

Effectiveness of compressor machine by using overall equipment effectiveness (OEE) method

Khawarita Siregar¹, Khalida Syahputri¹, Anizar, Rahmi M Sari¹, Indah Rizkya¹ and Mangara M Tambunan¹

¹Department of Industrial Engineering, Faculty of Engineering, University of Sumatera Utara, Medan-Indonesia

Abstract. Overall equipment effectiveness (OEE) is performance measure for machine/equipment effectiveness [1]. The effectiveness of machine/equipment will affect the productivity. PT Y is a company engaged in crude oil and natural gas production. Various obstacles are faced by PT Y in the course of its production, one of which is the problem of the productivity from every production process. Based on historical data from September 2016 – February 2017, the percentage of compressor's breakdown is above 20%. The company wants the upper limit of machines' breakdown only reached 10% for each period of production. Therefore needed improvement through analysis of availability, performance ratio, and rate of quality product. This study also will provide corrective suggestions through the calculation of OEE. The results of the experiment with the calculation of OEE shows that the compressor still working above the standard measurement and researcher suggests to make a preventive maintenance plan.

Keywords: Performance Ratio, Rate of Quality, Availability Ratio, Overall Equipment Effectiveness (OEE)

1 Introduction

When manufacturing companies have problems of the productivity, there are many of them more likely to implemented solutions by take overtime, increasing the work shift and buying new machine/equipments [2]. Supposedly, the companies must be more focused on improving the performance of existing machines, reducing setup time, reducing delays and improving the performance of the workers. If the repairs are impossible, the last option is buy a new machine.

The OEE is one of the approach that can calculation of overall equipment/machine effectiveness and can simplify the complexity of production problems into simple information. OEE can systematically analyze the production process and identify potential problems in influencing work of the machine. There are three basic metrics of the OEE such as performance, availability dan rate of quality [3]. Implementation of the OEE in manufacturing industry is a right continuous improvement strategy to meet customers satisfaction. Customers satisfaction depends on reliability, quality of product, accuracy in delivering goods, performance and service to customers..

PT. Y is a company that produces crude oil and natural gas. In carrying out its production activities, the company faces various problems, one of which is the high frequency of machine damage in each

production period. In previous research, it found that the frequency of machine damage is very high.

2 Research Method

Research on the past by Manjeet Singh, using OEE to reduce bottleneck operations in the process to the specified limit [4]. In the process consider three parameters namely availibility, performance, and quality level. In the results of Overall Equipment Effectiveness can be increased by minimizing the breakdown and changeovers losses are associated with availability and by minimizing the defects and setup scraps losses which are associated with quality.

Research by Katarzyna Szwedzka, et al is about implementation OEE in a company [5]. This research was conducted to find the possibilities of increasing the efficiency of production equipment in an industry. In the results, stop times of roller coaters can be reducing. The average failure rate before changed was 32.16%, after improvement to 15,19%. The solution provided is by replacing YBY2 and rubber rollers with polyurethane rollers. With this solution the number of damaged rollers can be reduced according to the target for calibration and regeneration. After improvement, OEE has increased by 16.4%.

Research conducted on the production at PT. Y starting from September 2016 until February 2017. The object of research studied is the primary data in

* Corresponding author: khawaritasiregar@yahoo.co.id

the form of frequency data damage to machinery and production processes. It also investigated secondary data in the form of historical data of product production and maintenance data. As for the amount

of breakdown time can be seen in Table 1. Therefore, required Overall Equipment Effectiveness (OEE) to calculate the performance of the compressor machine.

Table 1. Working Time and Delay

Month (2016-2017)	Working Time Available (Hrs)	Machine Delay Data		
		Maintenance (Hrs)	Set Up (Hrs)	Breakdown (Hrs)
September	720	10	1,91	47
October	744	16	1,08	61
November	720	12	1,67	64
December	744	10	1	79
January	744	5	4,5	28
February	696	2	0,67	31

The data of gas production on compressor machine can be seen in table 2.

