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CONTROL SYSTEM OF BIOMASS GASIFIER USING PLC

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Abstract:

India has many no of renewable energy resources. In that Biomass Gasifier plays a major role as an alternate energy source. But it facing lot of practical problems on operation due to shortage of manpower and also several problems may happen in these gasifiers. To overcome the above problems we go for automatic control systems in this gasifier. Therefore we can neglect the human efforts, errors and operators of the gasifier won't get affected by the out coming gases from the gasifiers due to this automation. The gasifier itself works according to the program which we have given. Automation is done in the miscellaneous function, fuel feeding system and all biomass gasifier control system by using PLC (Programmable Logic Controller). And then we develop the ladder logic program for sequence of operation in gasifier control system. In this system the ladder logic function is programmed by using INDRALOGIC software and the hardware component of PLC is Rexroth Bosch product.

Keywords: Programmable logic controller (PLC), Biomass gasifier, Indralogic.

I. INTRODUCTION

Biomass gasifier is an alternate source used for power generation and thermal applications. Lots of biomass fuels are available in rural areas. Some of the biomass fuels are wood waste, sawdust, briquettes, seed cakes, coconut shells, etc., These are available at low cost. So we can generate power at minimum cost using these fuels even though lots of practical problems occur in the biomass gasifiers. They are s follows i) Gasification is a involutes and sensational process, ii) To start the process, gasifier need at least half an hour of time, iii) Removal of ash and tarry contents and its handling is a dirty and time consuming process, iv) Getting the producer gas in a proper state is difficult, v) These gasifiers requires frequent refilling of the fuel. To overcome the above problems automatic control system is needed. The control system of biomass gasifier is capable of offering a wide range of solutions to suit these needs. These are achieved by utilizing a variety control system like embedded system or plc control system [1].

The embedded system is used to performing the specific task and the hardware components of embedded system is very low cost compare to plc. But it has few disadvantages like it does not use in high temperature region, Very less input/output modules, modification of program is not possible. For the above reasons the embedded system is not suited for biomass gasifier control system. Hence this paper is fully focused on control system of biomass gasifier using PLC.

II. PLC OPERATION

PLC is a solid state digital computer used to perform control functions in the industrial processes such as assembly lines and machinery. It doesn't have mouse, CD drive. Keyboard, disk drives and monitor like PC but it has communication ports and input/output terminals for devices. It is entirely different from PC. PLC is designed for large no of input/output and it has extended temperature ranges, resistance to electrical noises and vibration. The output of the equipment is controlled by the PLC based on the input conditions. It has different type of operations such as arithmetic, logical operation, on/off operations, sequencing, timing, and counting. In industry, PLC just replaces the control systems and wiring connections between the devices. Instead of connecting wires directly between the

devices, PLC provides wiring connections to them by connecting all wiring connection to the PLC. This is called soft wiring. PLC has memory, in that control program is stored. It performs operations according to the program.

PLC has many advantages over other control systems. It is known for its flexibility, low cost, operational speed, reliability, ease of programming, security, and it is easy in implementing changes and correcting errors [3].

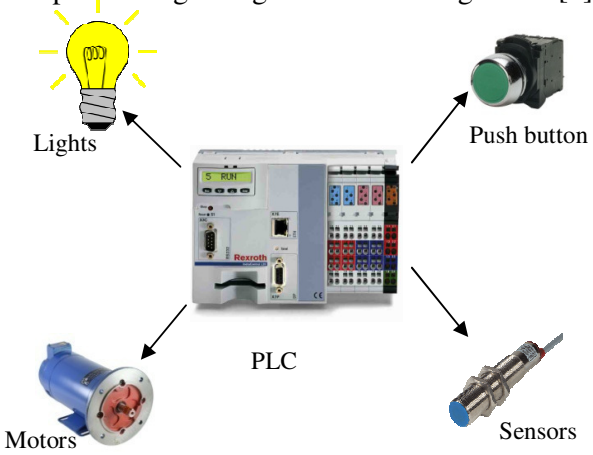


Fig.1. Typical functional components of PLC

A. Components of plc

PLC consists of the following components i) Central processing unit ii) Memory iii) Input/output iv) Power supply v) Programming device vi) Programming methods

CPU is the main component of the PLC since it is the nervous system of the controller and it is the decision maker. It consists of microprocessor and memory. These parts perform type of operations listed above. In PLC, memory is used to store data or information used for the process. It makes decisions according to the instructions present in the memory. They are RAM, ROM, EPROM and EEPROM. The input/output devices act as the interface between the controller and field equipments. Types of input/output devices are analog and digital devices. I/P analog devices are temperature and pressure sensor. Pushbuttons and limit switches are I/P digital devices. The analog O/P devices are hydraulic and pneumatic valves. Motor, lamp is examples for O/P devices. Internal circuits of the PLC are supplied with the DC power. Power is not supplied to the field devices through power supply in larger PLC system. This can be achieved by external current supplies for safety purpose. For entering the desired program we need a programming device, for this purpose PC can be used. Each brands of PLCs has desired software from their manufacture we can use this software in PC and we can program in our computer. PC and PLC can be connected through communication ports; we can edit and save our desired program in PCs. Several methods of programming are available, in that ladder logic is the universally accept method. It looks like a ladder hence it is called ladder logic. The input and output devices are symbols. The horizontal line is referred to as rung and otherwise called as network. The left vertical path indicates the power supply and right vertical line is the return path or neutral line.

