AUTOMATIC VISCOSITY MONITORING AND CONTROL IN SUGAR INDUSTRY

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ABSTRACT

Process control Industries like sugar mill, paper manufacturing industries, chemical and petrochemical product manufactures etc., are running continuously to satisfy the needs of customers. The industrial process are generally monitored and controlled through the Distributed Control System. In the existing method, a sample of massecuite was taken to the laboratory and measure the viscosity using viscometer. If it reaches the desired value it will go to the next stage of process otherwise again juice will be added and reheating process takes place till it reaches the desired value manually. In the proposed method, it demonstrates the monitoring and control of viscosity of cane juice automatically for maintaining good quality of a sugar. The parameters like temperature and viscosity are continuously monitored through IoT. The viscosity can be controlled by means of temperature and stirrer speed. The stirrer and heater were connected with the main process tank. Once the viscosity reaches the desired level and massecuite can be collected in another process tank.

Keywords: viscosity, massecuite, IoT, Temperature sensor, GSM

I. INTRODUCTION

In sugar industry, the measurement of viscosity playing a major role. There is always need to measure a viscosity of sugar syrup, to maintaining the sugar massecuite. At the same time, the measurement of viscosity is also difficult to measure. The industries are following the manual method for measuring the viscosity. In the proposed method, the viscosity is measured based on the temperature. The temperature and motor speed both are compared and viscosity has been measured. In the existing method, the person will take the sample of sugarcane juice and measure the viscosity value using viscometer. If the measured viscosity value is high, again the cane juice is added and it will be reheated till it reached the desired value. Similarly, if it is low, heating process will be continued after it reaches the desired value, it will be collected in another tank manually.

The main drawbacks of existing method are manpower is always needed for every stage. Continuous monitoring does not takes place in this method.

In the proposed system, the viscosity of the sugar cane juice is maintained at a specified value continuously [1]. The sugar cane juice from the storage tank is flow to the main process tank, where the juice is continuously heated. The cane juice in the main sugarcane juice tank whose viscosity value should be maintained [2]. The heat is directly proportional to viscosity. As temperature increases, viscosity of the cane juice increase. If viscosity value reaches the desired value, it will be collected in the next tank. Then the same process will be continued like a batch process. Simultaneously the temperature, level, flow value will also be measured and controlled. The parameters (temperature and viscosity) of all value will be sent to the microcontroller and then it is linked with IoT, where all the parameters are continuously monitored through IoT.

The main advantage of this proposed system is, No labour requirement in all the stage. Viscosity value to be measured and monitored

continuously through IoT [3]. It increases the productivity.

II.COMPONENTS

Temperature probe DS18B20 is used for measuring the temperature from -55˚C to 125˚C. The stirrer attached with the DC motor for continuously rotating the sugar syrup in the main process tank. Heater attached with the main process tank. Measured temperature and corresponding viscosity are send to the PIC18F452 microcontroller. All the data's are stored in the cloud data base. The GSM is used to send the data from microcontroller to the cloud data base. The information are monitored through mobile phone.

III. PROCESS EXPLANATION

In this proposed method two process tank has been used, one is the storage tank called Tank-1 and another one is the process tank called as Tank-2. The Tank-2 consists of heater and stirrer arrangement. The sugar syrup is flowing into the Tank-2 coming from the storage tank. The heater attached in the Tank-2 for heating the sugar syrup coming from the Tank-1. The stirrer is attached along with the motor arrangement is made for continuously stirring the sugar syrup while heating.

When heating takes place, viscosity of the sugar cane juice increases in the Tank-2. As viscosity value increases, the rotation speed of the motor will be gradually reduced. This motor speed is measured and given to the microcontroller and compared with the desired viscosity value[4]. If the measured value and reference value are equal, the processed sample is collected by another tank for the next process and heater will be turn off. If it is less than the heating will be maintained till it reaches desired value .This process is done like a batch process. The parameters like, temperature and viscosity from the controller are sent to the cloud data base by using GSM, and these parameters are monitored by mobile phone. In the cloud data base these values are stored.

The circuit diagram shown in figure 3.1 consists of Temperature sensor, ULN2003, PIC18F452 Microcontroller and LCD.

