Automated Waste Treatment on the Washer Machine
Based on PLC Control Systems in the Manufacturing Industry

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Abstract—This paper presents research conducted in the manufacturing industry in Indonesia. This manufacturing industry is the manufacturer of valve engine parts. In the processing of industrial waste, this company cannot manage all its own waste results to the maximum, so that it can disrupt the workings of the machine resulting in downtime. The water washer system on manual washer machine used to wash products mixed with used oil from previous work process. This results in a decrease in water washer quality and will take longer to wash the product. In an effort to manage waste and maintain the quality of the machine, we do research to separate waste oil on manual washer machine to extend the period of usage of water washer, which is by designing machine waste processing tool automatically based on PLC control system. In addition, we use the precipitation method to separate the waste in the water washer. The precipitation method is to allow the mixture of waste oil and water washer within the specified time period, so that the used oil can be drained to the maximum and the water washer can be reused on the manual washer machine. This system works automatically using PLC with the number of Input-Output required as many as 13 addresses. Input of 9 addresses with components in the form of reed switches, proximity switches, push button, selector switch and emergency switch. While the output of 4 addresses to turn on the relay coil where the relay will activate the solenoid. The program created has 2 menus, the manual and automatic menus. This system works automatically, then the washing process becomes faster 2 minutes each washing process. Used oil and water washer that has been deployed does not need to be processed by a waste company, so the company only removes used oil and does not need to spend to dispose of waste water. This is because the water washer can be reused by manual washer machine.

Keywords—used oil waste; washer machine; precipitation method; automation, PLC control systems

I. INTRODUCTION

This paper presents research conducted in the manufacturing industry, which is manufacturer of valve engine parts. Generally, the process of manufacturing valve engine includes the processes: Forging, Stellite Welding, Heat Treatment, and Machining. The Company strives to become the best valve engine manufacturer in Indonesia by lowering production machine downtime, reducing cost of spending, improving work efficiency, and increasing productivity.

With proper and correct waste treatment can improve the efficiency of work and maintain the quality of the machine in the process of manufacturing the product. The goal is that the resulting product can meet the standard process is determined and productivity increases with the environment of the work area is maintained so that the downtime of the machine can be pressed.

This company does not treat B3 waste as a whole. However, the many machines that operate, most of the waste treatment is still done manually and not maximal. In addition to causing unsafe working conditions such as eye irritation, slippery and dirty floors, this also results in increased B3 waste that affects the company's own expenses. For that, then the sewage treatment system was designed in manual washer machine automatically controlled by PLC control system. Based on this paper, we also refer and compare especially those related to the implementation of PLC in the experimental manufacturing system [5, and 6].

II. METHODOLOGY AND DESIGN

A. The Machine Before Modification

The manual washer machine is used instead of the automatic washer machine when the automatic washer machine is problematic and it can not be used. This machine is only there are 2 pieces, which is placed in the machining 2W (two wheel) and in the machining 4W (four wheel).

With the use of manual washer machines from various lines, then the type of waste produced to be diverse and not measurable. This happens because the process of washing products using additional oil that is...
sprayed on the product, whereas in the machine there is no good waste treatment. As a result waste oil produced by manual washer machine more than the automatic washer machine. Figure 1 shows washing water is on manual washer machine.

![Figure 1. Washing water is on manual washer machine](image)

The waste separation process is still done manually, i.e. by removing waste from the machine to the drum of waste placement, and then deposited for a specified time. After the used oil is separated onto the surface, then the used oil is separated manually by the operator. After the used oil is separated, the remaining soap water in the drum placement is poured back into the machine to clean the product. Figure 2 shows the illustration of waste treatment on manual washer machine and manual washer waste disposal site.

![Figure 2. (a) Illustration of waste treatment on manual washer machine and (b) manual washer waste disposal site](image)

**B. Design of Systems**

In designing the automation of waste treatment system on the washer machine, in addition to studying the initial conditions and a manual washer machine, we refer to previous research experiences. In this paper [1], we have design a laser sensor as a tool to check the height of the spring sun in a machine based on PLC controller system and HMI (Human Machine Interface) as the display information in the process and as entering the data. In this paper [2], we design and manufacture HMI program in improving the achievement of production, and allows an operator to operate beside it easier to troubleshoot the NTVS-2894 seat grinder machine thereby reducing downtime on the NTVS2894 seat grinder machine. We also have design and integrated SCADA system based on PLC and we made a scheduling program that can automatically control and monitor the power usage of conveyor motors, the coolant, and the hydraulic. [3, and 4]. Figure 3 shows the automation of manual washer hand washer treatment manually.

![Figure 3. Illustration of waste treatment automation on a manual washer machine.](image)

When the water washer from manual washer machine is dirty, as in Figure 1, water washer will be thrown to drum 1 manually by operator. This process cannot be done automatically because the water washer condition is influenced by the use of the machine only when the automatic washer machine on line has problems.

After the water washer was thrown into drum 1, the water washer will be sucked by the vacuum that flowed into the shelter. This shelter will be arranged by water level so it is not excessive in processing the water washer. After the water washer is processed, the oil will be separated to the top because of differences in water and oil density. The separated oil will be dumped to drum 2, automatically. The water washer that has been free from used oil will be returned to the manual washer machine automatically or manually. It is used during emergencies, for example when the maintenance process. All processes that run automatically will be controlled by PLC with the design as in Figure 4.
The function of the control system above, as follows:

This control system uses 2 phase MCB with maximum current of 3A. This is useful for protecting the factory's main circuit when the device control system is having problems. From MCB, the current flows to the front panel switch. This makes it easy for the operator to enable all of these control systems.

