IMPLEMENTATION OF TPM TO IMPROVE OEE IN SME – A CASE STUDY

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Abstract:

Excellence of operations involves efficient and effective use of manufacturing resources like Men, Machine, Material & Method. Any wastes occurring in these resources will add cost to the product and not the value. Hence, the Total Productive Maintenance (TPM) approach was taken to eliminate wastes and to improve the overall plant efficiency. This approach was implemented in a SME and the results were excellent. The case study resulted in tangible plant performance indicators like Reduction in Breakdowns, Increase in Mean Time Between Failure (MTBF), Reduction in Mean Time To Repair (MTTR) and improvement in Overall Equipment Effectiveness (OEE). Many intangible benefits were also achieved. Huge success achieved in involvement of operating employees in the implementation process.

Keywords: Lean Manufacturing, TPM, OEE, APQ Ratios, MTBF, MTTR

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1 INTRODUCTION

TPM is a Japanese Management System. During 1950's and 1960's Preventive Maintenance (PM) was very popular in Japan. Seichi Nakajima of JIPM, improved PM and systemized the new approach as TPM in 1971

TPM is a manufacturing philosophy to manage the manufacturing plant with Zero Breakdown, Zero Accidents and Zero Defects. The Moto is ZERO BAD. Before TPM, manufacturing performances were measured in isolation between Equipment Availability (A), Workmen Performance efficiency (P) and Rate of good quality products (Q). After TPM, the operations effectiveness measure of O.E.E (Overall Equipment Effectiveness) evolved by combining and multiplying (A) x (P) x (Q). By this measure, the perspective of Effectiveness came and industries started looking at ways and means to achieve higher level of OEE.

TPM is not just machine-oriented improvements. TPM is a culture that focuses on improving the effectiveness of the plant, equipment and processes through the empowerment of PEOPLE. It is a journey of positive culture change in the organization. From "I Operate – YOU Maintain" syndrome to "I Operate – I Maintain". Operators take ownership of the machines ("My Machine" concept). Lot of Training being given to operating employees to enhance the knowledge about the machine they operate and the product they produce. This gives empowerment to employees to stop – correct – run.

The Key objectives of TPM is PQCDSM which is Productivity, Quality, Cost, Delivery, Safety and Motivation

2 LITERATURE SURVEY:

[S.Nallusamy et al] made an attempt to implement total productive maintenance to achieve overall equipment effectiveness (OEE) close to world class standards in a PVC pipe manufacturing industry. The improved the OEE from 55.45% to 68.04%. They have introduced Jishu Hozen and Kaizen activities.

[Shahryar Irfan Virk et al] reviewed the TPM & OEE practices in manufacturing sectors through a narrative research based on the secondary data which was collected from the previously conducted empirical studies, case studies and literature reviews.

[Norman Gwangwava et al] have contributed in designing a framework that would identify and address the various problems, resulting in an optimized OEE rate.

[Tian Xiang et al] developed a ‘light’ total productive maintenance (TPM) model suitable for small and medium-sized enterprises (SMEs). The case study shows a significantly improved production efficiency of equipment. The model adopts a phased method to implement TPM, without aggravating the financial and human resource burden of the enterprise.

[R.V.Paropate et al] carried out a literature survey of about 10 papers on TPM and found that TPM is being adopted across many organizations in India.

[Sunadi et al] The research applied a case study in one of the plastic manufacturing industries. They applied Failure Mode and Effect Analysis (FMEA) along with Pareto chart, Cause and Effect Diagram (CED), and six big losses. They have improved the OEE from an average of 26.43% to 78.87%.

Siddharth Pal studied Indian Pump Manufacturing industries at Ahmedabad, to understand tools and techniques adopted in lean management by LMC, to know whether the lean management helps to improve productivity and reduction in cost for MSME units, to identify the major challenges in implementation of Lean management in Indian MSMEs. He found that 5S, Inventory Management and Flow Management has given maximum benefits.

Dhruv Shah, Pritesh Patel studied regarding Productivity Improvement by Implementing Lean Manufacturing Tools in Manufacturing Industry and found Lean is applicable for all the type of the organization irrespective of their size.

Gaps observed in Literature survey: Most of the survey papers were explaining about the effects of TPM implementation in Medium to large scale industries. There exists a gap for implementing TPM in Small scale industries which employees less educated operators. Here we need to consider going in for some Visual Management Tools like visual monitoring charts etc.

