OVERALL EQUIPMENT EFFICIENCY
IMPROVEMENT OF TURRET PUNCHING PRESS

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Abstract

In the current business scenario with emerging global competition and rising customer expectation, providing low cost and high quality products is a winning mantra. These high expectations can be met through low cost automation and by keeping low operational cost. Minimising the operation cost can be achieved by improving operational indicators like delivery, quality, performance of machine etc. Overall Equipment Effectiveness (OEE) under its umbrella deals with all the operational indicators at micro level which are required for achieving low cost operation. The focus of this study is on improving OEE of Turret punching press which is also the bottleneck machine with the help of techniques such as SMED, 5S, TPM, SOP etc. The project aims to minimize levels of six big losses (breakdown, setup and adjustment, small stops, reduced speeds, startup rejects, production rejects) thereby improving the efficiency of the machine.

Data collection format for measurement of machine utilization was finalized and then data was collected for one week for calculation of initial OEE. The initial OEE for the machine was found to be only 27.3%. Cross-functional team was formed to analyze the factors responsible for low OEE. Levels of six big losses were analyzed and systematic approach was formed to increase the efficiency.

Major losses which are responsible for low OEE (setup and adjustments, reduced speeds) were improved with the help of techniques like SMED, 5S, Kaizen, SOP. The techniques have helped in improving OEE from 27.3% to 50.5%. Improved OEE helped in generating extra capacity and hitting the bottom-line of the company with extra income from the existing machine. Though OEE was improved almost 2 times, few more outcome of the study were also shared with management which need investment and having long lead time. Upon implementation this, the OEE will improve further.

Key Words: Overall Equipment Effectiveness, Losses, Maintenance, Efficiency

Abbreviations
OEE Overall equipment Efficiency
SMED Single Minute Exchange of Die
SOP Standard Operating Procedure
TPM Total Productive Maintenance
TPP Turret Punching Press

1. INTRODUCTION

In the current business scenario with emerging global markets and strong competition, providing low cost and high quality products to customer through low cost automation and low operational cost is a winning mantra. The focus of top management is also on implementation of basic management principles which helps the company to grow.

1.1 Overall Equipment Efficiency

It is an approach to monitor and improve the effectiveness of any manufacturing process. It is a simple and practical approach and it takes the common productivity loss and group into three primary categories. It is a metric which focuses on how effectively the plant is working [1]. It can be calculated as,

\[ \text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality} \]

Where,

\[ \text{Availability} = \frac{\text{Operating Time}}{\text{Planned Production Time}} \]

\[ \text{Performance} = \frac{\text{Ideal Cycle Time}}{(\text{Operating Time} / \text{Total Pieces})} \]

\[ \text{and Quality} = \frac{\text{Good Pieces}}{\text{Total Pieces}} \]

1.2 Company Introduction

Solidus Hi-tech Products Pvt. Ltd. Unit -5 is a part of Metagraph group of companies established in 1948 in Pune. Group turnover is approx $20 Million having manufacturing units in Pune and Bangalore. Unit-5 is spread in 650.3 m², which involves in CNC turret Punching, Bending and Powder Coated Parts. Total number of employees is 186. Major customers are: APC by Schneider Electric, Schneider Electric, ABB, John Deere, JCB, Tyco Electronics, Tejas Networks, Mrotek, Phoenix Mecano

1.3 Parma 1225 TPP machine

Parma1225 is equipped with advance control with rugged frame and hydraulic ram. Features of the machine are: It is a 200 kN punch presses, maximum sheet thickness it can handle is 6.35 mm, it can accommodate work piece size up to 1250 x 2500 mm, it is a 21- station turret press with 8 A size, 8 B size, 3 C size and 2 D size stations, maximum diameter of punch it can be accommodate is Ø80 mm and it achieves accuracy of ± 0.10 mm with a repeatability of ± 0.05 mm over the entire table

1.4 Literature Review

Overall equipment effectiveness (OEE) is a mindset and it should be started throughout the company and with top down approach. Robert Hansen
[2] gave a concept that it should first be applied on bottlenecks which affects the throughput of the system and on other critical machines and expectations should be set and communicated down the line to all the employees. It is a multiple factor of availability, speed and quality and the result gives the actual effectiveness of factory floor output. The productivity development team [3] mentions that it is also an indicator of equipment’s health.

