



## Optimization of the Air Compressor to Get Good Compressed Air In MV. Dewi Amabarwati

Diah Zakiah<sup>1\*</sup>, Arif Hidayat<sup>2</sup>, Benny Syahrir Abdurohman<sup>3</sup>

<sup>1),2),3)</sup> Sekolah Tinggi Ilmu Pelayaran, Jakarta, Indonesia, email: [diahz2018@gmail.com](mailto:diahz2018@gmail.com)

\*Corresponding Author: Diah Zakiah

**Abstract:** Transportation is one of the supporting factors for the smooth running of the economy in a country. One of the transportation is sea transportation because it is more effective and efficient. For this reason, the ship which is the main factor in the smooth operation of sea transportation must be prepared in its operation, the main thing that can support the smooth running of a ship is the smooth operation of the main engine. In general, the main engine on board the ship uses a diesel engine type, and the starting system uses compressed air where the compressed air is produced by the compressor auxiliary aircraft, so it can be said that the compressor has an important role in the operation of the ship. The compressor is one of the aircraft that is used to compress low-pressure air with higher pressure. During the operation of the main engine when the motion occurs, sometimes there are obstacles or obstacles that cause damage to the air compressor, so the compressor cannot work optimally. This results in the process of filling the main engine starting water for too long and can affect the smooth process of movement. The purpose of this study is to find out the obstacles or obstacles that can interfere with the main engine of the composer. The method used by the author in this study uses descriptive qualitative with several methods, namely, approach methods and data collection techniques. In the discussion in this study the author by finding several solutions to problems carrying out maintenance on engine room blowers and routines on the compressor as well as cleaning rust on the plunger and parts of the auto drain solenoid valve. The conclusions obtained in this study must maintain the air temperature in the engine room and always clean the high-pressure valve and low-pressure valve and pay attention to the compressor temperature so it doesn't get too hot because it can produce worse air.

**Keywords:** Compressor, Main Engine, Auto Drain Solenoid Valve, High Pressure Valve, And Low-Pressure Valve

### INTRODUCTION

As the world's economy increases, transportation is needed to support the smooth running of the economy and sea transportation is one of the transportations that is good to use

because it is effective and efficient. For this reason, the ship which is the main factor in the smooth operation of sea transportation must be prepared in its operation, the main thing that can support the smooth running of a ship is the smooth operation of the main engine and do not forget the supporting aircraft that support the main engine to work well. In general, the main engine on board the ship uses a diesel engine type, and the starting system uses compressed air where the compressed air is produced by the compressor auxiliary aircraft, so it can be said that the compressor has an important role in the operation of the ship.

Compressor is one of the aircraft that is used to compress low-pressure air with higher pressure. The compressed air is accommodated in a pressurized air vessel of  $\pm 30 \text{ kg/cm}^2$ , which is then ready to be used as starting water to run the main engine and auxiliary aircraft either in the engine room or on the deck. For air services on the deck, such as air horns, control systems, accommodation cleanliness and others. During the operation of the main engine when the motion occurs, sometimes there are obstacles or obstacles that cause damage to the air compressor, so that the compressor cannot work optimally. This results in the process of filling the main engine starting water for too long and can affect the smooth process of movement.

## **LITERATURE REVIEW**

### **Definition of Air Compressor**

According to Ir Jusak Johan Handoyo (2015:126) states that an air compressor is a piece of auxiliary equipment that produces air until it reaches a pressure of  $30 \text{ kg/cm}^2$ , this compressor works with air with low pressure of  $8 \text{ kg/cm}^2$  (low pressure) and high-pressure air of  $30 \text{ kg/cm}^2$  (high pressure).

### **Function Compressor Air On Boa**

According to; Ernest Souchotte and David W Smith, (2005:147) "Air compressors are used on ships for starting diesel engines, for pneumatic control systems and for various pneumatic tools and cleaning equipment. But the biggest use of compressed air is for starting diesel engines, compressed air for starting is 25 bar or more provided by the piston compressor.

### **Classification and Working Principle of Air Compressor**

#### **Air compressor classification**

According to, Sularso and Haruo Tahara, (2004:172) "There are several types and models of compressors, depending on the volume and pressure it produces. The term compressor is used for the type of high pressure and blower for the lower pressure. On the basis of the compression method, compressors are divided into turbo and displacement types. This type of turbo is to increase the pressure and velocity of the gas by the centrifugal force generated by the impeller or by the lifting force generated by the blades. While the type of displacement is a compressor that increases the pressure by reducing or compressing the volume of gas that is sucked into the cylinder by a piston or blade.

