Measurement Of Overall Equipment Effectiveness (OEE) IMC Machine at Sugar Factory PT. ABC

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Abstract

PT ABC sugar factory is one of the business units of PTPN XI in the western region of East Java. During the milling period in 2022, the production process at the milling station often experiences a downtime process so that it disrupts the production process which hampers the sugar manufacturing process. The high downtime affects the yield of sugar capacity produced during the production process. The study was held to measure Overall Equipment Effectiveness (OEE) during the production process at the mill station on the IMC machine which functions as a medium for transporting chopped sugar cane to the juice press machine. The result of measuring the Overall Equipment Effectiveness value on the IMC machine produces a value of <85% as a standard value in the world.

Keywords: Overall Equipment Effectiveness, Total Productive Maintenance, Downtime

1. INTRODUCTION

Sugar is a strategic commodity that is closely related to people's livelihoods. Increasing sugar demand is in line with population growth and also the growth of the food and beverage industry in the country. (according to the Director General of Agro-Industry, Ministry of Industry) The increase in national sugar production can be driven by optimizing sugar production in every sugar factory in Indonesia. One of the sugar factories of PT ABC is a sugar factory owned by PTPN XI.

Based on observations made during May-August in 2022 during the sugar production period, at the mill station, several problems cause downtime it disrupts the production process because it requires repairs so that the machine can work again. At this time the IMC

machine is a machine that often breaks down, causing sugar production to stop. The IMC machine is a machine that functions as a means of transporting the chopped sugarcane from the unigator machine to the press station at the mill so that if the IMC machine has a problem, the process of extracting raw sap is automatically delayed.

The milling station functions to separate the sap (sugar cane milk) from the dregs which are carried out by milking. If there is a disturbance at this station, the next stages of purification, evaporation, and so on are not optimally running as they should. For this reason, maintenance is applied to the problematic equipment. The trouble here means, there is a decline in product quality and quantity.

Preventive maintenance usually includes overhaul, predictive, and repair activities. This is also due to the ineffectiveness of a system or method to measure equipment performance and provide solutions. Overall Equipment Effectiveness (OEE) is one of the performance measurement methods used by companies that can overcome engine problems.

Overall Equipment Effectiveness is a method of measuring the overall effectiveness of equipment used to evaluate the performance of a machine. OEE is used as an indicator of the level of productivity based on a certain level of expected performance (Susetyo, 2009). According to Naderinejad and Tabatabaei (2011), OEE is a measurement index that shows how the equipment works. OEE not only shows the number of products produced but also shows how the machines work and what percentage of defective products are compared to quality products so that OEE can be considered as an index of the health of a process or equipment.

2.   RESEARCH METHODOLOGY

This research was conducted at a mill station in in PT ABC within 3 months. The research was conducted on an IMC machine at a mill station. The data used in the research are primary data and secondary data. Main data includes observation data and interviews with several interested parties and secondary data includes data on downtime at milling stations on IMC machines and production capacity during the milling season. Data processing begins by calculating OEE on the IMC machine at PT ABC.

TPM functions to keep the equipment stable and avoid losses in the equipment while the machine is operating.OEE factor has three main factors in measurement, namely (1) the availability ratio, (2) the performance ratio, and (3) the quality ratio. The OEE calculation is

based on the three factors above to determine the final result. The standard OEE value can be seen in table 1 and the formula used to measure is as follows:

Overall Equipment Effectiveness (%) = $Availability \times Performance \times Quality \times$ 100%. The availability ratio describes the utilization of the time available in operating the machine during the production process. According to Nakajima, (1988) stated availability is the ratio of operating time, by eliminating equipment downtime to loading time. Availability can be calculated using the formula 2

$$Availability = \frac{operation\ time}{loading\ time}\ x\ \mathbf{100}\%$$

Performance Efficiency is described as the ratio of the quantity produced then multiplied by the ideal cycle time and then divided by the time available during the production process of a product. to determine the value of performance efficiency can be formulated as follows:

Performance Efficiency =
$$\frac{processed\ amount\ x\ ideal\ cycle\ time}{operation\ time}\ x\ 100\%$$

Rate of product quality is described as a ratio that describes the ability of a machine to produce products during the production process following standards. The formula used to measure this ratio is:

Rate of Quality Product =
$$\frac{processed\ Amount - defect\ Amount}{Processed\ Amount}\ x\ 100\%$$