3 RESEARCH OBJECTIVES:

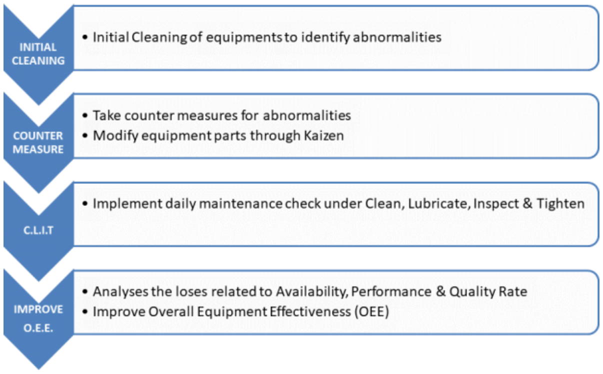
To deploy the powerful lean tool TPM in a SME,

- To reduce the equipment down times, reduce MTTR and to increase MTBF
- To improve production performance

- To improve Quality rate
- To improve Overall Equipment Effectiveness (OEE) of the plant.
- To make visual Management charts which is easily understandable by less educated workmen.

4 METHODOLOGY ADAPTED:

Being a Small scale industry, a simple, relevant, easily actionable yet result oriented methodology was designed. First 3 steps of Autonomous Maintenance (Jishu Hozen) was considered to establish the basic conditions of machines and for Daily Maintenance by employees. This helps in reducing breakdowns. Overall Equipment Effectiveness (OEE) was kept as an important measure.



5 IMPLEMENTATION OF ACTIONS:

5.1 INITIAL CLEANING

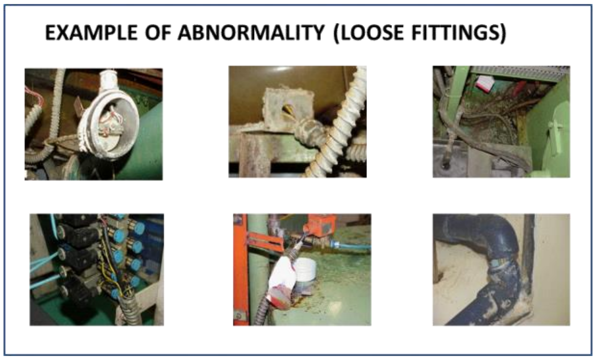
Cleaning to identify abnormalities
Cleaning is inspection
Use 5 senses for cleaning
Find out 7 types of abnormalities
Put tags on abnormalities
Prepare list of unfulfilled basic conditions

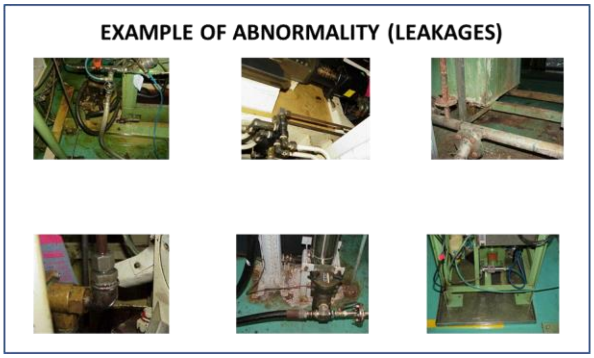
7 Types of Abnormalities

1. Minor flaws
2. Unfulfilled basic conditions
3. Inaccessible places
4. Contamination sources
5. Quality defect sources
6. Unnecessary and non – urgent items
7. Unsafe places

Many practical Initial cleaning exercises were carried out on the equipment to identify abnormalities. Abnormalities were grouped in to RED Tag items, WHITE Tag items. Also grouping was done on Electrical and Mechanical related issues.

Below are some of the photos of abnormalities observed.


EXAMPLE OF ABNORMALITY (LOOSE FITTINGS)


EXAMPLE OF ABNORMALITY (LEAKAGES)

5.2 COUNTER MEASURE

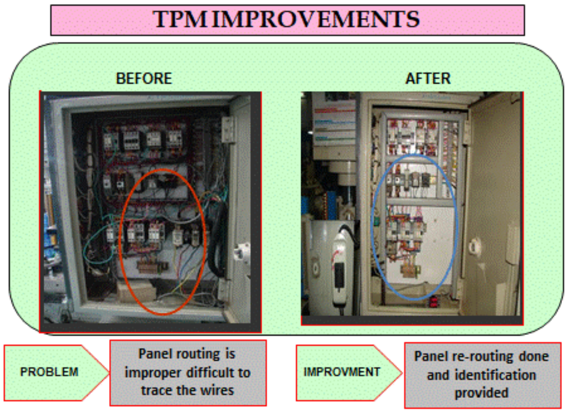
5.2.1. TAKE COUNTERMEASURE FOR ABNORMALITIES

