Automation of Manufacturing Welding Electrode Extruder Control Panel with PLC

S. Karthiga¹, P. Ananth², V. Deepika³, K. Gunasekaran⁴, A. Janani⁵

¹Assistant Professor, Dept. of Electrical and Electronics Engg., SNS College of Engineering, Coimbatore, India
²³⁴⁵ Students, Dept. of Electrical and Electronics Engg., SNS College of Engineering, Coimbatore, India

Abstract—The manual process of manufacturing the welding electrode takes more time and work. It also occupies more space for the control panel with the installation of PLC in the welding electrode manufacturing control panel the size of the panel is reduced to the great extent. It has reduced the cost of the panel and has increased the rate of the production. Here the entire process of electrode manufacturing is done automatically. The control panel includes three major controls. They are wire feeder control, extruder control and conveyor control. In the above PLC is used for the extruder control. The sequences of forward and reverse operations of the extruder are controlled by PLC with the suitable program fed in it. The wire feeder and conveyor are control with the help of contactor, timers and variable frequency drives by direct connections with the control panel. PLC is implemented for the control of conveyor process. The conveyor process panel consist of an OMRON PLC(12/8), SMPS, proximity sensors, MCB and relays. For application purpose light indicators, buzzers, exhaust fan and a model showing conveyor process are used. Any sequence of operation can be performed on the light indicator, buzzers, exhaust fan and conveyor model by feeding suitable program on PLC. The PLC program of this project are done and executed in CX-programmer on real time basis.

Keywords—PLC OMRON, ELECTRODE ROD MANUFACTURING, CX-PROGRAMMER.

INTRODUCTION

Today automation plays a major role in all fields, especially in the production field. In earlier days more number of persons were involved in production field. To reduce the time consumption and working of more labours, the automation comes into play. Programming logic controller play major role in automation field. Implementing the PLC is very simple with the help of programming knowledge, if the system to be controlled is thoroughly studied. In real time applications PLC works along its feedback coming from the sensors for position, speed, etc. The input and output cards of the PLC are cheap so that the healthy and spare capacity can be built into allow for the inevitable omissions and future developments. Most of the changes in PLC can be made simply and quickly. PLC program will automatically document the changes that have been made. PLC reduces the cost of over all system. In this project, PLC is programmed to move the conveyor for a desired distance either in forward or in reverse direction. Position of the conveyor is sensed using proximity sensors and it is feed back to PLC for the movement of conveyor a AC motor is used.

COMPONENT OF AUTOMATED SYSTEM

As the name implies the automation is done using PLC and variable frequency drives. The automation of the system is divided into two types:

- Hardware
- Software

The hardware includes into nine parts:

- Programmable Logic Controller: It is an industrial computer control system that continuously monitors the state of input devices and make decisions based up on a custom program to control the state of output devices.
- Drives: In this automation variable frequency drives are used in electro-mechanical drive system to control AC motor speed and torque by varying motor input frequency and voltage.
- Current Transformer: It is used for measurement of electric current. When current in a circuit is too high to directly apply to the measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit.
- Overload Relay: Electric motors need over current production to prevent damage from over-loading the motor or to protect against short circuits in connecting cables or internal faults in the motor windings.

The software includes:

- CX-Programmer: It is a PLC programming tool for the creation, testing and maintenance of program associated with OMRON CS/CJ-series PLCs, CV-series PLCs and C-series PLCs.
- CX-Programmer operates on IBM compatible personal computers with Pentium or better central processors, including Pentium II. It runs in a Microsoft Windows environment.
- It supersedes the OMRON application SYSWIN and SYSMAC-CPT.
Ladder Logic: It is one of the logic used in the PLCs. The other two logics are state logic and programming logic.

The standard features of the Ladder program are Cursor, Rung, Bus-bar, grid dots, rung margin area, automatic error detection.

CX-Programmer supports the mechanism for sharing symbol definitions with other compliant applications. This could allow for example, the symbols declared within CX-Programmer to be linked to a SCADA package so that the definitions and changes of addresses are synchronized. The program undergoes continual verification during its creation and any subsequent editing; this applies to both online and offline programming. Errors appear in red in the left-hand side of the ladder rung. This can happen, for example, when an element has been placed on a diagram window but has not been assigned a symbol or address.

**BLOCK DIAGRAM AND SPECIFICATION**

- **CUTTING SECTION:** In this section the electrodes are cut to the perfect length and dimensions. Then the cutted electrodes are placed in the wire feeder section.
- **WIRE FEEDER SECTION:** The wire feeder control consists of followings, 0.5 H.P Agitator wire feeder, 3 H.P Wire feeder, 5 H.P Pickup wire feeder. Initially all the wires that are cut and placed inside the agitator tub. At that time the 0.5 H.P agitator will operate in such a way that all the wires will set one by one on the 3 H.P wire feeder. The 5 H.P wire feeder is present next to the 3 H.P wire feeder. The 3 H.P wire feeder is placed behind the 5 H.P wire feeder because pickup feeder will push the wire at the faster rate than the 3 H.P wire feeders. From the wire feeder part the wire is moved to the extruder part through the metal tube connected in between them.
- **EXTRUDER SECTION:** The extruder part consists of the followings: 15 H.P extruder pump, 10 H.P extruder pump, 3 H.P cooler, 1 H.P pilot pump.
- **Extruder part** is the one where PLC is involved. It is used for extrusion purposes. Initially at the start of extruder operation both the 15 H.P and 10 H.P pump will work and extrudr will move forward. When the extruder comes in contact with the low pressure switch, then the 10 H.P motor will stop and 15 H.P motor will alone operate. It will continue to move forward pushing the flux until it reaches the high pressure switch. After reaching the high pressure switch, the extruder stops for 10 seconds and moves in reverse direction and this reverse movement is done by the 1 H.P pilot pump.
- The 1 H.P pilot pump continues to work until it reaches the low pressure switch. After reaching the low pressure switch the extruder stops and the 3 H.P cooler being run to cool the extruder. In the above the 15 H.P and 10 H.P pumps star-delta connected while 3 H.P and 1 H.P pumps are directly started. The parameters are,