Hansen [2], makes a point that OEE can be calculated accurately with very ease, and the calculation gives the information of the areas of concern or areas for improvement. Japan Institute of Plant Maintenance [4], touch upon that for improving OEE, company has to look upon the six big losses: breakdowns, setup and adjustments, small stops, reduced speeds, start-up rejects and production rejects.

The important factor for any successful OEE implementation starts from management’s mindset towards improvement [5]. The main challenge in starting an OEE implementation is that OEE tools and processes should possess different roles and disciplines in the company [6]. OEE programs must be on daily use for production line operator and should be followed up by manufacturing professionals and management, support maintenance technicians and design engineers, and fulfill many other functions throughout the plant.

Dr. Shigeo Shingo [7] has given a concept of single-minute exchange of dies (SMED) which focuses on bringing the changeover within ten minutes. This methodology worked for even huge machines. Kenichi Sekine and Keisuke Arai [8] in their book carried this improvement to next level and given concept that changeover shouldn’t be measured in minutes but in seconds. They termed their approach as zero changeovers. This approach focuses on bringing changeover to less than three minutes. All improvements related to quick changeover are based on the principle that any set-up is a waste and there is always a scope or improvement.

Fletcher Birmingham and Jim Jelinek [9] have given a concept that setup reduction involves basically three components and these are the cornerstones of setup reduction and the changeover race is won or lost in the pits.

The productivity development team [3] has given a concept that total productive maintenance (TPM) is a approach used by operators to prevent problems related to equipment with the help of knowledge and familiarity and Japan Institute of Plant Maintenance [4] have touched upon a concept that if a company has to perform better, than their aim should be to move company from traditional preventive maintenance to productive maintenance and then finally to Total productive maintenance.

Many people are thinking that maintenance problem is solved if they will purchase new equipments but unfortunately this is not the correct answer. In absence of regular and preventive maintenance new equipment will also breakdown. In today’s competitive world companies can’t afford to wait for breakdown, infact breakdown calls should be like surprise for a maintenance person [10]. Maintenance person has to come out of his/ her mental block regarding the philosophy “fix it when it breaks”. New measure of maintenance operation should be related to uptime not in the number of breakdowns repaired.

2. PROBLEM DEFINITION
To improve Overall equipment effectiveness (OEE) of turret punching press (TPP) by 15% through reduction of the six big losses

2.1 METHODS AND METHODOLOGY
- Level of six big losses were reviewed and analyzed by help of machine utilization chart, quality check sheet and Machine maintenance history
- Operating time of the machine was improved by: reduction of setup through implementation of quick changeover technique (SMED)
- Scheduling of planned maintenance through implementation of total preventive maintenance techniques
- Quick changeover technique was implemented
- Total Preventive Maintenance was implemented
- Performance of the machine was increased by: understanding and developing the standard operating procedure, training of operator on best operating practices of the machine and training of operator on seven types of waste and how to identify them
- Quality of the components was improved
- The process was reviewed
- Standard operating procedures were documented, controlled and efficiency was measured

3. DATA ANALYSIS
Data was collected using machine utilization chart for a period of 1st October to 7th October for calculation of initial OEE. The initial OEE for the machine was found to be only 27.3%. The levels of six big losses were determined.

![Fig. 1 Levels of big losses](image)

Fig. 1 Levels of big losses

Contribution of big losses was analyzed based on machine utilization and systematic approach was formed to increase the efficiency. More than 80% was contributed by
- Low speed
- High set-up time

4. SOLUTION PROCEDURE

4.1 Reason for Low Speed
Reason for low speed was as follows: Standard operating procedure for the machine was not available, no structured training was given to operator for operating parameters, improper clearance between
punch and die resulting increased pressure on the machine and operators were reducing the speed based on the sheet thickness:

- For sheet thickness between 1.0 to 1.5, speed was being kept 75%.
- For sheet thickness between 1.5 to 2.5, speed was being kept 50%.
- For sheet thickness above 2.5, speed was being kept 25%.

