# Wastewater Coagulant Dosing Control

## Turbidity as a dosing trim parameter

APPLICATION NOTE

**INDUSTRY**

Municipal Wastewater

**APPLICATIONS**

Chemically Assisted Settlement
Chemical Phosphorus removal

**MEASUREMENT**

Crude Sewage Turbidity
Settled Sewage Turbidity

**DOSING CHEMICALS**

Aluminium Sulphate
Polyaluminium Chloride
Ferric Sulphate

**PARTECH PRODUCTS**

7300w² Monitor
TurbiTechw² LS Sensor

**TYPCIAL DISCHARGE LIMITS**

Total P = 1 mg/l
Aluminium = 1 mg/l
Iron = 2 mg/l

**ASSOCIATED MEASUREMENTS**

Inlet Ortho-Phosphate
Final Effluent Ortho-Phoshate
and/orTotal Phorphorus

Control of coagulant dosing chemicals in wastewater treatment is an important issue, it links directly to both the site operating cost and to the effectiveness of the treatment process. Partech have successfully worked with one of the UK's water companies to apply our **TurbiTech Self Cleaning** sensors in the monitoring of Turbidity in Crude and Settled Sewage as a control parameter for the addition of coagulant chemicals

Unreacted coagulants are highly toxic to aquatic life primarily due to the low pH levels they cause, it is therefore important that overdosing does not occur, whilst maintaining sufficient dosing levels to ensure effective treatment. The Environment Agency will require a full risk assessment and normally impose discharge permits which include limits on metal residues. Reliable and responsive dosing control is therefore required to optimise the use of the selected coagulant chemical whether this is Aluminium or Iron based.

This document looks at the use of Turbidity as the control parameter, consideration of Phosphorus measurement may also be needed, either as a permanent inlet or effluent measurement or as part of the design process when considering the viability of relying on a diurnal P load profile.

The principal dosing regime on the majority of sites utilising coagulants for nutrient removal and for chemically assisted dosing is time or flow based depending on the size of the plant. However simply relying on flow or on historic data does not allow the control system to respond to changes in load, this is particularly important in areas where large population change occurs due to tourism or where industrial load impacts on the treatment system. This is where Turbidity has proven to be a highly effective, responsive measurement that is easy to apply and understand without high capital or operating costs.

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**Standard Dosing Formula**

$$\text{Coagulant Dose (mls/min)} = \frac{\text{Required Dose (mg/l) of Coagulant} \times \text{Flow (l/s)}}{\text{Conversion Factor}}$$

Where the conversion factor relates to the specific type of coagulant being applied.

This basic equation needs a number of trim factors to ensure the process remains in control under changing load conditions. Some are simple flow limits covering low flow and storm conditions, Additional BOD and Phosphorus load profiles are applied to cater for changes in load normally on a pre-determined diurnal profile.

Turbidity is then added as a live 'reactive' control parameter to give the control system the ability to react to unexpected or unpredictable changes in load. The self-cleaning mechanism on the **TurbiTech** sensor allows the Turbidity measurement to be taken in Crude and or Settled Sewage locations without any problems relating to fouling of the optical surfaces or ragging of the sensor.

The specific dosing relationship when Claral WT18 (an Aluminium based coagulant) is applied becomes

$$\text{Coagulant Flow (mls/min)} = \frac{\text{Required dose (mg/l } Al^{3+}) \times \text{Flow Rate (l/s)} \times \text{Turbidity Trim Factor}}{2.185}$$

The trim factor is site dependent, a typical factor for Feed Forward Control based on Crude Sewage Turbidity measurement is

$$\text{Trim Factor (\%)} = \frac{\text{Dose at specified Turbidity} \times 100}{\text{Required Dose}}$$

| *Example for works with required dose of 8 mg/l* | Turbidity | Dose at specified Turbidity | Trim Factor |
|---|---|---|---|
| Crude Sewage Minimum | 50 | 4 mg/l | 4/8*100 = 50% |
| Crude Sewage Maximum | 500 | 12 mg/l | 12/8*100 = 150% |

A similar table can be produced for Feed Back control based on Settled Sewage Turbidity measurement.

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