UNIT – V PRODUCTIVITY AND MODERN TOPICS

TOTAL PRODUCTIVE MAINTENANCE (TPM)

Total productive maintenance is a strategy that operates according to the idea that everyone in a facility should participate in maintenance, rather than just the maintenance team. This approach uses the skills of all employees and seeks to incorporate maintenance into the everyday performance of a facility.

TPM is a productive maintenance implemented by all employees in an organization. TPM involves everyone in the organization from operators to senior management in equipment improvement.

Total = All individuals in the organization working together.

Productive = production of goods that meet or exceed customer's expectations.

Maintenance = keeping equipment and plant in good condition at all times.

History

- This is an innovative Japanese concept.
- Developed in 1951.
- Nippondenso was the 1st company that implemented TPM in 1960.
- Based on these developments Nippondenso was awarded the distinguished plant prize for developing and implementing TPM, by the Japanese Institute of Plant Engineers (JIPE).
- This Nippondenso became the first company to obtain the TPM certifications.

GOALS:

- Increase production quality.
- Increase job satisfaction.
- Using teams for continuous improvement.
- Improve the state of maintenance
- Empower employees

Why TPM:

 Avoid wastage in quickly changing economic environment.

 Producing goods without reducing product quality.

 Reduce cost for production

 Produce a low batch quantity at the earliest time.

 Goods send to the customer must be non-defective.

Objectives of TPM:

1. To create a collective culture to the attainment of maximum efficiency in all the production process.

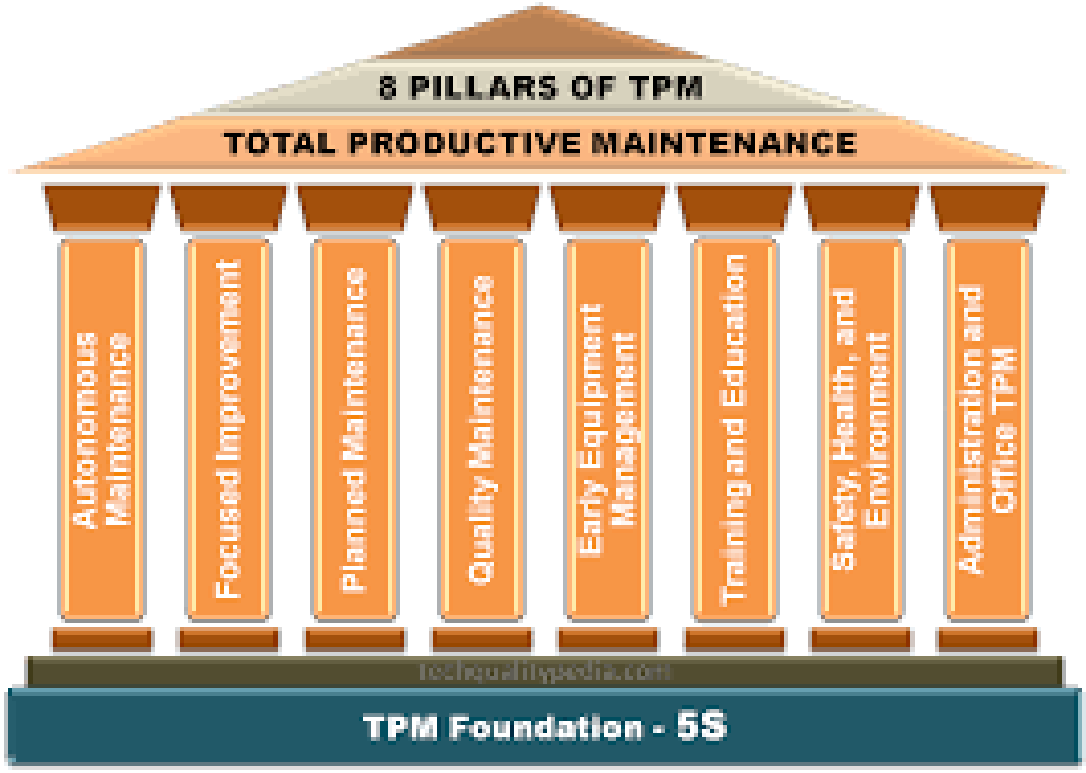
2. To prevent production losses and to attain zero accident, zero defect and zero breakdowns in the manufacturing process.