4.2 Improvements for Low Speed

Following activities were carried out to improve speed and performance:

- Training for best practices for operating TPP
- Developing of standard operating procedure
- Training for basic punch and die geometry, clearance and TPP master tool list

4.3 Reason for High Set-up Time

The initial changeover process was as follows:

- searching for appropriate punch and Die, setting of Punch and Die accordingly, searching for material in stores, loading of sheet on the machine, applying of kerosene incase of copper sheet and applying cello-tape in case of coated sheet and transfer of programming on the machine

The changeover time varies from 40 min to 90 min.

4.4 Improvements for High Set-up Time

Setup time was reduced by quick changeover technique known as SMED and implementation of 5S principles.

- Activities were categorized as internal and external activities
  - Internal activities : Setting of Punch and Die accordingly, loading of sheet on the machine, setting of the program
  - External activities : Searching for appropriate punch and Die, searching for material in stores, applying of kerosene in case of copper sheet and applying cello-tape in case of coated sheet

- Internal activities were converted to external activities
- Streamlining of internal and external activities by: Implementation of 5S, providing punch and die storage rack, and labelling for easy retrieval, keeping raw material close to machine
- Manufacturing of shadow board
- Developing of standard operating procedure for changeover

4.5 Standardization

Once the improvements were implemented, next and most important step was to standardize and sustain. To ensure other parameter does not nullify, the following activities were carried out:

- Some lubrication schedules were added to the existing process of daily, weekly and monthly preventive maintenance, for smooth operation and to avoid breakdowns
- My machine campaign was organized to increase the awareness towards importance of preventive maintenance
- Zonal leader and Deputy zonal leader were made to involve everybody in the shop floor for maintaining quality
- Suggestion scheme and Kaizen process was initiated, employees were recognized for this and then this activity was started companywide

5. RESULTS AND DISCUSSION

Techniques like quick changeover (SMED), 5S, developing of SOP for changeover, making of shadow board and providing punch and die storage rack helped in reducing set-up time.

Developing of SOP for TPP operating, TPP master tool list and providing training on best practices on machine operating and basic punch, die geometry helped in increasing the machine speed.

Kaizen and suggestion scheme has motivated employees. Data was collected for a period of 4th January to 5th February with the help of machine utilization chart and together all these techniques has facilitated in improving OEE from 27.3 % to 50.5 %.

Though OEE was improved almost 2 times, few more outcome of the study was also shared with the management which needs investment and with mid term goal. Upon implementation, this will also improve OEE.

Fig. 2 Initial and final loss percentage

Fig. 3 Initial and final OEE

Tangible Benefits

- OEE was improved by 23 %
• Cost Savings through Kaizen for TPP is Rs 48,910/- per month
• Changeover time improvement:
  10 min~30 min from 40 min~90 min
• Speed improvement:
  Speed is increased from 75 % to 90 % for thickness up to 2 mm and 50 % to 60 % for thickness above 2 mm

Intangible Benefits
• Improved House Keeping level
• Reduction in tool search time
• High employee morale
• Improved motivation level and Team Work

6. CONCLUSION
OEE was improved by reducing six big losses through implementation of techniques like,
• SOP – Standardizing the process and following the standard process has helped in increasing performance of the machine
• Training – On the job training and sharing the best way to do the job has helped in increased performance of the machine
• SS – Implementation of 5S technique has improved availability of the machine
• Quick changeover – This has helped in reducing the changeover time and increased availability of machine
• Kaizen – This has helped in enhancing synergy in shop floor people to give improvement ideas and increasing OEE
• Recognition – This tools has helped in continual motivation of employees and keeping them attach to the work
• My Machine My area – It has provided sense of ownership for workforce

7. REFERENCES