INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

Optimization of Coagulant Using Artificial Neural Network

Dr. M. Raju, Dr.P.Vijayakarthik
Department of Computer Science and Engineering,Shadan College of Engineering and Technology HYD,T.S,INDIA
Dr.A.N.Nanadakumar
IES College of Engineering, Thrissur, Kerala, India

Abstract-The complex nature of drinking water treatment unit processes, utilities have quantifying the relationships that exist between process input and output. Process models, where they exist, are often site specific and they are unable to handle continous variations in one or two key process variables. The artificial neural network technology is a robust artificial intelligence technology that can handle the treatment process. In water treatment, ANNs have enormous potential, especially to support workers in plant operation. Water plants are taking large volumes of data, especially information about water quality parameters, ANNs can be used for the prediction of water quality. With use of ANNs in real time, system will get more efficient, so reducing costs and increasing the quality of water. In this paper, the artificial neural network is used for the prediction of optimum coagulant dosage in Pillur water treatment plant, Coimbatore

1. Introduction

1.1 General: Water treatment is a well known process and it is used for many years. The raw water quality available in India varies significantly, resulting in modifications to the conventional water treatment scheme consisting of aeration, chemical coagulation, flocculation, sedimentation, filtration and disinfection. The water is treated differently in many water treatment plants depending upon the quality of water entering into the treatment plant. The rapid growth of population has exerted the portable water demand, which requires exploration of raw water sources, developing treatment and distribution systems.

1.2 Water Quality Parameters: The water quality parameters which are relevant to this project work and which are used in the artificial neural network development model are discussed. 1.2.1 PH of Water: PH indicates the level of acidity of the water but it actually a measurement of the potential activities of hydrogen ions (H+) in the water sample. The PH range is about 6.0 to 7.8 but for drinking purposes WHO has set a standard PH level between 6.5 to 8.5. The factors affecting the PH value of water is the concentration of carbon dioxide (CO2) in the water.Natural and unpolluted rainwater can be used as acidic as PH 5 to 6 because it absorbs CO2 during the day and release it during the night, PH levels in water can change from day to night.

1.2.2 Turbidity: The turbidity may be caused by large amount of clay, silt, sawdust, wood ash, microorganisms and plant fibres. Such particles can cause tastes, carry bacteria and plant nutrients can cause chlorine in the disinfection process. The flow rate of water body is a primary factor influencing turbidity level. High flow rate of water can carry more particles and larger sized

sediment which causes higher turbidity level. In general, turbidity will increase significantly during and afterb rainfall, which causes sediment to be carried in to the stream.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

1.2.3 Colour: The colour of the stream water is an indication of a source and it can provide important information about the water quality. Darker colour water absorb more of sun heat and raise water temperature. Natural water can range from less than 5 hu in very clear waters to more than 300 hu in muddy water. An aesthetic objective of < 15 hu has been set by WHO for colour in drinking water. It is very necessary to treat this parameter as colour values above 15 hu can be detected in a glass of water by most water consumers.

1.2.4 Alkalnity: It is not a pollutant, it is a tool measure of the substance in the water that have "acid-neutralizing" ability of water to resist changes in the PH. Water with low alkalinity is liable to change in PH water with high alkalinity is able to resist major shifts in PH. The major sources of alkalinity are limestone, which can contain carbonate, bicarbonate and hydroxide compounds.

1.2.5 Total Solids: The total solids represents suspended or dissolved matters in water or waste water and it relate both the specific conductance and turbidity.It includes both the total suspended solids (TSS), and the total dissolved solids (TDS), TSS includes a materials such as silt, decaying and animal matter, industrial wastes. High concentration of both TSS and TDS reduces water clarity, and decreases photosynthesis, and lead to an increase in water temperature.