3. To involve all the employees from bottom to top in the TPM programs.

4. To obtain zero production losses through integration of the activities of the teams with the production team.

5. To manufacture products with good quality.

TOTAL PRODUCTIVE MAINTENANCE



PRINCIPLES OF TPM

- Use Overall Equipment Effectiveness (OEE) as a compass for success.
- Improve existing planned maintenance systems
- Work toward zero losses
- Providing training to upgrade operations and maintenance skills
- Involve everyone and utilize cross-functional teamwork

TYPES OF MAINTENANCE

- Breakdown Maintenance
- Preventive Maintenance
- Periodic Maintenance
- Predictive Maintenance
- Corrective Maintenance

Breakdown Maintenance

- Repairs or replacements performed after a machine has failed to return to its functional state following a malfunction or shutdown. e.g., an electric motor of a machine tool will not start, a belt is broken, etc.
- Under such conditions, production department calls on the maintenance department to rectify the defect.
- After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs.

Preventive Maintenance

- The primary goal of preventive maintenance is to prevent the failure of equipment before it actually occurs.
- It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail.
- It is a daily maintenance which includes cleaning, inspection, oiling and re-tightening of equipment's.
- Improved system reliability.
- Decreased cost of replacement.
- Decreased system downtime.
- Better spares inventory management.

Periodic maintenance (TBM)

- Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.
- Extended life and use of the equipment.
- Reliable production at the times when machine is needed most.

Predictive maintenance

- This is a method in which the service life of important part is expected based on inspection or diagnosis, in order to use the parts to the limit of their service life.
- Compared to periodic maintenance, predictive maintenance is condition based maintenance.

Corrective maintenance

- Maintenance actions carried out to restore a defective item to a specified condition.
- Corrective maintenance is probably the most commonly used approach, but it is easy to see its limitations.
- When equipment fails, it often leads to downtime in production.
- In most cases this is costly business. Also, if the equipment needs to be replaced, the cost of replacing it alone can be important.
- It is also important to consider health, safety and environment (HSE) issues related to malfunctioning equipment.

5S Philosophy

Based on five Japanese words that begin with 'S', the 5S Philosophy focuses on effective work place organization and standardized work procedures.

Pillar 1 - 5 S

1. Sort: (Seiri)
2. Set in Order: (Seiton)
3. Shine: (Seiso)

4. Standardize: (Seiketsu)

5. Sustain: (Shitsuke)

1. SEIRI - Sort out: This means sorting and organizing the items as critical, important, frequently used items, useless, or items that are not need as of now. Unwanted items can be salvaged. Critical items should be kept for use nearby and items that are not be used in near future, should be stored in some place. For this step, the worth of the item should be decided based on utility and not cost. As a result of this step, the search time is reduced.

2. SEITON - Organize: The concept here is that "Each items has a place, and only one place". The items should be placed back after usage at the same place. To identify items easily, name plates and coloured tags has to be used. Vertical racks can be used for this purpose, and heavy items occupy the bottom position in the racks.

3. SEISO - Shine the workplace: This involves cleaning the work place free of burrs, grease, oil, waste, scrap etc. No loosely hanging wires or oil leakage from machines.

4. SEIKETSU - Standardization: Employees has to discuss together and decide on standards for keeping the work place / Machines / pathways neat and clean. This standards are implemented for whole organization and are tested / inspected randomly.

5.SHITSUKE - Self-discipline: Considering 5S as a way of life and bring about self-discipline among the employees of the organization. This includes wearing badges, following work procedures, punctuality, dedication to the organization etc.

