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ChemScan® Application Summary #104 Phosphate Sequesterant Feed Control

Statement of the Problem

Water utilities and industrial water treatment programs use a variety of phosphate products to control scale and corrosion within the water system. Phosphate also is used to sequester specific metal ions which may present a health problem or result in poor water quality.

Products can be classified as either orthophosphates or polyphosphates (molecularly dehydrated phosphate). Although polyphosphates tend to revert to an orthophosphate form in water, the rate of reversion is very slow in pure water. The reversion rate can be accelerated as pH is lowered, as water temperature is increased and also with exposure to intense uv light. Several hours to days would be for complete reversion at normal water distribution system temperatures and at neutral to high pH. This can be reduced to a few minutes with uv light and low pH.

Typical products used include the following:

Polyphosphates	ANSI/AWWA	Chemical Formula
Sodium Hexametaphosphate	B502	$Na_3 (PO_3)_6$
Sodium Tripolyphosphate	B503	$Na_5 P_3O_{10}$
Orthophosphates		
Monosodium Phosphate	B504	NaH_2PO_4
Disodium Phosphate	B505	Na_2HPO_4

Control Strategy

Where there is a variable metal ion concentration in water due to background water chemistry characteristics or upstream treatment residuals, flow pacing alone may not produce a consistent phosphate residual at the point of measurement. Also, the effects of polyphosphate reversion to orthophosphate form may be seen at measurement points within the water system that are remote from the point of application.

For proper measurement and control it is essential to know the form of phosphate being applied so that the appropriate analysis technique can be used.

ChemScan Analysis Methods

ChemScan uses a vanadomolybdate reagent to detect the available inorganic phosphorous in water. ASA has also used a ferric method that will respond to all phosphorous present that is available to sequester metal ions (Total Available Phosphorous) for certain applications.

The vanadomolybdate method will detect the orthophosphate fraction of inorganic phosphorous in water. Vanadomolybdate does not respond to polyphosphates but, because of the acidic nature of the method, will tend to redissolve any particulate or colloidal phosphate in the sample. (See ChemScan Method Summary #40, Ortho-Phosphorous in Water or Wastewater.)

Subtraction of the ChemScan results using a total phosphorous method from the results using an ortho-phosphorous method can be used under certain conditions and recalculation of results as P to results as PO_4 to provide a determination of polyphosphate under the following general formula:

Total phosphite - orthophosphate = polyphosphate

Apparatus

A ChemScan Process Analyzer can be used to detect total phosphate using the ferric method or vanadomolybdate after photochemical digestion. A ChemScan analyzer can also detect total, ortho and poly phosphate fractions using a combination of methods.

Although filtration of water samples is not required for analysis, some fraction of phosphate present may be in the form of precipitates or coagulated products from prior treatment steps. Acidification of the sample by ChemScan prior to analysis will hydrolyze these substances making the bound phosphate available for analysis. Acid hydrolysis may also convert some polyphosphate present into orthophosphate form and should therefore not be performed when the exact form of phosphate is important or if only the amount of phosphate available to sequester metal ions is to be measured.