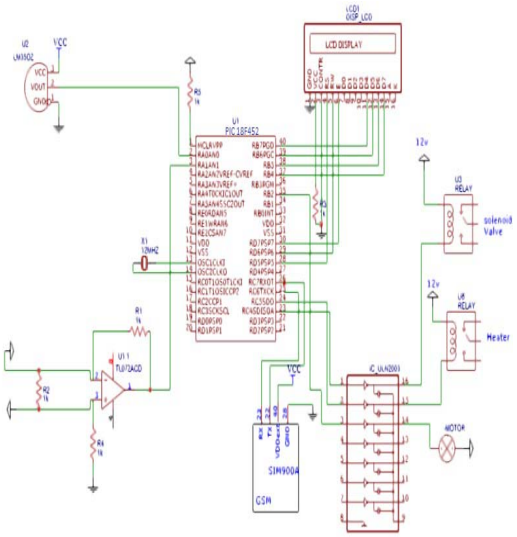


Figure 3.1 Circuit diagram of Automatic Viscosity Monitoring and Control in Sugar Industry.

The measured signals are amplified with signal conditioning circuit and it is sent to the PIC18F452 microcontroller. The process parameters like temperature and viscosity of cane juice are displayed in the LCD. A Driver circuit is used to control the controller output and sent to the relay circuit for activating the DC motor. In the microcontroller, port A the pin number 2 and the pin number 3 is connected to Temperature sensor. The Port B is connected to the LCD of the pin numbers 11, 12, 13 and 14. Port C is connected to the GSM. From the Microcontroller, the information is sent to GSM, then it will sent to Cloud database. The process parameters such as temperature and viscosity can be retrieved in mobile phone.

IV . SOFTWARE DESCRIPTION

The Internet of Things (IoT) is the network of physical devices, vehicles and home applications and other items embedded with electronics, software, sensors, actuators and connectivity which enables these objects to connect and exchange data. It is a special logic that describes the concept of everyday physical objects being connected to the internet and being ability to identify themselves to other peripheral devices. It has evolved from the convergence of wireless technologies, Micro electro mechanical systems(MEMS), micro services and the internet.

In the proposed method, IoT with the help of Android studio software was used. It is the official IDE for Android application

development. On the top of the capabilities, Android studio offers

1. Flexible Gradle-based build system.
2 Build variants and multiple apk file generation.3.Programming Code templates help to build common app features. 4. Drag and drop theme editing are carried out by Rich layout editor. 5. Lint tools to catch performance, usability, version compatibility and other problems. 6. Proguard and app-signing capabilities. 7. Google cloud platform features make easy to integrate Google cloud messaging, control the electronics devices through wireless and app engine.
The flexibility of the Android build system enables to achieve all of this without modifying the app's core source files.

V. RESULTS AND DISCUSSION

In the proposed method, the amount of juice flow, heating process and stirrer are controlled according to the viscosity value of massecuite. The process executed is shown in Table 5.1. This table shows the viscosity control. The set value of the viscosity is 65 mPa/sec. the solenoid valve-1 and solenoid valve-2 are the inlet and outlet of the main process tank respectively. When viscosity value is low the solenoid valve-1 and solenoid valve-2 are close, stirrer is rotating and heater is on. If viscosity value reaches the desired value, then the heater and the stirrer will going to OFF stage and solenoid valve-2 gets opened. If the viscosity goes beyond the desired value, the solenoid valve-1 gets open, the stirrer and the heater remain ON.

Table 5.1 describes the different viscosity values and corresponding operations of solenoid valve 1, solenoid valve 2, heater and stirrer. Figure 5.1 shows the graph between Time(secs) Vs Temperature(˚C) . Figure 5.2 shows the graph between Time(sec) Vs Viscosity(mPa/sec). Figure5.3 shows the graph between Temperature(˚C) Vs Viscosity(mPa/sec). Figure 5.4 shows the hardware setup of the proposed work.

Table 5.1 Different Viscosity values and corresponding operations

S. No	Viscosity Value	Solenoid Valve 1 (inlet)	Solenoid Valve 2 (outlet)	Heater	Stirrer
1	**40 (LOW)**	**OFF**	**OFF**	**ON**	**ON**
2	**65 (SET VALUE)**	**OFF**	**ON**	**OFF**	**ON**
3	**70 (HIGH)**	**ON**	**OFF**	**ON**	**ON**