Following countermeasure were taken for Abnormalities

- Oil leaks were arrested
- Bolts and nuts were standardized
- Spillage of Bur and coolant arrested

5.2.2. MODIFY EQUIPMENT PARTS THROUGH KAIZEN

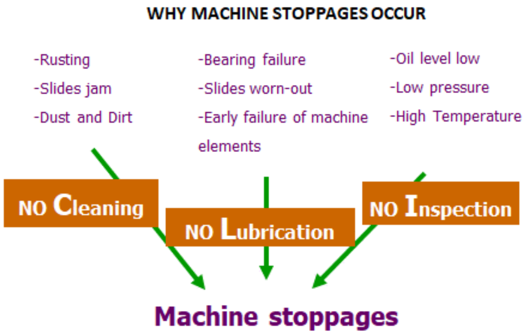
- Space created around the Machine / Equipment
- Hydraulic oil level indicator, Lubrication oil level indicator, and the machine operator modified pressure gauges positions to facilitate easy inspection.



5.3 C.L.I.T

5.3.1. IDENTIFY CAUSES FOR PAST BREAKDOWNS

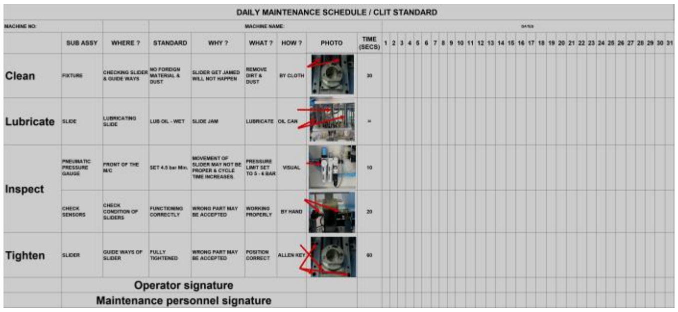
Typically, loose bolts and poor lubrication cause 60% of breakdowns. Dirty conditions are a major cause of failure and accelerate wear and deterioration of machinery. Product quality, throughput, safety and morale are all inextricably linked to the machine condition.



5.3.2. IMPLEMENT DAILY MAINTENANCE CHECK UNDER C.L.I.T

(Clean, Lubricate, Inspect, Tighten)

Equipment specific daily maintenance checklist prepared, incorporating pictures for easy understanding.



DAILY MAINTENANCE SCHEDULE / CLIT STANDARD

MACHINE NO: MACHINE NAME: DATES

	SUB ASSY	WHERE ?	STANDARD	WHY ?	WHAT ?	HOW ?	PHOTO	TIME (SECS)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Clean	FIXTURE	CHECKING SLIDER & GUIDE WAYS	NO FOREIGN MATERIAL & DUST	SLIDER GET JAMED WILL NOT HAPPEN	REMOVE DIRT & DUST	BY CLOTH		30																															
Lubricate	SLIDE	LUBRICATING SLIDE	LUB OIL - WET	SLIDE JAM	LUBRICATE	OIL CAN		[illegible]																															
Inspect	PNEUMATIC PRESSURE GAUGE	FRONT OF THE M/C	SET 4.5 bar Min.	MOVEMENT OF SLIDER MAY NOT BE PROPER & CYCLE TIME INCREASES	PRESSURE LIMIT SET TO 5 - 6 BAR	VISUAL		10																															
	CHECK SENSORS	CHECK CONDITION OF SLIDERS	FUNCTIONING CORRECTLY	WRONG PART MAY BE ACCEPTED	WORKING PROPERLY	BY HAND		20																															
Tighten	SLIDER	GUIDE WAYS OF SLIDER	FULLY TIGHTENED	WRONG PART MAY BE ACCEPTED	POSITION CORRECT	ALLEN KEY		60																															
	Operator signature																																						
	Maintenance personnel signature																																						