#### **Air compressor working principle**

According to Ir Jusak Johan Handoyo (2015:225) "Air compressors in general work the same principle, namely like pumps that use a piston (piston), both for low pressure and high pressure and are equipped with valves." The working principle of the compressor is as follows:

##### **1) Suction Step**

When the crankshaft rotates in the direction of the arrow, the piston moves from TDC (top dead center) to BDC (bottom dead center) by crank pull. This is where the

occurrence of negative pressure (below atmospheric pressure) in the cylinder, and then the intake valve is opened by the pressure difference so that air from outside is sucked in.



Figure 1. suction steps

2) Compression Step

When the crankshaft rotates in the direction of the arrow and the piston moves from TMB (Bottom Dead Point) to TDC (Top Dead Point), the intake and exhaust valves are closed and the air in the cylinder is compressed.

3) Step Out

As the piston moves up, the pressure in the cylinder will increase. Then the outlet valve will be opened by the air pressure and the air will come out.



Compressing air

Figure 2. discard steps

### Main Components of Air Compressor

#### Fixed Part

Air compressor fixed parts include: Cylinder head (cylinder head) Serves as the seat of the low-pressure valve which is where the outside air enters the compressor; Crankcas Serves to support the entire load and as a seat for bearings, crankshafts, cylinders and reservoirs of lubricating oil; Base plate/foundation As a support for the air compressor holder so that the compressor is not shifted due to the vibrations generated by the air compressor itself. Parts that move back and forth: Pistons; Oil scrapper ring; Connecting road; Cross head; Drive motor.

#### Air Compressor Operation

The following are ways to operate an air compressor: Manual System, With this manual system, the compressor cannot work or stop by itself. The compressor must always be supervised to maintain the maximum pressure that has been determined. For example, in an

air vessel, the maximum pressure is 30 kg/cm<sup>2</sup>, then at that pressure, it must be turned off, namely by breaking the electric motor current in the switch box. Similarly, when running the compressor, electric current is entered by pressing the ON button on the switch box; Automatic System, Basically when starting or stopping automatically works based on pressure switches, magnetic valves and other equipment. The pressure switch usually works based on the air pressure in the air vessel, so it can disconnect the current and connect the current automatically. When the pressure in the air vessel exceeds the limit specified on the pressure switch, the pressure switch opens and cuts off the current flowing in the motor. And vice versa if the pressure of the air vessel exceeds the lowest limit then the pressure switch closes and flows current to the motor and will rotate to run the compressor. So stop or start is set by the pressure switch.

### **Automatic Operation**

When the compressor works automatically or manually, the auto drain solenoid valve opens for a while ( $\pm 1$  minute) starting and stopping by several methods. Among others : a. Suction valve. b. Speed variations. c. Release the pressure placed on the suction valve lining in its seat. d. Filling cylinder volume spaces.

### **Air Compressor Maintenance**

According to, Ir. Jusak Johan Handoyo (2015:49) "Maintenance is the single most important factor to be able to adapt to modern society and play a dominant role in the world of shipping. The failure of a ship to serve its customers is because the ship is not properly cared for and will result in huge losses and can bring down the performance of the ship unit." We know that treatment is expensive and it is a temptation for everyone to postpone treatment until a future time. It is clear that there is an optimal treatment strategy but it is not an easy task to implement it.

### **Control of spare parts**

According to; Gunawan Danuasmoro, (2003:59) "Maintaining that spare parts are always available as part of the maintenance activities on board." Time to repair the damage can be reduced if there is a proper spare parts control system in place and such that onboard spare parts can be easily and quickly obtained either from stock on board or from a central warehouse onshore or from suppliers. An ocean liner can carry a total of 4000 spare parts at an order cost of about US\$ 600,000. For companies, it is very important to always control it because spare parts are "dead capital", and need space and arrangement. A well-regulated system will be able to control spare parts inventory because it requires serious effort to compile and run it, so the system must be simple.

