APPLICATION Notes
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# Turbidity Monitoring in a Municipal Drinking Water Treatment Plant

## Introduction

When water is destined for human consumption, its clarity is very important. The measure of relative sample clarity is known as turbidity. Using turbidity as a control parameter can provide these key benefits to a municipal drinking water treatment plant operator:

- Improves plant efficiency by optimizing proper chemical dosage.
- Insures the production of high quality, safe water for public distribution.
- Indicates incoming water quality.
- Ensures compliance with regulatory standards

Figure 1 below shows the typical treatment stages used in a municipal drinking water plant.

## Overview of Initial Treatment Stages

The initial treatment stages in a drinking water plant handle the raw incoming water. The type and quantity of impurities varies depending on the raw water source. Surface waters are low in dissolved solids and hardness, but may be high in suspended solids due to sediment content. Ground water is typically low in suspended solids, but may be high in hardness and tends to have more dissolved solids.

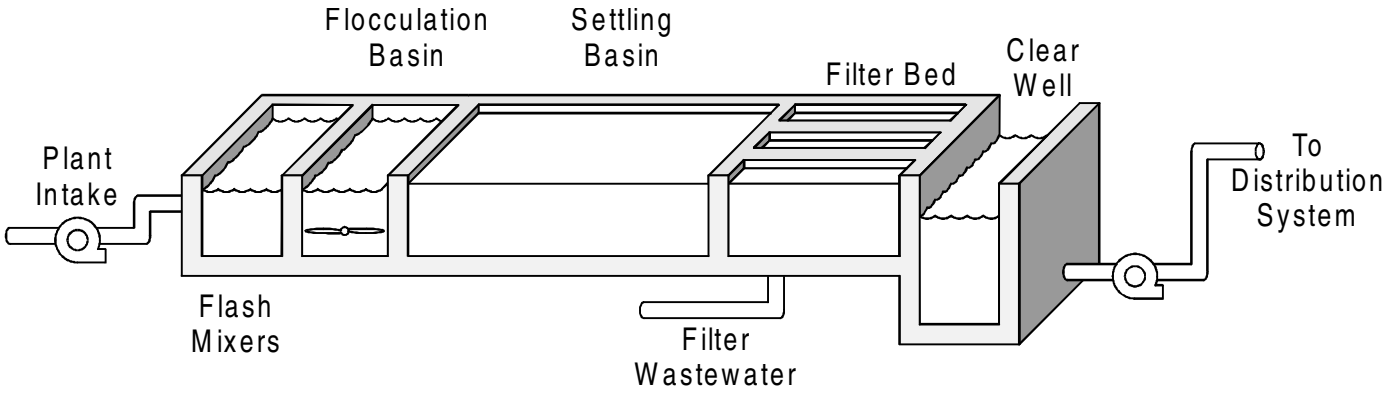


*Figure 1*
*Drinking Water Plant Treatment Stages*

Raw water is typically processed in three initial treatment stages as shown in Figure 2.

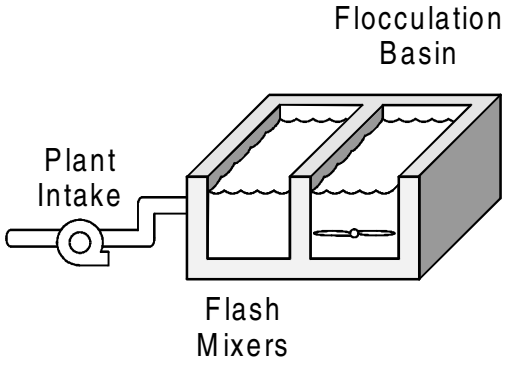


*Figure 2*
*Initial Treatment Stages*

- **Plant Intake:** Water is pumped into the plant from the raw water source. If necessary, the incoming water is passed through a screen to remove large debris (leaves, branches, etc.). In most cases, pretreatment with an oxidizer, such as chlorine or ozone, is used to destroy microbiological contaminants and oxidize materials which may cause taste and odor problems.

  Product Application

  Monitoring turbidity at this location will help the operator detect an upset condition that could reduce the effectiveness of normal treatment methods. Using this incoming water quality measurement, the operator can make an informed choice on which treatment method to use.

  Recommended System:

  Steady Stream 4 High-range Turbidimeter System (consisting of Model T53A4E1N analyzer with auto-ranging 0-1000 NTU scale, and Model 8324T1E0C4NN sensor)

- **Flash Mixers:** A coagulant, such as alum or ferric chloride, is added in the flash mixers to promote the formation of "floc." Carbon or sodium chlorite may also be added to control taste and odor.

- **Flocculation Basin:** The water is mixed for at least 30 minutes with giant revolving paddle wheels to create just enough disturbance to aid "flocculation." Other chemicals may be added to adjust the acidity of the water, making conditions optimum for the formation of "floc."

**Overview of Intermediate Treatment Stages**

After initialing treating the incoming raw water, the water enters two intermediate processing stages as shown in Figure 3.

