DEPARTMENT OF AEROSPACE ENGINEERING
19MEE304 Total Quality Management

Topic: Total Productive Maintenance (TPM) - Concepts, Improvement Needs

1. Introduction to TPM

Total Productive Maintenance (TPM) is a systematic approach that integrates maintenance activities into the overall manufacturing process to improve equipment effectiveness and eliminate losses. It involves operators in the maintenance process, fostering a sense of ownership and responsibility for machine upkeep.

Objectives of TPM:

- Maximize **equipment effectiveness**.
- Minimize **breakdowns, defects, and losses**.
- Increase **employee involvement and autonomy**.
- Achieve **zero defects, zero accidents, and zero breakdowns**.

2. Key Concepts of TPM

TPM is based on **eight pillars**, each addressing a critical aspect of maintenance and productivity:

1 Autonomous Maintenance (Jishu Hozen)

- Operators take responsibility for **routine maintenance**.
- Includes **cleaning, lubrication, tightening, and inspections**.
- Helps detect **early signs of machine deterioration**.

2 Planned Maintenance

- Scheduled preventive maintenance to avoid unexpected breakdowns.
- Uses **historical data and predictive analysis**.
- Involves replacing parts before failure occurs.

3 Focused Improvement (Kobetsu Kaizen)

- Continuous improvement approach to eliminate losses.
- Uses methodologies like **PDCA, 5-Why Analysis, and Root Cause Analysis (RCA)**.

4 Quality Maintenance

- Defect prevention through proactive machine care.
- Implements **Poka-Yoke (error-proofing)** techniques.
- Aims for **zero-defect manufacturing**.

5️⃣ Early Equipment Management

- Involves designing machines for **ease of maintenance**.
- Uses insights from **TPM experiences** to improve new equipment.

6️⃣ Training and Education

- Enhances skills and technical knowledge of operators.
- Ensures employees understand **equipment operation and failure mechanisms**.

7️⃣ Safety, Health, and Environment (SHE)

- Ensures a **safe and healthy workplace**.
- Implements **risk assessments and hazard prevention measures**.

8️⃣ TPM in Administration

- Extends TPM beyond production areas to office functions.
- Improves **workflow, efficiency, and overall productivity**.

3. TPM Metrics & Key Performance Indicators (KPIs)

TPM success is measured using the **Overall Equipment Effectiveness (OEE)** metric, which includes:

- **Availability (%)** = (Operating Time / Planned Production Time) × 100
- **Performance (%)** = (Actual Output / Theoretical Maximum Output) × 100
- **Quality (%)** = (Good Parts / Total Parts Produced) × 100

OEE = **Availability × Performance × Quality**

Ideal **OEE benchmark**:

- **World-class OEE**: 85% and above
- **Typical industry average**: 60-70%

4. Improvement Needs for TPM Implementation

🔹 Cultural Change and Employee Involvement

- Shift from reactive to **proactive maintenance mindset**.
- Encourage operator ownership of equipment.
- Conduct **TPM awareness training and engagement activities**.

🔹 Data-Driven Decision Making

- Use **IoT sensors, predictive analytics, and AI** for real-time monitoring.
- Implement **CMMS (Computerized Maintenance Management Systems)**.

◈ Standardized Maintenance Procedures

- Develop **checklists, SOPs, and best practices** for equipment care.
- Ensure consistent **training and documentation**.

◈ Cross-Functional Collaboration

- Involve maintenance, production, and quality teams.
- Establish **regular TPM review meetings**.

◈ Continuous Improvement Culture

- Encourage employees to **identify small inefficiencies** and improve them.
- Reward and recognize contributions to TPM success.

5. Industrial Case Studies on TPM Implementation

Case Study 1: Toyota Production System (TPS)

- Implemented **Autonomous Maintenance** at all levels.
- Reduced **unplanned downtime by 60%**.
- Achieved a **20% increase in OEE**.

Case Study 2: Tata Steel

- Focused on **Zero Breakdown initiatives**.
- Used predictive maintenance via **IoT-based monitoring**.
- Improved **equipment uptime by 25%**.

Case Study 3: Honda Motors

- Applied TPM in engine assembly plants.
- Reduced defect rates by **30%**.
- Increased machine lifespan through **preventive maintenance schedules**.

6. Challenges in Implementing TPM

⃠ **Resistance to Change** – Employees may resist added maintenance responsibilities. ⃠ **Initial Cost & Time** – Requires investment in training and infrastructure. ⃠ **Integration with Digital Technologies** – Aligning TPM with **Industry 4.0** technologies can be challenging.

7. Conclusion

◈ **TPM is a powerful tool** for improving **productivity, reliability, and quality**. ◈ Proper **implementation and employee involvement** are key to success. ◈

Industries adopting **predictive maintenance and digital TPM** will stay ahead in manufacturing excellence.