5.4 IMPROVE OEE

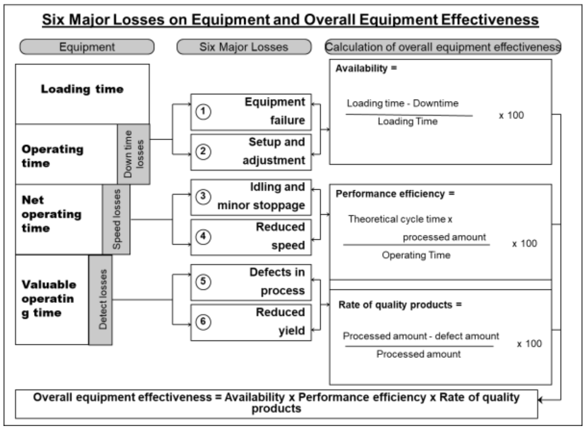
O.E.E. (Overall Equipment Effectiveness) = A (Availability Rate) * P (Performance Rate) * Q (Quality Rate)

Where,

A (Availability Rate) = Loading Time – Down Time / Loading Time

P (Performance Rate) = (Theoretical cycle time * processed amount) / Operating time

Q (Quality Rate) = (Processed amount – Defect amount) / Processed amount



O.E.E. was calculated based on above formulae. Deep analysis was done along with the operating members. People were taught regarding the data collection and root cause analysis.

BEFORE	Month 1	Month 2	Month 3	Avg / Month
O.E.E.	49.7	56.2	51	52.3

6 Losses were analyzed and necessary countermeasures and improvements were made as required.

6. MTTR & MTBF

MTBF (Mean Time Between Failure) = Total duration under consideration / Number of breakdowns during that duration. This is normally denoted in number of Days

MTTR (Mean Time To Repair) = Total Downtime / Number of breakdowns

This is normally denoted in number of Hours

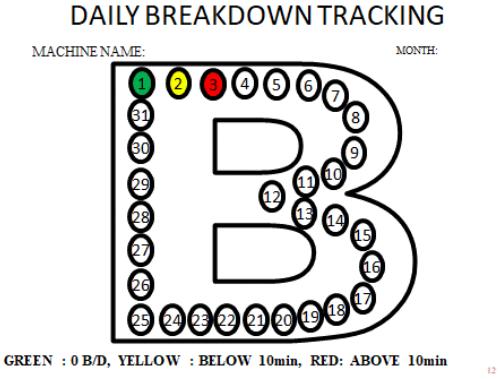
	BEFORE TPM
MTBF (in DAYS)	13.3
MTTR (in Hours)	6.5

7. STANDARDIZATION & TRAINING TO EMPLOYEES:

- Standard Operating Procedures (SOP) made
- Employees were trained in new method of working.
- Check points included in the company's manufacturing documents.
- Visual Display Management System implemented for tracking of Breakdown and Customer Complaints.

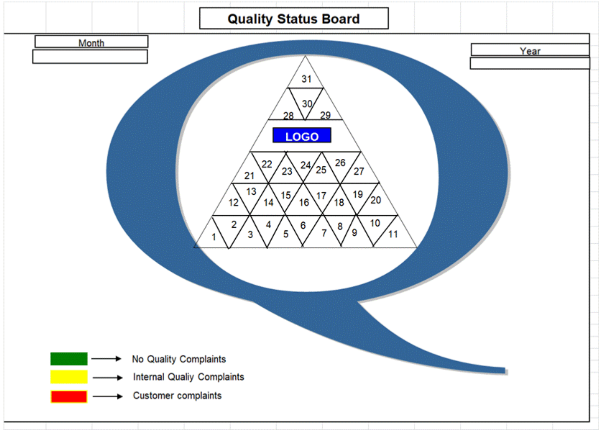
Visual Management Charts were prepared for indicting Breakdown Issues happening in the shop floor.

In Breakdown chart, GREEN = NO Breakdown, YELLOW = Breakdown less than 10 Mins, RED = Breakdown for more than 10 Mins



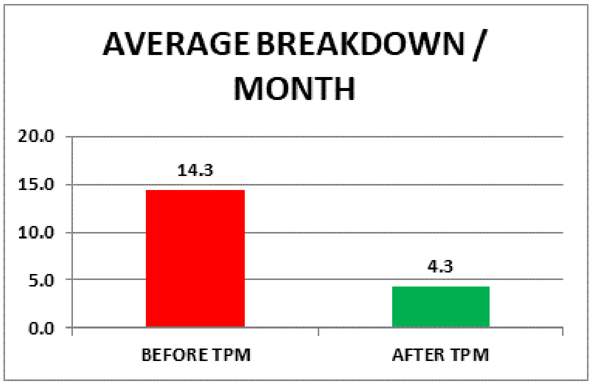
Visual Management Charts were prepared for indicting Quality Issues happening in the shop floor.

