International Journal of Engineering Research & Management Technology ISSN: 2348-4039
July-2016 Volume 3, Issue-4
Email:editor@ijermt.org www.ijermt.org

ANALYSIS OF TPM IMPLIMENTATION IN AUTO SECTOR -A CASE STUDY

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ABSTRACT: TPM is an aggressive strategy focuses on actually improving the function and design of the production equipment. TPM aims to increase the availability/effectiveness of existing equipment in a given situation, through the effort of minimizing input (improving and maintaining equipment at optimal level to reduce its life cycle cost) and the investment in human resources, which results in better hardware utilization

TPM brings maintenance as a necessary and vitally important part of the business. The TPM initiative is targeted as to enhance competitiveness of organizations and it encompasses a powerful structured approach to change the mind-set of employees thereby making a visible change in the work culture of an organization.

1. INTRODUCTION

In today's global economy, the survival of companies depends on their ability to rapidly innovate and improve. As a result, an increasing search is on for methods and processes that drive improvements in quality, costs and productivity. In today's fast changing marketplace, slow, steady improvements in manufacturing operations will not guarantee profitability or survival. Companies must improve at a faster rate than their competition if they are to become or remain leaders in their industry.

TPM is a plant improvement methodology which enables continuous and rapid improvement of the manufacturing process through the use of employee involvement, employee empowerment and closed looped measurements of results**.** Total Productive Maintenance (TPM) is a well-defined and time-tested concept for maintaining plants and equipment. TPM can be considered the science of machinery health.

2. LITERATURE REVIEW

TPM is designed to maximize the overall equipment effectiveness. It involves all departments that plan, use and maintain equipment, involves all employees from top management to front line workers. The concept of TPM was developed in Denso, A tier one automotive supplier in the Toyota group of suppliers, during 1960s and 70s in Japan. The central thrust of the program was the complete elimination of the "six major equipment losses". (McKone et al. (1999)[1] propose a theoretical framework by testing how the contextual issues affect firm's maintenance systems when implementing TPM.. Hyland et al (2004)[2] highlighted prospective benefits of Kaizen, as organizational performance improvement in the form of reduction in waste, breakdowns, lead time, setup time. Chaser (1998)[3] who believed that Kaizen is based on small incremental changes in routine functioning of the organization, which further reduces waste and improve productivity and quality of the product. Suzaki (1987)[4] considers kaizen as a philosophy which is widely practiced in manufacturing process and quality circles. Kaizen is based on the concept that there is always room for improvement of the process. The key concept behind effective improvements was autonomous maintenance (Robinson, Charles J 1995).[5] The concept of overall equipment effectiveness (OEE) and focused improvement were found to be quite encouraging for success of TPM. The aim of the TPM is to improve the labour productivity and to reduce the maintenance cost (Suzuki, Tokutaro 1994).[6] It aims to bring equipment to peak operating condition by eliminating the losses that hamper plant effectiveness. That is to achieve zero breakdowns, zero defects and zero accidents (Ljungberg, O. 1998).[7] TPM helps organize maintenance activities by applying the following actions:-

Cultivate a sense of ownership in the operator by introducing autonomous maintenance – the operator takes responsibility for the primary care of his/her plant.

3. IMPLEMENTATION METHODOLOGY

TPM refers to a Management system for optimizing the productivity of manufacturing equipment through systematic equipment maintenance involving employees at all levels. Under TPM, all employees are involved in keeping the equipment in good working order to minimize Production losses from equipment repairs, assists, set-ups.

3.1. 5S – The Foundation Of TPM

TPM starts with 5S. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. 5S is a foundation program before the implementation of TPM. If this 5S is not taken up seriously, then it leads to 5D (delays, defects, dissatisfied customers, declining profits, and demoralized employees).

Table No. 1.1 5-S

Japanese Term	English Translation	Equivalent 'S' term
Seiri	Organization	Sort
Seiton	Tidiness	Organize
Seisio	Cleaning	Sweep
Sieketsu	Standardization	Standardize
Shitsuke	Discipline	Self-Discipline

3.2.Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a way to monitor and improve the efficiency of your manufacturing process.

OEE is broken down into three measuring metrics of **Availability**, **Performance**, and **Quality**. These metrics help gauge your plant's efficiency and effectiveness and categorize these key productivity losses that occur within the manufacturing process.

