396P pH/ORP Sensor*

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