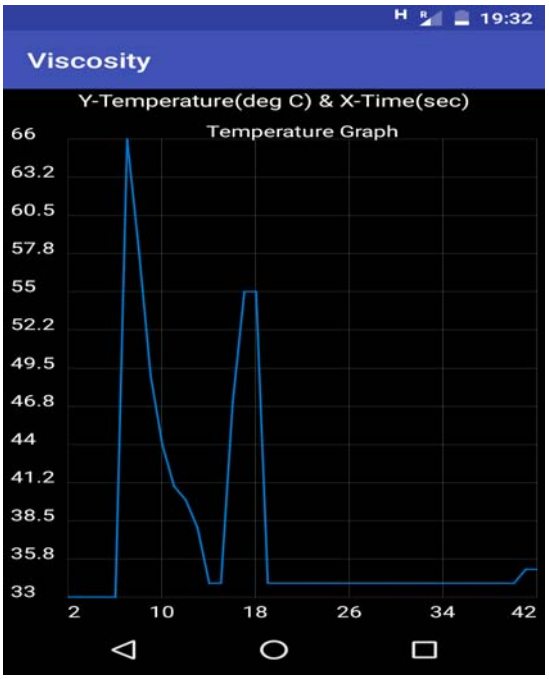


Figure 5.1 Time(secs) Vs Temperature(˚C)

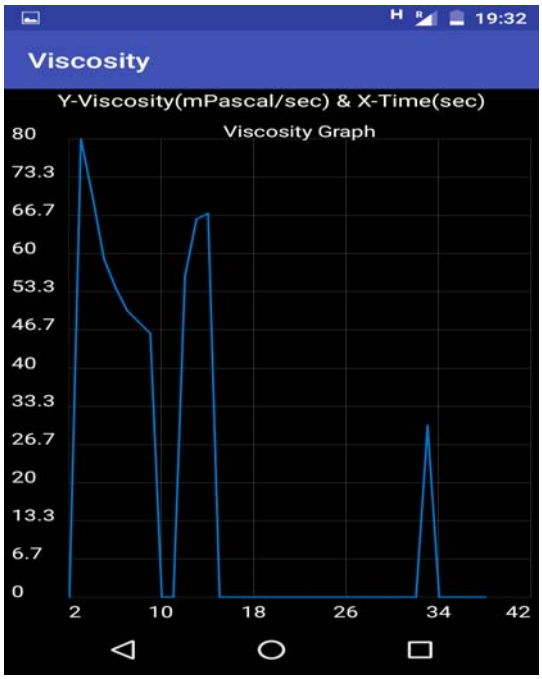


Figure 5.2 Time(sec) Vs Viscosity(mPa/sec)

