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Pneumatic Conveying Of $A1C1_3$ and Blow Pot Automation Using PLC

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Abstract— **Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. In order to control various plant process and industrial operations, scientists have introduced computer based controllers like PLC, DCS etc. Pneumatic conveying of AlCl3 and blow pot automation is carried out using Programmable Logic Controllers (PLC).The predecessor for the PLC system is Relay System which has many disadvantages And to overcome that disadvantages, we have introduced Computer based automation it in our paper.**

Index Terms:**--Automation, Computer based Controllers, PLC, and Relay system.**

I. INTRODUCTION

Automation is the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), in concert with other application of information technology (such as computer aided technology –CAD, CAM, CAX) to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialisation, automation is a step beyond mechanization.[2]

Whereas Mechanization provided human operators with machinery to assist them with muscular requirements of work. Automation greatly reduces the need for human sensory and metal requirements as well. Processes and systems can also be automated.

Our paper entitled “Pneumatic conveying of AlCl3 and Blow pot automation using PLC” is concerned with the automation of Unit-300 of oxidation plant at KMML.The entire Unit is currently running under Relay system. Specialised hardened computers, referred to as Programmable Logic Controllers (PLCS), and are frequently used to synchronize the flow of input 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 almost any industrial processes.[4]

The process of pneumatically conveying Aluminum chloride is the major part of automation in this unit. In olden days this process in oxidation unit is carried out by using man power.[5] Our project is aimed at reducing the man work involved in industries and plants, and completely convert this unit to a machine operated one.[6] This use of PLCs has greatly contributed to the plant automation [3].

II. PROCESS FLOW DIAGRAM

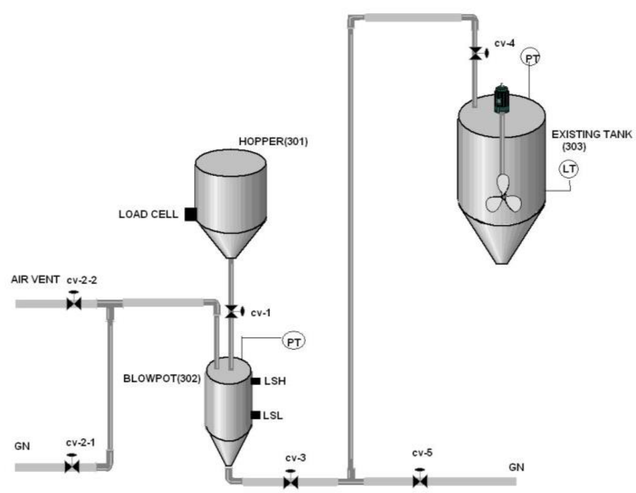

Fig 1. Process Flow Diagram

If the sequence control is activated it shall start with batch setting in the weight of Aluminium chloride (AlCl3) to be transferred followed by filling , pressurizing , emptying , and de-pressurizing. The program will continue until the set quantity of AlCl3 is transferred to the dissolving tank D-303. Then to stop the sequence control, this program has to shut all the valves followed by de-pressuring.

1. Power supply to program logic controller (PLC) / operator interfaces unit (OIU) is always in ON condition (3SS-1A).

2. Switch on power supply to the AlCl3 blow-pot system (3SS-2A) which is located in the control panel

3. Reset 3HS-6/3HS-7 so that 3CV-6A/3CV-7A opens through solenoid valve 3SOV-6A/3SOV-7A.

4. Set the quantity of AlCl3 to be transferred to the dissolving tank (D-303) in the batch set and then activate the start sequence.

5. Filling : when the pressure is zero kg/cm2 g, 3PSL-1A actuates solenoid valve 3SOV- 1A and opens filling valve 3CV-1A and AlCl3 is dumped in to the blow pot filling status Will come in local/ control panel. When material reaches high level or set value, either 3LSH-1A or 3BS-1A, de-energizes solenoid valve 3SOV-1A and filling valve 3CV-1A closes.

6. Pressurizing*:* the valve position switch fixed to, on closing the filling valve 3CV-1a its limit switch 3ZSC-1A actuates solenoid valves 2SOV-2A-1.blow pot pressurizing status will come in local/ control panel. Nitrogen pressurize the blow pot and when its pressure reaches the set value, 2.8kg/cm2g, the pressure AlCl3 feed valve(3CV-4A) to the dissolving tank.

7. Emptying*:* the valve position switch 3ZSO-4A, fixed to the valve 3CV-4A solenoid valve 3SOV-5A and cyclic
3 timer 3XC-1A in the PLC there by opening the valve 3CV-5A and 3CV-3A. Timer 3XC-1A will open the discharge valve 3CV-3A through solenoid valve 3SOV-3A of the blow pot for a fixed time period and then closes the discharge valve 3CV-3A for a fixed time period. Now the system runs blow pot emptying sequence and its status indication will be available in local or control panel. Through a program it shall be possible to change in the values of A & B through the keypad of operator interface unit in such a way that the feed to the dissolving tank can be adjusted to the wishes of the operator. When the blow pot is at low level the switch 3LSL-1A de-energized solenoid valve 3SOV-4A, 3SOV-5A and 3SOV-3A through timer 3XC-1A.

