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Calculation and Improvement of Overall Equipment Effectiveness (OEE) of A Model Machine in A Production Line

Aditya Sharma[1], Rashmi Maheshwari[2], Aniket Juneja[3], Jay Prakash Rajput[4]
[2]*Associate Professor, Mechanical, IMS Engineering College, Ghaziabad.*[1,3,4]*UG Scholar, Mechanical, IMS Engineering College, Ghaziabad*

Abstract: The study in this paper is carried out on the topic calculation and improvement of Overall Equipment Effectiveness of a model machine in a production line. The purpose of this study is to focus on improvement by visibility of losses with in the process and quantifying them. OEE is guided by the principal of management through effective measurement and increasing process efficiency thorough elimination of all losses in the process. Today's manufacturing environment demands lean and extremely efficient production processes. OEE offers a means of controlling the whole production process by analysing results from the totality of events.

Production in efficiencies and stoppages are blame on equipment failure. OEE will provide information on the root cause and production inefficiency and thus lead to a targeted resolution. OEE helps industries produce more without investing in new production capacity.

It does this by reducing TPM losses i.e. downtime, set up and adjustment losses and improving operators performance. The OEE was found to be 60 % in the identified model machine. Through the case study of implementing TPM in a piston manufacturing production line, the increasing efficiency and productivity of plant in terms of Overall Equipment Effectiveness (OEE) are discussed.

The result obtained from TPM approach showed that the OEE was improved from 60% to 65% which indicated the desirable in all manufacturing industry.

Keywords: TPM, OEE, PM, AM, QM, SOP, KAIZEN, POKAYOKE, 5S, SMED.

I. INTRODUCTION

Total Productive Maintenance (TPM) is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to an organization. TPM focuses on keeping all equipment in top working condition to avoid breakdowns and delays in manufacturing processes.

TPM is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns, and promotes autonomous maintenance by operators through day-to-day activities involving the total work force.

Overall equipment effectiveness (OEE) is a term coined by Seiichi Nakajima in the 1960s to evaluate how effectively a manufacturing operation is utilized.

It is based on the Harrington Emerson way of thinking regarding labour efficiency. The results are stated in a generic form which allows comparison between manufacturing units in differing industries.

It is not however an absolute measure and is best used to identify scope for process performance improvement, and how to get the improvement.

If for example the cycle time is reduced, the OEE will increase i.e. more product is produced for less resource. Another example is if one enterprise serves a high volume, low variety market, and another enterprise serves a low volume, high variety market. More changeovers (set-ups) will lower the OEE in comparison, but if the product is sold at a premium, there could be more margin with a lower OEE.

II. LITERATURE REVIEW

A. Tpm Pillars

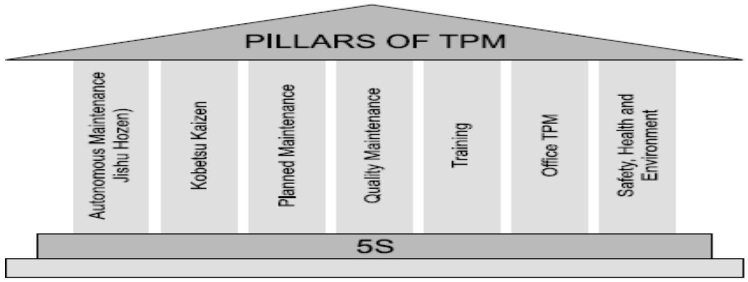

Fig. 1 TPM Pillars

B. 5s-Tpm Foundation

5S is the name of workplace organisation method that uses a list of five Japanese words namely: seiri, seiton, seiso, shiketsu and shitsuke. 5S is very effective in improving the organizational metrics and has been shown to increase aspects such as productivity and quality. 5S consists of five basic steps:

1) *SEIRI Sorting:* all the items in the workplace and removing everything that is not necessary and does not contribute to the creation of value for the customer.
2) *SEITON* **-** *Setting in Order* **:** everything that remains in an organized manner such that find items and raw materials is easy. This reduces waiting and searching time in the process enhancing the flow of value throughout the value chain
3) *SEISO* **-** *Shining (Cleaning):* is a way of making any abnormalities visible as well ensuring that quality of the final product is of a high standard. It has been observed that a clean and organized workplace has a positive effect on worker morale, not to mention that it also ingrains a sense discipline – all of which has an impact on overall productivity
4) *SHIKETSU Standardizing:* ensures that the improvements made are documented for posterity as well as serving as a basis for further improvements and training.
5) *SHITSUKE Sustaining***:** the improvements through scheduled audits is a way of stabilizing the system by ensuring the agreed standards are been followed. [2]

C. Autonomous Maintenance (Jishu Hozen)

Jishu Hozen or Autonomous Maintenance places the responsibility of basic maintenance activities on the hands of the operators and leaves the maintenance staff with more time to attend to more complex maintenance tasks. Maintenance activities that are carried out by shop floor workers include basic cleaning of machines, lubricating, oiling, and tightening of nuts and bolts, inspection, diagnosis of potential problems and other actions that increase the productive life of machines or equipment [3]

D. Planned Maintenance

The objective of Planned Maintenance is to "establish and maintain optimal equipment and process conditions" **(**Suzuki 1994). A system developed to cover daily, weekly and monthly checks in conjunction with identifying symptoms of deterioration and implementing an equipment refurbishment program. Planned maintenance is the scheduling of maintenance activities based on observed behaviour of machines such as failure rates and breakdowns. By scheduling these activities around such metrics, the cycle of breakdowns and failure is broken thus contributing to a longer service life of machines. [4]

E. Quality Maintenance

This TPM pillar addresses the issue of quality by ensuring equipment is able to detect and prevent errors during production. By detecting errors, processes become reliable enough to produce the right specification the first time. The quality aspect of maintenance is very important because it helps in preventing defects from moving down the value chain which only leads to a lot of rework [3]

F. Focussed Improvement

In this pillar, cross-functional teams are assembled with the main working on problematic equipment and coming up with improvement suggestions. Focused improvement includes all activities that maximize the overall effectiveness of equipment, processes, and plants through uncompromising elimination of losses and improvement of performance. Kaizen is implemented by lower management and workers but relies heavily on support from senior management. This pillar focuses on that “A very large number of small improvements are more effective in an organizational environment than a few improvements of large value.”[5]

G. Early Equipment Maintenance

Early Maintenance uses the experience gathered from previous maintenance improvement activities to ensure that new machinery reaches its optimal performance much early than usual. Early management is a system that addresses these concerns and uses input from the staff who will be using the equipment before installation. [5]

H. Education and Training

This pillar is concerned with filling the knowledge gap that exists in an organization when it comes to total productive maintenance. Lack of knowledge in the tools can stand in the way of proper implementation leading to mediocre results at best and failure at worst. Without proper training, tools such as TPM can be misunderstood by the staff which can result in disastrous results for the company. [7]

I. Health, Safety & Environment

That workers must be able to perform their functions in a safe environment devoid of health risks cannot be gainsaid.
The health, safety and environment pillar of total productive maintenance ensures that all workers are provided with an environment that is safe and that all conditions that are harmful to their well-being are eliminated.[3]

J. TPM in Office Functions

Taking TPM to the administrative functions is the next logical step in the total productive maintenance program so as to have the whole organization speaking from the same page. Spreading the initiative into other functions removes the silo mentality and encourages horizontal cooperation within the workforce. The organization will also benefit by having a larger pool of workers who understand the principles of TPM and can easily be called upon to play a positive role in its implementation.