Pillar 2 – JISHU HOZEN

This pillar is geared towards developing operators to be able to take care of small maintenance tasks, thus freeing up the skilled maintenance people to spend time on more value added activity and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating. By use of this pillar, the aim is to maintain the machine in new condition. The activities involved are very simple nature. This includes cleaning, lubricating, visual inspection, tightening of loosened bolts etc.

Policy:

1. Uninterrupted operation of equipments.
2. Flexible operators to operate and maintain other equipments.
3. Eliminating the defects at source through active employee participation.

Steps in JISHU HOZEN:

1. Preparation of employees.
2. Initial cleanup of machines.
3. Take counter measures
4. Fix tentative JH standards
5. General inspection
6. Autonomous inspection
7. Standardization

Each of the above-mentioned steps is discussed in detail below.

1. Train the Employees : Educate the employees about TPM, Its advantages, JH advantages and Steps in JH. Educate the employees about the equipment they use, the frequency of oiling, day-to-day maintenance activities required and the abnormalities that could occur in the machine and way to find out the abnormalities.

2. Initial cleanup of machines:

- ❖ Arrange all items needed for cleaning.
- ❖ On the arranged date, employees clean the equipment with the help of maintenance department.
- ❖ Dust, stains, oils and grease has to be removed.

3. Counter Measures:

- ❖ Inaccessible regions had to be reached easily. E.g. If there are many screw to open a flywheel door, hinge door can be used. Instead of opening a door for inspecting the machine, acrylic sheets can be used.
- ❖ To prevent work out of machine parts necessary action must be taken.

- ❖ Machine parts should be modified to prevent accumulation of dirt and dust.

4. Tentative Standard:

- ❖ JH schedule has to be made and followed strictly.
- ❖ Schedule should be made regarding cleaning, inspection and lubrication and it also should include details like when, what and how.

5. General Inspection:

- ❖ The employees are trained in disciplines like Pneumatics, electrical, hydraulics, lubricant and coolant, drives, bolts, nuts and Safety.
- ❖ This is necessary to improve the technical skills of employees and to use inspection manuals correctly.
- ❖ After acquiring this new knowledge the employees should share this with others.
- ❖ By acquiring this new technical knowledge, the operators are now well aware of machine parts.

6. Autonomous Inspection:

- ❖ New methods of cleaning and lubricating are used. Each employee prepares his own autonomous chart / schedule in consultation with supervisor.
- ❖ Parts, which have never given any problem, or part, which don't need any inspection, are removed from list permanently based on experience.
- ❖ Including good quality machine parts.
- ❖ This avoids defects due to poor JH.
- ❖ Inspection that is made in preventive maintenance is included in JH.
- ❖ The frequency of cleanup and inspection is reduced based on experience.

7. Standardization:

- ❖ Upto the previous step only the machinery / equipment was the concentration. However in this step the surroundings of machinery are organized.
- ❖ Necessary items should be organized, such that there is no searching and searching time is reduced.
- ❖ Work environment is modified such that there is no difficulty in getting any item.
- ❖ Everybody should follow the work instructions strictly.

- ❖ Necessary spares for equipment’s is planned and procured.

Pillar 3 – KAIZEN

"Kai" means change, and "Zen" means good (for the better).

Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization. Kaizen is opposite to big spectacular innovations. Kaizen requires no or little investment. The principle behind is that "a very large number of small improvements are move effective in an organizational environment than a few improvements of large value. This pillar is aimed at reducing losses in the workplace that affect our efficiencies. By using a detailed and thorough procedure we eliminate losses in a systematic method using various Kaizen tools. These activities are not limited to production areas and can be implemented in administrative areas as well.

Kaizen Policy:

1. Practice concepts of zero losses in every sphere of activity.
2. Relentless pursuit to achieve cost reduction targets in all resources
3. Relentless pursuit to improve over all plant equipment effectiveness.
4. Extensive use of PM analysis as a tool for eliminating losses.
5. Focus of easy handling of operators.

