

## Assembly Programmable Logic Control (PLC) in the Rotary Dryer Machine for Processing Waste Liquid System

Hendra<sup>1, a \*</sup>, A. Indriani<sup>2, b</sup>, Hernadewita<sup>3, a</sup> and Y. Rizal<sup>4, a</sup>

<sup>1</sup>Mechanical Engineering Dept University of Bengkulu, Indonesia

<sup>2</sup>Electrical Engineering Dept University of Bengkulu, Indonesia

<sup>3</sup>Industrial Engineering Dept University of Mercubuaana Jakarta, Indonesia

<sup>4</sup>Mechanical Engineering Dept University of Andalas, Padang Indonesia

<sup>a</sup>h7f1973@yahoo.com, <sup>b</sup>aniz\_raimin@yahoo.com

**Keywords:** PLC, Rotary Dryer Machine, Waste Liquid, Environment, Smart Relay Zelio.

**Abstract.** Programmable Logic Controller (PLC) is widely used to control systems on the manufacturing industry, automotive industry and etc. PLC is used to regulate the production process and machine systems to work simultaneously and continue. PLC has system to regulate the movement of machine components, displacement system of product, system settings motion or displacement of other components. PLC is a control system with some advantages such as simple in design, easy to use and circuit modification, low cost, easy maintenance, high reliability and safe. In this paper, we will focus on the PLC that used in the control of equipment movement on the rotary dryer system for waste liquid processing. PLC will be control the movement of the motor for drum of dryer, heating system, water circulation in the wet scrubber system, vacuum cleaner and smoke systems. All these systems are connected by PLC and working by arranged the setting time of system. The first process, PLC will activate the motion system of motor to drive the dryer drum rotating to left or right side. Then the burner is active for heating the drum of dryer. Effect in this process made smoke and dust happen in the rotary dryer system. The pump automatically will be activating to spray water on a wet scrubber system to catch the dust and smoke. Dust and smoke will be inhaled by the blower and flow back into the rotary dryer machine. Therefore there is no smoke and dust flowing into the environment. The results show that the PLC can be control the motion system and processes machine rotary dryer to drying the waste liquid in short time. Such as 20 minutes to 5 liters of liquid waste volume and 30 minutes to 15 liters and made the waste liquid be friendly environment.

### Introduction

Programmable logic control (PLC) is a program that can be used to control the production process or transfer systems in the industry of manufacturing, automotive, chemistry and etc. PLC can to control the production processing, motion system of equipment, the movement of goods, the system of color settings and other systems. Principle of PLC is to process and set of the system using a programming language or ladder program. PLC have some advantages such as simple in design, easy to use and circuit modification, low cost, easy maintenance, high reliability and safe.

PLC has been use in the testing of rubber [1], water pumping system [2], spraying robots [3], making and mixing color process [4], three phase of induction motors [5], boiler [6], roll in the continuous pickling line [7] and others. In the previous study, the control system is connected by cables (by contactors and relays). Which the control circuit must be designed, chosen the specification and installation of the cable, installation of control systems must be carefully and in accordance with the design. It is takes time and high costs. Therefore by using the PLC system, the time to installation and operation can be reduced and cost becomes low. The principle of PLC different with the PC, which the PLC are digital input-output unit that directly linked to switched, sensors, relays and other external components. In the operation, the PLC does not require operator

with good expertise in the field of electronics, having simple trouble shooting, fault indicator is showed by lights, the control circuit is using the software so easy to design and modify the circuit. PLC applications can be seen in the field of manufacture, automotive, cement plants, lifts or elevators, power plants, agricultural processing, traffic light control, beverage manufacturers, and other security controls. Application of the PLC can be seen in Figure 1 where the PLC uses in the motor control system.