III. HARDWARE AND SOFTWARE DESCRIPTION OF PLC IN BIOMASS GASIFIER

PLCs may need to interact with people for the purpose of configuration, alarm reporting or everyday control. A Human-Machine Interface (HMI) is employed for this purpose. HMIs are also referred to as MMIs (Man Machine Interface) and GUIs (Graphical User Interface).A simple system may use buttons and lights to interact with the user. Text displays are available as well as graphical touch screens. More complex systems use programming and monitoring software installed on a computer, with the PLC connected via a communication interface [2].

A. Hardware

The hardware components used for the development of this setup are Rexroth Bosch PLC, push buttons, DC wiper motors, limit switches, Proximity sensors, Air blower, Electronic Igniter, Connecting wires. Details of each component are described below:

1. Rexroth Bosch PLC

The Indralogic L20 of Rexroth is a compact PLC including a standardized I/O system on the basis of terminal technology and is designed for

logic operation. Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Typical applications of Indralogic L20 are Handling and assembly systems, Packaging and foodstuff machine, Printing and paper processing machines, Machine Tools. The Indralogic L20 may only be operated under the assembly, installation, and ambient conditions (temperature, system of protection, humidity, EMC requirements etc.,) [4].

TABLE I
SPECIFICATION OF REXROTH BOSCH PLC

Description	Specification
Processor	ST microelectronics ST40 with 192MHZ
Working memory	16Mbytes DRAM and 64kbytes NVRAM.
Inputs	8 digital inputs (24V DC supply)
Outputs	8 digital outputs (24V DC supply)
Communication Interface	Ethernet connection or Serial RS232 interface
User memory for program	1Mbytes
Weight	200 grams

2. Proximity sensors

A proximity sensor is used as the input device for sensing the level of fuel in the storage chamber. It can detect the nearby object without any physical contact of the sensed object. There are no moving parts in it so it can withstand for long duration and it has high reliability.

3. DC Wiper Motor

DC Wiper motor act as the drive system for conveyor operation, door open close operation and the control system of motor is achieved by programmable logic controller (PLC).

4. Push buttons

Push buttons is made up of hard material or plastic used for simple switching operation. Here it acts as the input device and used for start and stop operation.

5. Limit switches

Limit switch is a mechanical switch which converts mechanical movement into electrical signal. It is actuated by the physical contact of the object. In this control system, limit switches are used to control the door open close operation.

IV. SOFTWARE DESCRIPTION

In this paper, software used for the PLC system is “Indralogic”. Here ladder logic is used as the programming language. It is a symbolic representation of control logic or set of instructions. This program is to be entered in to the plc memory for execution of real time process.

V. INTERFACING

PLC used in this system is REXROTH BOSCH with 8 digital inputs and outputs. The input ports are connected to the four limit switches and three sensors. The output ports are connected to the conveyor, blower, igniter, and motors for door movement. PLC consists of an on delay timer using that timing pulse can be generated in the necessary place. The I/O port addresses are specified according to our input/output port requirements in the plc. While interfacing PLC must be connected to the specified I/O devices in the appropriate port address and then ladder program is created by using PLC software. Addresses are given in the program must matched with those in the i/o port address

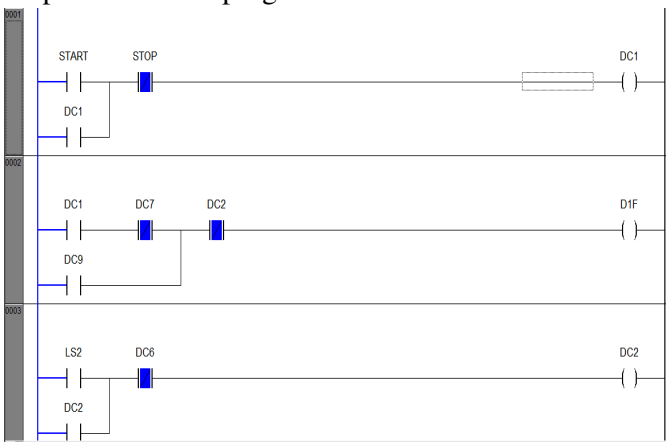
after that desired program is downloaded into the PLC memory for real time working.

Fig. 2 Interfacing PLC

VI. RESULTS AND DISCUSSION:

After the interfacing process is done with biomass gasifier setup, complete checking is done for detecting errors and trials were done and the proposed setup was successfully worked as per the given control system.