Kaizen Target:

Achieve and sustain zero loses with respect to minor stops, measurement and adjustments, defects and unavoidable downtimes. It also aims to achieve 30% manufacturing cost reduction. Tools used in Kaizen:

1. Why - Why analysis.
2. Poka yoke. (Poka-Yoke is Japanese term, which in English means ‘Mistake Proofing prevention').
3. Summary of losses.
4. Kaizen register.
5. Kaizen summary sheet.

The objective of TPM is maximization of equipment effectiveness. TPM aims at maximization of machine utilization and not merely machine availability maximization. As one of the pillars of TPM activities, Kaizen pursues efficient equipment, operator and material and energy utilization that is extremes of productivity and aims at achieving substantial effects.

Pillar 4 - PLANNED MAINTENANCE:

It is aimed to have trouble free machines and equipment's producing defect free products for total customer satisfaction. This breaks maintenance down into four "families" or groups, which was defined earlier.

1. Preventive Maintenance
2. Breakdown Maintenance
3. Corrective Maintenance
4. Maintenance Prevention

With Planned Maintenance we evolve our efforts from a reactive to a proactive method and use trained maintenance staff to help train the operators to better maintain their equipment.

Policy:

1. Achieve and sustain availability of machines
2. Optimum maintenance cost.
3. Reduces spares inventory.
4. Improve reliability and maintainability of machines.

Target:

1. Zero equipment failure and break down.
2. Improve reliability and maintainability by 50 %
3. Reduce maintenance cost by 20 %
4. Ensure availability of spares all the time.

Six steps in Planned Maintenance:

1. Equipment evaluation and recoding present status.
2. Restore deterioration and improve weakness.
3. Building up information management system.
4. Prepare time based information system, select equipment, parts and members and map out plan.
5. Prepare predictive maintenance system by introducing equipment diagnostic techniques and
6. Evaluation of planned maintenance.

Pillar 5 - QUALITY MAINTENANCE:

It is aimed towards customer delight through highest quality through defect free manufacturing. Focus is on eliminating non-conformances in a systematic manner, much like Focused Improvement. We gain understanding of what parts of the equipment affect product quality and begin to eliminate current quality concerns, and then move to potential quality concerns. Transition is from reactive to proactive (Quality Control to Quality Assurance).

QM activities is to set equipment conditions that preclude quality defects, based on the basic concept of maintaining perfect equipment to maintain perfect quality of products. The condition is checked and measure in time series to very that measure values are within standard values to prevent defects. The transition of measured values is watched to predict possibilities of defects occurring and to take counter measures beforehand.

Policy:

1. Defect free conditions and control of equipment's.
2. QM activities to support quality assurance.
3. Focus of prevention of defects at source.
4. Focus on poka-yoke. (Fool proof system)
5. In-line detection and segregation of defects.

6. Effective implementation of operator quality assurance.

Target :

1. Achieve and sustain customer complaints at zero
2. Reduce in-process defects by 50 %
3. Reduce cost of quality by 50 %.

Data requirements:

Quality defects are classified as customer end defects to get data on

1. Customer end line rejection
2. Field complaints.

For customer-end data, we have In-house, data include data related to products and data related to process Data related to product:

1. Product wise defects
2. Severity of the defect and its contribution - major/minor
3. Location of the defect with reference to the layout
4. Magnitude and frequency of its occurrence at each stage of measurement
5. Occurrence trend in beginning and the end of each production/process/changes. (Like pattern change, ladle/furnace lining etc.)
6. Occurrence trend with respect to restoration of breakdown/modifications/periodical replacement of quality components.

Data related to processes:

1. The operating condition for individual sub-process related to men, method, material and machine.
2. The standard settings/conditions of the sub-process
3. The actual record of the settings/conditions during the defect occurrence.

Pillar 6 - TRAINING:

It is aimed to have multi-skilled revitalized employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently. Education is given to operators to upgrade their skill. It is not sufficient know only "Know-How" by they should also learn "Know-why".

By experience they gain, "Know-How" to overcome a problem what to be done. This they do without knowing the root cause of the problem and why they are doing so. Hence it becomes necessary to train them on knowing "Know-why".