8. De-pressurizing: The solenoid valve 3SOV-2A de-energizes on actuation of low level switch 3LSL-1A closes pot pressurizing valve 3CV-2A-1 and opens vent valve 3CV-2A-2. Thus nitrogen is released through the vent valve to atmosphere, pot is de-pressurized, and status indication will available in local/control panel.

9. The cycle will repeat till the set quantity of Aluminium Chloride is transferred to the dissolving tank.

III. BLOCK DIAGRAM AND PROCESS DESCRIPTION

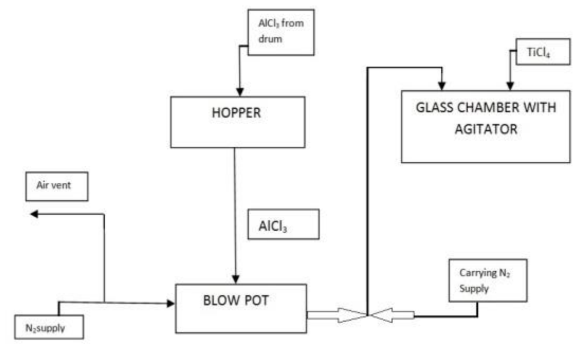

Fig 2. Block Diagram

The hopper is filled with Aluminium chloride according to the batch set. When the blow pot to the batch set. When the blow pot low level switch is energized, the filling valve opens, blow pot is filled with AlCl3, until the high level switch is energized. Afterwards the filling valves are closed and pressurizing process starts. The blow pot is pressurized with at least 6kg/cm2.and after the blow pot pressure reaches the required value. The emptying valve opens and material forced up to the D-303 via feeding valve Carrying N2 supply also provided so as the consistent pneumatic supply. The air vent is used reduce excess pressure in blow pot.

IV. RELAY SYSTEM - PREDICISSOR METHOD

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.[7] Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.[8] The first relays were used in long distance telegraph circuits as amplifiers; they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.[1]

V. COMPUTER BASED AUTOMATION

PC based controls are programmed on a window computer and used to communicate with and monitor an entire material handling system and specific material handling equipment.[9] They are not tied to anyone hardware platform. They allow fast communication controls programming and equipment. They also support more programming languages. One demerit is that it is difficult to implement system changes down the road because it is hard to find control engineers familiar with the platform.[2]

VI. PROGRAMABLE LOGIC CONTROLLERS

A programmable logic controller is a specialized computer used to control machine and process.[10] It uses a programmable memory to store instructions and specific functions that include On/Off control, timing, counting, arithmetic, and data handling. Control engineering has evolved over time. In the past humans was the main method for controlling a system.[11] More recently electricity has been used for control and early electrical control was based on relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relays to make simple logic control decisions.[12] The development of low cost computer has brought the most recent revolution the Programmable Logic Controller (PLC).The advent of PLC begins in the 1970 and has become the most common choice for manufacturing controls. PLCs have been gaining popularity on the factory floor and will probably remain predominant for some time to come. Most of this is because of the advantage they offer. They are cost effective for controlling the complex systems, computational abilities allow more sophisticated control, and troubleshooting aids make programming easier and reduce down time, flexible and can be reapplied to control other systems quickly and easily.

The main difference from other computers is that PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output (I/O) arrangements. These connect the PLC to sensors and actuators. PLCs read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems. Some use machine vision. On the actuator side, PLCs operate electric motors, pneumatic or hydraulic cylinders, magnetic relays, solenoids, or analog outputs. The input/output arrangements may be built into a simple PLC, or the PLC may have external I/O modules attached to a computer network that plugs into the PLC.

PLCs have built in communications ports, usually 9-pin RS-232, but optionally EIA-485 or Ethernet. Modbus, BACnet or DF1 is usually included as one of the communications protocols. Other options include various fieldbuses such as Device Net or Profibus. Other communications protocols that may be used are listed in the protocols. Most modern PLCs can communicate over a network to some other system, such as a computer running a SCADA (Supervisory Control and Data Acquisition) system or web browser.PLCs used in larger I/O systems may have peer-to-peer (P2P) communication between processors. This allows separate parts of a complex process to have individual control while allowing the subsystems to co-ordinate over the communication link. These communication links are also often used for HMI devices such as keypads or PC-type workstation.[3]

VI. ADVANTAGES

Relay logic is used for controlling the operation of blow pot automation in UNIT-300.[15] The cost required for the construction of relay logic is lesser. It use relays as the control and logic devices, and using insulated wires. It is not easily damaged by slightly elevated supply voltages, and is not affected by electrical „noise" and static electricity.[1] In this system, failure of one contact switch cannot be detected easily i.e., Troubleshooting become difficult. Field wire required becomes higher. Here control cannot be distributed. Operator time needed is higher. One PLC can replace thousands of relays.[16]

The control system used for the automation of a blow pot is PLC (Programmable Logic Controller) .It can be used for controlling the operation of pneumatic conveying from the control room. So field wiring needed is less. Maintenance and troubleshooting become very by using PLC as the controller. Centralized monitoring are provided by Programmable logic controller with the help of SCADA (Supervisory Control and Data Acquisition System). [3]

VII. CONCLUSION

Successful experimental results were obtained from the described scheme indicating that the PLC can be used in automated systems. The monitoring Control system of the blow pot, Controlled by PLC proves its high accuracy in speed regulation of blow pot operation.

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