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Comparison of % Cod Removal With Rule Based Fuzzy Approach In Activated Sludge Process at Gajrawadi Sewage Treatment Plant

KEYWORDS: aeration time, cod, mlss,stp

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ABSTRACT *Activated sludge process is the important unit in Municipal Sewage treatment plant (stp) with basic parameters of mlss and aeration time. From data collection of year 2008 and 2009 for Gajrawadistp and consideringmlss and aeration time as an input parameters, to get % cod removal as an output parameter. Results are generated with the help of matlab software using fuzzy approach.The output value of %cod removal obtained same values with very minor deviation. Results are analyzed and compared with laboratory analysis.*

1.Introduction

Untreated wastewater usually contains numerous pathogenic or disease microorganisms that dwell in the human intestinal tract and toxic compounds may be present in certain industrial waste. These may contaminate the land or the water body, where such sewage is disposed off. Therefore it is must for municipal authorities to install and operate Sewage Treatment Plant. The Activated Sludge Process is used routinely for biological treatment of municipal wastewater because of its less land requirement and flexibility of operation.

The operation of a sewage treatment plant (stp) is affected by biological factors. In order to follow the treatment plant performance during the operation, effluent measurements are not sufficient. Prediction of any parameters depending upon the influent water quality helps the operator to control the system and to take necessary precautions before any problem arise. In wastewater treatment plants, values of parameter such as COD in biological treatment plant are either estimated via some kinetic equations considering biomass and substrate or measured in the effluent. By using the simulation like fuzzy approach, upcoming situation can be predicted and precautions can be taken.

2.Description of Gajrawadi STP

Gajrawadi Sewage Treatment Plant is located in south east of the Vadodara city. The sewage from east zone and central zone of Vadodara is being treated in this treatment plant, which is almost 50% - 60% of total sewage of Vadodara city.

The configuration of Aeration tank is as follows.

Shape : Rectangle

Size of tank : 36.4 mt x 73 mt x 3.92mt

Type of aeration : Surface aeration

No. of Aerators in each compartment: 8 nos.

Detention time : 6-8 hrs.

3. Most affecting parameters in Activated Sludge Process

Activated sludge refers to a mass of microorganisms cultivated in the treatment process to break down organic matter into carbon dioxide, water, and other inorganic compounds.

Aeration:

The activated-sludge process contains an aeration tank or tanks in which air or oxygen is introduced into the system to create an aerobic environment that meets the needs of the biological community and that keeps the activated sludge properly mixed. An aeration source is required to ensure that adequate oxygen is fed into the tank and that the appropriate mixing takes place. This source may be provided by pure oxygen, compressed air or mechanical aeration.

MLSS (Mixed Liquor Suspended Solids):

In the aeration tank, contact time is provided for mixing and aerating influent wastewater with the microbial suspension referred to as the mixed liquor suspended solids (MLSS). MLSS in Activated Sludge Process should be maintained because if MLSS content is too high, the process is prone to bulking and the treatment system becomes overloaded. This can cause the dissolved oxygen content to drop with the effect that organic matters are not fully degraded and biological 'die off'.

COD (Chemical Oxygen Demand):

Itis a measure of the capacity of water to consume oxygen during thedecomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite.

4. Rule based Fuzzy approach

The operators working in municipal Sewage Treatment Plant or in industries are not well educated. Therefore they cannot understand the exact precision and quantitative measures of the output which is evaluated in the laboratory. The crisp value of various parameters obtained from laboratory is difficult to understand and operate by the operator. Rule based fuzzy approach provide the categorization of the output and input and to carry out the efficient operation of treatment plant. Fuzzy based approach is a well-known tool for automation of wastewater treatment plants.Rule-based fuzzy approach facilitates the input and refinement of expert knowledge in problem-solving modules. These systems can be efficiently implemented and

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can incorporate human-like reasoning concerning qualitative information.

5. Methodology

5.1Data collection and laboratory analysis

Collecting data of year 2008& 2009 with output cod values which have been analyzed in laboratory.

5.2Evaluation of parameters for fuzzification using regression

By making program with regression can be produced membership function.

Table 1 Categorization by using multiple linear regression program

Input-1: Aeration Time	Input-2: MLSS	Output: %COD removal
Very low - 6.0 - 6.5	Low - 1700 - 2810	Low - 80-83.5
Low - 6.0 -7.0	Medium - 1700 - 4100	Medium low - 81-86
Medium low - 6.5 -7.3	High - 2810 - 4100	Medium - 83.5-89.5
Medium - 7.0-7.65		Medium High- 86.5-92
Medium High - 7.3-8.65		High - 89.5-93
High - 7.95-9.3		
Very High - 8.65-10.0		

5.3Use of fuzzy approach in Matlab

5.3.1 Membership Function for output parameter %COD removal

After categorization of input and output values making mf of input and output parameter.

