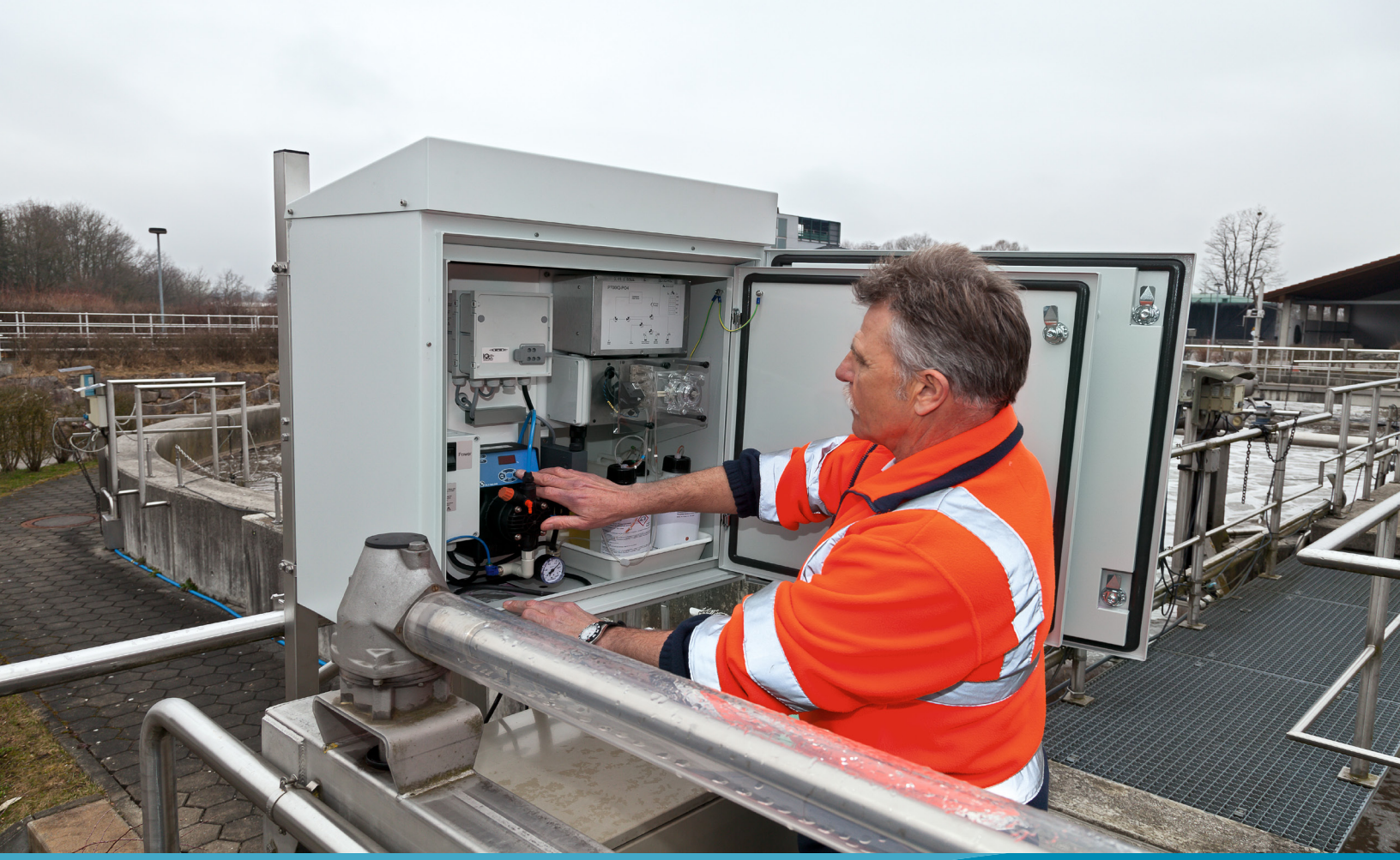


Orthophosphate

REDUCING TOTAL PHOSPHORUS IN WATER RESOURCE RECOVERY FACILITIES

Technical Note
T622

YSI
a xylem brand

Reducing Total Phosphorus in Water Resource Recovery Facilities

a xylem brand

YSI IQSensorNet and Orthophosphate
Technical Note T622

Water Resource Recovery Facilities (WRRF) undergo continuous monitoring of multiple parameters and compounds throughout the treatment process on a daily basis. And the monitoring and subsequent control of those parameters and compounds during the process is essential to optimizing efficiencies of the plant on a daily, weekly, and annual basis.