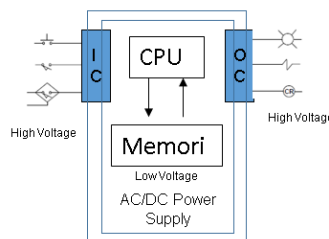
In this paper, PLC is used to control the motion system on the machine of rotary dryer for waste liquid treatment by using the smart relays Zelio (see Fig. 1). And focused on the working system of the PLC to control a move of engine components such as motor for movement drum of dryer, pump, burner and blower.



**Figure 1. Application of PLC in Motor**



**Figure 2. PLC (Smart Relay Zelio) [8]**



**Figure 3. Component of PLC**

## Research Method

Working principle of PLC can be seen in Figure 3, and Figure 3 shows that the main components of the PLC is a component input, output, CPU and memory for processing input and output. PLC memory consists of RAM and ROM in which programs created can be edited and stored in the RAM. To run the program in the RAM, PLC used the operating system contained in the ROM. PLC used programming language such as:

1. Ladder diagram (LD).
2. Language Instruction list (IL) or statement list (SL).
3. Sequential function chart (SFC).
4. High level language such as Visual Basic.

LD and IL is a language that is widely used in the control process because it is easy to understand the symbols. The symbol is same as images relay and contactor. The line of process in PLC is also

same with electrical flow from left to right and its call ladder line. IL process made the same language with the manufacture of listings on assembler language. In this paper, the programming language used is the type of Ladder Diagram (LD). LD forms can be seen in Figure 4 and used into the control process to instruct the components of rotary dryer machine to move to processing liquid waste such as drum motor, water pump, blower and burner. Setting time on the PLC to set the rotary motion of the engine components is 20 to 30 minutes to dry the liquid waste volume 5 and 15 liters.