III. OEE (OVERALL EQUIPMENT EFFECTIVENESS)

OEE (Overall Equipment Effectiveness) is a metric that identifies the percentage of planned production time that is truly productive. Overall equipment effectiveness (OEE) is a term coined by Seiichi Nakajima in the 1960s to evaluate how effectively a manufacturing operation is utilized. It is based on the Harrington Emerson way of thinking regarding labour efficiency. The results are stated in a generic form which allows comparison between manufacturing units in differing industries. It is not however an absolute measure and is best used to identify scope for process performance improvement, and how to get the improvement. If for example the cycle time is reduced, the OEE will increase i.e. more product is produced for less resource. Another example is if one enterprise serves a high volume, low variety market, and another enterprise serves a low volume, high variety market. More changeovers (set-ups) will lower the OEE in comparison, but if the product is sold at a premium, there could be more margin with a lower OEE.
OEE consists of three underlying components, each of which maps to one of the TPM goals set out at the beginning of this topic, and each of which takes into account a different type of productivity loss.
OEE has three factors which are multiplied to give one measure called OEE.
Performance x Availability x Quality = OEE:

An OEE score of 100% is ideal for a production.
An OEE score of 85% and above is world class for a production.
An OEE score of 60% and above is fairly good for a production.
An OEE score of 40% is not uncommon for a production.

A. OEE Calculation

1) *Availability:* The Availability is a factor of the OEE Metric represents the percentage of scheduled time that the operation is available to operate. Availability takes into account all events that stop planned production long enough where it makes sense to track a reason for being down.
2) *Performance Efficiency:* Also known as "process rate", the Performance portion of the OEE Metric represents the speed at

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which the Work Centre runs as a percentage of its designed speed.

3) *Quality:* The Quality Metric is a pure measurement of Process. Quality takes into account manufactured parts that do not meet quality standards, including parts that need rework.

Performance x Availability x Quality = OEE

Fig.2 OEE calculation

IV. OEE CALCULATION OF A MODEL MACHINE

In this section, the OEE calculation is demonstrated through case study of a model machine. Section 3.1 gives a brief review of case organization and then the OEE is calculated.

A. *About XYZ*

XYZ is one of the prestigious piston manufacturing organizations in India. XYZ is involved in manufacturing of piston since 1972. Having various machines in piston lines working 24 hours a days. This continuous employment of machines sometimes leads to failures and breakdown.

To calculate this breakdown and save from unnecessary failures. XYZ adopted OEE calculation to calculate this hidden time to improve the efficiency of the plant.

B. *Calculations and Data Requirement*

The following data is available in engineer's logbook related to model machine which is provided by the Company:

1) Piston production data of a production line
2) Breakdown losses (Mechanical and Electrical)
3) Tool change time loss
4) No material time loss
5) No operator

C. *Availability*

AVAILABILITY = (LOADING TIME-DOWN TIME) *100/LOADING TIME

DOWN TIME = ELEC BREAKDOWN + MECH BREAKDOWN + TOOL CHANGE TIME + SET UP TIME + INSPECTION TIME

DATA ANALYSIS

1) Plant Operating Time = Shift Length – Breaks
2) Planned Shutdown Time = Tea Breaks Time + Lunch/Dinner/Supper Break Time
3) Down Time = Waiting Time for Operator + Setups & Changeover Time + Material Flow Shortage Time + Failure or Breakdown Time + Meeting Time

D. *Production Time Data*

1) Plant Operating Time = Shift length x 60 min = 8 x 3 x 60 = 1440 min/day
2) Working days in a month = 25 x 1440 = 36000 min/month
3) Planned Down Time = Cleaning+ Break+ Meeting Time = 30 +150 + 45 = 225 min/day

E. *Performance*

Performance = SOR*NOR

Where, SOR = Standard Operating rate

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=Std. Cycle Time/Actual Cycle Time

NOR = Net Operating Rate

=Actual Cycle Time*Production/Operating time

F. Quality

Quality = (Total Count-Rejections) / Total Count

G. Setup And Adjustment

Production Time = Actual Production/Standard Production*Working Time

Total Production Time = Previous model production time + Setting model production time

