Progress in Engineering Application and Technology Vol. 2 No. 2 (2021) 931–937

PEAT

Homepage: http://penerbit.uthm.edu.my/periodicals/index.php/peat
e-ISSN : 2773-5303

Evaluation of The Operational Performance and Maintenance of Valves in Biodiesel Plant

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DOI: https://doi.org/10.30880/peat.2021.02.02.084
Received 13 January 2021; Accepted 01 March 2021; Available online 01 December 2021

Abstract: This research about to evaluate the operational performance and do maintenance of valves in biodiesel plant. This paper discuss the performance of valve by observe the flowrate at the main pipe. After do an observation, the selected valve will be maintenance. An experiment was conducted with do maintenance at two butterfly valves in different area. The experimental result was evaluated by observe the flowrate gauge and pressure gauge reading and compare before maintenance and after maintenance. The result shows the flowrate for V101 can be increase for 50 percent by do maintenance from 160.25m^3/s to 240.37 m^3/s. For the V201, flowrate also increase from 12 m^3/h to 18 m^3/h where approximately 50 percent increasing after do maintenance and to the optimum value. The valve can extend their life expectancy and can be used for many years with the excellent performance.

Keywords: Performance Valves, Flowrate, Butterfly Valve

1. Introduction

Valve is a mechanical device that controls the flow and pressure of fluid within a system or process. Nowadays valves can control not only the flow, but also the rate, the volume, the pressure, and the direction of a fluid within a pipe. Valves are not limited to fluids and can control liquids, gases, vapors, slurries, or dry materials [1]. Valves can turn on or off, regulate, modulate, or isolate. Valves also can control the flow of all types of commodities. From the thinnest gas to highly corrosive chemicals, from superheated steam to toxic gases, from abrasive slurries to radioactive materials, valves can be designed to service at all [2].

The reliability of a valve is essential for the safety of the entire plant. Almost all pressure measuring instruments work in conjunction with a valve or a combination of valves [1]. The choice of a high quality valve is not only essential to ensure the accuracy of the pressure measurement, but also to prevent dangerous leaks or damage to the plant.

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The reasons for wrong valve selections such as missing knowledge, choosing the cheapest solution, missing process data and the right way to reduce valve failure is to select the right valve for the given application and process condition. It is important to know how to do a maintenance on valve based on the performance and why that valve need to do a maintenance.

It is important understanding the standard operating procedure of maintenance valve before do the maintenance to make sure the maintenance work running smoothly. The consideration need to be highlight on selected valve such as the valve is damaged at seat or seal, the valve not fully close and the material carrying in pipe not suitable with the valve. Due to limited knowledge in performance of valve, this project is to evaluate the performance of operational and maintenance of valve at UTHM Biodiesel Plant. The main significant of this project is to study the performance of valve and how to do troubleshooting on valve.

2. Sampling

In this experiment the valves were tested to evaluate the performance of butterfly valve. The butterfly valve is located at different area which is cooling tower area and heat exchanger area. After the evaluation of performance was done, the selected valve will undergo maintenance. All the consideration such as standard operating procedure and safety at workplace were consider.

3. Equipment and Methods

3.1 Equipment

3.1.1 Butterfly valve

The butterfly valve has a unique body style unlike the other valves. The butterfly uses a circular plate or wafer operated by a wrench to control flow. A 90 ° turn of the wrench moves the wafer from a fully open position to a fully closed position [7]. The wafer remains in the stream of flow and rotates around a shaft connected to the wrench. As the valve is being closed, the wafer rotates to become perpendicular the direction of flow and acts as a dam to reduce or stop the flow[4]. When the valve is fully open, the disc is rotated a quarter turn so that it allows an almost unrestricted passage of the fluid [6]. The valve may also be opened incrementally to throttle flow. The great advantage is the narrow width and light weight, low cost, the frictionless rotation that require little torque and the simplicity of the design. The butterfly valve are well suited for large size, large flow and slurry service and are often the valve of choice for waterworks[11]. This experiment evaluates the butterfly valve (see Figure 1 and Figure 2) at the cooling tower and heat exchanger area at plant.

