ALUM AND LIME DOSING CONTROLLERS FOR WATER TREATMENT PLANT

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by

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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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I endorse the declaration by the candidate.

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Dr. Palitha Dassanayake

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Abstract

Many techniques are applied to the control of Alum and Lime commonly termed as coagulant dosing in a drinking water treatment plant. Coagulant dosing rate is non linear correlated to raw water parameters such as turbidity, conductivity, pH, temperature, etc. Manual method called Jar testing is used to decide the Alum and Lime dosage. However in practical situation, Jar testing is carried out maximum three times per day. But the parameters of water sources are continuously changing specially on rainy days. Therefore overdosing and underdosing of Alum and Lime are normally occurred. Excessive coagulant overdosing leads to increase treatment costs and human health problems, while underdosing leads to failure to meet the water quality targets and less efficient operation of the water treatment plant. It means that important requirement arises to automate the system with optimum coagulant dosage.

The research is aimed to propose an alternative to the jar test allowing for an on line determination of optimal coagulant dosage from raw water characteristics and design a system for feeding Alum and Lime automatically with a monitoring display.

The reasonable assumption made by this research is, except turbidity and pH value, other parameters are almost same throughout year. After analyzing thousand number of jar test results with corresponding turbidity values and pH value of incoming water, it was found turbidity value of raw water and the dosage of Alum has a relationship and pH value of raw water and the dosage of Lime has another relationship. Relationship of turbidity value of raw water and the dosage of Alum is second order polynomial. However pH value of raw water and the dosage of Lime have stepwise relationship. And also actual values of three hundred situations were taken and applied to check the validity of relationships and it is proved that the relationships which has obtained are well suited to develop the automation system.

Next objective is designing of hardware and software part of controller of an automotive system to dose Alum and Lime using the relationship. PIC16F876 microcontroller is selected as the controller; it made the task easier. Since PIC16F876 has 8-bit with analogue to digital converters, it handled analogue output of turbidity sensor and pH sensor. In this project MAX 7219 display driver IC could be easily interfaced with microcontroller by using three wires (SDO, SDI and SCLK) and LOAD (CE) which is common today named as Serial Peripheral Interface (SPI).The PIC16F876 chip is in electrical erasable packaged version (FLASH), and it helped for programming several times for testing our object before implementing.

Finally complete control and feeding system for Alum and Lime was designed. Value of turbidity was measured by a turbidity sensor. That value was taken to the microcontroller that decides the Alum dosage and changes the valve position using stepper motor accordingly. Either increment or decrement of the value of turbidity by 10 makes the changing of valve position in ADC. Either increment or decrement of the value of pH value by 0.1 makes the changing of valve position in LDC. Using MAX7219 IC current value of turbidity and current value of pH are displayed in ADC and LDC respectively.

Key features of the system are simple relationships constructed to find optimum coagulant dosage and ability of handling practical situations of water treatment plants using automation system with microcontrollers.

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ANN	-	Artificial Neural Network
FRBS	-	Fuzzy Rule Based System
SCD	-	Streaming Current Detector
ADC	-	Alum Dosing Controller
LDC	-	Lime Dosing Controller
A/D	-	Analogue to Digital
SOM	-	Self Organizing Map
UEGO	-	Universal Exhaust Gas Oxygen
LCD	-	Liquid Crystal Display
USB	-	Universal Serial Bus
PLC	-	Programmable Logic Controllers
PIC	-	Programmable Intelligent Computer