OEE = Availability x Performance x Quality

Thus OEE is = A x PE x Q x 100%

3.3. TPM House Pillars

TPM now comprises of eight different sections which have come to be known as pillars. Each pillar has its own areas of responsibility, but they also have areas where they overlap. TPM starts with 5S. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. If this 5S is not taken up seriously, then it leads to 5D. They are Delays, Defects, Dissatisfied customers, declining profits and Demoralized employees. These eight pillars complete a TPM house to achieve zero targets and these pillars are:

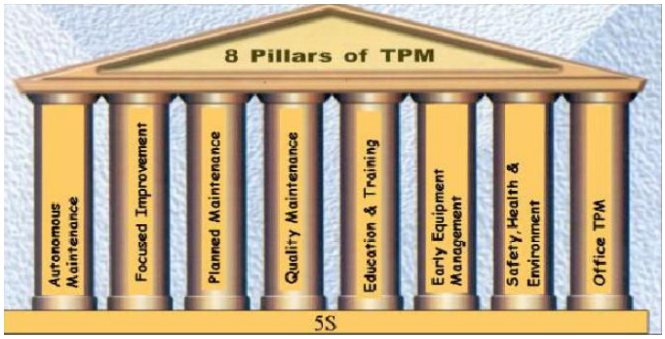

Fig. 3.1 TPM Pillars

3.3.1 Jishu Hozen (Autonomous Maintenance) Pillar

Jishu Hozen (Autonomous maintenance):- 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.

Policy:

- Uninterrupted operation of equipment's.
- Flexible operators to operate and maintain other equipments.
- Eliminating the defects at source through active employee participation.

Targets:

- Reduce oil consumption
- Reduce process time
- Prevent occurrence

Jishu Hozen steps

- Preparation of employees
- Initial cleanup of machines.
- Take counter measures
- Fix tentative JH standards
- General inspection
- Autonomous inspection
- Standardization

3.3.2 Kobetsu Kaizen (Focused Improvement)

"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. 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.

Policy:

- Practice concepts of zero losses in every sphere of activity.
- Relentless pursuit to achieve cost reduction targets in all resources
- Relentless pursuit to improve over all plant equipment effectiveness.

Targets:

- Overall equipment effectiveness is greater than 85%
- Achieve and sustain zero losses with respect to minor stops
- Manufacturing cost reduction by 30%
- Reduce defects and unavoidable downtime
- Product changeover time less than 10 minutes

Tool Used:

- PDCA
- Loss Tree
- Pareto Analysis
- WHY-WHY Analysis
- PM Analysis

3.3.3 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, viz., preventive maintenance, breakdown maintenance, corrective maintenance, and maintenance prevention. PM targets

are zero equipment failure and break down, improve reliability and maintainability by 50 percent, reduce maintenance cost by 20 percent, and ensure availability of spares all the time. PM is of following types:

- Preventive Maintenance
- Breakdown Maintenance
- Corrective Maintenance
- Maintenance Prevention

3.3.4 Hinshitsu Hozen (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, like focused improvement. QM targets are achieve and sustain customer complaints at zero, reduce in-process defects by 50 percent, and reduce cost of quality by 50 percent.

Policy:

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

Target:

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

Tool Used

- QM Matrix
- 7QC Tools
- Visual Control System
- PM Analysis

Steps Used in Quality Maintenance Pillar

- Confirm the present status
- Survey process which generates defects
- Survey and analyze 3M condition
- Study fuguai countermeasure
- Analyze conditions for non-defective products that are not confirmed
- Improve 3M condition
- Set 3M condition
- Improve checking method intensification

3.3.5 Early Management:-

Early Management is the fifth pillar of TPM and aims to implement new products and processes with vertical ramp up and minimized development lead time. It is usually deployed after the first four pillars as it builds on the learning captured from other pillar teams, incorporating improvements into the next generation of product and equipment design. Early Management is also called initial flow control pillar.

Policy:

- Lead time reduction in new product development
- Handle more new products with existing resources
- Achieving vertical start-up of new equipment
- Reduction in capital investment cost

Targets:

- Capital investment cost saving by 10% of the investment
- Manufacturing lead time reduction by 50%
- New product development time within 85% of customer delivery schedule

Tool Used:

- Maintenance prevention design
- Maintenance prevention checklist
- Life cycle costing
- Concurrent Engineering

Steps used in Early Management Pillar:

- Survey and analysis of present status
- Establish Initial control system
- Debugging and training of new system.
- Full utilization and fixation of new system

3.3.6 Education and Training Pillar:-

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" they should also learn "Know-Why". Training target are achieve and sustain downtime due to want men at zero on critical machines, achieve and sustain zero losses due to lack of knowledge/skills/techniques, and aim for 100percent participation in suggestion scheme.