Figure 1: Butterfly valve (V101)

Figure 2: Butterfly Valve (V201)

3.1.2 Flowmeter gauge

The volume flowrate, Q of a fluid is defined as be volume of the fluid that passing through to given crosses sectional area per unit time. The cross sectional area is a term often use to describe the area through which something flow for example the circular of pipe. Volume flowrate measures the amount of volume that passes through an area per time. It measure in SI unit which is m^3/s. Flowmeter is a device used to measure the volume or mass of a gas or liquid [9]. Flow meters refer to many names such as flow gauge, flow rate gauge, flow indicator, flowrate sensor. It's depending on the particular industry to measure the flow in the plant. The most frequently used the flowmeter is utility and the greatest variety of flow meters focus on measuring gasses and liquid in a pipe [9]. Improving the precision, accuracy, and resolution of fluid measurement are the greatest benefits to the flowmeters. Precision flowmeter are used to provide an accurate monitoring and flowcontrol.

Figure 3: Flowrate gauge

3.1.3 Pressure gauge

A pressure gauge is a device that helps monitor performance parameters. Water systems and tanks function because the water or air that runs through them is pressurized. A pressure gauge measures the force of the pressure in the water or air so that it can determine whether any errors in the tanks or systems have [5]. Pressure is normally expressed in terms of pound per square inch (psi). Pressure gauges also used for measure the pressure in the pipe.

Figure 4: Pressure gauge

3.2 Methods

Method that been used in this experiment for evaluate the performance of valve is by do observation on flowrate gauge reading. The flowrate reading is taking before maintenance and after maintenance valve. The result flowrate will be compare before and after maintenance. The equipment in this experiment involves parameter the valve flowrate based on flowrate gauge and pressure gauge, to observe the valves that not achieve the requirement. Second, the external observation based on valve condition such as leakage or not fully closed.

In this experiment the valves will be tested for evaluate the performance of valve is butterfly valve. After the evaluation of performance done, the selected valve will be maintenance. The process will be run and do the observed by flowrate gauge, run by using Scada to observe the performance of the valve.

3.3 Equations

Flow rate Q is defined to be the volume of fluid passing by some location through an area during a period of time,

$$Q = \frac{V}{t} = \frac{Ad}{t} = A\frac{d}{t} \quad Eq.1$$

But the term d/t is the just length of the volume of fluid divided by the time it took the fluid to flow through its length, which is just the speed of the fluid. So, it can replace d/t with v in the previous equation and get

$$Q = A\,v \quad Eq.2$$

A is the cross sectional area of a section of the pipe, and v is the speed of the fluid in that section [10]. The new formula for the volume flowrate, that is often more useful than the original definition of volume flowrate because the area A is easy to determine. Most pipes are cylindrical which means the area can be found with

$$A = \pi r^2 \; Eq.3$$

The second formula by based on pressure is

$$Q = \frac{\pi D^4 \Delta P}{128\,\mu \Delta x} \quad Eq.4$$

Where the ΔP is the pressure difference.between the two ends of pipes, μ is.dynamic viscosity, and Δx is the length.of the pipe.

4. Results and Discussion

4.1 Maintenance of Butterfly Valve (V101)

At the V101, the flowrate is calculated based on pressure gauge reading using formula had been mention. Reading from pressure gauge before maintenance is 50 psi equal to 160.25 m^3/s. The reading quite high due to located near the pump and at main pipe. V101 have an issue that not fully closed cause of rusty at the disc and it stick at the disc and body. Maintenance work been done by removing the rusted at disc and do a cleaning inside the body. After maintenance, the reading on the pressure gauge increase up to 75 psi equal to 240.37 m^3/s.

Figure 5: Butterfly valve (V101) before maintenance

Figure 6: Butterfly valve (V101) after maintenance

4.2 Maintenance of Butterfly Valve (V201)

At the V201, the flowrate been observed by flowrate gauge that been install at main pipe. The reading from flowrate gauge before maintenance is 12 m^3/h. The flowrate at V201 bit slow than the flow at V101 because of at V101 located near the pump. V201 had an issue on the disc deffect that effect to the flowrate at main pipe. The disc been cleanup by using sand paper and can make the flowrate smooth than before. After maintenance, flowrate gauge shows the reading up to 18 m^3/h.

Figure 7: Butterfly Valve (V201) before maintenance

Figure 8: Butterfly valve (V201) after maintenance

4.3 Table Results

Flowrate before maintenance and after maintenance have been compared and the result shown an increasing in process flowrate. For the V101, flowrate before maintenance was calculated at 160.25 m^3/s and after maintenance flowrate increase to 240.37 m^3/s. The flowrate increase about 50 percent and it will be the optimum flowrate for that process.

Table 1 show the result of flowrate V101 before maintenance and after maintenance and Figure 9 shows the graph of flowrate before and after maintenance for V101.