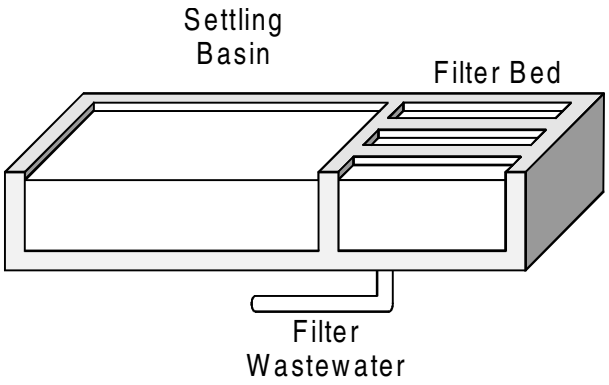


*Figure 3*
*Intermediate Treatment Stages*

- **Settling Basin:** After flocculation, the water flows to the settling basin where suspended particles are captured by the "floc." Most of the "floc" settles to the bottom of the basin where it is removed as bio-solid sludge. Flocculation and this settling stage typically remove more than 90% of the suspended particles from the water.

  Product Application

  The effectiveness of coagulant dosage is determined at the outlet of the settling basin. This turbidity measurement enables the operator to adjust chemical usage without endangering water quality, creating an optimum level of plant efficiency.

  Recommended System:

  Accu4™ Low-range Turbidimeter System (consisting of Model T53A4A1N analyzer with auto-ranging 0-100 NTU scale, and Model 8320T1A0C3NN sensor)

- **Filter Bed:** Since a few suspended solids remain, the water must now be filtered through the filter bed. The filter bed typically consists of varying grades of stone, sand, and in some cases, charcoal. As the water flows downward by gravity through the filter bed, any remaining suspended particles are trapped. The filtered water is again treated with an oxidizer to produce a residual that ensures disinfecting throughout the distribution system. Periodically, the

filter bed is cleaned of trapped particles by a "backwashing" process that reverses the flow of water through the filter bed. The resultant filter bed wastewater is drained off.

Product Application

Monitoring turbidity is recommended in two places: the filter bed effluent and the filter wastewater outlet. The turbidity of the filter bed effluent is measured to meet regulatory requirements, calculate filter efficiency, and check for filter breakthrough. This measurement can also be used to determine when it is necessary to backwash the filter. Monitoring the filter wastewater outlet enables the operator to determine when a filter backwash cycle is complete.

| Filter Bed Effluent Recommended System: |
| --- |
| Accu4™ Low-range Turbidimeter System (consisting of Model T53A4A1N analyzer with auto-ranging 0-100 NTU scale, and Model 8320T1A0C3NN sensor) |

| Wastewater Outlet Recommended System: |
| --- |
| Steady Stream 4 High-range Turbidimeter System (consisting of Model T53A4E1N analyzer with auto-ranging 0-1000 NTU scale, and Model 8324T1E0C4NN sensor) |

**Final Treatment Stage**

After filtration, the water is treated with chlorine or some other disinfectant, and sent to a clear well for final processing as shown in Figure 4.

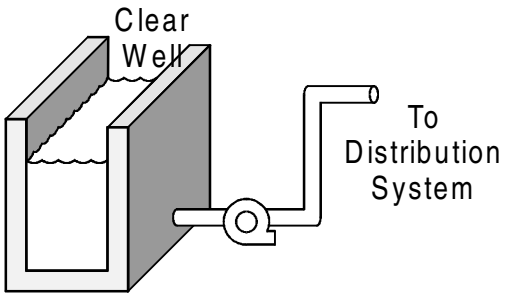


*Figure 4*
*Clear Well Final Treatment Stage*

The clear well serves two purposes. First, it allows more contact time for the oxidizer, added after the filter bed, to complete the disinfecting process. Secondly, it stores excess water to ensure the plant has a readily available supply of water during times of large demand. The water is piped from the clear well to the public through the water distribution system.

Product Application

Measuring turbidity after the clear well enables the operator to determine the overall effectiveness of water treatment. Because this is the final measurement before the water is distributed for public consumption, it helps insure that the water is safe. This measurement can also be used to determine if the plant is meeting regulatory requirements.

| Recommended System: |
| --- |
| Accu4™ Low-range Turbidimeter System (consisting of Model T53A4A1N analyzer with auto-ranging 0-100 NTU scale, and Model 8320T1A0C3NN sensor) |

**Summary**

There are many different reasons for monitoring and controlling turbidity in a municipal water treatment plant. To a great extent, the most important reason is to guarantee public safety by insuring regulatory compliance. If a water treatment plant cannot meet the primary standards mandated by the EPA, it will be assessed a fine or forced to shut down its operation until it can comply. Other reasons for monitoring turbidity are to:

- Determine proper chemical dosage at the flash mixers
- Establish fliter backwash cycles
- Detect filter breakthrough
- Control water quality at the influent and effluent points of the treatment plant

With an understanding of the processes used to treat drinking water, it is readily apparent that turbidity is an essential and vital measurement requirement for public water systems.

***Worldwide Headquarters and Sales:***

**GLI International, Inc.**
9020 West Dean Road
Milwaukee, Wisconsin 53224
U.S.A.

*Phone:* [414] 355-3601
*Fax:* [414] 355-8346
*E-mail:* info@gliint.com
*Web:* www.gliint.com

***Represented By:***