Application Note AN-PAN-1039

Determination of ortho- and total phosphate phosphorus in water

Online analysis according to EN ISO 6878

Phosphorus removal is essential in wastewater treatment plants to ensure the environmental balance is not upset by discharged effluent. In the treatment facility, it is important to know the bioavailable orthophosphate phosphorus (o-PO_4-P) concentration in the influent stream either to feed bacteria or to calculate the amount of reagents needed for chemical treatment.

For environmental compliance monitoring purposes, treated effluent is monitored for total phosphate phosphorus (TP), i.e. the sum of all insoluble and dissolved phosphates present.

This Process Application Note describes the benefits and uses of the Metrohm 2035 TP Analyzer to monitor both o-PO_4-P and TP according to EN ISO 6878 (formerly DIN 38405-D11) around the clock.

INTRODUCTION

The abundance of phosphorus compounds in wastewater is problematic. Elemental phosphorus is highly reactive and thus binds easily to oxygen, forming phosphates (orthophosphates o-PO_4, polyphosphates, and organic phosphates). Phosphates in water sources can come from minerals, detergents, agricultural (fertilizer) runoff, and other anthropogenic influents. Environmental agencies have strict regulations regarding industrial phosphate emissions. Total phosphate phosphorus (TP) is a plant nutrient, which in high concentrations in surface waters can lead to eutrophication (overfertilization). For biological sewage and wastewater treatment, the bioavailable o-phosphate phosphorus (o-PO_4-P) is necessary for the bacteria to live, but this can be detrimental to rivers and lakes. An increase in these nutrients fosters growth which depletes dissolved oxygen and kills fish, or even introduces harmful toxins (algal blooms). Phosphorus removal is therefore essential in wastewater treatment plants to ensure the environmental balance is not harmed by discharged effluent (Figure 1).

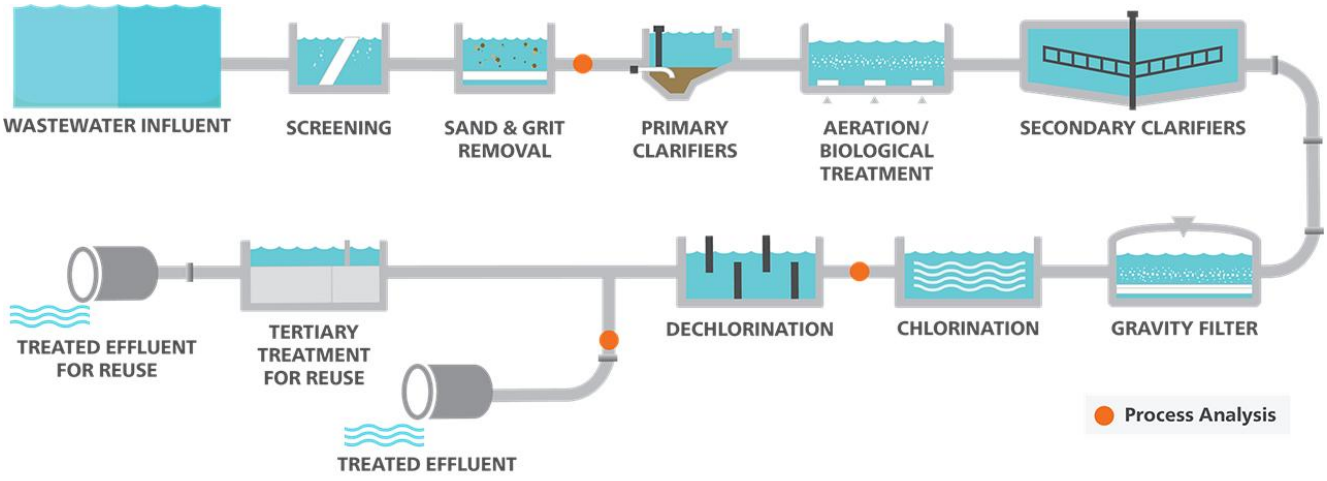

Figure 1. Process analyzer locations in the wastewater treatment process for phosphorus.