One of the compounds that is critical for treatment plants to measure at many stages during the process – from primary settling to the aeration tanks and to the effluent – is orthophosphates (also known as soluble reactive phosphorus and commonly referred to as phosphate).

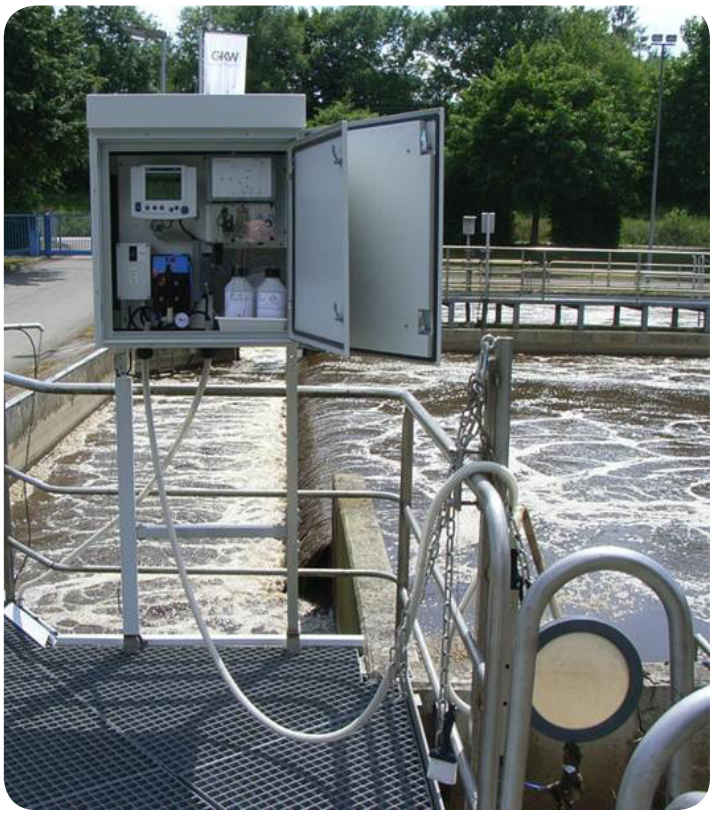
Since phosphorus is the nutrient in short supply in most fresh waters, even a modest increase in phosphorus can, under the right conditions set off a chain of undesirable events in a stream, including accelerated plant growth, algae blooms, low dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals.

Monitoring phosphate during the wastewater treatment process allows for fine-tuning and optimizing chemical dosing for removal of phosphate, which provides significant cost savings to the plant while protecting the aquatic environment downstream of the facility.

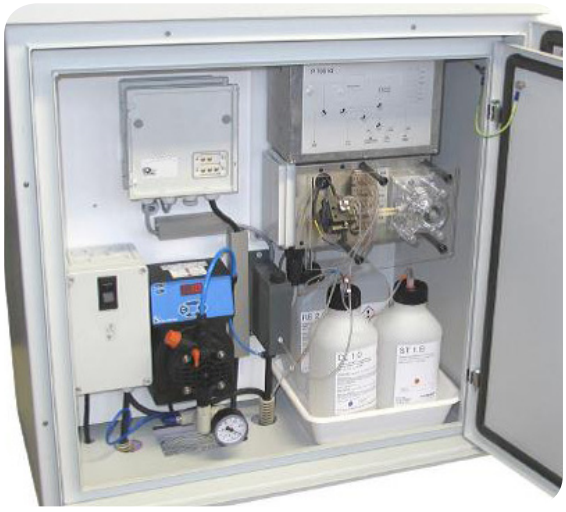
YSI, a Xylem brand, recently introduced the P 700 IQ Orthophosphate Analyzer – to be used as a stand-alone analyzer or in conjunction with other sensors in an IQ SensorNet 2020 XT continuous monitoring and control system – to address the needs of the wastewater treatment industry. The P 700 measures the amount of orthophosphate throughout the wastewater treatment process and can help determine whether or not it's been eliminated.

INSTRUCTIONS FOR ACHIEVING LOW EFFLUENT TOTAL PHOSPHORUS

The following provides simple step-by-step instructions for achieving low effluent total phosphorus (TP) in treated municipal wastewater, facilitating the control of chemical dosing based on data from online analyzer(s) throughout the process.



