Course Number : CE 332
Course Name : Environmental Engineering Lab
Course Credit : 1.50

Experiment No. 3
Determination of Turbidity of Water

INTRODUCTION

The term "turbid" is applied to water containing suspended matter that interferes with passage of light through the water or in which visual depth is restricted. *Turbidity* may be caused by a wide variety of suspended substances of various sizes ranging in size from colloidal to coarse particles, depending on the degree of turbulence. In rivers under flood conditions, most of the turbidity will be due to relatively coarse particles. Whereas in lakes and other waters existing under relatively quiescent conditions, most of the turbidity will be due to colloidal and extremely fine particles.

ENVIRONMENTAL SIGNIFICANCE

Turbidity is important for water supply engineers as turbid water is not aesthetically acceptable to people. There is always a fear among the people that turbid water may cause diseases. For filtration, turbid water is not suitable as it causes quick clogging of filter bed that necessitates the use of pre-treatment plant. Turbidity is also an important parameter in disinfection process. Disinfection is usually accomplished by means of chlorine, ozone, or chlorine dioxide. To be effective, there must be contact between the agent and the organisms to be killed. However, in cases in which turbidity is caused by municipal wastewater solids, many of the pathogenic organisms may be encased in the particles and protected from the disinfectant. Hence USEPA has placed a maximum level of *0.5* to 1.0 units of turbidity, depending on the disinfection process used, as the maximum amount allowable in public water supplies.
According to Bangladesh Environment Preservation Act (1997), drinking water standard for Turbidity is 10 NTU (Nephelometric turbidity unit).

STANDARD UNIT OF TURBIDITY

Because of the wide variety of materials that cause turbidity in natural waters, it has been necessary to use an arbitrary standard. The original standard chosen was

$$1 \text{ mg } SiO_2/L = 1 \text{ unit of turbidity}$$

and the silica used had to meet certain specifications as to particle size.
Standard suspensions of pure silica are not now used for measuring turbidity. They were used originally to calibrate the Jackson candle turbidimeter, the former standard instrument for turbidity measurement [results expressed as JTU (Jackson Turbidity Unit)]. This was a rather crude instrument in which the turbidity of a suspension was measured by the depth of suspension through which the outline of a flame from a standard candle just disappeared. The Jackson candle turbidimeter was removed as a standard procedure from the 17th edition of "Standard Methods", as it has generally been replaced in practice by more reliable, sensitive,

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and easier to use instrument that depend upon the principle of nethelometry. Also silica as a standard reference material has been replaced by standardized preparations of formazin polymer. The formazin suspensions were first calibrated against the Jackson candle turbidimeter, and thus there is some relationship between turbidity measurements by the Jackson Candle Turbidimeter and nephelometry.

However, the Jackson candle turbidimeter measures the interference of light passage in a straight line while nephelometry measures the scattering of light from particles. Because of this basic difference in the phenomenon measured, results from the two different procedures on different suspensions can vary widely. In order to avoid any confusion this may cause, turbidity measurements by the standard nephelometry procedure are now reported in Nephelometric Turbidity Units (NTU). In additions to formazin standards, commercially available standards such as styrene divinylbenzene beads are also available.

THEORY

The current standard method for measurement of turbidity depends upon instruments that employ the principles of nephelometry. In this instrument, a light source illuminates the sample and one or more photoelectric detectors are used with a readout device to indicate the intensity of scattered light at right angle to the path of the incident light. It is customary to use a particular formazin polymer suspension as a standard, or commercially available preparations may also be used. When using formazin standard, 40 NTU are about equivalent to 40 Jackson candle turbidity units (JTU). Turbidities as low as 0.02 NTU can be determined by this procedure provided that water with sufficiently low turbidity can be obtained for use in instrument calibration. Samples with turbidities greater than 40 NTU are diluted with turbidity-free water until values within the range of 30 to 40 NTU are obtained. The turbidity is then determined by multiplying the measured by the dilution factor.

APPARATUS: DR LANGE Turbidimeter

PROCEDURE

(1) Ensure that the Turbidimeter has been standardized recently.
(2) Fill the clean sample cell with the water sample and place it in the sample cell holder. Cover the sample cell with the light shield. Turn on the switch and read the turbidity directly from the monitor.

ASSIGNMENT QUESTIONS

(1) Discuss the environmental significance of turbidity.
(2) Why turbidity is important in "filtration" and "disinfection" processes?
(3) Write down the methods that are commonly used for removing turbidity from water.

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