How to Improve Flow-Paced Chlorine Dosing in Water Treatment Oxidation Processes

Feedback dosing control, where flow-pace is combined with a residual Chlorine or ORP sensor feedback, is the best available dosing control for oxidation.

Improved Flow-Paced Chlorine Dosing

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Watercore - WATER AND WASTEWATER TREATMENT AND PURIFICATION FOR BUSINESSES

EDGECLIFF, NSW, AUSTRALIA, October 21, 2020 /EINPresswire.com/ -- 1. INTRODUCTION
Chlorination is an oxidation process widely used in the water treatment industry for different purposes, such as disinfection or Iron and Manganese precipitation and removal or wastewater treatment.

Chorine is a powerful oxidant commercially available in different forms, however from a chemical perspective the oxidation process is generally, slow and non selective. Both aspects bring challenges to the dosing process.

Chemicals are expensive. This is not only regarding procurement, but transport, storage and operator training add costs to the equation. There is also an environmental toll, so using the minimum dosing amount will safe money and reduce other business efforts.

In those situations where the water flow is constant and there is a consistent water quality, a manual dosing control can be enough. However, in most water treatment applications the feed water quality is very inconsistent and a more complex Chlorine dosing control is required.

In disinfection and oxidation applications, a minimum residual Chlorine level is expected to verify that the process is complete. Chlorine injection will be controlled based on that parameter.

2. WHY THE LACK OF SELECTIVITY IS A CHLORINATION CHALLENGE
Whenever Chlorine is dosed into a water stream, it will trigger different oxidation reactions with

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dissolved and suspended matter:
Oxidising organic compounds
Oxidising bacteria, virus and micro-organisms and so disinfecting the water
Oxidising inorganic compounds, such as dissolved Iron and Manganese

All those reactions will be responsible for the "Chlorine demand" of that water stream and will consume the free-Chlorine available. Unfortunately, it is not possible to stop any of those reactions from happening, whether or not they are part of your concerns.

However, when disinfection is the main objective, it is possible and in general much better to filter out as many organic compounds as possible before the oxidation process is initiated. It is also possible and recommended to run Iron and Manganese oxidation and removal in a separate initial stage, as this reaction can be catalysed and Iron and Manganese precipitates will be harmful to any downstream process.

Filtering organic compounds and removing Fe and Mn will facilitate the disinfection process and reduce the Chlorine demand on the water stream, so chemical dosing will be minimised.

3. FLOW-PACE DOSING CONTROL
Many Chlorine dosing systems use a very basic control based on the flow rate. This control adapts to changes in the flow, but not to changes in the water quality or Chlorine degradation (common with time, light exposure, etc.).

In the flow pacing dosing control, the dosing pump receives a signal from a flow meter (typically pulses) and reacts accordingly, increasing or decreasing the dosing rate. The flow meter should be installed in-line with the dosing pump to guarantee accurate flow-pace dosing.

Unfortunately, flow-pace dosing control does not guarantee consistent downstream Chlorine residual or contact time. The problem is that the actual Chlorine demand in the feed water stream depends on many water parameters. For example, a higher organic load or the presence of Iron and Manganese will mean an increase of the Chlorine demand.

To address these changes in the raw water characteristics and/or the degradation of the dosed Chlorine, a Chlorine residual or an ORP signal can be added to the equation to improve the overall system response.

4. FEEDBACK DOSING CONTROL
The feedback dosing is a more advanced control in which the flow-pace dosing system is

adjusted based on a Chlorine residual (or ORP) signal and an operator-entered set-point. It can be considered as an improvement of the flow-pace method, and in most cases will require a PLC, as most dosing pumps in the market can only be controlled by external pulses.

When the measured residual is higher than the set-point, the Chlorine injection rate is reduced and vice versa.

A very important consideration when implementing feedback dosing control is that this system must take into account the process lag-time. Process lag time is the time from when a change in Chlorine injection is made to when the measured Chlorine residual (or ORP) reflects the change.

The process time will depend on chemical, physical and practical installation parameters:
Hydraulic transport of Chlorine between the dosing point and the sensor
The place where the sensor can be installed to provide a reliable measurement
Mixing of the Chlorine with water and chemical oxidation time

5. FEEDBACK SENSOR: FREE-CHLORINE VS ORP
In choosing a sensor for our PLC controlled water treatment units, flexibility is key. The integration process is so much simpler when familiar with the sensors used so we always recommend to reduce the range.

There are three basic questions to ask before choosing a sensor:
In how many different applications is it useful?
Is the accuracy enough for our typical applications?
Do I understand how it works?
In this sense, an ORP sensor is a better option than a free-Chlorine sensor. Initially, it can be used with any Oxidant, not just with Chlorine. Secondly, oxidation potential is quite a simple concept, easy to measure. Free-Chlorine readings need to take different chemical compounds into consideration and is very PH dependent. In addition, the technical data sheet for most free-Chlorine sensors in the market don’t quite explain what they measure and that is unhelpful.

6. CONTROL CHALLENGES ASSOCIATED WITH THE PROCESS LAG-TIME
To account for the lag-time, the control loop must be tuned to react slowly in comparison to the process lag-time. If not, the dosing will be quite unstable. However, by increasing the response time, the control performance will be reduced and the residual level will oscillate around the setting point.

In those cases where the feedwater quality has high variability, a long process lag-time can result in controller settings that can’t deliver acceptable performance. Hence, it may be impractical to use a single feedback control loop where the Chlorine residual feedback is measured too far downstream of the injection point. Ideally, the total lag-time should not exceed 3 to 5 minutes.

7. CONCLUSION
Feedback dosing control, where a flow-pace control is combined with a residual Chlorine or ORP sensor feedback reading,

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