Table 1: Result of Flowrate V101 Before Maintenance and After Maintenance

Valve	Flowrate m^3/s	
	Before maintenance	After maintenance
V101	160.25	240.37

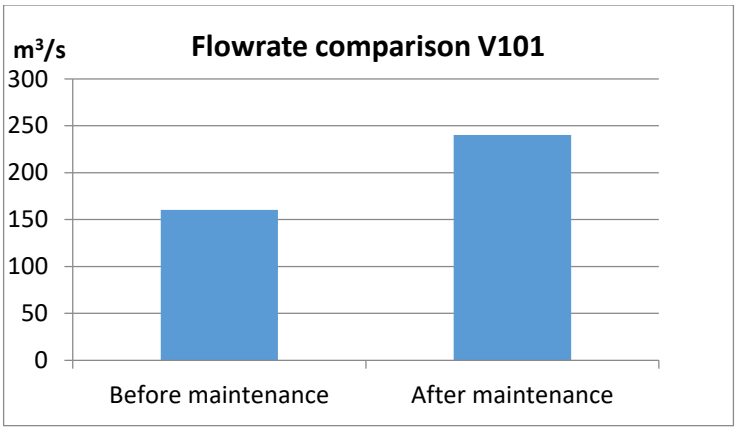

Figure 9: The graph of flowrate before and after maintenance for V101

For the V201, the flowrate before maintenance that been observe at flowrate gauge is 12 m^3/h. After maintenance work, the reading at flowrate gauge up to 18 m^3/h and it increase about 50 percent. The flowrate at the line V201 is 18 m^3/h and it becomes the optimum flowrate with smooth than before. Table 2 show the result of flowrate V201 before maintenance and after maintenance and Figure 10 shows the graph of flowrate before and after maintenance for V201.

Table 2: Result of Flowrate V201 Before Maintenance and After Maintenance

Valve	Flowrate m^3/h	
	Before maintenance	After maintenance
V201	12	18

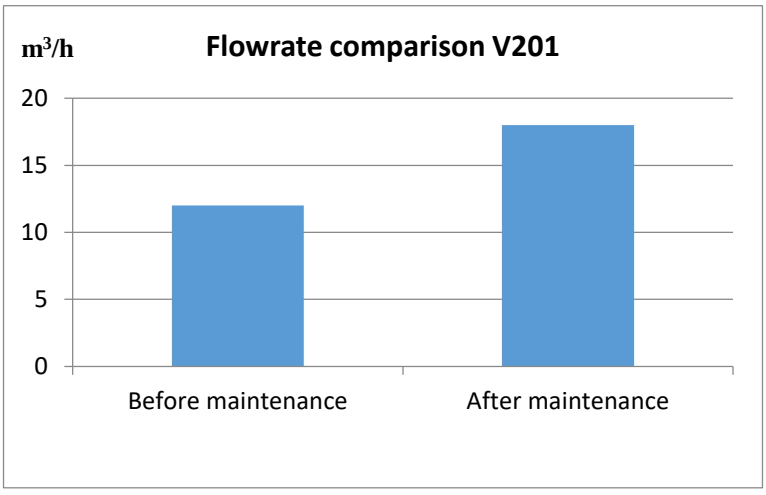

Figure 10: The graph of flowrate before and after maintenance for V201

5. Conclusion

In the process pipe line, valves are installed with a different type and different function to make sure the plant operate well either with automatically or with the manual. Valve can be operating automatically by using the actuator and can control the flow by open about 25 percent, 50 percent or fully open. There are many ways valve can be damage, broken or leakage, it is because of environment

condition or the carrying fluid in pipe can be damaged to the body valve. Body valve and the other parts inside the body did not do the maintenance, will be reducing life expectancy. Maintenance schedule can help to taking care of life expectancy of valve. Taking care of valve including inside and outside of body can make the valve in a good condition.

Basically from this study, observation on the pressure gauge and flowrate gauge to show the current flowrate in the main line pipe. The selected valve will do maintenance and compare the flowrate before and after maintenance. After maintenance work done, the optimum flowrate can be achieve and the valve can be increase the life expectancy for many years and can function with excellent. Valve performance based on flowrate for V101, can be increase for 50 percent by do maintenance from 160.25 m^3/s to 240.37 m^3/s. For V201, flowrate also increase from 12 m^3/h to 18 m^3/h where approximately 50 percent increasing after do maintenance. From the result obtained, the objectives have been achieved. This mean, maintenance is important to make sure the life expectancy of valve and its affecting to get the optimum flowrate.

Acknowledgement

The authors would like to thank the Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia for its support.

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