



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 ($\text{o-PO}_4\text{-P}$) 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 $\text{o-PO}_4\text{-P}$ and TP according to EN ISO 6878 (formerly DIN 38405-D11) around the clock.

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 ($\text{o-PO}_4\text{-P}$) 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).

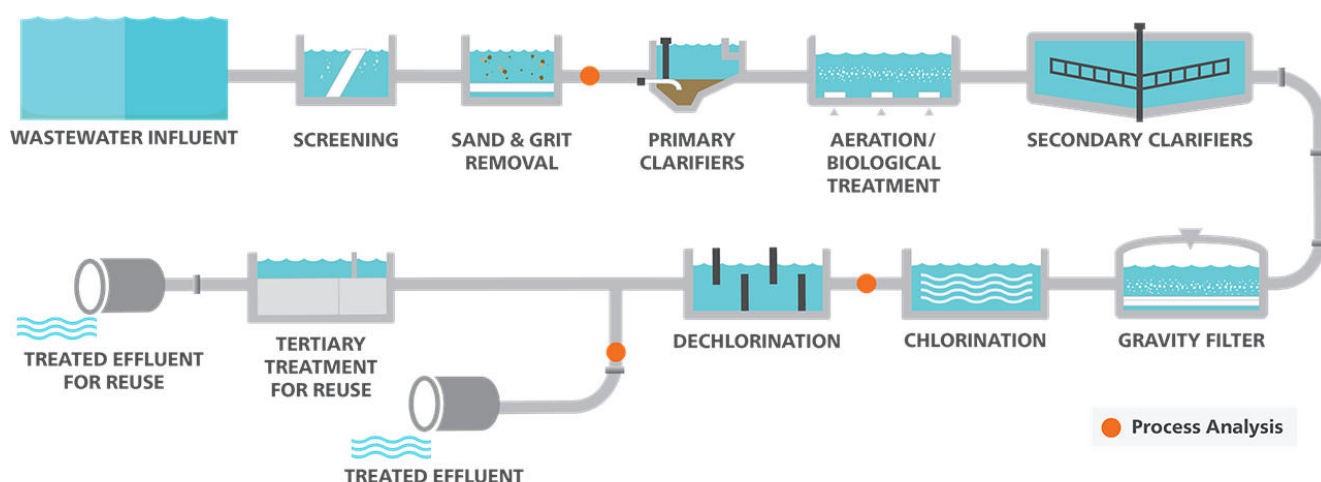


Figure 1. Process analyzer locations in the wastewater treatment process for phosphorus.

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 $\text{o-PO}_4\text{-P}$ 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-PO₄-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-PO₄-P. To monitor both o-PO₄-P and TP according to **EN ISO 6878**, a compact digestion cuvette

APPLICATION

The colorimetric determination of o-PO₄-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.

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.

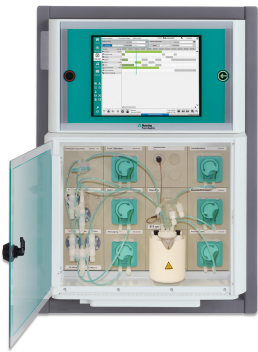


Figure 2. The 2035 TP Process Analyzer from Metrohm Process Analytics.

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



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CONFIGURATION



2035 Process Analyzer - Photometric

測光測定のための2035 プロセスアナライザーは、幅広い濃度範囲においても安定性を示すコンパクトな光度計モジュールを有し、温度調整可能で、またスターラーが装備されています。この分析装置には選択できる2つのオプションがあります。：キュベットシステムと光ファイバー浸漬プローブです。キュベットシステムは試薬の消耗を抑えるためにコンパクトでありながら、感度を高く保つための長い光路長を提供します。光ファイバーによる浸漬プローブにより、製品のアプリケーション範囲は著しく広がりました。というのも、内部希釈工程および、キュベットシステムよりも短いビーム経路により、高濃度サンプルの高精度測定が可能になったからです。測光分析は一般的かつ頻繁に使用される方法であり、この方法によって飲料水中のアンモニアやマンガンや鉄、また食塩水中のカルシウムやマグネシウムなどのイオンまでも測定することができます。サンプルの色素や濁りなど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ができます。