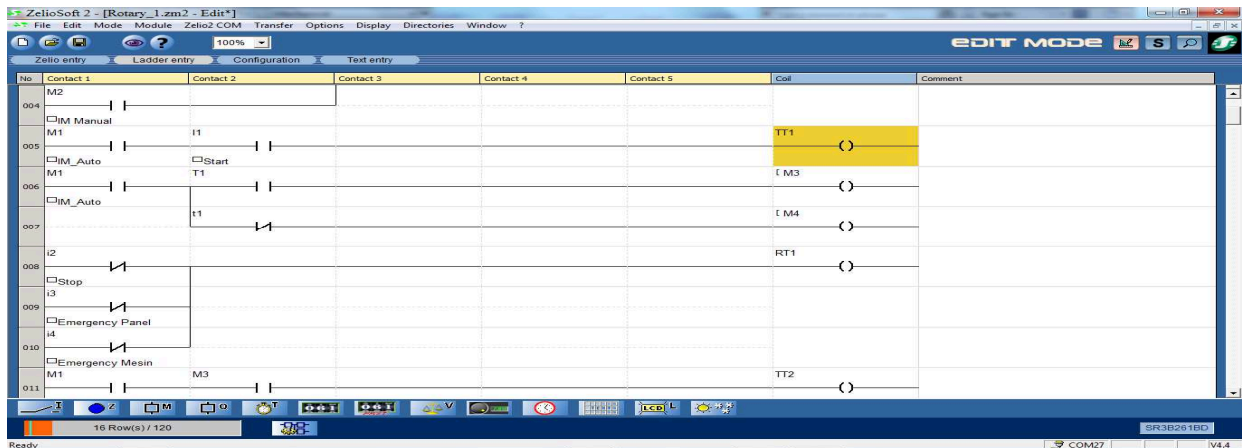


Figure 4 Ladder Diagram PLC

## Discussion and Results

The operation of rotary dryer machine is successfully done by using the Smart Relay Zelio from Schneider Company [8]. The ladder program in Zelio software is developed and checked before uploading into the PLC. Setting ladder program for rotary dryer machines can be seen in Figure 5. The components on the rotary dryer machine moving in accordance with the setting time order. The process of setting time on a PLC to the rotary dryer machine components to move or work can be seen in Figure 6. The setting time for the rotary motion of the drum dryer is 20 minutes for a capacity of 5 liters of liquid waste. For setting other components is arranged after the motor works to drive a drum of dryer and burner will be active from the beginning of motion drum of dryers. The pump and blower will be work when the smokes happen in the drying chamber. The results show that the motor can move 20 minutes at a temperature of  $75^{\circ}\text{C}$  and get draining liquid waste dries into charcoal. After 20 minutes, all components of rotary dryer machine will be stops operating. To more volume of liquid waste (15 liters), setting time to move of components rotary dryer machine is set at 30 minutes with same way as shown in Figure 6. After 30 minutes the liquid waste become soil-solid at a temperature of  $95^{\circ}\text{C}$  and the results are different from the settings 20 minutes in which liquid waste into charcoal.

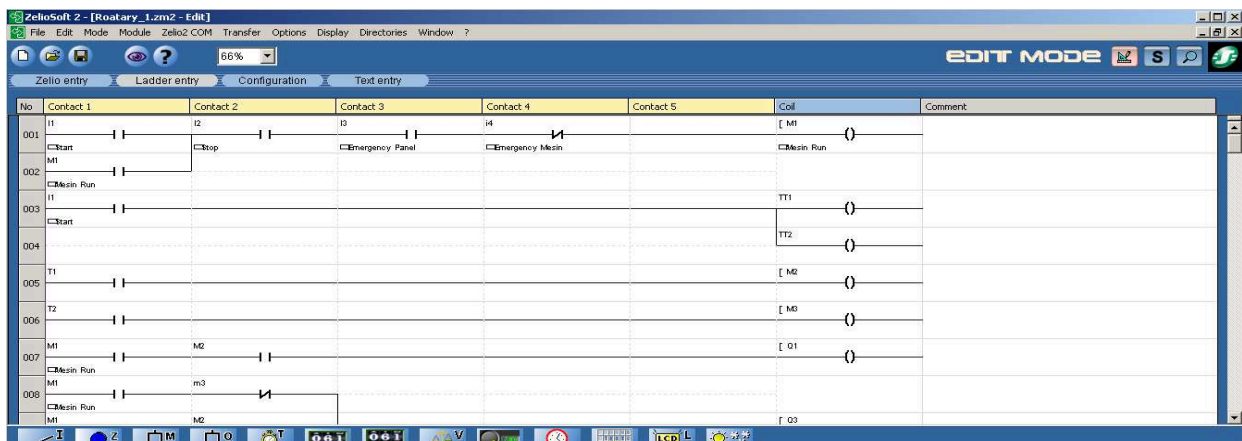


Figure 5 Ladder Diagram for Machine of Rotary Dryer Component

From this test shows that the PLC is works well in regulating the movement of the motor drive system on the drum of dryer rotary dryer machine. And also set up a working system overall components of rotary dryer machine such as pumps, blowers, burners and others. This system can be controlled by user using LD to modified setting time in the PLC and machine still is used without stopping or disturbing its connection. Utilizing the some sensors such as limit switches, ON-OFF switches, timer contact, and etc. can be made the function of PLC better to applied on the machine rotary dryer. With the ladder diagram programming of PLC, the rotary dryer machine was operated to drying the waste liquid that environment friendly.