1.3 About Pillur Water Treatment:

The water quality parameters which are relevant to this project work and it is used in the Artificial Neural Network development model. The treatment plant for case study in this project work is the 31.25MLD capacity water treatment plant functioning under the water supply scheme for corporation and other beneficiaries in Coimbatore district with pillur reservoir as source. The surface water mostly contains both dissolved and suspended particles. The coagulation control is essential for satisfactory water quality treatment. In Pillur water treatment plant, they are using Alum as a coagulant. . Usage of excess of coagulant dosage will result in high cost, but the required target will be achieved. The required concentration of coagulant dosage to destabilize any colloidal particles in the water treatment plant is evaluated using Jar test and Streaming Current Detector(SCD). The Atrificial Neural Network modelling is a method and it can be applied to problems for determining the optimum coagulant dosage and with enough data, a successfull model can be developed. In this project work, an Artificial Neural Network model was developed and it will enable the plant operators to obtain required alum dosages and to predict the treated water parameters easily within a short period of time.

II.MATERIALS AND METHODS: For training the ANN network, we collected nearly 1039 days data for period of 2004to 2008. The data obtained from the water treatment plant were entered in the computer in excel format, so that it can be used as feed data for the ANN. The ANN has the capacity to predict the optimum coagulant dosage. Once a set of training data is given into the system it has the capability to analyze the optimum coagulant dosage required. Many calculations can be avoided and accuracy can be obtained when it is done using ANN.

2.1 Artificial Neural Network(ANN): An Artificial neural network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain process information. The key element of the paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to sove specific problems.ANN is also like people, they learn by example. AN ANN is configured for a specific application, such as

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

pattern recognition or data classification, through a learning process. Learning in biological system involves adjustment to the synaptic connections that exist between the neurons. This is true of ANNs as well. The first artificial neuron was produced in 1943 by the neurophysiologist Warren Mcculloch and the logician Walter Pits. In earlier days when ANN was introduced technology was not much developed to support the development. Nowadays there are more software available for ANN. 2*.2 Architecture of Artificial Neural Network:*
The basic structure of an artificial neural network
- Input layer
- Hidden layer
- Output layer

In input layer, the data is feed into the network and it can be used for both training and validation. Hidden layer is the most important layer where the weights are calculated, adjusted and other process takes place. Output layer consists of a set of target calculated during training purposes, if a new input is given after passing through the hidden layer it will look closely associated output, if it is not relative to the targeted output it will again back propagate into the network.

2.3 MATLAB Software: MAT LAB-Mathematical laboratory, which means mathematical software, originated and mainly developed by mathematicians. The name envisages a laboratory for matrix calculations, where the mathematical term of a matrix refers to an array. While MATLAB was designed for numerical linear algebra in the beginning, it has become tool for all types of mathematical calculations in the mean time. Nowadays, MATLAB has been applied in nearly every field of scientific or technical calculations. In the academic branch there is almost no university where MATLAB is not available. With MATLAB innumerable types of mathematical operations can be performed. Of course, numerous linear algebra calculations are available, such as inversion of matrices, Eigen value and Eigen vector determination, which can be applied to perform various tasks. It can perform basic statistics, numerical differentiation and integration, evaluate all types of functions, solve dynamical systems and partial differential equations, estimate parameters and so forth. All this is part of core MATLAB a collection of basic mathematical tools. The package used for this study is MATLAB (R2008b).

2.4 Operations in MATLAB: When MATLAB is opened, the user obtains a graphical user interface on the display, containing several windows. The main window to start with, is the „Command window", where commands are given and answered. Simple function can be performed in this window. Very important is the workspace view, where all the variables of current session are visible and directly available. The workspace of the just started session is depicted on the left side of the command window. The workspace appears only if the view is selected in the „Desktop" submenu.

Next to mention is the „command history" view in which all commands are listed. The user can initiate the repeated command mostly with some workspace variables changed; by double click in the command history window. It is an alternative method to copy a former command in the history view and paste it.

2.5 Creations of M-file: The work with M-File replaces extensive operations in the command window nevertheless, for certain tasks, the command window will remain the most direct and simple way to compute with MATLAB. The above said is a small introduction to the MATLAB. Next is the methodology using with the neural network is being performed.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

2.6 ANN model using MATLAB:

 The artificial neural network is coded in the m-file and it is executed in the MATLAB R2008b software.