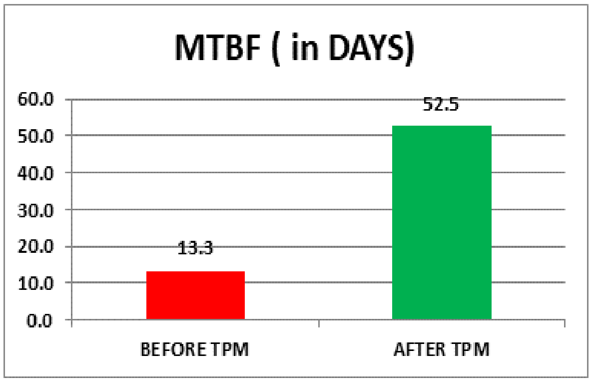
In Quality Status Chart, GREEN = NO Quality complaints, YELLOW = Internal Quality issue (within the plant), RED = Customer Complaint



8. RESULTS

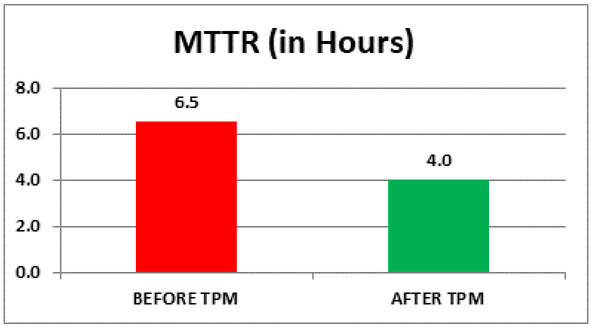
8.1 TANGIBLE RESULTS:

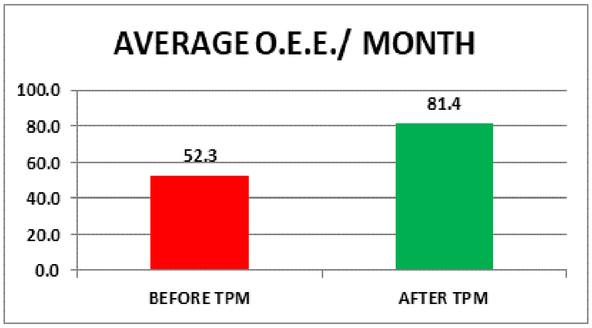




Average Breakdown /Month has come down from 14.3 to 4.3.

Mean Time Between Failures (MTBF) has increased from 13.3 days to 52.5 days





Mean Time To Repair (MTTR) has come down from 6.5 Hours to 4 hours

Average O.E.E. / Month has increased from 52.3 to 81.4

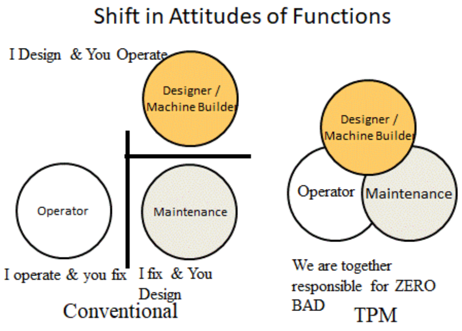
8.2 INTANGIBLE RESULTS:

1. Employees involvement, safety, morale, satisfaction and motivation improved
2. Employees' knowledge about the machine functions, causes for breakdowns and corrective actions improved exponentially.
3. Self-confidence is gained through "Zero Accident", "Zero Failure" and "Zero Defect" operations
4. Safer, cleaner and tidier work environment
5. Better communication and cooperation among departments, divisions and units

6. Increased employee participation and satisfaction

7. There was a Big shift in attitudes of functions like Machine Designer, Maintenance & Operating team. Before, they were working in silos and hence frequent complaints about each other. After, they started working together to ensure the equipment uptime is 100%.

8. All the kaizens done on initial machines has been horizontally deployed to other relevant machines. Some of them has become an important input to consider while ordering new machines.



9. CONCLUSION:

TPM implementation in SME results in huge operational performance improvements and also improvement in employees' knowledge and skill. This is a long-term sustainable benefit for the organization. Based on this case study experience, it is evident that this can be implemented in any kind of industry where there is maximum use of machines and equipments in the plant.

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