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Turbidity Measurement by Alum Dosage Addition in Water Treatment Plant

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Mohanraj.K, Balaji N, Anbumani.K, Madhumita S, Rohind Praveen Raj S, & Harini M
Department of Instrumentation and Control Engineering
Sri Sairam Engineering College

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ABSTRACT: One of the many chemical processes that regulate water quality is water treatment. The three key processes to be taken into consideration were coagulation, flocculation, and sedimentation.Many water sources nowadays are contaminated by industrial, agricultural, and domestic contaminants. As a result, the effects of wastewater pollution on the ecosystem are of great concern. The above-mentioned standard procedures and stages still have a drawback, namely a high operating cost, hence our approach calls for implementing a specially created laboratory treatment facility.

1. INTRODUCTION

Modeling is the study of creating representations of the real system. The created model must accurately reflect the physicalprocess. In order to model a process, theoretical research and experimental analysis are required Various input and output data collected by measuring equipment from the experimental approach includethe process. The second strategy is based on the laws of mass balance and basic physics.

DifferentialThe theoretical approach represents the process model using equations. This study is focused on Employing mass balance equations, a dynamic model is developed. The dynamic model illustrates the changing nature ofthe mechanism Manyglasses of watersupply today have been contaminated by anthropogenic activities such as industrial operations, home waste, and agricultural runoff. There is growing public awareness about how wastewater contamination affects the environment. There are still certain restrictions, including that of high operating costs, despite the fact that some standard wastewater treatment procedures, such as chemical coagulation, adsorption, and activated sludge, have been used to remove the contamination.

In order to implement the thorough analysis of wastewater using MATLAB software, we are here. would allow for the treatment of wastewater and its eventual use as portable water.

OVERVIEW OF EXISTING AND PROPOSED SYSTEM

The necessity for very low-power receiver solutions is a common demand. The power consumption and battery capacity of a network node determine its lifespan. Mechanical vibrations, temperature gradients, and electromagnetic fields all have the potential to scavenge energy and extend the life of batteries.

DISADVANTAGES OF THE EXISTING SYSTEM

I. Consumes a lot of time
II. Large process
III. Accuracy less

ADVANTAGES OF THE PROPOSED SYSTEM

Why the need for human involvement since it is automatic. As we employ advanced software and

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technology, we might predict 80–90 percent in terms of accurate results.

2. BLOCK DIAGRAM

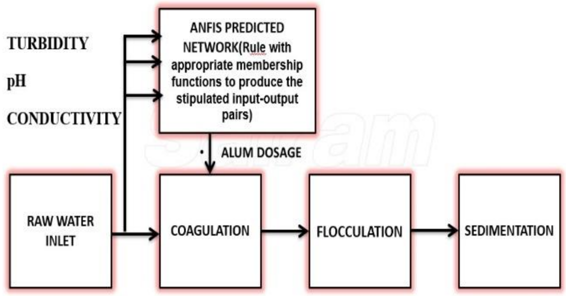

Fig 2.1- Process flowchart in block form

- We are testing three parameters: conductivity, pH, and turbidity.
- These are the crucial factors that must be examined in order to obtain high-quality water.
- The wastewater must go through some treatments such as coagulation, flocculation, and sedimentation to produce portable drinking water.
- The raw water is collected from various water bodies such as lakes, ponds, dams, etc., and is collected through an inlet valve.
- ANFIS is an integration system that employs neural networks to enhance the fuzzy inference system, according to the Neural Networks idea.
- To create the specified input-output pairings, ANFIS builds a set of fuzzy if-then rules with the required membership functions.
- It has various benefits including the capacity for rapid learning, adaptation, and the ability to capture the nonlinear structure of a process
- After that, alum powder is used to treat the water before the coagulation procedure.
- The following are benefits of utilizing alum powder in water bodies: Al2SO4 or aluminumsulfate is employed as a flocculant to clear water sources of undesired color and turbidity
- It has been utilized for this purpose since antiquity, and filtration is frequently used in conjunction with it in traditional water treatment procedures all over the world.

EXPERIMENTAL SETUP

Fig 2.2-Experimental Design

Coagulation, flocculation, and sedimentation are the three main steps in the water treatment process. The creation of dynamic models for all three processes uses mass balance equations.

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The aforementioned procedures are regarded as mixing procedures.

Raw water containing suspended solids enters a tank with a constant holdup capacity in each of the three processes at a constant volumetric flow rate.

With time, the number of suspended particles in the stream that is entering changes.

Finding the transfer function connecting the exit concentration and the inlet concentration is desired. It is a presumption that the stream's density will never change.

Since the holdup volume is fixed, the intake and output flow rates are equal.

