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RESEARCH ARTICLE

PLC Based Automation of Biogas Plant

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Abstract

The research paper deals with the Automation of Biogas Plant which is processed by the technology or Automation tool of PLC (Programmable Logic Controller). Our main aim for the Biogas Plant is to control and monitor the various parameters in the plant like temperature, motor, pump, level, heater, buzzer, etc. Each of these parameters needs to be optimally managed to achieve greater efficiency. PLCs are armoured to serve conditions (dust, moisture, heat, cold etc.) & have the facility for extensive input/output (I/O) arrangement. PLCs read limit switches, analog process variables (such as temperature & pressure) and the positions of complex positioning systems. PLCs operate electric motors, magnetic relays or solenoids or analog outputs.

INTRODUCTION

This Biogas plants are always case-specific. They are designed according to those particular conditions and characteristics and quantities of raw materials as intended when commissioning a plant. There are several technological and operational solutions to choose from and the length of the technology chain applied differ from smaller to larger scale according to factors, such as investment and operational cost, workload, the end-use of digestate intended, goals for energy production etc. In small household plants very simple technological solutions are used. On farm scale the technology becomes somewhat more elaborate, but the aim is to still keep it simple and easy-to-use, while on large, centralized scale the biogas plant may consist of several different processing units the operation of which requires more monitoring and knowhow. Processes and systems can also be automated.
Automation plays an increasingly important role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities. Many roles for humans in industrial processes presently lie beyond the scope of automation. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible. Specialized hardened computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

OBJECTIVE

The main objective of this project was to design and implement an automation of Biogas plant using the technique of Programmable Logic Controller (PLC) coupled with the prototype Biogas plant in close combination with software intelligence, the gathered data which will provide automatic control in the normal functioning of the production process in Biogas Plant besides providing user interactivity.

METHODOLOGY

A project overview is shown in figure1, where the block diagram of this project showing how PLC is controls the process of Biogas Plant. When push button is on, the waste material (Cow dung, etc.) enters to the digester tank through pump, the level sensor check the reference level of water and waste material. Mixer will on to make slurry. If the digester tank temperature senses below reference temperature (55°C), heaters will on. The buzzer will on as the process complete and gas stores in a storage tank and manure will be collected in separate chamber and this manure is used as best fertilizer for agriculture(Figure 1). The various steps for carrying out implimentation of proposed work for Automation of Biogas Plant are shown in figure 2.

The various steps for carrying out implimentation of proposed work for Automation of Biogas Plant are shown in figure 2.

Step 1. Biogas is produced by the biological breakdone in the organic matter in the absence of oxygen. So the primary requirement for the Biogas production is organic waste material such as biomass, manure, muncipal wastes, green waste, plant materials and crops.

Step 2. Mix water and substrate to make a slurry material which is send to digester tank.

Step 3. Level is sensed by the level sensor and if the level is less than the reference value in the level sensor, the pump and solenoid gets ON.

Step 4. In this process biodegradable organic materials are decomposed in the absence of oxygen to produce methane.

Step 5. Temperature is required for fermentation in between 35 to 55 degree celcius to fomation of methane and temperature is controlled by temperature sensors using PLC.

Step 6. Biogas plant produces high quality biofertilizers and biogas comprises primarily methane (CH_4) and Carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes.

PLC PROGRAMMING USING LADDER DIAGRAM

Zeliosoft 2[1] is used for the analysis of project. This software will enable the communication between hardware, which are different parameters (level, temperature, pH, pump, valve, motor) to control and monitors using ladder programming in Zeliosoft 2.

Rung 1
In rung one push button is triggered and memory bit M1 is set.

Rung 2
In this rung there is a stop switch to stop the entire process when some fault will occur.

Rung 3 and 4
Level is sensed by the level sensor and if the level is less than reference value in the level sensor, the pump and solenoid gets ON.

Rung 5
After the reference value approached then the pump and solenoid gets off and buzzer buzzes for 5 seconds.

Rung 6
The Timer is indicating time for 5 seconds.

Rung 7
Temperature sensor senses the temperature of heater and if it will less than 55 degree Celsius then heater will ON and when the reference temperature approaches the heater will get OFF.

RESULTS AND DISCUSSION

The work under study has investigated the new possibilities and scope of energy management working systems of energy demand self sufficient. After carrying out the various applications of Automation using PLC to obtain the desired objectives of the work it is learnt that on Automated Biogas Plant with greater efficiency of Biogas production is developed. The work undertaken in this study focused on the process of automation of Biogas plant in which various components were controlled by the use of Programmable Logic Controller (PLC).

After designing and implementing the proposed work, the investigator anticipated the following results.