Total Working Time = Shift during Changeover

Setting Time = Total working time – Total production time

Standard Setting Time = 144 minutes

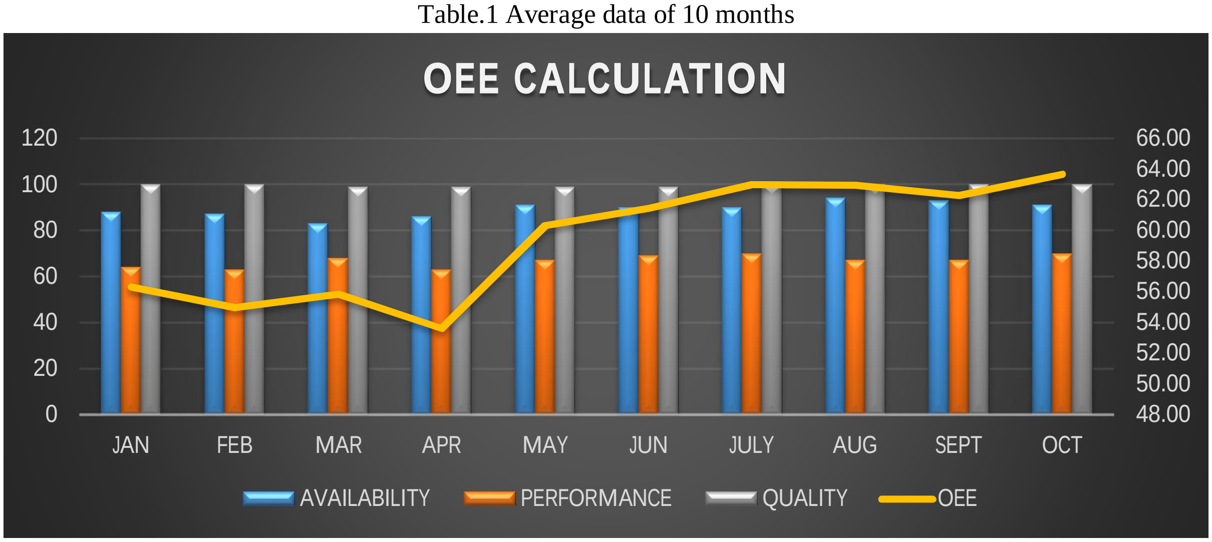
Time Loss = Setting Time -144

V. DATA ANALYSIS

A. OEE calculation of a model machine from January 2016 to October 2016 (before implementation of TPM and 5S):

MONTH	AVAILABILITY	PERFORMANCE	QUALITY	OEE
JAN	88	64	100	56.32
FEB	87.3	63	100	55.00
MAR	83	68	99	55.88
APR	86	63	99	53.64
MAY	91	67	99	60.36
JUN	90	69	99	61.48
JULY	90	70	100	63.00
AUG	94	67	100	62.98
SEPT	93	67	100	62.31
OCT	91	70	100	63.70
AVERAGE	**89.33**	**66.8**	**99.6**	**59.47**

Table.1 Average data of 10 months



Graph 1. OEE Calculation

B. Improvements

Followings are some improvements for maintaining the 5S and TPM in a cell.

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Fig. 3 Before and after pic of inspection table.

Fig.4 Setting Piston inspection almirah

C. OEE calculation of a model machine from February 2017 to March 2017 (after TPM and 5S implementation):

MONTH	AVAILABILITY	PERFORMANCE	QUALITY	OEE
FEB	89	73	100	64.97
MAR	87	73	100	63.51
AVERAGE	**88**	**73**	**100**	**64.24**