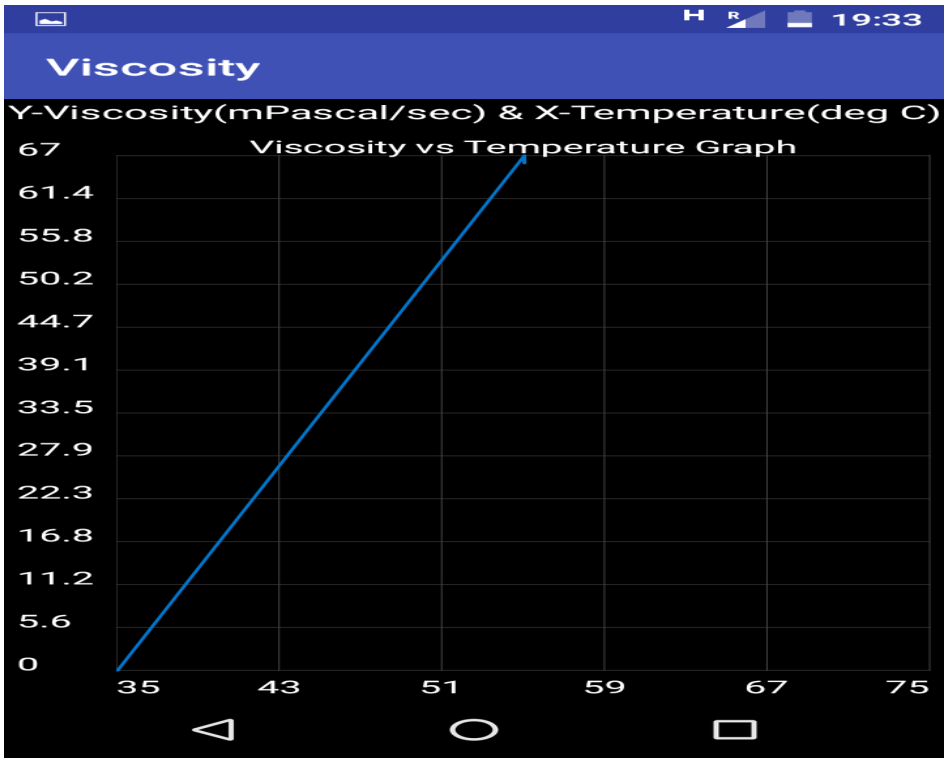
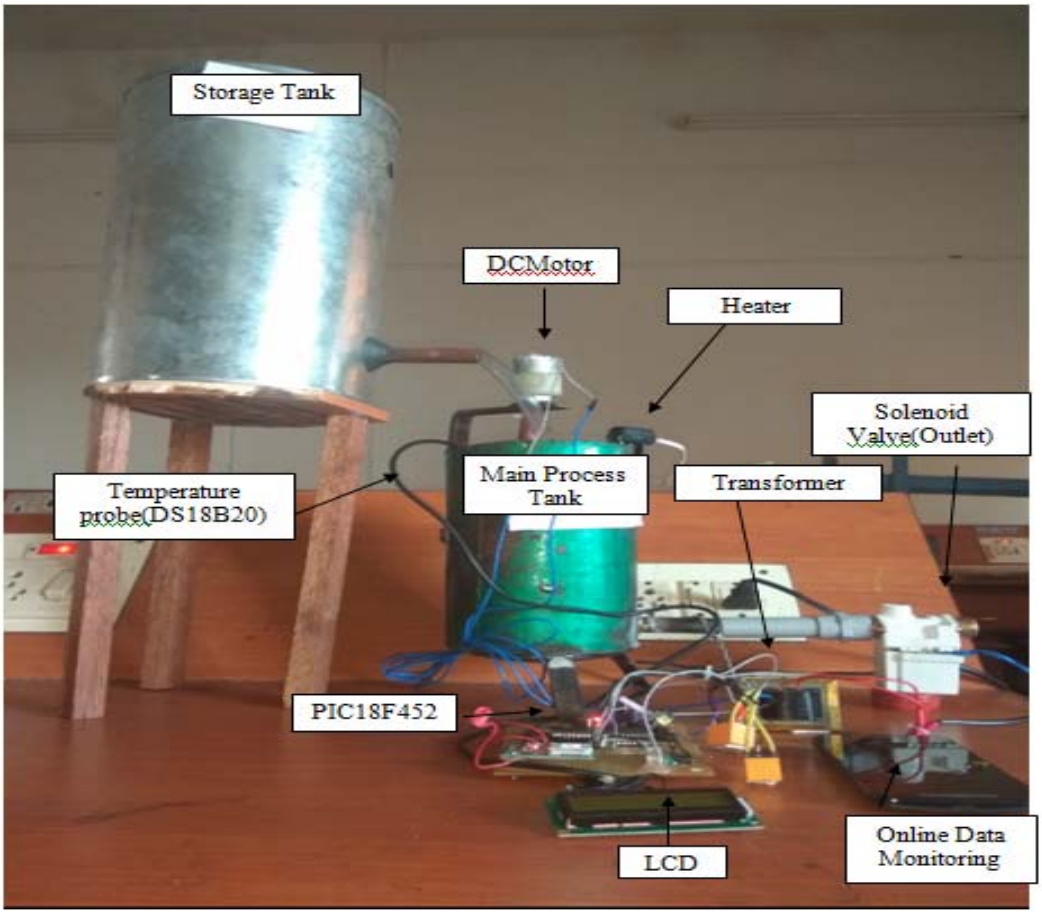


Figure 5.3 Temperature(˚C) Vs Viscosity(mPa/sec)



Figuare 5.4 Hardware setup of the proposed work.

VI. CONCLUSION

In sugar industry, the quality of sugar maintanence is very important that depends on the size of the crystal and the colour of the sugar. Automatic viscosity monitoring and control in massecuite finds a wider application in all sugar industries. In this proposed method, a prototype for automatic control for viscosity was designed. This enables continuous monitoring of viscosity. The viscosity value and related parameters was continuously monitored through IoT. It provides a better monitoring over the internet through mobile phone.

In future this method will definitely bring along with it benefits which enable the factory to make maximum profit at minimum cost. By measuring the viscosity of the cane juice continuosly, provides high quality of the sugar.

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