### **Spare Part System**

In order to maintain all the spare parts on the ship, it is necessary to have a system to manage all things related to spare parts. All of this must contain information on how to handle spare parts, the amount of stock/inventory, minimum/maximum inventory, storage location, delivery period, order specifications, order records and others. The spare parts system must also be manageable and labeled according to the classification code.

## **RESEARCH METHOD**

### **Approach and Data Collection Method**

#### **Approach Method**

The approach method used by the author is to use a qualitative method. According to Moleong (2002: 3), "that qualitative research is a research procedure that produces

descriptive data in the form of written or spoken words from people and observable behavior. that qualitative research is a particular tradition in the social sciences which fundamentally depends on observing humans in their own realm and dealing with these people in their language and in their terminology. Qualitative research also emphasizes the process of deductive and inductive inference and also emphasizes efforts to answer research questions through formal and argumentative ways of thinking. In conveying the problem in this thesis, it is descriptive to describe and describe the object under study, or a description of the facts that exist in the field.

### **Data Collection Techniques**

Observation is a way of collecting data by making observations directly to the field where the research is carried out so that the data obtained by the author is objective. As long as the author conducts research on a ship directly on an auxiliary aircraft, namely an air compressor, there are often problems with the air compressor where the problem is caused by a lack of supervision in the operation and maintenance of the air compressor.

Observation is a technique of collecting data by using the senses so that it is not only by observing with the eyes. Observation can be done through sight, smell, hearing, touch, and taste. Direct observation in the sense of observational research can be done with tests, questionnaires, recordings, pictures, sound recordings. In using the observation method, the most effective way is to complete it with an observation format or blank as an instrument. The compiled format contains items about the events or behaviors that are described as going to happen.

Literature study is the method used by the author to collect data. The literature study was taken by the author by reading books and other sources to be used as references and reference material in writing this thesis. Literature study conducted by the author as a material for comparison and discussion related to the problems taken in the writing of this research.

### **Research subject**

In this chapter, no population and samples are taken because this thesis uses a case study that occurred on the MV. DEWI AMBRWATI ship with the object of study being an air compressor.

### **Data analysis technique**

The analysis is carried out with the aim of simplifying the processed data so that it is easy to understand and interpret. In this thesis, the type of data obtained is a qualitative data type, so that in the process of data analysis is done by means of non-statistical data. Data analysis activities using this method are carried out by reading the data that have been collected, while for the data analysis method this thesis uses descriptive data analysis, where the author describes all events or events that occur on ships related to air compressors. From the existing data, the authors make observations starting from the problems that occur, read the data collection, and think about the best problem solving so that the problems that arise can be solved properly, so this study uses qualitative description. The qualitative descriptive method is a method that describes the direct events that occur related to problems with the compressor that cause the air compressor to get an air of poor quality.

## **FINDINGS AND DISCUSSION**

### **Data Description**

**Decreased performance of high-pressure valve and low-pressure valve.**

On June 29, 2020 the ship carried out a maneuver from Bunati Kalimantan to Weda Halmahera. At that time compressor, no.1 was run according to the procedure for filling the air bottle. At that time the charging time was longer than usual which resulted in a delay in maneuvering. Normal filling of the air bottle from empty is about 15 minutes, which if more than that time indicates there is a problem with the compressor. At that time, after waiting 20 minutes, the air bottle filled with compressor no.1 was still not fully filled, so it can be concluded that there was a problem with compressor no. Then compressor no.2 is turned on to help the process of filling the air bottle for smooth during maneuvers.



**Figure 3. Low Pressure Valve**



**Figure 4. Valve High Pressure**

### **Solenoid valve auto drain malfunction**

The incident of this problem occurred on August 25, 2020, at that time a change over unit was carried out from compressor no. 2 to compressor no.1. Then check when the compressor is running, at first compressor no.1 runs normally, and the pressure gauge looks normal showing 9 bar, but after waiting 10 minutes the pressure in the air bottle shows no pressure in the bottle. After the incident, observations were made on compressor no. 1 regarding the duration/loss of air produced by the compressor. Then after a detailed observation it turned out that there was damage to the auto drain solenoid valve, which resulted in the compressor running continuously because the air produced came out through the drainage.