Most phosphorus in treated wastewater is bound into other filterable forms and removed as precipitated sludge. Chemical treatment with Ca, Al, and/or Fe for coagulation can be costly and slow, allowing biological treatment to rise in popularity over the last decade. In the treatment facility it is important to know the o-PO_4-P concentration in the influent stream either to feed the bacteria or to calculate the amount of reagents needed for chemical treatment. For environmental compliance monitoring purposes, treated effluent is monitored for TP—the sum of all insoluble and dissolved phosphates present. TP is not useful for identifying the origin of the phosphorus within a process, only for overall monitoring and wastewater compliance purposes.

The 2035 TP Analyzer from Metrohm Process

Analytics (**Figure 2**) can keep track of both o-PO_4-P and TP around the clock. With direct colorimetric applications, only o-PO4-P is measured in a sample. TP can be determined by digesting the sample with heat, an oxidizing agent, and acid before performing the photometric measurement on the freed o-PO_4-P. To monitor both o-PO_4-P and TP according to **EN ISO 6878**, a compact digestion cuvette photometer module is used. Multiple sample streams can be connected to the 2035 TP Analyzer, allowing complete control over the phosphorus treatment process. The analyzer can send alarms for peak concentrations, saving bacteria, or notifications if regulation limits are exceeded.

APPLICATION

The colorimetric determination of o-PO_4-P and TP is based on **EN ISO 6878** (formerly DIN 38405-D11) using a compact digestion cuvette photometer module. Organic and inorganic phosphate compounds are oxidized, then ammonium molybdate and potassium antimonyl tartrate are added to form phosphomolybdic acid. The ascorbic acid reduction forms molybdenum blue which is measured at 875 nm.

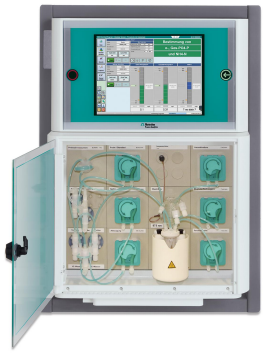

Figure 2. The 2035 TP Process Analyzer from Metrohm Process Analytics.

Table 1. Parameters for TP monitoring

TP category	Range	Detection limit
Low TP	0–150 µg/L PO_4-P	5 µg/L
Standard TP	0–5 mg/L PO_4-P	50 µg/L
High TP	0–100 mg/L PO_4-P	1 mg/L

FURTHER READING

Brochure: Environmental Testing Industry I - Online Analyzers for Municipal Wastewater Analysis

Phosphor species in process water

Wastewater treatment plants: Nitrogen removal simultaneous analysis of ammonia, nitrate and nitrite

BENEFITS FOR ONLINE ANALYSIS

- **Save money by reducing downtime**: analyzer sends alarms for out-of-specification values which inform the operator sooner
- **Process data available at your fingertips 24/7** means no waiting for slow, manual laboratory methods
- **Efficient chemical treatment** by constantly monitoring the influent streams

CONTACT

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CONFIGURATION

2035 Process Analyzer - Photometric

測光測定のための2035 フロセスアナライサーは、幅広い濃度範囲においても安定性を示すコンハクトな光度計モシュールを有し、温度調整可能て、またスターラーか装備されています。この分析装置には選択てきる2つのオフションかあります。: キュヘットシステムと光ファイハー浸漬フローフてす。キュヘットシステムは試薬の消耗を抑えるためにコンハクトてありなから、感度を高く保つための長い光路長を提供します。光ファイハーによる浸漬フローフにより、製品のアフリケーション範囲は著しく広かりました。というのも、内部希釈工程およひ、キュヘットシステムよりも短いヒーム経路により、高濃度サンフルの高精度測定か可能になったからてす。
測光分析は一般的かつ頻繁に使用される方法てあり、この方法によって飲料水中のアンモニアやマンカンや鉄、また食塩水中のカルシウムやマクネシウムなとのイオンまても測定することかてきます。
サンフルの色素や濁りなとといった不都合なマトリックス効果は、発色試薬を添加する前と後の差異を測定することによって排除することかてきます。