The YSI orthophosphate analyzer mounted outdoors next to aeration basin with the filter shown in the foreground.



Inside view of the YSI orthophosphate analyzer.

The primary objectives for the treatment process as it pertains to total phosphorus are:

- to achieve < 1.0 mg/L TP
- to ideally minimize total chemical usage
- to ultimately realize lower operating costs

The chemical treatment mechanism that is utilized is iron or aluminum salts reacting with soluble phosphate, forming an insoluble compound that is removed by sedimentation or filtration

Within the wastewater treatment process, there are several control alternatives that a facility can consider. These alternatives are:

- **Flow-proportional feed-forward control** – chemical dosing is adjusted proportional to the measured wastewater flow

- **Load-proportional feed-forward control** – chemical dosing is adjusted proportional to the load calculated from wastewater flow and the upstream online phosphate measurement

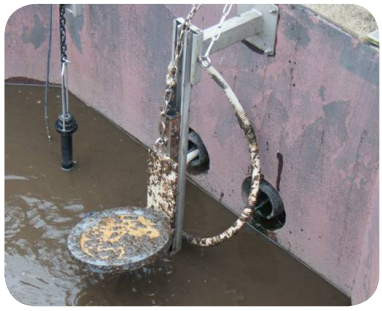
- **Feedback control** – chemical dosage is adjusted based on the downstream online phosphate measurement

Chemical dosing options that a wastewater treatment plant can pursue are:

- **Pre-precipitation** – When identifying a chemical dosing point before the biological process, phosphorus is removed in the primary settling tanks. In conjunction with that, the online phosphate measurement would be taken between the primary settling and aeration tanks to be used as part of a system based on feedback control.

- **Post-precipitation** – When chemical dosing is done after the biological process, phosphorus is removed in the final clarifiers or effluent filters. The online phosphate measurement would be taken between the aeration tanks and the final clarifier, or after the final clarifiers with feedback control.

- **Simultaneous (pre- and post-precipitation)** – This option utilizes chemical dosing before and after the biological process, which facilitates very low effluent phosphorus limits.



The filter can be mounted horizontally or vertically.

CONTROL SYSTEM DESCRIPTION

The P 700 IQ online colorimetric phosphate analyzer can be the primary component of a wastewater treatment plant control system. The P 700 comes with a built-in sample transport pump as well as a filtration mechanism. It provides automatic calibration and facilitates low reagent consumption. The P 700 can be used as a stand-alone analyzer, or it can be used with the YSI IQ SensorNet 2020XT controller with built-in proportional output, to control variable-speed chemical metering pumps.

6 STEPS TO CONTROL SYSTEM IMPLEMENTATION

1) Benchtop jar testing – This critical first step will provide a benchmark for the execution of phosphorus measurement and treatment for the wastewater facility. It is essential at the outset to evaluate pre- and post-precipitation, and jar testing provides that quick analysis to help determine the most effective chemical needed for your process (i.e. Alum or Ferric chloride)

2) Determine appropriate chemical dosage – Once it is determined which chemical should be utilized, the jar testing will also help to estimate the chemical dosage required to achieve the total phosphorus effluent target.

3) Determine chemical storage requirements – Based on the estimated chemical dosage – and as a result the long-term chemical usage – it is then necessary to determine the chemical delivery and storage requirements. And there are numerous options as to how treatment chemicals are supplied and delivered: 55 gallon drums, 330 gallon totes, or in bulk tanks installed on-site and refilled as needed by a local distributor.

4) Locate measurement system and chemical feed and storage facilities – Establishing the location of the actual measurement within the treatment process is an important step, as the location should not be too far downstream from the dosing location so as to minimize lag time. The feed location should be chosen in an area that is well-mixed, so that the chemical is well dispersed throughout the solution. One ideal place for the feed location is in the flow distribution chamber.

5) Install and commission measurement system – Once the location of the measurement system has been determined, the next step is to install and commission the system accordingly. As part of this process, it is important to select a response time, and to identify measurement, cleaning, and calibration intervals for long-term optimization of the system.

6) Tune control system – As the control system is commissioned and begins to provide online measurements, it is important to adjust set-point and gain setting, so as to achieve desired P removal at the lowest optimal chemical consumption.

Processing magazine's 'Breakthrough Product of the Year, 2013' - YSI Orthophosphate

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