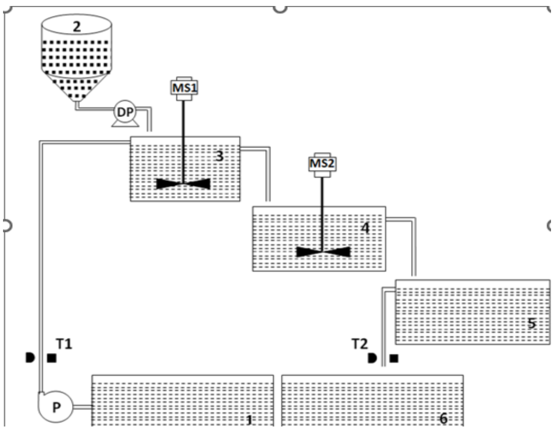

Fig 2.3- Schematic illustration

The above diagram denotes the following modes of operation:

1. Raw Water Tank
2. Chemical Dosage Tank
3. Coagulation Tank
4. Flocculation Tank
5. Sedimentation Tank
6. Treated Water Tank
7. P – Pump
8. DP – Chemical Dosage Pump
9. T1 & T2 – Turbidity Sensors 1&2
10. MS1 & MS2 – Motor with Stirrer 1&2

3. MATHEMATICAL MODELING OF WATER TREATMENT PLANT

Material Balance Equation

Flow rate of suspended solids in − flow rate of suspended solids out = rate of accumulation of suspended solids in the tank

Coagulation Process

$$Q_1C_1 - Q_1C_2 = V_1\frac{dC_2}{dt} \text{--------}(1)$$

Flocculation Process

$$Q_1C_2 - Q_1C_3 = V_2\frac{dC_3}{dt} \text{--------}(2)$$

Sedimentation Process

$$Q_1C_3 - Q_1C_4 = V_3\frac{dC_4}{dt} \text{---------}(3)$$

Fig 3.1 Mass Balance Equation

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Where,

Q_1	Inlet flow rate to the unit processes
C_1	Inlet water turbidity to Coagulation Process
C_2	Inlet water turbidity to flocculation Process and outlet water turbidity from Coagulation Process
C_3	Inlet water turbidity to Sedimentation Process and outlet water turbidity from flocculation Process
C_4	Outlet water turbidity from sedimentation Process
V_1	Volume of Coagulation Process Tank
V_2	Volume of flocculation Process Tank
V_3	Volume of Sedimentation Process Tank

Fig 3.2 The expansion of equation and symbols

Coagulation Process

$$Q_1C_1 - Q_1C_2 = V_1\frac{dC_2}{dt} \quad --(1) \qquad \frac{C_2(s)}{C_1(s)} = \frac{1}{(V_1/Q_1)s+1} = \frac{1}{\tau_1 s+1} \quad --(4)$$

Flocculation Process

$$Q_1C_2 - Q_1C_3 = V_2\frac{dC_3}{dt} \quad --(2) \qquad \frac{C_3(s)}{C_2(s)} = \frac{1}{(V_2/Q_1)s+1} = \frac{1}{\tau_2 s+1} \quad --(5)$$

Sedimentation Process

$$Q_1C_3 - Q_1C_4 = V_3\frac{dC_4}{dt} \quad --(3) \qquad \frac{C_4(s)}{C_3(s)} = \frac{1}{(V_3/Q_1)s+1} = \frac{1}{\tau_3 s+1} \quad --(6)$$

Detention Time = Volume of the Tank/Flow rate

Fig 3.3 The regulating equations

Coagulation Process

Detention Time = Volume of the Tank/Flow rate =1min
Flow rate = 60Litre/Hour = 1 Litre/min
Volume = Detention time * Flow rate = 1min *1 Litre/min
Volume = 1 Litre

Flocculation Process

Detention Time = Volume of the Tank/Flow rate =20 min
Flow rate = 60Litre/Hour = 1 Litre/min
Volume = Detention time * Flow rate = 20 min *1 Litre/min
Volume = 20 Litre

Sedimentation Process

Detention Time = Volume of the Tank/Flow rate =60 min
Flow rate = 60Litre/Hour = 1 Litre/min
Volume = Detention time * Flow rate =60 min *1 Litre/min
Volume = 60 Litre

4. IMPLEMENTATION OF DECISION TREE IN PYTHON

- Get ready for the dataset. Using the Python Sklearn module, divide the dataset into train and test halves. Develop the classifier.
- Make predictions.
- Calculate the accuracy.
- Import the Turbidity_csv file to any platform of our choice (Jupyter, google collab)

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Alum(g)	Treated In Alum(g)		Treated In Alum(g)	Treated Initial water Turbidity(NTU)(10.11)	
2	15.39	4.5	13.73	13.73	4.759
2.5	13.15	5	2.716	2.716	2.208
3	2.486	5.4	0.841	0.841	0.759
3.5	0.828	5.8	0.298	0.298	0.591
4	0.312	6	2.165	2.165	0.241
4.5	1.954	6.5	9.686	9.686	0.086
5	3.457	7	14.33	14.33	0.446
6	8.972				

Fig 4.1 Alum Dosage Results using a Jar test

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=10,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

Fig 4.2 Applying Tree Classifier and checking for Accuracy

```
Accuracy Score = 59.29878048780488
Confusion Matrix =
 [[274 128]
 [139 115]]
Classification Report =
              precision    recall  f1-score   support

           0       0.66      0.68      0.67       402
           1       0.47      0.45      0.46       254

    accuracy                           0.59       656
   macro avg       0.57      0.57      0.57       656
weighted avg       0.59      0.59      0.59       656
```

Fig 4.3 Accuracy Score and confusion Matrix

5. RESULTS AND CONCLUSION

The confusion matrix and accuracy score have been obtained using the Decision Tree Classifier.

Results for turbidity are provided. In the future, the numerous water characteristics, including conductivity, pH, chloramines, and others, may be measured and analyzed to provide predictive analysis.

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