Table .2 Average improved data of 2 months

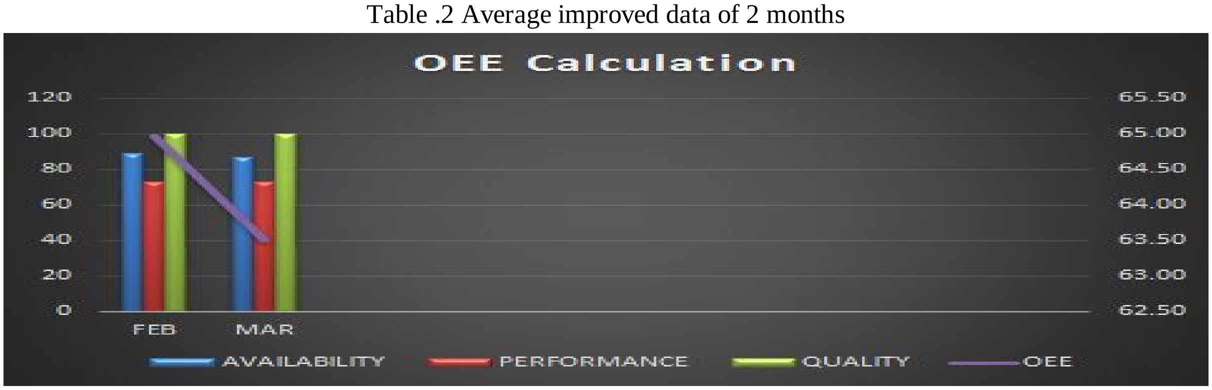

Fig.5 Graph showing improved OEE

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VI. RESULT

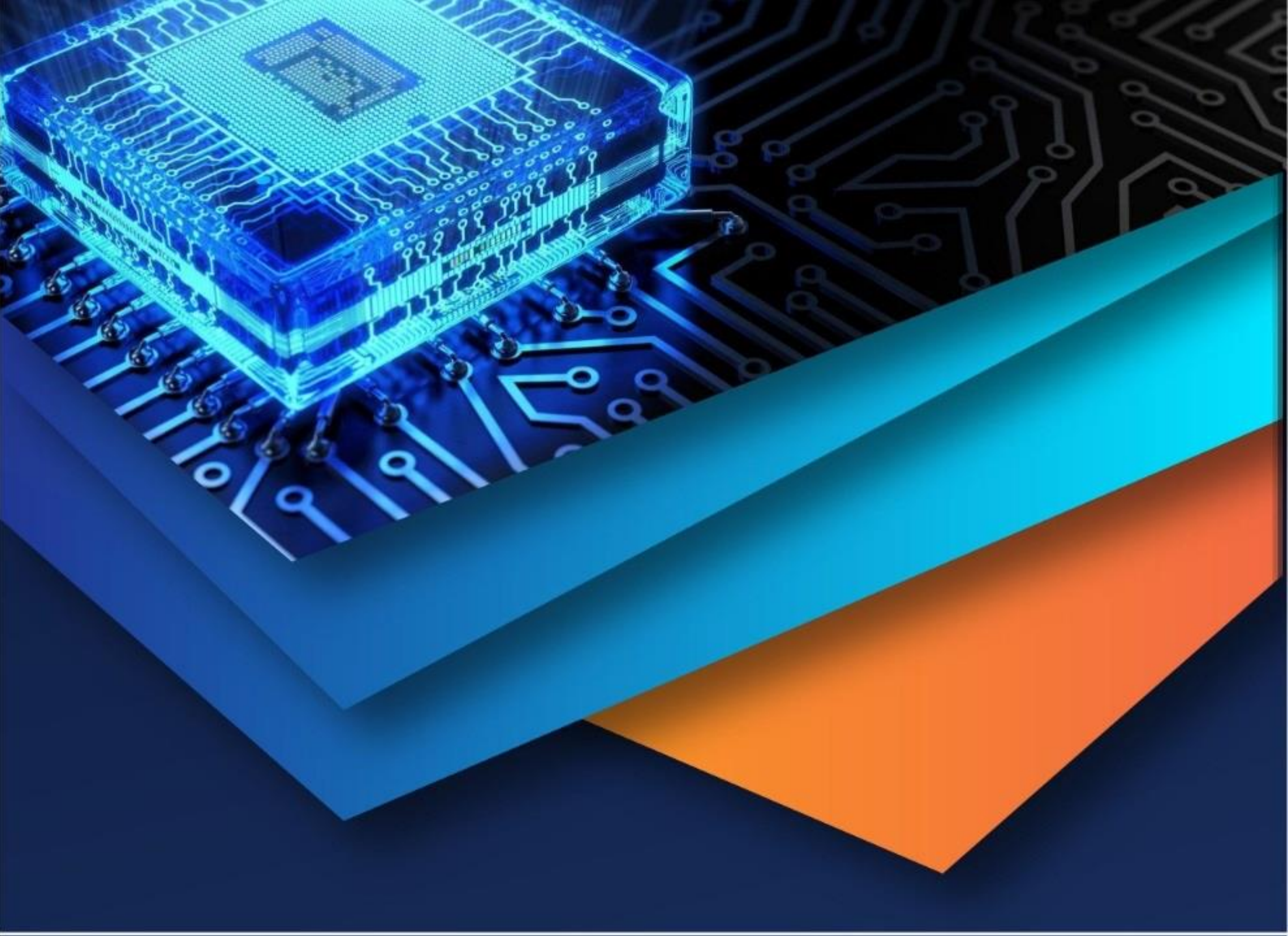
After implementation of the TPM and 5S techniques, the Overall Equipment Effectiveness (OEE) of a model machine improved from 60% to 65%.