**Figure 5. Solenoid Valve Auto Drain**

### **Data analysis**

In this section the author will describe the existing data and explain the causes of problems with the air compressor and look for the relationship between the problems and how to overcome these problems. The air compressor used on board the MV. DEWI AMBRWATI is an air compressor with the brand JPSAUR & SOHN. The main power used to drive the air compressor is by utilizing the rotation of an electric motor which is connected to a clutch in which the clutch is also connected to the flywheel on the compressor. The working system is to compress air into an air vessel using a piston in a cylinder, the compressed air will pass through 2 (two) valves, namely the low pressure and high pressure sections. After knowing the performance of the air compressor and the use of compressed air on board, then we must also know that the optimal compressor performance is determined from the proper and correct operation and maintenance of the air compressor, and is supported by the presence of components that have good functions and work.

### **Decreased performance of high pressure valve and low pressure valve.**

Lack of maintenance on the compressor, especially on the high pressure valve and low pressure valve because the valve is very sensitive, because if the valves cannot function properly, there will be a decrease in performance on the compressor so that it takes longer to fill the air bottle which is intended for maneuver.

### **Damage to the auto drain solenoid valve.**

Solenoid valve or electric valve is a valve that is driven by electrical energy, has a coil as its driver which functions to move a piston that can be driven by an electric current, an electric valve has an output hole, an input hole, and an additional hole. The input hole serves as a terminal / where the air enters, then the output hole serves as a place for air to come out, while the additional hole serves as a channel to remove trapped air when the piston moves or changes position when the solenoid valve is working.

### **Solution to the problem**

The cause of problems with the air compressor is the emergence of scale or carbon that has accumulated so that it interferes with the work of the valve that should open and close, the valve cannot work optimally and the water vapor produced from production is too much, resulting in damage to the compressor part. This must be addressed immediately because it will interfere with the work of the compressor which can cause problems with the production of high pressure air, so that the work of machinery using compressed air will be disrupted and cause chaos in the work process on board. So the authors take the results of solving problems that refer to the user guide or instruction manual book, including:

- a) Decreased performance of the air compressor high pressure valve and low pressure valve  
Perform maintenance on engine room blowers and routine maintenance on compressors. Efforts must be made to maintain the engine room air temperature so that the air entering the compressor does not exceed its normal limit and clean the dirt (carbon) deposits attached to the high-pressure valve and low-pressure valve. To maintain the engine room temperature, what must be done is the maintenance of the blowers in the engine room, including balancing the air entering the engine room and the air leaving the engine room and cleaning the filter on the compressor every 2000 hours according to d with the instruction manual.
- b) Solenoid valve auto drain malfunction

Perform rust cleaning on the plunger and parts of the auto drain solenoid valve. In this case, cleaning the rust by sanding, to smooth the work of the plunger up or down so that the part will not get stuck causing air to come out, this can also prevent the occurrence of a damaged seal which will cause the spring that pushes the plunger to break, although this requires a little longer time than replacing a new one but this requires a little cost compared to replacing because if you replace you also have to think about the factor of providing spare parts from the office which takes a long time if something similar happens, cleaning the rust yourself can be done if the rust is still possible so that we can clean it but if on the contrary, the rust looks like it can't be cleaned even though we have sanded it because the rust has eaten away the inside then it's best if we replace either replacing the plunger itself or directly replacing the solenoid valve auto drain, so from that You can observe when we disassemble the solenoid valve. if it feels we have done all the things that have been explained we can see when the compressor is running and if the compressor is normal as usual then the problem that occurs with the compressor is sorted out and the ship can maneuver calmly again on the next trips.

## **CONCLUSIONS AND SUGGESTIONS**

### **Conclusion**

Based on the results of the discussion and description of the previous chapters, the authors can draw the conclusion that the performance decline of the high-pressure valve and low-pressure valve is the emergence of dirt deposits (carbon) attached to the valve due to the abnormal temperature in the engine room which is too hot which results in the temperature at the engine room being too hot. Lubrication rises and creates carbon in the valve section which interferes with the work of the valves and the solenoid valve auto drain damage occurs due to rust on the plunger which hinders the work of the plunger.

### **Suggestions**

From the conclusions above, the writer gives advice on the problems that occur, to always maintain the air temperature in the engine room and always clean the high pressure valve and low pressure valve, and always change the lubricating oil according to the working hours in the manual book, always pay attention to the compressor temperature because if the compressor is hot, the air production will be worse which results in a lot of evaporation of water, this water vapor if too much will settle on the solenoid valve which causes the solenoid to rust and be damaged.

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