Improvement Suggestion Performance of Blowing Machine Line 4 with Total Productive Maintenance (TPM) Method at PT. Coca-Cola Amatil Indonesia Medan Unit

Defi Irwansyah¹*, M Reza Fahlevi Harahap¹, Cut Ita Erliana¹, Nurintan Asyiah Siregar², Jamil Afrianto³, Nurmaawati⁴, Dwi Irawan⁵, Rianti Setyawasthi⁶, Meiffa Herfianti⁷, Mimi Kurnia Nengsihi⁸, Ninin Rahaningsih⁹, Renny Kurniawati⁹, Ponidi¹⁰ and I Ketut Sudarsana¹¹

¹Departement of Industrial Engineering, Universitas Malikussaleh, Aceh Utara, Indonesia
²Department of Management, STIE Labuhanbatu, Sumatera Utara, Indonesia
³Department of Accounting, Universitas Dehasen Bengkulu, Indonesia
⁴Depatemen of Industrial Engineering, University of 45 Surabaya, Indonesia
⁵Department of Engineering, Faculty of Engineering, Universitas Muhammadiyah Metro, Indonesia
⁶Department of Management, Faculty of Economic, Universitas Islam 45 Bekasi, Indonesia
⁷Departement of Management, Universitas Dehasen Bengkulu, Indonesia
⁸Department of Accounting Information System, STMIK IKMI Cirebon, Indonesia
⁹Politeknik APP Kementerian Perindustrian Jakarta, Indonesia
¹⁰Department of Mechanical Engineering, Universitas Muhammadiyah Surabaya, Surabaya, Indonesia
¹¹Department of Religious Education, Institut Hindu Dharma Negeri Denpasar, Indonesia

* defiirwansyah@unimal.ac.id

Abstract. Maintenance is an activity to maintain facilities or equipment of the factory and make repairs or adjustments to the necessary replacement to satisfactory condition of production operations in accordance with what is planned. Companies often experience damage to the Blowing machine so that interconnected machines cannot be operated. The purpose of this study was to improve the performance of Blowing line 4 engines with the Total Productive Maintenance (TPM) method at PT. Coca-Cola Amatil Indonesia Medan Unit, also to determine the level of Blowing machine performance based on the analysis of overall equipment effectiveness (OEE) at PT. Coca-Cola Amatil Indonesia Medan Unit. The method used in this study is the overall equipment effectiveness (OEE) method to measure Ishikawa's treatments and diagrams to compare and propose low engine performance. The results of data processing shows machine maintenance has not comply the OEE standards in July 81.48%, August 81.48%, September 78.07%, October 81.22%, November 78.08%, and those that fill the standards in June amount to 86.48%, with losses that most affect the effectiveness of equipment in line 4 blowroom machine is Equipment Failure Losses of 11.42% based on the results of the study, the proposed improvement in engine performance is to provide training to
employees, and increase operator awareness against engine damage, thus the production process will run smoothly.

1. Introduction
At this time, engine/equipment factors very influential production results, where engine/equipment factors are affected by engine damage that takes a long time to make repairs, cleaning the installation, and setting tools. Information obtained from the department of machine production that is often damaged is the blowroom. The damage in the blowroom machine is due to human error, spare parts, not in accordance with the specifications specified. In the present time, the blowroom machine often experiences damage every month in 2017 with the duration of the machine stopping one to three hours each month, as a result the entire production process stops for a long time, accordingly wasting productive time as a result of a monthly production decline, there are losses resulting in loss [1], [2].

PT. Coca-Cola Amatil Indonesia Medan Unit is one of the companies engaged in large-scale beverage production. PT. Coca-Cola Amatil Indonesia Medan Unit is located on Jl. Yos Sudarso KM, 14 Medan-Belawan. The company produces bottle beverage such as Coca-Cola, Sprite, Fanta, Fresh Tea, Pulpy Orange, Ades. PT. Coca-Cola Amatil Indonesia Medan Unit make a production stock to maintain the level of finished products inventory in the warehouse to fill demand for the next few days. This is due to the availability and reliability of the engine is very important to recorded. The machines used in the company are mixer machines, empty bottles, bottle washer, filler, crowner, date code, packer, and palletizer. The several machines, has often damaged suddenly is the blowroom. The blowroom functions as a bottle printing tool, the machine is one of the most important machines in the production of coca-cola drinks in the company.

To get a machine that can maintain its reliability, it is necessary to do a good concept. Total Productive Maintenance (TPM) is a good concept to realize this. Because the concept besides involving all personnel in the company also aims to take care of all production facilities/ performance maintenance owned by the company. TPM is a management system in the maintenance of equipment, machinery with the aim of achieving zero defects, zero breakdown, and zero accident [3]. With the implementation of a good maintenance system, production facilities are expected to work as expected. Thus, production facilities will have a high level of reliability, so the quality of the products produced will be maintained and productivity can be maintained.