Policy:

- Focus on improvement of knowledge, skills and techniques.
- Creating a training environment for self-learning based on felt needs.
- Training curriculum / tools /assessment etc. conductive to employee revitalization
- Training to remove employee fatigue and make, work enjoyable.

Target:

- Achieve and sustain downtime due to want men at zero on critical machines.
- Aim for 100 % participation in suggestion scheme.

Tool Used:

- Training program
- One point lessons
- On job training
- Certified external training courses

Steps in Educating and training activities:

- Setting policies and priorities and checking present status of education and training.
- Training the employees for upgrading the operation and maintenance skills.
- Preparation of training calendar.
- Kick-off of the system for training.
- Evaluation of activities and study of future approach.

3.3.7 Office TPM:-

Office TPM should be started after activating four other pillars of TPM (AM, Kaizen, PM, and QM). 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 and its benefits are involvement of all people in support functions for focusing on better plant performance, better utilized work area, reduce repetitive work, reduced administrative costs, reduced inventory carrying cost etc. Office TPM

addresses twelve major losses. They are

- Processing loss
- Cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories
- Communication loss
- Idle loss
- Set-up loss
- Accuracy loss
- Office equipment breakdown
- Communication channel breakdown, telephone and fax lines
- Time spent on retrieval of information
- Non availability of correct on line stock status

Policy:

- Just in time supplies to operation and maintenance
- Increase own productivity and lower cost
- Improving work efficiency
- Office automation

Targets:

- Management losses due to material, tools etc are zero
- Online raw material rejection are zero
- Consumable cost reduction by 30%
- Kaizen per employee per month is zero

3.3.8 Safety, Health and Environment Pillar:-

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. Safety, health and environment target are zero accident, zero health damage, and zero fires

Policy:

- Creating safe and Hygienic work place
- Eliminating unsafe practices and condition.
- Creating pollution free pleasant work environment

Targets:

- Zero accident
- Zero health damage
- Zero fire
- Zero noise zones

Tool Used:

- Safety patrols
- Yellow safety tags
- ISO 14001
- Green Environment

4. RESULTS AND CONCLUTIONS

After kick off the TPM company has gained the extraordinary results in terms of Productivity, Quality, Cost, Delivery, Safety, and Morale. The company has also achieved tangible intangible benefits after kick-off the TPM.

4.1 Results Obtained For Setup Loss

Figure 4.1(a) highlights the total reduction in setup loss after kaizen implementation. The setup loss was maximum in LMS department which was covering 81% of the setup loss. In LMS the subgroup cylindrical grinding in grinding section department covering 52% of the setup time. In year 2009 the

setup loss was 12177 min/setup and the target was to achieve 3875min/set up to year2013. So after the implementation of kaizen idea the actual setup loss was 9800 mins/setup up to year 2010 and it was reduced to 3900 min/setup up to year 2013 i.e. up to 68% overall reduction in all four jost.

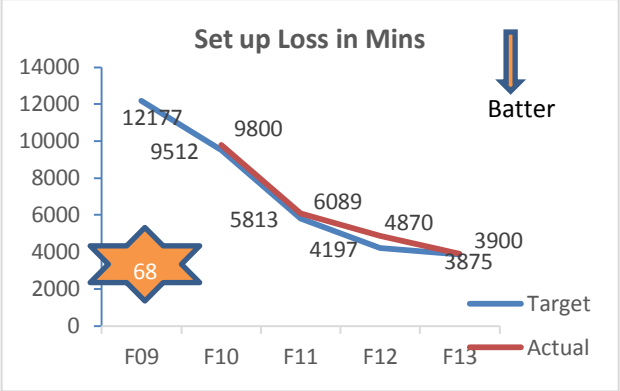

Fig.4.1 (a) Reduction in Setup Loss

Figure.4.1 (b) highlights the total reduction in set up time after the implementation of kaizen idea. The setup time on cylindrical grinding machine was 91min/setup before implementation of kaizen idea. Now it is reduced up to 70% by implementing the kaizen idea i.e. to design the component specific tail stock center.