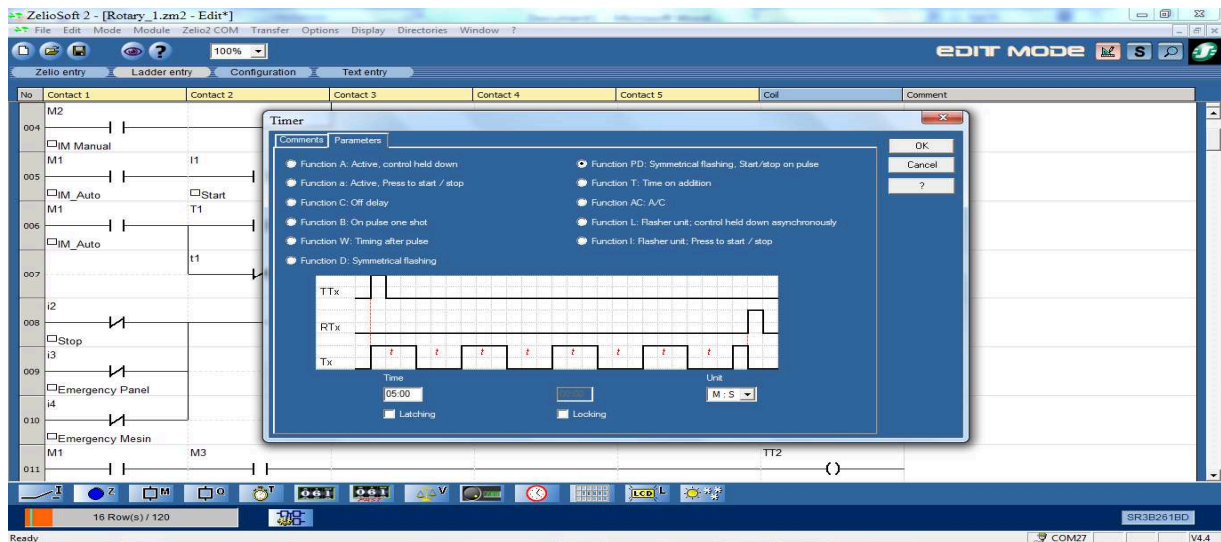


Figure 6 Setting Time PLC for Machine of Rotary Dryer Component

## Conclusion

Results of assembly PLC to rotary dryer machine for waste liquid treatment were concluded:

1. The ladder language programs in the PLC to set working time of components of rotary dryer machine such as the motor to moving the drum dryers, pump, burner, and blower is working well.
2. PLC can be control the motion system and processes on the machine rotary dryer for 20 minutes to 5 liters of liquid waste volume with the drying temperature  $75^{\circ}\text{C}$  and 30 minutes to 15 liters by the drying temperature  $95^{\circ}\text{C}$  and also waste liquid be friendly environment.

## References

- [1] A.M Gaur, Kumar, R., Kumar, A., and Rana, D. S., *PLC Based Automatic Control of Rheometer*, *International Journal of Control and Automation*, Vol. 3 No. 4, December, 2010.
- [2] Akayleh Ali, Mohammed Al\_Soud, Essam Abdallah, Salah Addallah, *Water Pumping System with PLC and Frequency Control*, *Jordan Journal of Mechanical and Industrial Engineering*, Volume 3, Number 3, September 2009 ISSN 1995-6665 Pages 216 – 221.
- [3] Maha M. Lashin, *Different Applications of Programmable Logic Controller (PLC)*, *International Journal of Computer Science, Engineering and Information Technology (IJCSSEIT)*, Vol. 4, No. 1, February 2014.
- [4] S.T. Sanamdikar and Vartak C, *Color making and mixing process using PLC*, *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)*, Volume 2, Issue 5, September – October 2013, ISSN 2278-6856.

- 
- [5] Yasar Birbir, H.Selcuk Nogay, *Design and Implementation of PLC-Based Monitoring Control System for Three-Phase Induction Motors Fed by PWM Inverter*, *International Journal of Systems Applications, Engineering & Development*, Issue 3, Volume 2, 2008.
- [6] Shital S. Chopade, Pradhuman Verma, Prashant Verma, *Simulation of Boiler Control using PLC & SCADA*, *International Journal of Engineering and Advanced Technology (IJEAT)*, ISSN: 2249 – 8958, Volume-3, Issue-3, December 2013.
- [7] N., A., Noda, Hendra, M., Oosato, K., Suzumoto, Y., Takase, and Wenbin LI, *Strength Analysis For Shrink Fitting System Used For Ceramics Rolls In The Continuous Pickling Line*, *Key Engineering Materials Vols. 462-463 (2011) pp 1140-1145*
- [8] Schneider Electric Automation Business, Introduction to PLC Shceineder.