After performing the calculations and analysis, the next step is to draw conclusions based on world-class company standards as shown in Table

Table 1 . World Class Overall Equipment Effectiveness Factor

Overall Equipment Effectiveness Factor	Worldwide Overall Equipment Effectiveness standard value
Overall Equipment Effectiveness	>85.0%
Availability	>90.0%
Performance Rate	>95.0%
Rate of Quality Product	>99.9%

3.   RESULT AND DISCUSSION

3.1.   Availability Rate

Availability is a ratio based between actual uptime and load time. The availability Level can be seen in Table 2. From the calculation results above, it can be concluded that the IMC value from May to August 2022 did not experience a significant movement.

3.2.   Performance Rate

Performance measurement that describes the machine's time to produce a product in an ideal time based on machine operating time. The results of the calculation and analysis of the Performance Rate can be seen in Table 3.

3.3.   Quality Rate Quality

Is a measure of the percentage of the number of products produced that are not defective and meet predetermined production specification standards. The results of the analysis and calculation of the Quality Rate can be seen in Table 4.

3.4.   Overall Equipment Effectiveness calculation

After analyzing and calculating the availability rate, performance rate, and quality rate, the next step is to calculate the overall value of the Overall Equipment Effectiveness on the IMC machine during the May-August 2022 period. The OEE calculation for the May-August 2022 period can be seen in Table 5.

Table 2. Availability Rate

No	Period	Avaibility time	Planned downtime	Loading time	Unplanned downtime	Operating time	Avaibility Ratio (%)
1	Period 1	96	0	96	0,4	95,6	99,5%
2	Period 2	360	0	360	2,5	357,5	99,3 %
3	Period 3	360	0	360	2,1	357,9	99,4 %
4	Period 4	360	0	360	1,25	358,75	99,6 %
5	Period 5	384	0	384	0,5	383,5	99,8 %
6	Period 6	360	0	360	2,16	357,16	99,2 %

Table 3. Performance Rate

No	Period	Total (ton)	Ideal Cycle Time (Hours /Ton)	Operating Time (time)	Performance Efficie (%)
1	Period 1	7.831,82	0,009	95,6	73.7 %
2	Period 2	34.253,79	0,009	357,5	86,2 %
3	Period 3	35.851,50	0,009	357,9	90,1 %
4	Period 4	28.490,79	0,009	358,75	71,47 %
5	Period 5	39.048,16	0,009	383,5	91,6 %
6	Period 6	36.794,36	0,009	357,16	92,7 %

Table 4. Quality Rate

No	Period	Total product	Defect	Rate of Quality Product %
1	Period 1	7.831,82	1.957,95	75
2	Period 2	34.253,79	8.563,44	74,99
3	Period 3	35.851,50	9.962,87	72,21
4	Period 4	28.490,79	7.122,69	75
5	Period 5	39.048,16	9.762,04	75
6	Period 6	36.794,36	9.198,59	75

Table 5. OEE Value

No	Period	Available Ratio (%)	Performance Ratio (%)	Rate of quality product (%)	OEE (%)
1	Period 1	99,5	73,7	75	54,9
2	Period 2	99,3	86,2	74,99	64,1
3	Period 3	99,4	90,1	72,21	64,6
4	Period 4	99,6	71,47	75	53,3
5	Period 5	99,8	91,6	75	68,5
6	Period 6	99,2	92,7	75	68,9
average		99,46	84,29	74,53	62,3

Based on the results of the OEE calculations and analysis in Table 4, it can be concluded that the average value of the IMC machine for the May-August 2022 period is 62.3%. and based on Table 4, this value does not meet the global standard set at 85%. the lowest value in Overall Equipment Effectiveness is found in the Rate of Quality, which is only 74.53% (Table 6).

Table 6. Overall Equipment Effectiveness world-class measurement and the company measurement.

	Value Company	Standard world-class
Availability	99,46%	>90,0%
Performance	84,29%	>95,0%
Quality	62,3%	>99,9%

4.   SUMMARY

The conclusion is based on the discussion of the Overall Equipment Effectiveness measurement, the average IMC machine for the May-August 2022 period has an effectiveness of 62.3%, this value does not meet the standard limit applied, which is > 85%, of IMC machines, the lowest percentage is at the Product Quality Level with a percentage of only 74.53% while the highest percentage is at the availability level with a value of 99.46%.

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