Active control system is also marked with the active indicator light on the front of the panel to facilitate the operator in knowing the condition of the control system. This indicator light uses AC 220V light so that the current from the selector switch can be sent directly to the indicator light. And light colors that can be seen easily.

Input is divided into several parts, namely: vacuum, control panel, and water level.

- Vacuum. Vacuum uses air cylinders that are side-by-side. For that use reed switch as security and effectiveness. Reed switches used must be with 24V voltage specifications and work with small currents. For that reason, K1H C1 reed switch is used. Figure 5 shows the pneumatic vacuum circuit.

- Control Panel. In the control panel, there are input selector switch, emergency stop, and push button as inputs. For selector switch requires 2 types, 3 positions and 2 positions. For 3 positions required when manual or automatic position where the center position is used to reduce the risk of operating errors. While 2 positions are used to manually position the water cylinder night using vacuum. Emergency stop is used to force forcibly entire process control system. While the push button with the NC (Normally Closed) specification when activated.

- Water level. Water level uses a proximity switch as an indication that the required water has reached the target. Proximity switch requires a large enough diameter to be able to detect exactly when reaching the target. Omron E2E-X7D1-N with M18 sensor diameter m cukupi requirement of water level.

The required PLC has at least 10 Input-Outputs each. Then the PLC used is Compact Omron CPM2A PLC type. In addition to easy to apply, Omron CPM2A also has a complete feature. There is an internal power supply with a voltage of 24V and a current of 0.3A to turn on most components and some common to provide choice in the application of components. Output is also divided into several parts. In the control panel, on the vacuum, and at the shelter.

- Control Panel. On the control panel are used indicator lights for the water cylinder on the vacuum described in the Figure 5. This lamp requires a voltage of 220V. For that, this lamp is regulated by Omron CPM2A PLC passing through 24V coil relay.

- Vacuum. In vacuum there is output on selenoid valve water and wind using a 220V voltage regulated by Omron CPM2A PLC passing through a 24V voltage relay.

- Shelter. At the shelter there is an output to dispose of the water washer and oil that has been separated by using a 220V voltage-operated valve regulated by Omron CPM2A PLC passing through a 24V coil relay.

III. TESTING

A. Input Testing

How to test the PLC input can be done in two ways, namely by connecting the PLC with the PC and can see the led indicator on the physical appearance PLC. Testing is done by pressing pushbutton, enable the selector switch, enable the proximity switch, and activate the reed switch on the cylinder. Parameters OK at the time of testing is if when input is enabled it will turn on the indicator lights that are on the PLC in accordance with the address that has been given to each inputan. PLC input...
testing includes: push button cycle on, solenoid 1, manual up-down switch selector, emergency stop, reed switch top, reed switch down, proximity switch, selector auto switch, and selector switch manual.

B. Testing Control System

In testing the working system of this tool is to determine whether the system work on the machine is running well, and according to the program that has been determined. The control system test is performed under normal conditions, manual mode, and auto mode.

C. Output Testing

Test method of PLC output can be done by connecting PLC with personal computer through monitoring mode and can see directly through led status in PLC and by seeing the change or movement of output used. The tested devices are: vacuum down cylinder, vacuum up cylinder, solenoid 1, and solenoid 2.

D. Analysis of Results

The analysis is done by testing how effectively the time of deposition on used oil waste processor automatically. By taking samples at the bottom at the beginning of the shelter has been filled with water washer mixed with used oil as much as 32.148 m3. the volume is obtained from the area of the shelter that has been filled with water washer length 38cm x 47cm x 18cm. Then every hour, the sample is taken back at the bottom of the shelter to see if it is time to remove the used oil and clean the water washer.

Furthermore, 5 samples were taken from the water washer sediment. Namely: the initial condition of the shelter is filled with water washer, one hour after deposited, two hours after depositing, three hours after being deposited, and four hours after being precipitated.

From the 5 samples above, all samples were left for 12 hours, so that the used oil on the water washer was lifted up. From the visible conditions, in the 4th sample water washer was precipitated for 3 hours, there was no used oil that appeared at the top. This is not much different from the sample to 5. So, it can be concluded that the process of deposition of water washer and used oil will be separated for 3 hours. This settling time is used as a sediment timer in the PLC program.

Figure 6 shows realization the automation of waste treatment on the washer machine.


IV. CONCLUSIONS

In this paper we have discussed the research on automation of waste treatment on the washer machine based PLC control system in the manufacturing Industry. This system works automatically using PLC Omron CPM2A type with the required number of Input-Output of 13 addresses. Input of 9 addresses with components such as: reed switch, proximity switch, push button, selector switch and emergency switch. While the output as much as 4 addresses to turn on the relay coil, where the relay will activate the solenoid. The program created has 2 menus, namely manual menu and automatic menu. Because this system works automatically, the operator does not need to spend extra energy that wastes productive time employees. With design this automatic washer wastewater process, washing process becomes faster 2 minutes each washing process. Used oil and pre-deposited water washer does not need to be processed by a waste company. This has a positive impact so that the company only removes used oil and does not need to spend to dispose of waste water, because water washer can be reused by manual washer machine.
REFERENCES


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