

TE 4225

Total Productive Maintenance (TPM)

Total Productive Maintenance

(Previous)

- TPM is a maintenance management system for optimizing the productivity of manufacturing equipment through systematic equipment maintenance involving **employees at all levels**.
- It is a maintenance program which involves a **newly defined concept** for maintaining plants and equipment. The goal of the TPM is to markedly **increase production, while at the same time, increasing employees' morale and job satisfaction**.
- In TPM, **everyone is involved** in keeping the equipment in good working order to minimize production losses from equipment repairs, set ups etc.

Objectives of TPM

1. Aim at the creation of **collective culture** relating to the attainment of maximum efficiency throughout the production process.
2. Use the system so as to prevent losses and to reach the '**zero accident**', '**zero defect**' and '**zero breakdowns**', in the maintenance process.
3. Involve the entire work force from **bottom to top**.
4. Obtain '**zero losses**' by **integrating the activities of teams** with the production system.

Wastes eliminated in TPM

- TPM eliminates **six** big losses which are as listed below-
 1. **Breakdowns** which can result in long, expensive repairs.
 2. **Set ups and change overs** which can take much longer time than needed.
 3. **Idling and minor stoppages** which are hard to quantify and add up to losses.
 4. **Reduced equipment speed** which results in gradual deterioration of equipment cycle times.
 5. **Defects and reworks** which results in quality losses and unhappy customers.
 6. **Start-up losses** which can take much time to get to steady state after a change.

Equipment maintenance techniques

- TPM uses **four** equipment maintenance techniques-

1. Preventive maintenance: Involves **cleaning, inspection, oiling and re-tightening of the parts** which help to retain the healthy condition of the equipment and prevents failures through the prevention of deterioration, periodic inspection or condition diagnosis to measure data about deterioration.

Preventive maintenance is further classified into Periodic maintenance (Time based maintenance, TBM) and predictive maintenance.

Equipment maintenance techniques

- Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent failure and process problems.
- The predictive maintenance is condition based maintenance which manages trend values by measuring and analyzing data about deterioration and employs surveillance system which is designed to monitor conditions through an on-line system.

Equipment maintenance techniques

2. **Corrective Maintenance:** It is to **modify or improve** an equipment for increased reliability and easier maintenance. This means that the equipment with **design weaknesses are redesigned to improve reliability or maintainability.**

3. **Maintenance Prevention:** It is to design and **install new equipment** that are **maintenance-free** based on the study of the weaknesses of the current equipment.

4. **Breakdown Maintenance:** It is to **repair equipment quickly after they breakdown.**

Benefits of TPM

- Increased equipment **productivity**.
- Reduced equipment **downtime**.
- Increased plant **capacity**.
- Lower maintenance and production **cost**.
- Approaching zero equipment-caused **defects**.
- Improved **return** on investment.
- Rectified customer **complaints**.
- Reduced **accidents**.
- Ensuring **pollution** control measures.
- Better Understanding of the **performance** of equipment.
- Better understanding of **critical equipment** and the worth of deploying improvement effort for potential benefits.
- Improved **teamwork** and a less adversarial approach between production and maintenance.
- Improved **procedures** for changeovers and set ups, better **training** of the operators and maintainers, which all lead to reduced costs and better service.
- Generally increased **involvement of the work force**.

Performance measurement of Maintenance System (DEFINITIONS & MATH IMPORTANT)

- **Overall Equipment Efficiency (OEE):** is a combination of the uptime (availability of the equipment), cycle time efficiency (production efficiency) and quality output of the equipment. This can be increased through implementation of TPM.

$$\text{OEE \%} = \text{Up time \%} \times \text{Speed \%} \times \text{Quality\%}$$

Performance measurement of Maintenance System

- The uptime (availability of the equipment) is the proportion of time the equipment is actually available out of the time it should be available. It is given by the following formula-

$$\text{Uptime\%} = [(\text{MTBF} - \text{MTTR}) / \text{MTBF}] \times 100$$

- Where, MTBF is the Mean Time Between Failures and MTTR is the Mean Time To Repair.

Performance measurement of Maintenance System

- Further, the formula for the MTBF is given as below-

$$\text{MTBF} = \text{Total Running Time} / \text{Number of Failures}$$

$$\text{Speed (\%) Efficiency} = (\text{Actual cycle time} / \text{Design cycle time}) \times 100$$

$$\text{Quality (\%) Efficiency} = (\text{Good parts produced} / \text{Total parts produced}) \times 100$$

Pillars of TPM (Previous)

- TPM has 8 pillars which will enhance it's success. These pillars are listed as below-
 1. Early Equipment Maintenance
 2. Jishu Hozen (Autonomous Maintenance- operators ownership)
 3. Kaizen(continuous improvement)
 4. Planned Maintenance
 5. Quality Maintenance
 6. Training
 7. Office TPM
 8. Safety, health and environment.
- ***Explain the Pillars of TPM (Self Study)