Table 2. Production Data

Month	Processed Amount (MMSCF)	Waste Amount (MMSCF)
September 2016	115,97	2,66
October 2016	124,59	2,74
November 2016	118,01	2,65
December 2016	122,28	2,77
January 2017	113,98	2,41
February 2017	105,02	0,00

OEE is the overall equipment effectiveness to evaluate performance performance and reliability of equipment. OEE is also used as an opportunity to improve the productivity of a money company in the end as a decision-making step.

According to Nakajima (1998), there are several steps of OEE calculations, namely [6]:

1. Availability is a ratio that describes the utilization of time available for the operation of machinery or equipment.

$$\text{Availability} = \frac{\text{Loading time} - \text{Down time}}{\text{Loading time}} \times 100\% \quad (1)$$

2. Performance is a ratio that describes the ability of the equipment in producing goods.

$$\text{Performance} = \frac{\text{Processed amount} - \text{Theoretical Cycle Time}}{\text{Operation Time}} \times 100\% \quad (2)$$

3. Rate of Quality is a ratio that describes the ability of the equipment in producing products in accordance with the standard or ratio of the number of good products to the total number of products processed.

$$\text{Rate of Quality} = \frac{\text{Processed amount} - \text{Reject Amount}}{\text{Processed amount}} \times 100\% \quad (3)$$

4. Perhitungan overall equipment effectiveness, diperoleh dari hasil perkalian ketiga kategori tersebut.

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Rate of Quality} \quad (4)$$

3 Result and Discussion

The value of OEE and the three ratios is the reference to which this analysis is based. Availability ratio achievement from September 2016 to February 2017 can be seen in Figure 1.

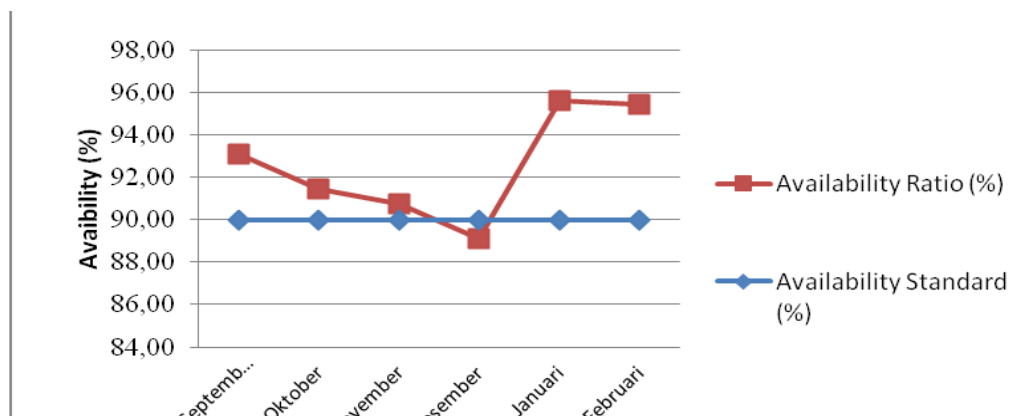


Figure 1. Availability Ratio Compressor Machine Achieving Chart

From the figure above, the value of availability ratio on compressor machine in December 2016 is below the set target, which is 90%. Then it can be concluded that availability of the machines below 90%. But there is an increase from January to February 2017.

In the analysis results above, the achievement of availability ratio has not reached the established

standard. It states that the amount of time available for compressor machines has not been used effectively. But there has been an increase from January to February 2017.

Achievement of performance efficiency from September 2016 to February 2017 can be seen in Figure 2.