2. Related Works
Maintenance is an activity to maintain machinery/equipment and make repairs or adjustments/replacements that are needed to satisfactory condition of production operations in accordance with what is planned. With the maintenance activities, the machine/equipment can be used according to the plan and not damaged as long as it is used for the production process or before a certain period is planned to be achieved [4]. Maintenance is a supporting activity for commercial activities, like other activities, maintenance must be effective, efficient and low-cost. With this maintenance activity, the machine or production equipment can be used according to plan and not damaged for a certain period of time that has been planned to be achieved.

3. Research Methodology
3.1. Operational Variable
Operational variables used in this study are:
- a. The loading time data is the data of the time activity.
- b. Engine breakdown data is damage that usually occurs more than 10 minutes.
- c. The setup time data is the unavailability of the production machine due to the exchange of models or products.
- d. Cycle time data is the length of time for one product unit.
- e. The amount of output is how much product is produced by the machine.
- f. The number of product defects is that many defective products are produced by the machine.
3.2. Analysis Model
In this study has been used analysis model as follows:

- Counting Availability Rate
  \[ AR = \frac{\text{Loading time} - \text{Downtime}}{\text{Loading time}} \times 100\% \]

- Counting Performance Rate
  \[ PR = \frac{\text{Processed amount} \times \text{Ideal cycle time}}{\text{Operation time}} \times 100\% \]

- Counting Quality Rate
  \[ RQ = \frac{\text{Output} - \text{Defect}}{\text{Output}} \times 100\% \]

3.3 Step by Step in Research Implementation
The research steps contain the steps to be taken during the research and useful as a reference for systematic progress. The following are the research steps which can be seen in Figure 1.

Start

Problem Identify

Formulate The Problem

Research Goal

Data Collecting

Primary Data
  - Interview
  - Observation

Secondary Data
  - Loading Time of machine Data
  - Downtime of machine Data
  - Output Data
  - Setup Data
  - Defect Data

Data Processing

Counting Availability Rate value
Counting Performance Rate value
Counting Quality Rate value
Counting OEE
Counting Six Big Losses value
Anlyze cause and effect with Ishikawa diagram

Result Analyze

Conclusion

Figure 1. Step by Step in Research Implementation
4. Result and Discussion

Overall Equipment Effectiveness (OEE) is a total measurement of availability that is related to the effectiveness of production activities and product quality. OEE measurement shows how well the company uses its resources including equipment, workers and the ability to satisfy consumers in terms of shipping according to quality specifications according to consumers.

To calculate OEE, a calculation will be made to find OEE's components, like Availability, Production effectiveness, Rate of Quality Product, by multiplying the values of Availability, Production effectiveness, and Rate of quality (AV x PE x RQ).

The success of TPM activities must be measured the implementation of activities is clear and directed. The parameter for measuring this activity is the TPM index, which includes availability, which is the availability of the machine. This value is a parameter of the success of maintenance activities. The availability index (AV) set by the JIPM (Japan Institute of Plant Maintenance) is a minimum of 90%. Calculation of Availability of Blowing machines in June 2017 can be seen in the table below:

**Table 1.** Research Data of *Availability Blowing* Machine on June 2017

| Month     | June (minute) | July (minute) | August (minute) | September (menit) | October (minute) | November (minute) |
|-----------|---------------|---------------|-----------------|-------------------|------------------|------------------|
| **Loading Time** | 24960         | 22080         | 22080           | 24960             | 23040            | 24960            |
| **Downtime**    | 2639          | 2856          | 2856            | 3866              | 3866             | 4016             |

Counting of Availability machine on June 2017, is Discovered:

\[ Operation\ time = loading\ time - downtime \]
\[ = 24960 - 2639 \]
\[ = 22321\ minute \]

Then, availability = \( \frac{loading\ time - downtime}{loading\ time} \times 100\% \)
\[ = \frac{24960 - 2639}{24960} \times 100\% \]
\[ = 89,42\% \]

With the same method to count Availability on July, August, September, October, and November can be seen in Appendix 2. Recapitulation of Availability calculations can be seen in Table 2.

**Table 2.** Recapitulation of Availability During Six Months in 2017

| Month    | Information         | Loading time (minute) | Downtime (minute) | Operating time LT – DT (minute) | Availability AR (%) |
|----------|---------------------|-----------------------|-------------------|---------------------------------|---------------------|
| June     |                      | 24960                 | 2639              | 2639                            | 89,42               |
| July     |                      | 22080                 | 2856              | 19224                           | 87,06               |
| August   |                      | 22080                 | 2856              | 19224                           | 87,06               |
| September|                      | 24960                 | 3866              | 21094                           | 84,51               |
| October  |                      | 23040                 | 3866              | 19174                           | 83,22               |
| November |                      | 24960                 | 4016              | 20944                           | 83,91               |
From the above calculation recapitulation can be seen the highest Availability value is in June that is 89.42% and the lowest is in November with a value of 83.42% and the average value of Availability Rate is 85.86%.

The overall effectiveness of equipment and machinery (overall equipment effectiveness) is a TPM index to see overall line conditions and overall equipment effectiveness which is the result of multiplication between availability (AV), production effectiveness (PE), and quality level (RQ). The standard for overall effectiveness of equipment and machinery (OEE) set by JIMP is 85%.