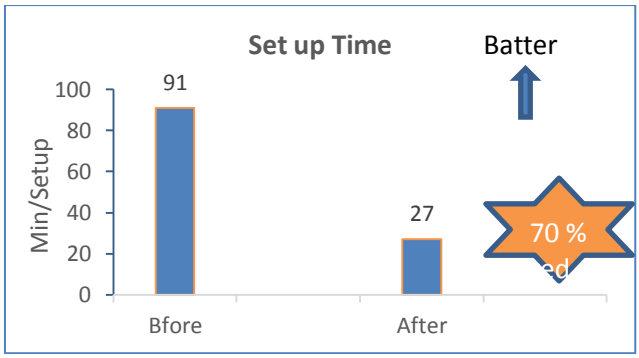

Fig.4.1 (b) Reduction in Set-up Time

The fig.4.1 (c) highlights the increase in production capacity by reducing the setup loss after the implementation of kaizen idea. Before implementation the production capacity was 40 Units/hr and after implementation it is increased up to 46 Units/hr i.e. increased up to 15%.With the increase in production capacity hence increase the production.

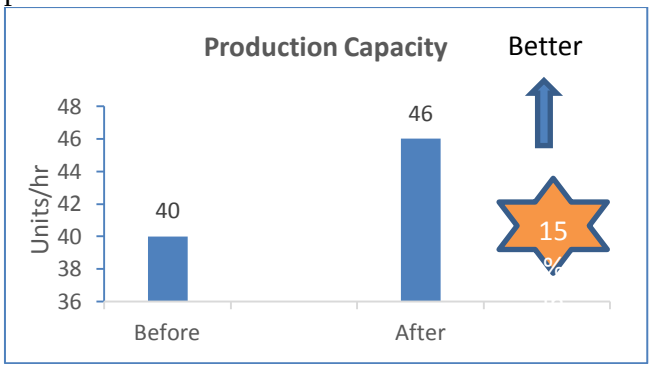

Fig.4.1 (c) Increase in Production Capacity

Figure 4.1(d) highlights the decrease in average time /setup by reducing the setup loss after implementation of kaizen idea. The average time/ setup in 2009 were 4.66 hr/setup and after implementation of kaizen it was 2.31 hr/setup i.e. decreased almost up to 50%.

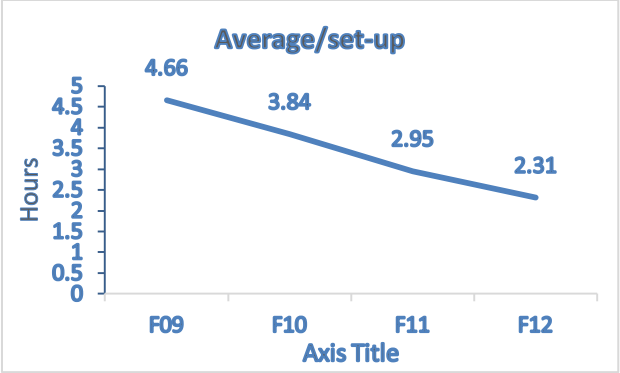

Fig.4.1(d) Decrease in avg. time set-up

4.2 Results Obtained For Tool Change Loss

Figure 4.2(a) highlights the total reduction in tool change loss after the implementation of kaizen idea. Tool change loss was maximum in HMS department i.e. 57%. In HMS the vertical centre machine in differential housing department covering 20% of tool change loss. In the year 2009 the tool change loss was 1365 min. and the target was to achieve 486 min. up to year 2013.So after the implementation of kaizen idea the actual tool change loss was 1092 min. up to year 2010 and it was reduced up to 490 min. to year 2013 i.e. 64%.

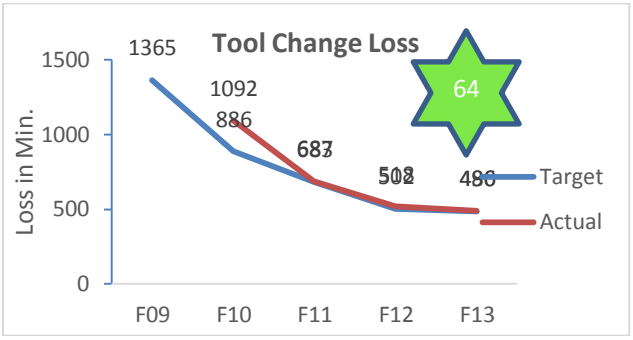

Fig.4.2 (a) Decrease in Tool change Loss

Figure 4.2(b) highlights the tool change time reduction after the implementation of kaizen idea. The tool change loss was maximum on vertical centre machine in differential housing section i.e. 42 min/setup before implementation of kaizen idea. Now the tool change time reduced up to 18 min/set after the implementation of kaizen idea i.e. 57%