 Initially the data has to be documented in the Microsoft excel format, which is going to be the input medium for the neural network.

 The data has to be introduced into the network using the command, and then the data which is being fed will be of various dimensions and of different nature and so input data has to be standardized.

 Then the standardized data has to be divided into two categories one for the training purpose and the other one is for validation purpose.

 The data will be divided in the ratio 80:20, that is 80% is for training purposes and the remaining 20% is for validation purposes.

 Next step in training the network, the built inn function „minimax" is called for the standardization purpose, the data collected for the training purpose will be standardized at this stage.

 Then the feed forward back-propogation network is selected and then the number of hidden layers and the number of epochs should be given. The „NET"

Syntax is used for training the network.

 Then the number of epochs is given as 1000 that is the number of times network has to undergo back and forth per second has to be given, then the error gradient is given as 1xe-4.

 The network undergoes process and then after this data has to be destandardized and the output has to be simulated using the function „simout".

 Next the data which is allotted for validation purposes will enter the network and then it will check the performance of the network, then it will prompt input for the test data, then it process the data and then the output is generated.

III.RESULTS AND CONCLUSION 3.1 Result by ANN Model: The data collected from the water treatment plant is fed in ANN model and the following results were set obtained. The ANN model shows the plot between the actual value and the predicted value by ANN for both training data set as well as validation data.

IV CONCLUSION 4.1 Conclusion from ANN Modelling: The following conclusions are made from the ANN model:

 The supervised neural network model has been created.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

 The ANN model can predict the target for any set of new inputs very near to the probable output.
 Based on the accuracy of prediction the ANN model is found to be best suited model for prediction of target for new projects.
 The ANN model, even though not explaining the relationships of input variable with the output variables, is the better tool for the accurate prediction of target.
 The ANN model gives best accuracy and time consuming process.

4.2 Scope for future study:

This model, however, is only based on the precious behaviour of operators and jar-test results. Further work is needed to develop a model taking into account the dynamics of the process, and allowing to predicted treated water parameters, mainly turbidity at the output of the clarification process. The concept demonstrated in this project work can be applied in the modelling of other water treatment process such as filtration and chlorination.

S.N0.	PH	Turbidity	Alkalnity	TDS	EC	AV	PV	Mean
1	7.25	6	28	97	138	8	8	0.312
2	6.98	32	20	81	115	16	16	0.1594
3	6.93	42	20	76	109	24	24	0.4684
4	6.91	50	18	69	98	32	32	0.3818
5	6.92	87	18	78	99	42	42	0.8060

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 3 Issue 4 – www.ijrmmae.in – Pages 38-43

V.REFERENCES

[1]. Baxter.c.w,Zhang.q.,Stanley,S.J.,Shariff.R.,Tupas.R-R.T., and Stark. H.L.,(2001).Drinking water quality treatment: The use of Artificial nueral networks.can.j.Civil Engineering.28(SUPPI), 26-35.
[2]. Mirsepassi.A.,Cathers.B, and Dharmappa. H.B.(1995).Application of artificial neural networks to the real time operation of water treatment plans. In IEEE International Conference on neural networks.Proceedings. Perth, Australia:IEEE.
[3]. Psychosis .D.C.,and ungar.L.H(1991).Direct and indirect model based control using Artificial neural networks.Ind.Eng.Res.30,2564-2673.
[4]. Schlenger .D.L.,Riddle,W.F.,Luck,B.K., and Winter,M.h.(1996),Automatic management strategies for water treatment facilities.Denver.co.AWWARF and AWWA.
[5]. Stanley.S.J.Baxter.c.w.,Zhang.Q, and Sherrifs.(2000).process modelling and control of enhanced coagulation.Denver.co.AWWARF and AWWA.
[6]. Zhang.Q and Stanley.S.J.(1999),Real-Time Water Treatment Process control with Artificial neural networks.J.Env.Eng.125(2), 152-160.