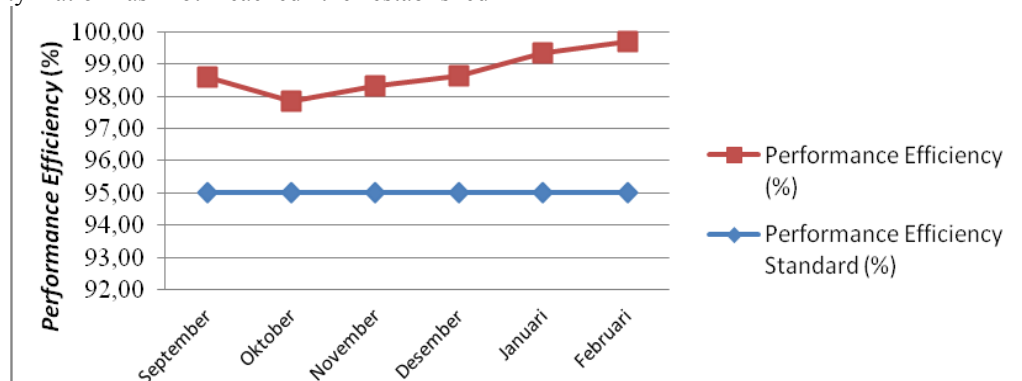
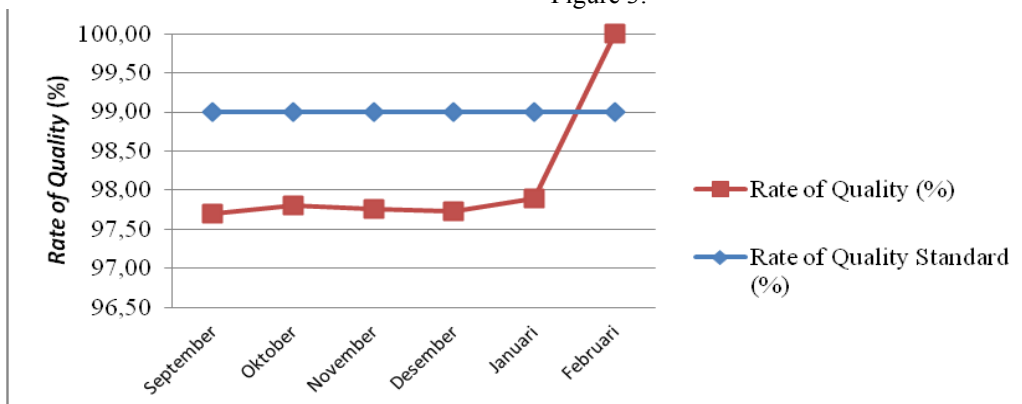


Figure 2. Achievement of Performance Ratio Machine Compressor

In the calculation of performance efficiency, starting from September 2016 to February 2017 are all above the established standard of 95%. Performance efficiency has reached the standard during September 2016 until February 2017. Then it can be concluded that performance of the compressor engine in separating the effective fluid.

Standard quality ratio or rate of quality is 99%. Based on the calculation of the rate of quality in September 2016 up to January 2017 the rate of quality is below the standard. This is due to the water content in the processed gas in the Compressor machine. The achievement of the quality ratio value from September 2016 to February 2017 can be seen in Figure 3.



Gambar 3. Rate of Quality Compressor Machine

Rate of Quality engine compressor during September 2016 until February 2017 has not reached the established standard. This is due to the presence of water in the gas entering the engine.

The value of OEE is obtained from the multiplication in formula number 4. The default OEE value is 85%. The achievement of OEE values from September 2016 to February 2017 can be seen in Figure 4.