(i) Regulation of quality and pumpable raw material.
(ii) Regulation of Digester tank filling as per desired levels.
(iii) Regulation of gas reservoir filling levels.
(iv) Estimation and regulation of process temperature.
(v) Estimation and regulation of pH value.
(vi) Estimation of Biogas quantity.
(vii) Estimation of Biogas composition.
(viii) Addressing of hygienic aspects of Biogas plants.
(ix) Addressing of safety measures regarding fire.

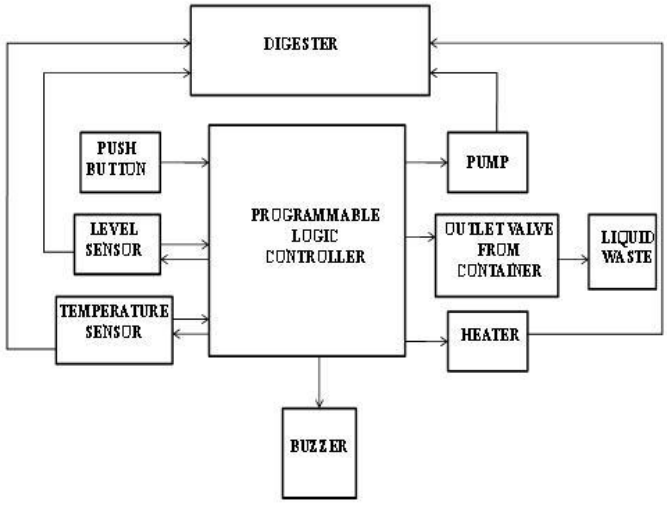

Fig 1. Project Overview

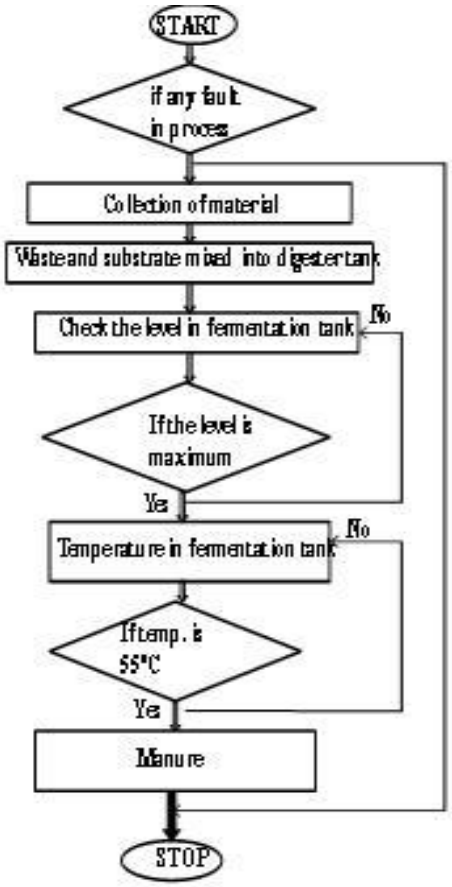

Fig 2. Project Flow Chart

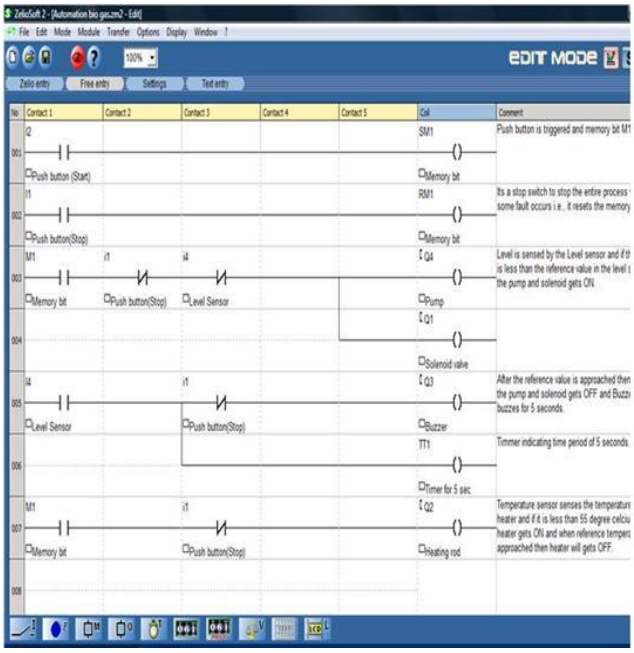

Fig 3. Zeliosoft 2 Programmer

CONCLUSIONS

The main objective of this paper was to develop a Biogas Plant which will work on the principles of Automation using PLC. The project was conceived very easy to handle with the help of PLC & it is very important especially in our country where the sources of energy are lacking. This innovative system was successfully implemented. This paper helped to acquire knowledge and gainful insights into the subject which we have shared in this paper.

REFERENCES

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