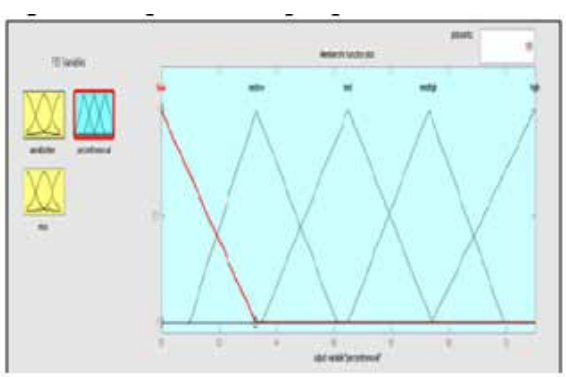

Fig 1 Trimf of Output parameter of %COD

5.3.2 Application of Rule- Based approach (IF-THEN)

Rule Editor (Application of Rule- Based approach (IF-THEN)):

The following rules are being framed for describing the process. The selection of rules is based on experience of the process.

5.3.3Surface Viewer

The surface viewer is having the surface consisting of three parameters MLSS, Aeration Time and %COD removal. As the surface is smooth it reflects the easy transition from one category to another.

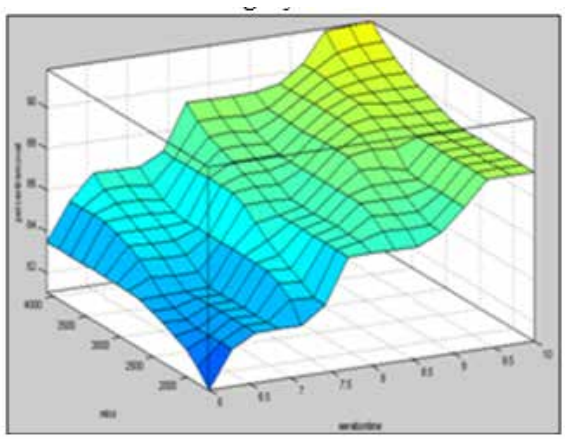

Fig 2 Surface Viewer of %cod removal

5.3.4FIS Evaluation in Matlab

After getting output values with smooth surface viewer we have to convert into crisp values by following command:

```
Command Window
>> z=readfis('std_copy');
>> evalfis([7.49 3124],z)

ans =

    87.4966

>> evalfis([7.86 2484],z)

ans =

    86.4672

>> evalfis([8.66 4056],z)

ans =

    89.2499
```

5.4 Making comparison of output values obtained from Rule Based Fuzzy Approachwith laboratory analysis values.

Volume : 5 | Issue : 1 | Jan 2015 | ISSN - 2249-555X

Table 2Comparison of Fuzzy Approach Data With Laboratory Values

MLSS (Mg/lit)	Aeration Time (tank capacity / flow) (Hrs.)	% COD Removal by laboratory analysis	% COD Removal obtained from Fuzzy Logic	Difference between laboratory % COD Removal and %COD removal by fuzzy model
2990	8.44	89.24	88.23	1.01
2002	9.26	90.62	88.86	1.75
2981	8.38	87.94	88.01	-0.08
2830	8.63	91.45	89.11	2.34
1928	8.06	87.63	86.96	0.67
2386	7.94	88.78	86.47	2.31
2868	8.68	88.77	89.27	-0.50
2208	7.91	87.54	86.46	1.07
2208	8.60	88.67	87.68	1.00
2012	8.91	86.72	87.32	-0.61
2891	8.22	88.89	87.50	1.39
2682	7.98	87.50	86.62	0.88
2864	8.47	88.71	88.34	0.37
2241	8.61	88.48	87.74	0.74
2516	8.61	88.68	88.36	0.31
2336	8.93	88.89	87.94	0.95
2180	8.62	88.80	87.62	1.18
2356	8.30	89.74	87.75	1.99
2306	8.56	87.94	87.88	0.06

6.Conclusion

The output value of %COD removal obtained by Rule Based Fuzzy Approach and when compared with laboratory data, shows same value with small deviation of 0.02% to 2%. As the Result obtained by fuzzy approach can get rapidly with less laborious work. By linguistic output parameter workers can understand easily to operate any unit. This approach is also beneficial to control the unit and increase the efficiency of working.

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