

ABSTRAK

PT Indocement Tungal Prakarsa Tbk (PT INTP) adalah perusahaan manufaktur semen yang mengalami peningkatan nilai *downtime* untuk mesin yang berada di *Plant 9* pada tahun 2022 sebesar 57%. Berdasarkan data yang diperoleh dari perusahaan, 80% dari nilai *downtime* keseluruhan berasal dari mesin *Ball Mill CM9A*, *Ball Mill CM9B*, dan *Ball Mill CM9C*, sehingga ketiga mesin tersebut dijadikan objek penelitian. Peningkatan *downtime* menandakan mesin-mesin produksi mengalami penurunan kinerja pemeliharaan baik efektivitas, maupun reliabilitasnya dan dampaknya mengarah pada penurunan kualitas dan output produksi. Kecenderungan terjadi penurunan kinerja mesin menyebabkan perlunya dilakukan konfirmasi penurunan kinerja mesin lebih lanjut dan dilakukan *risk assesment*. Perusahaan juga memerlukan alternatif-alternatif strategi pemeliharaan yang sesuai dan tidak hanya dapat meningkatkan efektivitas mesin, tetapi juga meningkatkan reliabilitas mesin.

Pengukuran kinerja mesin dan *risk assesment* dilakukan menggunakan *Equipment Performance and Reliability (EPR)*. Pemilihan alternatif strategi pemeliharaan dilakukan berdasarkan *Multi Attribute Decision Making (MADM)* dengan teknik *Fuzzy Analytical Hierachhy Process (F-AHP)* dan *Fuzzy Measurement Alternatives and Ranking according to the Compromise Solution (F-MARCOS)*. F-AHP digunakan untuk pembobotan kriteria dan F-MARCOS digunakan untuk penilaian dan pemeringkatan kriteria. Kriteria yang digunakan dalam penelitian ini adalah ketersediaan (C_1), kecepatan putar mesin (C_2), dan frekuensi kerusakan (C_3). Alternatif strategi pemeliharaan yang diusulkan adalah *Time-Based Maintenance (A₁)*, *Usage-Based Maintenance (A₂)*, *Condition-Based Maintenance (A₃)*, dan *Predictive Maintenance (A₄)*.

Hasil penelitian menemukan bahwa tingkat performa pemeliharaan ketiga mesin *ball mill* memiliki efektivitas mesin dengan nilai sedang dengan nilai rata-rata *machine effectiveness* masing-masing adalah 62%, 63%, dan 63% dan reliabilitas mesin dengan nilai buruk dengan nilai masing-masing sebesar 27%, 30%, dan 32%. Berdasarkan EPR, dengan performa pemeliharaan pada tingkat 4 disarankan untuk melakukan *risk assesment* dan menyusun strategi perbaikan dengan mempertimbangkan risiko dan konsekuensi kegagalan. Penyebab utama kinerja mesin yang buruk berdasarkan *risk assesment* adalah *consecutive shutdown* yang disebabkan karena mesin lain (*kiln*) sedang dalam *maintenance* atau *breakdown*. Penyebab lainnya adalah motor pompa saluran ke *separator* mengalami *trip* dan *power supply incoming transformer* mengalami *trip*. Strategi pemeliharaan terpilih adalah *Condition-Based Maintenance (CBM)* dengan nilai 0,3308. Beberapa rekomendasi implementasi CBM adalah memasang sensor monitoring di seluruh sub sistem *ball mill*, melakukan berbagai analisis status mesin untuk perencanaan pemeliharaan, mengintegrasikan *Computerized Maintenance Management Systems (CMMS)* dan *Decision Suport Systems (DSS)* untuk membantu pengambilan keputusan lebih cepat dan akurat alih-alih manual, serta *training* staf dan karyawan tentang implementasi CBM baik secara teoritis, maupun praktik.

Kata kunci: Pemilihan Strategi Pemeliharaan, MADM, F-MARCOS

ABSTRACT

PT Indocement Tunggak Prakarsa Tbk (PT INTP) is a cement manufacturer that has experienced an increase in the downtime value for machines in Plant 9 in 2022 by 57%. Based on company data, 80% of the overall downtime comes from the Ball Mill CM9A, Ball Mill CM9B, and Ball Mill CM9C machines, so these three machines were used as research objects. Increased downtime means that production machines experience a decrease in maintenance performance, both effectiveness and reliability, and the impact leads to a decrease in quality and production output. The tendency for machine performance to decline causes the need to confirm further machine performance decline and carry out a risk assessment. Company also need alternative maintenance strategies that are appropriate and not only increase machine effectiveness, but also increase machine reliability.

Machine performance measurements and risk assessments are carried out using Equipment Performance and Reliability (EPR). The selection of alternative maintenance strategies is carried out based on Multi Attribute Decision Making (MADM) with the Fuzzy Analytical Hierarchy Process (F-AHP) technique and Fuzzy Measurement Alternatives and Ranking according to the Compromise Solution (F-MARCOS) technique. F-AHP is used for criteria weighting and F-MARCOS is used for criteria assessment and ranking. The criteria used in this research are availability (C_1), machine rotation speed (C_2), and failure frequency (C_3). The proposed alternative maintenance strategies are Time-Based Maintenance (A_1), Usage-Based Maintenance (A_2), Condition-Based Maintenance (A_3), and Predictive Maintenance (A_4).

The result of this study found that the level of maintenance performance of the three ball mill machines had medium machine effectiveness with average machine effectiveness values of 62%, 63% and 63% respectively and machine reliability with poor scores with each value of 27 %, 30%, and 32%. Based on EPR, with maintenance performance at level 4 it is recommended to carry out a risk assessment and develop a repair strategy by considering the risks and consequences of failure. The main cause of poor machine performance based on risk assessment is consecutive shutdowns caused by other machine (kiln) being under maintenance or breakdown. Another cause is that the line pump motor to the separator trips and the incoming transformer power supply trips. The selected maintenance strategies are Condition-Based Maintenance (CBM) with value of 0.3308. Some recommendations for implementing CBM are installing monitoring sensors throughout the ball mill sub-system, carrying out various machine status analyzes for maintenance planning, integrating Computerized Maintenance Management Systems (CMMS) and Decision Support Systems (DSS) to help make decisions more quickly and accurately instead of manual, as well as training for staff and employees regarding the implementation of CBM both theoretically and practically.

Keywords: *Maintenance Strategy Selection, MADM, F-MARCOS*