The employees should be trained to achieve the four phases of skill. The goal is to create a factory full of experts.

The different phase of skills is

Phase 1: Do not know.

Phase 2: Know the theory but cannot do.

Phase 3: Can do but cannot teach

Phase 4: Can do and also teach.

Policy:

1. Focus on improvement of knowledge, skills and techniques.

2. Creating a training environment for self-learning based on felt needs.

3. Training curriculum / tools /assessment etc conductive to employee revitalization

4. Training to remove employee fatigue and make, work enjoyable.

Target:

1. Achieve and sustain downtime due to want men at zero on critical machines.

2. Achieve and sustain zero losses due to lack of knowledge / skills / techniques

3. Aim for 100 % participation in suggestion scheme.

Steps in Educating and training activities:

1. Setting policies and priorities and checking present status of education and training.

2. Establish of training system for operation and maintenance skill up gradation.

3. Training the employees for upgrading the operation and maintenance skills.

4. Preparation of training calendar.

5. Kick-off of the system for training.

6. Evaluation of activities and study of future approach.

Pillar 7 - OFFICE TPM:

Office TPM should be started after activating four other pillars of TPM (JH, Kaizen, QM, PM). Office TPM must be followed to improve productivity, efficiency in the administrative functions and identify and eliminate losses. This includes analyzing processes and procedures towards increased office automation. Office TPM addresses twelve major losses. They are

1. Processing loss

2. Cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories

3. Communication loss

4. Idle loss

5. Set-up loss

6. Accuracy loss

7. Office equipment breakdown

8. Communication channel breakdown, telephone and fax lines

9. Time spent on retrieval of information

10. Non availability of correct on line stock status

11. Customer complaints due to logistics

12. Expenses on emergency dispatches/purchases.

Kaizen topics for Office TPM:

- Inventory reduction
- Lead time reduction of critical processes
- Motion & space losses
- Retrieval time reduction.
- Equalizing the work load
- Improving the office efficiency by eliminating the time loss on retrieval of information, by achieving zero breakdown of office equipment like telephone and fax lines.

Office TPM and its Benefits:

1. Involvement of all people in support functions for focusing on better plant performance

2. Better utilized work area

3. Reduce repetitive work

4. Reduced administrative costs

5. Reduced inventory carrying cost

6. Reduction in number of files

7. Productivity of people in support functions

8. Reduction in breakdown of office equipment

9. Reduction of customer complaints due to logistics

10. Reduction in expenses due to emergency dispatches/purchases

11. Reduced manpower

12. Clean and pleasant work environment.

Pillar 8 - SAFETY, HEALTH AND ENVIRONMENT:

Target:

1. Zero accident,

2. Zero health damage

3. Zero fires.

In this area focus is on to create a safe workplace and a surrounding area that is not damaged by our process or procedures. This pillar will play an active role in each of the other pillars on a regular basis.

A committee is constituted for this pillar, which comprises representative of officers as well as workers. Senior vice President (Technical), heads the committee. Utmost importance to Safety is given in the plant. Manager (Safety) is looking after functions related to safety.

To create awareness among employees various competitions like safety slogans, Quiz, Drama, Posters, etc. related to safety can be organized at regular intervals.

Difficulties faced in TPM implementation:

One of the difficulties in implementing TPM as a methodology is that it takes a considerable number of years. The time taken depends on the size of the organization. There is no quick way for implementing TPM. This is contradictory to the traditional management improvement strategies.

Following are the other difficulties faced in TPM implementation.

- Typically people show strong resistance to change.
- Many people treat it just another “Program of the month ” without paying any focus and also doubt about the effectiveness.
- Not sufficient resources (people, money, time, etc.) and assistance provided
- Insufficient understanding of the methodology and philosophy by middle management

• TPM is not a “quick fix ” approach, it involve cultural change to the ways we do things

• Departmental barrier existing within Business Unit

• Many people considered TPM activities as additional work/threat.