

ChemScan[®]

PROCESS ANALYZERS

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ChemScan[®] Method Summary #131 Total Phosphorous in Water or Wastewater

Phosphorus Analysis Classifications

Phosphorus analysis can be classified by the type of preprocessing performed on a sample. Phosphorus may be found in several forms in wastewater, including dissolved form (orthophosphate), inorganic form (reactive plus condensed or acid hydrolyzable phosphate) and organically bound forms. Total Phosphorus is the sum of reactive, condensed and organic phosphorous. A significant fraction of condensed and organic phosphorous in treated wastewater represents phosphorous after chemical or biological treatment, available for removal by sedimentation or filtration.

Total Phosphorus (TP) is the form of analysis typically cited as an effluent parameter for municipal and industrial wastewater treatment plants. Total Phosphorous in effluent is a measure of the remaining dissolved phosphate plus any insoluble phosphorous carried over into the effluent in the form of precipitates or within microbes. Digestion using chemicals, heat or enzymes may be required to separate phosphorous from the precipitate or microbe. Following digestion, all phosphorous is converted into dissolved (ortho) phosphate for analysis. Total Phosphorous is not, however, the form of analysis that is the most useful for process monitoring or control purposes because the Total Phosphorous analysis does not identify the original form of phosphorous in the effluent. Total Phosphorous is typically analyzed strictly for compliance monitoring purposes in wastewater. (See Method Summary #40 for a discussion of orthophosphorous analysis) or where the source of phosphorous is from poly-phosphate (See Method Summary #132) such as in potable or industrial water corrosion control applications. (See ChemScan Application Summary # 104, Phosphate Sequesterant Feed Control)

ChemScan Analytical Method

The standard ChemScan method for Total Phosphorous analysis is based on an initial UV absorbance analysis of the sample to characterize the suspended content, followed by acid hydrolysis to liberate condensed phosphate and finally an analysis of the total reactive phosphorous using the Vanadomolybdate Method (Standard Method 4500-PC.). Ammonium molybdate reacts under acid conditions with orthophosphate to produce molybdophosphoric acid. Further reaction with vanadium produces vanadomolybdophosphoric acid, which has strong absorbance spectra in the ultraviolet and visible wavelength range.

In wastewater, the suspended content of the sample will correlate with the organic fraction, while analysis of the hydrolyzed sample will measure phosphate from the condensed and dissolved fractions of the sample. The combined result of this analysis will correlate with classic Total Phosphorous analysis using typical laboratory digestion methods, but without the need to operate such methods in an on-line analyzer. In water applications, photochemical digestion of the sample using uv light and persulfate may be required prior to analysis.

Monitoring System Requirements

Sample extraction points are a function of the phosphorous removal process (chemical, biological or combined). See ChemScan Application Summaries #91 "Chemical Phosphorous Removal" and #92 "Biological Phosphorous Removal." Chemical precipitation processes typically use aluminum or iron salts, applied upstream of the primary clarifier, in the aeration basin or immediately after the aeration basin. Some designs have multiple addition points. Another option is the use of separate tertiary chemical precipitation tank as a polishing step following the initial chemical or biological treatment.

The ChemScan Process Analyzer can accommodate samples with up to 150 mg/l of total suspended solids and turbidity of up to 60 NTU. Samples extracted from points in the treatment process ahead of secondary clarification will typically exceed these solids or turbidity specifications. These samples will require filtration or settling prior to analysis to produce a sample meeting ChemScan solids and turbidity requirements. ChemScan has cross flow membrane filters and porous plastic cyclic filters available for use with on-line analyzer systems. Sample points should be selected to assure that fat, oil and grease (FOG) will be low enough not to interfere with the sample filtration method selected for the analyzer system. Raw wastewater samples (especially prior to screens, grit removal, FOG removal and primary clarification) are difficult to analyze and are of questionable value. Much of the Total Phosphorous load on the process is the sum of the soluble phosphate contributed by the incoming wastewater plus the phosphorous from the organic fraction contributed by the Return Activated Sludge plus the phosphorous of any recirculation flow back from the later stages of the treatment process. The ideal initial sample point is after RAS and recirculation addition to the primary effluent.