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Measurement of Turbidity with Given Waste Water Sample

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Abstract: *Turbidity is a key indicator of water quality and is especially important in the assessment of wastewater. It refers to the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye. This project focuses on the measurement and analysis of turbidity in a given wastewater sample to evaluate the presence and concentration of suspended solids.*
The objective of this project is to measure the turbidity level using a turbidity meter (nephelometer) and assess whether the sample meets environmental discharge standards. The process involves the collection of a wastewater sample, calibration of the turbidity sensor, and subsequent measurement. The data collected will be analysed to determine the level of contaminants and provide insight into the effectiveness of treatment processes or the need for further purification.
This project also highlights the significance of turbidity measurement in environmental monitoring, public health, and regulatory compliance. It emphasizes the importance of maintaining low turbidity in discharged wastewater to prevent environmental degradation and ensure water safety

Keywords: Turbidity, Nephelometer

I. INTRODUCTION

Water constitutes 70 per cent of the earth's surface and is definitely the most valuable natural resource we have (Orebiyi and Awomeso, 2008). The dehydration problem can lead to kidney and heart disease, cause headache and reduce the physical performance of humans (Popkin and Rosenberg, 2010). In addition to drinking, water is used to wash, clean and cook. Water also makes a large contribution to the industry where it is used to generate electricity in power plants and is used for transporting people and goods.The water pollution issue surrounding the world has increased concern among many people. Water pollution can be described as the contamination of water resources by thepresenting of sewage, germs and toxic chemicals (Iqbal et al.,2013). Human activities are the biggest contributors to water pollution (Chen et al., 2007). The water quality level can be determined by observing the level of turbid water. The level of turbid water changes due to the existence of suspended particles, organic matter and chemicals (Verma and Prachi, 2012; Mylvaganam et al., 1998). The easiest way to estimate the turbidity level is by evaluating the colour of a water sample because colour is relatively easy to measure as compared to dissolved organic matter (Christian and Sheng, 2003). Turbidity measurements are widely used in the water treatment industry. The sensor that is used to measure the turbidity level is called a turbidimeter (Omar and Matjafri, 2009). The presence of particles causes the light to be scattered from the straight line and reduces the light intensity (Ródenas-Torralba et al., 2007). The existence of coloured particles or contaminated water can absorb the light energy and this effect can be used to design a precise turbidimeter. A turbidimeter is also widely utilized in the food and beverage industry to control the quality of products (Fleet and Siebert, 2005) and determine the rehydration of dairy powder (Gaiani et al., 2009).

II. LITERATURE REVIEW

A long time ago, the turbidity level was measured using aJackson Turbidity Unit (JTU). This unit is based on theJackson Candle method, where it observes the reduction oflight intensity in a column of water. The turbidity leveldepends on how much volume of water has to be added to thecolumn to reduce the intensity of the candlelight (Muer,1911). JTU units are no longer used nowadays because turbidwater cannot be measured with fewer than 25 JTUs

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(Myre andShaw, 2006).Nowadays, a turbidimeter uses the NephelometricTurbidity Unit (NTU) as the unit of measurement. The international level of turbid water for domestic use is standardized between 5 and 25 NTU (Gasim et al., 2006). Formazin Turbidity Units (FTUs) are another unit of turbidity measurement. The FTU works with a nonspecific or nondescript measurement angle, which differs from the NTU.The NTU works on 90° of angle measurement. The FTU is not recommended for use because the US Environmental Protection Agency has made a rule that a turbidimeter is required to be designed based on 90° of angle measurement (Basic Turbidimeter Design and Concept, 1999). The other parameter that is used to measure the turbidity level is total suspended solids (TSS). The unit for TSS is milligram per litre of pure water (mg/l). Research conducted by Lewis et al. (2002) and Hannouche et al. (2011) determined the relationship between the TSS unit and the NTU unit. Holliday et al. (2003) and Baker et al. (2001) suggested a related equation between these two units, which can be described as: NTU a(TSS)b (1) where a is the regression-estimated coefficient and b is approximately equal to 1 for all particles.

III. EXPRRIMENTAL WORK

Title: Measurement of turbidity of given wastewater sample

3.1) Practical significance

Turbidity plays a crucial role in measuring the quantity of suspended sediment in the water, which can have many negative effects on aquatic life. Aquatic plants can be blocked from receiving sunlight, aquatic organisms can be smothered, and contaminants and pathogens, such as lead, mercury, and bacteria, can be carried by the suspended sediments that cause turbidity. The clarity of water is determined by turbidity. The presence of suspended materials in water, such as clay, silt, and algae, can cause water clarity to be reduced and turbidity to occur.

3.2) Industry/Employer Expected outcome

Apply pollution control methods to mitigate different types of pollution in the chemical industries.

3.3) Course Level Learning Outcome

Select the appropriate treatment method required for treating chemical industrial wastewater.

3.4) . Laboratory learning Outcome

Use turbidity meter to measure turbidity of given wastewater sample.

3.5) Relevant Affective Domain Related outcome

1. Follow safe practices
2. Practice good housekeeping
3. Work as a leader/a team member

3.6) Relevant Theoretical Background

Turbidity often indicates the presence of dispersed and suspended solids like clay, organic matter, silt, algae and other microorganisms which makes the water turbid. Human activities such as construction, mining, agriculture and high sediment level entering during rainy season increases turbidity of water. The colloidal material which exerts turbidity provides adsorption sites for chemical that may be harmful or cause undesirable tastes and odors and for biological organism that may be harmful. The turbidity may interfere with light penetration and photo synthetic reaction in streams and lakes. Turbidity increases the load on slow sand filters.

The suspended matter in water which interferes with passage of light is called turbidity.