When the push button is pressed for the first time means, storage chamber door1 will get opened for getting the fuel by the conveyor, if sensors detects the predetermined level of the fuel in the chamber, door1 get closed and conveyor also cut-off, then fuel get transferred into the hopper region. Blower will automatically turn on by the control logic and after some time delay igniter also will on. If temperature reaches the 60 degree Celsius in the gasifier, igniter will automatically turn off. Whenever fuel reaches the minimum level, starting process will happen for one more time automatically. It is clearly seen that gasifier setup worked successfully according to the control logic specified in the program.



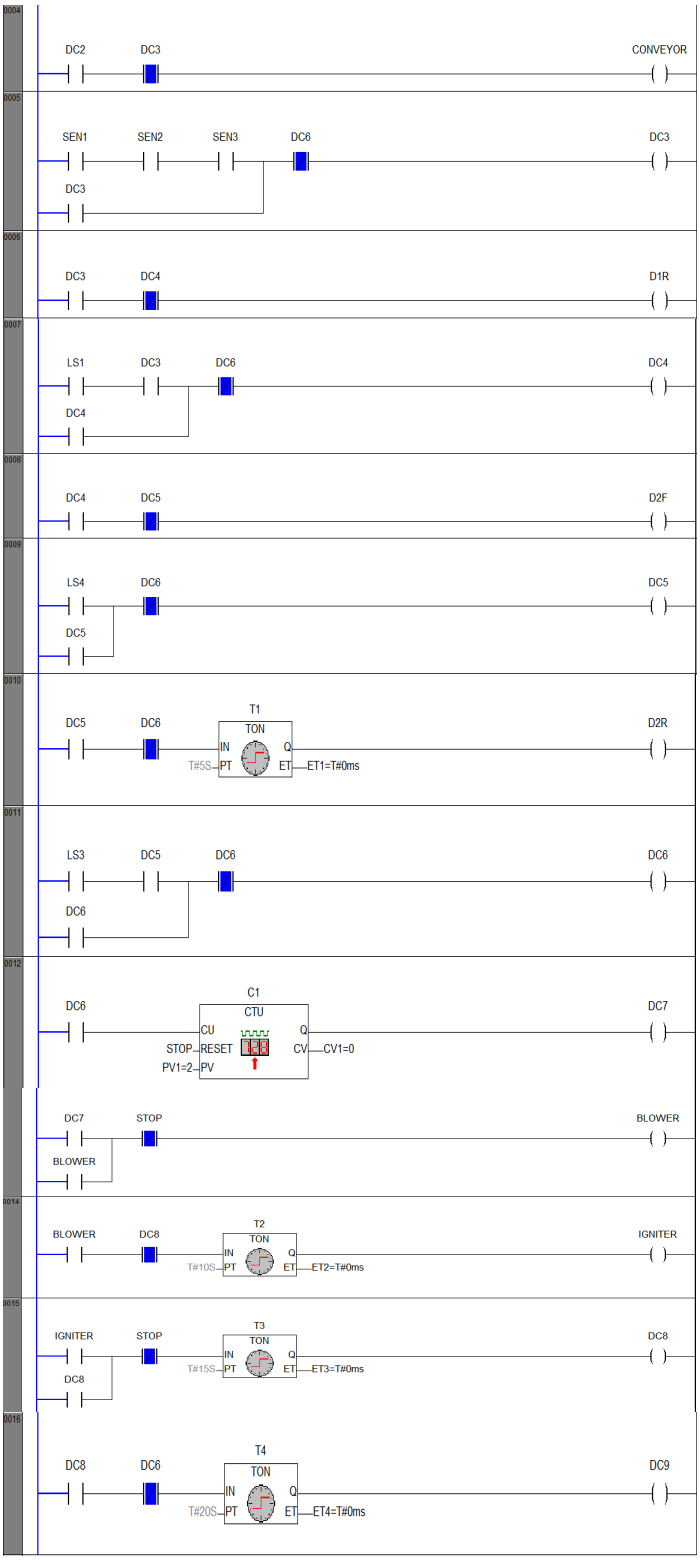


Fig. 3 ladder diagram for biomass gasifier controls

VII. CONCLUSION

In this paper, the biomass gasifier was developed with fully automatic controls. This paper involves three stages. Stage 1: Hardware components and software description of PLC was studied. Stage 2: Ladder logic was developed according to the sequence of operations in gasifier. Stage 3: Biomass gasifier was interfaced with Rexroth Bosch PLC hardware. The control system of biomass gasifier was initiated with manual switching control and other operations like conveyor system and fuel feeding system was automated. This system provided good stability, high safety for operators, it overcomes manual errors and it can operate without any human intervention.

REFERENCES

[1] *K.Sivakumar, Automation of 10 KW Biomass Gasifier and its effectiveness on saw dust briquettes with binder cow dung.*

[2] *Saurabh Sharma, Application of PLC for Elevator Control System.*

[3] *Cheded, L. Al-Mulla, Ma'an, Control of a four-level elevator system using a programmable logic controller, International Journal of Electrical Engineering Education.*

[4] *Rexroth indralogic L20 03VRS system description – operating and programming guide.*