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>415volts</td>
</tr>
<tr>
<td>Current</td>
<td>8.8Amp</td>
</tr>
<tr>
<td>Frequency</td>
<td>50Hz</td>
</tr>
<tr>
<td>Speed</td>
<td>950rpm</td>
</tr>
<tr>
<td>Power</td>
<td>4Kw</td>
</tr>
</tbody>
</table>

- **CONVEYOR CONTROL:** The conveyor control involves the controlling of following motors: 1 H.P motor BR1 conveyor, 1 H.P motor BR2 conveyor, 1 H.P motor TP conveyor, 2 H.P main conveyor, 1 H.P caterpillar, 1 H.P unloading, 0.5 H.P printing and 2 H.P transfer conveyor.
- The flux coated electrode from the extruder is transfer to the main conveyor through the transfer conveyor. From the main conveyor the electrodes moved further where undergo a sequence of process such as cleaning of lower portion of rod and printing the company name on the lower portion. The caterpillar conveyor is used for...
holding electrode during cleaning and printing. The BR1 and BR2 conveyor are used to make sure that electrodes are enter through the other parts of the conveyor. After all the required process is completed the electrodes are collected from the unloading conveyor. The parameters are mentioned below.

<table>
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<tr>
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<td>50Hz</td>
</tr>
<tr>
<td>Speed</td>
<td>1415rpm,1360rpm,1380rpm</td>
</tr>
<tr>
<td>Power</td>
<td>0.75Kw</td>
</tr>
</tbody>
</table>

CONTROL PROCESS
WELDING ELECTRODE: Welding electrodes are used in welding various methods in the fabrication of equipments and allied industries, construction of steel structure such as bridges, factory shields, in the manufacture of ships, vehicles and engineering equipment. Mild steel is welded by electrodes to a maximum among all the metals and alloys. Therefore mild steel is welding electrode is the most widely used core wire. Besides this, special grade electrodes are being developed for specific applications.

Welding electrodes comprise basically of steel core wire and coating ingredients or flux mild steel core wires are used in majority of unalloyed steel electrodes. Besides mild steel, nickel-copper, nickel irons are also used in MIG and TIG welding in fertilizer, chemical and surgical instrument making industry. Coating ingredients are basically rutile, potassium silicate, sodium silicate and minerals like quartz, calcite and mica. Ferro-alloys are also used in the formulations of fluxes.

Technology And Process: Wires of different chemical compositions and sizes are obtained from different steel manufacturers. In electrode making plant, they are chemically cleaned, cut to different length (30 the selling prices of welding electrodes vary according to length of the electrodes and the raw materials used).

There are two methods of applying flux coating on the core wire
a) Dipping method
b) Extrusion method

a) Dipping Method: Number of core wires cut to definite length is clamped vertically in a fixture and are dipping in a bath of molten flux gets adhered to the core wire, the fixture is raised and the flux is allowed to dry.

b) Extrusion Process: Extrusion method is very fast and economical method. It produces strong uniform and concentric coatings and has largely replaced the dipping process. Coating ingredients as discussed earlier are mixed up in desired quantities, binder (often sodium silicate) is added and the resultant mass is brought in the form of a thick, viscous, stiff paste. This paste is shaped in the form of a cylinder which is fed into the extrusion press. Core wire and thick paste of flux simultaneously under pressure pass through a die, does attaching the flux coating on tyhe core wire. The coating thickness depends upon the die opening and can be varied. As a next step the flux from the gripping end of the electrodes are fed to ovens where they are dried and baked to remove excess moisture. The electrodes are there after sorted, wrapped in polythene paper, put into packets, and bulk is boxed into wooden cases. Packets and boxes generally have information about electrode coding, electrode size, nature of current and polarity, batch number, name of the manufacturer, date of manufacturer, etc.

EXTRUSION WELDING
Extrusion welding allows the application of bigger welds in a single weld pass. It is the preferred technique for joining material over 6mm thick. Welding rod is drawn into miniature hand held plastic extruder, plasticized, and forced out of the extruder against the parts being joined, which are softened with a jet of hot air to allow bonding to take place.

Fig: Block diagram of extrusion process
RESULT
The movement of extruder in the forward and reverse operation is controlled by using the PLC. The electrode rod is coated with the various chemicals. The manufacturing of welding electrode is done and extrusion section is only controlled using the PLC. The final electrodes are coated, edged and in printed format is manufactured.

FUTURE WORK
Though this project is used to controlling the extruder section only. This can be extended to the wire and conveyor section in order to reduce the manual process and cost of the project can be reduced. The further controlling of conveyor and wire feeder can be implemented.

CONCLUSION
In welding electrode manufacturing, the working of extruder, wire feeder and conveyor has been done. Programming in PLC also learned through this project. In welding electrode manufacturing, at present PLC control is involved only with the extruder. In order to decrease the panel size further, the wire feeder and conveyor must also be controlled with PLC. For conveyor process control, PLC with all its advantages was implemented. Various program logics for the conveyor control is done and the expected results are experimented and verified on real time basis. This manufacturing can be extended as conveyor with the variable speed control.

REFERENCES