VII. CONCLUSIONS

Today TPM may be the only thing that stands between success and total failure for some companies; it has been proven to be a program that works. It is essential for a company to improve the production rate and quality of the products. In order to achieve this, the Overall Equipment Effectiveness was improved with low machine breakdown, less idling and minor stops time, less quality defects, reduced accident in plants, increased the productivity rate, optimised process parameters, worker involvement, improved profits through cost saving method, increased customer satisfaction and increasing sales. Employees must be educated and convinced that TPM is not just another "program of the month" and that management is totally committed to the program and the extended time frame is necessary for full implementation. TPM success requires strong and active support from management, clear organizational goals and objectives for TPM implementation. The Overall Equipment Effectiveness of a model machine in a piston manufacturing line was increased from 60% to 65% through the implementation of availability, better utilization of resources, high quality products and also raised employee morale and confidence.

VIII. REFERENCE

[1] Harsha G. Hegde, N. S. Mahesh & Kishan Doss 2009 "Overall Equipment Effectiveness Improvement by TPM and 5S Techniques in a CNC Machine Shop" volume 8 issue 2
[2] Amit Kumar Gupta, Dr. R. K. Garg September 2012 "OEE Improvement by TPM Implementation Of Broaching Machine: A Case Study" volume 1 issue 1
[3] Jitendra Kumar July 2016 "OEE IMPROVEMENT BY TPM IMPLEMENTATION OF A BOILER PLANT: A CASE STUDY" volume 4 issue 7
[4] S. R . Vijayakumar, S .Gajendran "IMPROVEMENT OF OVERALL EQUIPMENT EFFECTIVENESS (OEE) IN INJECTION MOULDING PROCESS INDUSTRY" volume13
[5] C.J. Bamber, P.Castka, J.M.Sharp, & Y.Motara,2003 "Cross Functional team Working for Overall Equipment Effectiveness", Journal of Quality in Maintenance engineering, Vol 9 No.3
[6] Albert H.C.Tsang & P.K.Chan, 2000 "TPM implementation in China: a case study", International Journal of Quality & Reliability Management, Vol 17 No.2
[7] P.Sharma, Vishwas Bhave, Dr. H.B. Khurasia, & B.Shikari "Enhancing overall equipment effectiveness (OEE) through TPM"
[8] Paul Dean CEng, 2006 "OEE Thoughts", Shire Systems Limited Orjan Ljungberg, 1998 "Measurement of Overall Equipment Effectiveness as a basis for TPM activities", International Journal of Operations & Production Management, Vol 18 No.5
[9] Total Productive Maintenance by Steven Borris, McGraw Hill Publications Title (0-07-146733-5) ("McGraw-Hill") Copyright Act of 1976



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