The OEE calculation for June 2017 is as follows:

\[
OEE = AV \times PE \times RQ
\]
\[
= (89.42 \% \times 96.76 \% \times 99.96 \%) \times 100 \%
\]
\[
= 86.48 \%
\]

In the same way for the calculation of July, August, September, October, and November can be seen in Annex 5. Recapitulation of calculation of Overall Equipment Effectiveness can be seen as in Table 3.

**Table 3. Recapitulation Counting of Overall Equipment Effectiveness in 2017**

| Month     | Availability Rate (%) | Performance Efficiency Rate (%) | Rate of Quality Rate (%) | OEE (%) |
|-----------|------------------------|---------------------------------|--------------------------|---------|
| June      | 89.42                  | 96.76                           | 99.96                    | 86.48   |
| July      | 87.06                  | 93.63                           | 99.96                    | 81.48   |
| August    | 87.06                  | 93.63                           | 99.96                    | 81.48   |
| September | 84.51                  | 92.44                           | 99.94                    | 78.07   |
| October   | 83.22                  | 97.65                           | 99.95                    | 81.22   |
| November  | 83.91                  | 93.10                           | 99.96                    | 78.08   |
| Total     | 515.18                 | 567.21                          | 599.73                   | 81.13   |
| Average   | 85.86                  | 94.53                           | 99.95                    | 81.13   |

Based on the results of the evaluation with the TPM method using the OEE calculation (Overall Equipment Effectiveness), the effectiveness of the equipment and the machine as a whole was not good only in June which fill the standard of 86.48%, while July, August, September, October and November did not reach the value OEE is 81.48%, 81.48%, 78.07%, 81.22%, 78.08% and the average value of Overall Equipment Effectiveness is 81.13%. Thus the OEE value of Blowing Line 4 machine is still below the standard value set by JIMP which is 85% aka and losses which most influence the effectiveness value of the equipment in the blowroom machine is Equipment Failure Losses of 11.42%.

The development of machine maintenance procedures is intended to improve engine performance. Low engine performance due to the maintenance system of the engine that has not run well identified by the Cause And Effect Diagram, then re-analyzed based on the mapping of maintenance activities and the development of maintenance programs with indicators will be obtained that can indicate an increase in company productivity. Analysis of indicators of productivity improvement is also discovered out by using the Cause and Effect Diagram approach so that a clear picture of the difference between actual conditions and the conditions of the effort is obtained.
The following table is a description for engine performance efforts at PT. Coca-Cola Amatil Indonesia Medan Unit.

**Table 4.** Improvement Suggestion Performance of Blowing Machine

| Common Factor       | Causes of problems in the maintenance system | Level 1 | Level 2                                      | Level 3                                      |
|---------------------|----------------------------------------------|---------|---------------------------------------------|---------------------------------------------|
| Human /operator     | Provide training to operators                | Training of tackling machine damage | Providing knowledge to the operator in the maintenance of the engine |
|                     |                                               | Operators must increase their level of concern | Improve discipline |
| Machine and Equipment | It is offer to minimize the frequency of engine damage | Carry out regular maintenance activities | Provide parts that are difficult to obtain before damage occurs |
|                     |                                               | Provide parts that are difficult to obtain before damage occurs | Check the nose water and lubricate the extruder |
| Material            | In order to keep the Blowing machine from being damaged | Immediately replace damaged components | Improve accuracy in setting the machine |
| Method              | OEE                                          | Shorten *downtime*                      | Routine maintenance |

5. Conclusion

The conclusions that can be drawn from the discussion of this final project are as follows:

1. From the results of processing data obtained, maintenance of the machine has not fill the OEE standard, like in July 81.48%, August 81.48%, September 78.07%, October 81.22%, November 78.08% and that fulfilling The OEE standard is 86.48% in June, with the average value of Overall Equipment Effectiveness being 81.13% on blowroom line 4 and based on the Japan institute of Plant Maintenance (JPIM) the value has not reached the standard of > 85% and losses that most influence the effectiveness of equipment in the blowroom machine are Equipment Failure Losses of 11.42%.

2. Based on the results of the research, the improvement suggestion in engine performance is to provide training to employees, as well as to increase operator awareness of engine damage, thus the production process will run smoothly.

References

[1] A. Corder, *Teknik Manajemen Pemeliharaan*. Erlangga, 1988.
[2] A. A. Mishra, “Supply Chain Management of Guava- A Case Study of Allahabad District (Uttar Pradesh, India),” vol. 4, no. 12, p. 9, 2013.
[3] K. Livia and P. D. Fewidarto, “Evaluasi Peningkatan Kinerja Produksi melalui Penerapan Total Productive Maintenance di PT Xacti Indonesia,” *Jurnal Manajemen dan Organisasi*, vol. 7, no. 1, pp. 32–47, Nov. 2016.
[4] K. E. McKone, R. G. Schroeder, and K. O. Cua, “The impact of total productive maintenance practices on manufacturing performance,” *Journal of Operations Management*, vol. 19, no. 1, pp. 39–58, Jan. 2001.