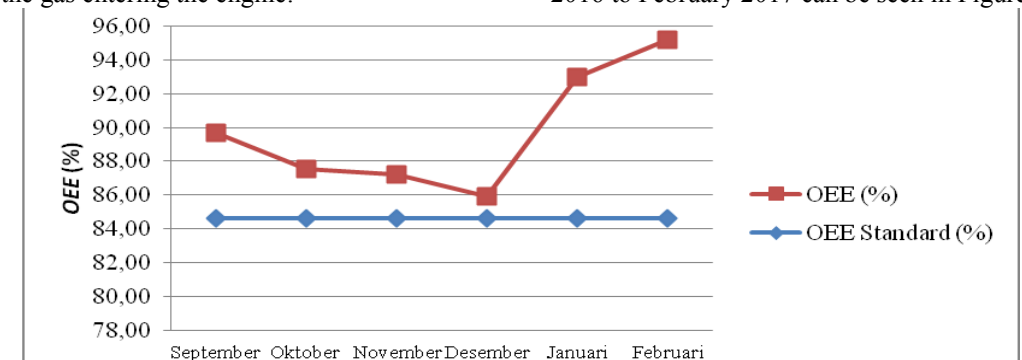


Figure 4. Achievement of OEE Machine Compressor

* Corresponding author: khawaritasiregar@yahoo.co.id

From the picture above, it is seen that every month the OEE value is above the target set. This indicates that the effectiveness of compressor machines during September 2016 to February 2017 is above target. The low value of OEE is availability and rate of quality.

The causes of the low value in oee is a lack of time for the availability of machinery for production due to damage to the engine and the presence of water in the gas entering the compressor engine. Performance achievement results are above the standard. Then it can be concluded that the compressor engine has been used effectively.

PT Y has regulated preventive maintenance of machine and equipment but only based on the economic life of the compressor engine compiler components. With a maintenance system like this, it still causes the engine to break down frequently. The suggestions for improving the effectiveness of compressor engine can be done by Preventive Maintenance, following three solution:

1. Increase the availability by reducing the compressor's downtime by doing maintenance of machine correctly in right schedule, inspect the compressor engine regularly, true machine setting and SOP, and also periodical training for operator.
2. Increase the performance by keep the machine in good condition, maintain the availability of materials.
3. Increase the rate of quality by using materials with good quality, doing the correct setting of the machine, Pay attention to cleanliness and neatness, and implementing of 5S.
 - a. Seiri (Sort), is the sorting, removal, and storage of goods that are necessary or not required for production activities in the workplace [10]. On the production floor the goods are identified as items that are no longer needed or not needed while are the old machine is already damaged, the components of the machine that already broken.
 - b. Seiton (Stabilize), is a regulatory and marking activity for the required goods and the placement of such goods at a fixed and accessible location to support production activities. The sugestion improvements are put the packaging materials on the production floor in one place and placed in the packing area, and the hygiene kits hanging on the wall.
 - c. Seiso (Shine), is activities that emphasize the separation, cleaning of the workplace from dust and others in order to maintain workplace hygiene and safety. In running this program, each section is not distinguished and all operators in the company are required to implement it. Activities required by all operators are sweeping the floor, cleaning the area around of the equipment and the machine, and reporting unsafe conditions.
 - d. Seiketsu (Standarize), is an activity to perform tasks such as sort, stabilize, shine implemented

and executed consistently. Companies need to establish a 5S agreement that is mutually agreed upon by all operators, so that the agreement becomes a legitimate rule, which every operator must comply its.

- e. Shitsuke (Habituation), is a self-discipline concerning 5S, so each operator perceives it as a corporate culture that must be continuously implemented to serve as a basis for continuous improvement. The company and the operators can hold discussions for each set period of time.

This solution can decrease damaged of the compiler engine compiler component. The solution can avoid breakdown, and delay on the compressor engine, so as to increase the effectiveness of the compressor engine.

4. Conclusion

From the OEE calculations for the overall performance of the compressor engine obtained during September 2016 until February 2017 has reached the desired target, it indicates the compressor is used effectively.

To improving effectiveness of the compressor engine is done by increasing the Preventive Maintenance, by making a compressor engine maintenance schedule regularly and performing maintenance on time, using materials with good quality so that the compiler component is not easily damaged, and implementation 5S such as:

1. Seiri: sort the the old machine is already damaged, the components of the machine that already broken.
2. Seiton: put the packaging materials on the production floor in one place and placed in the packing area, and the hygiene kits hanging on the wall
3. Seiso : sweeping the floor, cleaning the area around of the equipment and the machine, and reporting unsafe conditions
4. Seiketsu : Make the agreement of implementation 5S between company and operators.
5. Shitsuke: The company and the operators can hold discussions for each set period of time

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