Presence of suspended and colloidal solids particles scatters the part of incidence light. When light is passed through a sample having suspended particles, some of the light is scattered by the particles. The scattering of the light is generally proportional to the turbidity. Turbidity is a measure of the quality of water. A Nephelometric turbidimeter is an instrument for measuring concentration of suspended particulates in a liquid. A Nephelometer measures suspended particulates by employing a light beam (source beam) and a light detector set often at 90° to the source beam. Particle density is then a function of the light reflected into the detector from the particles.

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3.7) Actual diagram used in the laboratory with equipment specifications

Required Resources / apparatus / equipment with specifications

Sr.No.	Instrumentation/Components	Specification	Quantity
1	Nephlometric turbidity meter	Range: 0 10000NTU,Principle: 01Nephelometric, Ratio: Full time ON or OFF, Accuracy +/- 2% of reading 0.01NTU, Resolution: 0.0001NTU	01
2	Sample cell	Standard	04
3	Flask	1000 ml	01
4	Funnel	50 mm	01
5	Hydrazine sulphate		10 gm
6	Hexamethylenetetramine		100 gm
7	Distilled water		2 Ltr

IX. Precautions to be followed

1. Check the electrical connections properly.
2. Do not spill water on light source
3. Clean turbidity meter before using.

X. Procedure

A. Reagent preparation

1. Dissolve 5 gm Hydrazine sulphate H6N2O4S in distilled water and dilute to 400 ml in a volumetric flask (solution-1)
2. Dissolve 50 g of pure (>99% purity) hexamethylenetetramine (C6H12N4) in the 500-ml flask containing about 400 ml of ultra-filtered deionized water (solution-2).
3. Pour solution-2 into the 1-liter volumetric flask containing solution-1. Dilute to the mark with ultra-filtered deionized water.
4. Stopper the flask and gently invert several times to mix.
5. Allow the solution to stand for 48 hours at 25 ±1 °C (68 to 72 °F). During this time, the white polymer suspension will develop. The resulting standard is 4000 NTU.
6. Immediately before dilution, invert the flask containing the stock suspension to mix. 7. Dilute the stock suspension before use with ultra-filtered deionized water to achieve a standard of the desired NTU value.
8. Dilution rates for several standard suspensions are listed below.

NTU VALUE	Ml of 4000 NTU stock per Liter
400	100
100	25
50	12.5
20	05
10	2.5
04	01
02	0.5

B. Calibration of the apparatus

1. Switch on the equipment and keep it for 30 minutes.
2. Select range depending upon expected turbidity of given sample of water. 3. Set zero of the instruments with turbidity free distilled water.

value using knob. 3. In another sample cell, take standard solution of 400 NTU and adjust the reading 400 NTU

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C. Operation of instrument

1. Take water sample in sample cell.
2. Fill it up to the mark and wipe with tissue paper.
3. Insert cell in turbidimeter.
4. Note down the reading shown by meter.

IV. CONSTRUCTION AND WORKING

4.1 Construction:

Light Source

This component emits a beam of light, usually white light or infrared light, into the sample. Common light sources include tungsten filament lamps or LEDs.

Sample Chamber:

This is a cuvette or a space where the liquid sample is placed for measurement.

Optical Sensor:

This is a detector that measures the amount of scattered or transmitted light. It can be a photocell or photodiode.

Display Unit:

This component shows the turbidity reading, typically in Nephelometric Turbidity Units (NTU).

Microprocessor:

This unit collects data from the optical sensor and performs calculations to convert the raw data into a meaningful turbidity measurement, says BOQU.

Cleaning Systems:

Some digital turbidity meters, particularly those used in online applications, may include cleaning systems to ensure accurate measurements, says BOQU.

4.2 Calibration Controls:

These allow for regular calibration to ensure accuracy, says BOQU.

4.3 Working Principle:

Light Emission: The light source emits a beam of light into the sample.

Scattering and Absorption: The light interacts with suspended particles in the liquid, causing some of it to scatter or be absorbed.

Light Detection: The optical sensor measures the amount of light that is scattered or transmitted through the sample.

Data Processing: The microprocessor calculates the turbidity value based on the light intensity detected by the sensor.

Display: The turbidity reading, usually in NTU, is displayed on the screen.

Digital Turbidity Meter

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V. RESULTS

5.1 Range of turbidity

Digital turbidity meters typically consist of a light source, a photo detector, and a display unit. The light source emits light that passes through the sample and the scattered light is detected by the photo detector. The amount of scattered light is then converted into a turbidity value and displayed on the screen.Generally speaking, a turbidity reading below 5 NTU appears clear, while a reading of 55 NTU will start to look cloudy and a reading over 500 NTU will appear …The turbidity meter features two automatically switching measuring ranges between 0 … 50 NTU and 50 … 1000 NTU for increased accuracy. The precision of the turbidity meter ensures accurate measurements in all relevant applications.

5.2 Results for sample of turbidity

Drinking water standards require turbidities of less than 1 NTU

River water turbidity refers to the cloudiness or haziness of the water caused by suspended particles like silt, clay, algae, and organic matter.

Turbidity of 0-10 JTU is considered normal.

VI. CONCLUSION

The "Measuring Water Quality Using Arduino and Turbidity Sensor" project has been built and tested successfully. System that tracks water quality in real time at the water sources. Researchers can forecast natural processes in the environment, gain knowledge from them, and identify how humans affect an ecosystem by using the Water Quality Monitoring (WQM). In addition to helping with restoration, these measurement efforts can guarantee that environmental regulations are being met. The WQM, which makes use of IoT technologies, must be a practical and effective system for tracking drinking water quality.

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