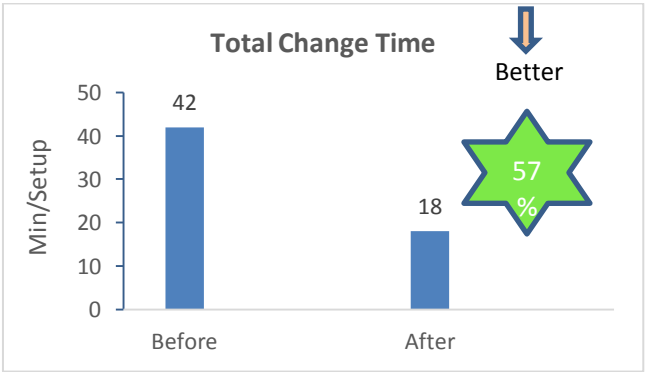

Fig.4.2 (b) Decrease in Tool change Time after TPM

Figure 4.2(c) highlights the increase in production capacity by reducing the tool change loss after the implementation of kaizen idea. Before implementation the production capacity was 60 units/hr and after implementation of kaizen idea the production was 65 units/hr i.e. increase up to 8% of the production capacity and hence increase the production.

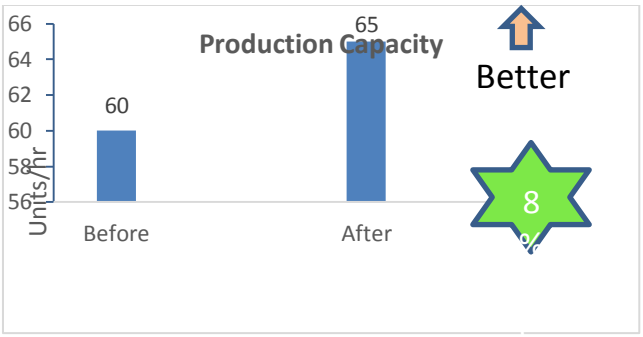

Fig.4.2 (c) Improvement in Production capacity

Figure 4.2(d) highlights the tool change loss and number of kaizen performed for the year of 2009-13. The tool change loss was 1365min in the year of 2009 and it was reduced to 486 min to the year of 2013 i.e.64% reduction. The number of kaizen performed in 2009 was 6 and it increased up to 26 to the year of 2013 i.e.76% increase.

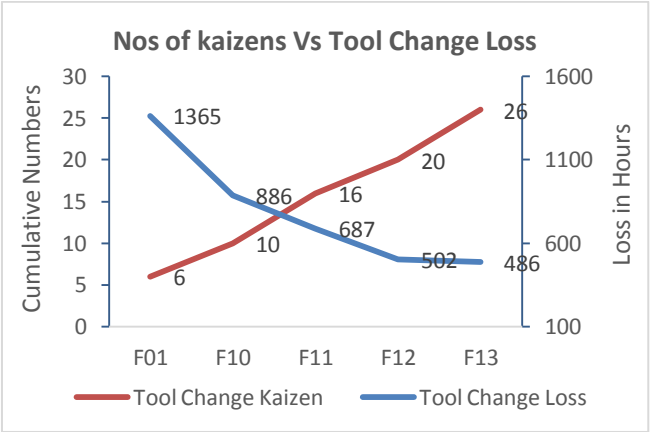

Fig.5.2 (d) Reduction in Tool change loss & Increase no. of kaizen

4.3 Result Obtained For Energy Loss

Figure 4.3(a) highlights the total energy reduction after the implementation of kaizen idea. Energy loss was maximum in paint shop which was covering 32% of energy. In 2008 energy consumption was 471 units and the target was to achieve 390 units up to 2013. So after the implementation of kaizen idea actual energy consumption was 425 units up to year 2009 and it is further reduced up to390 units to year 2013 i.e. 17% reduction.

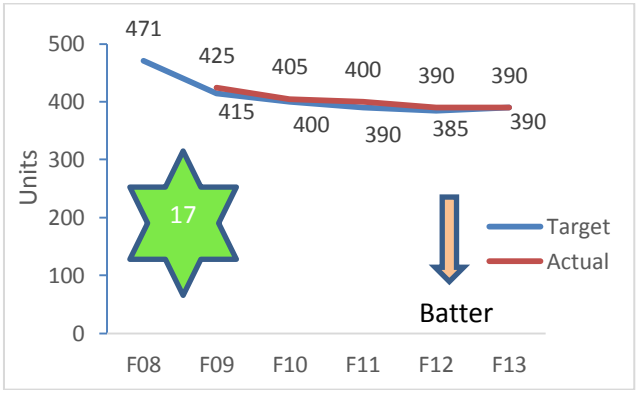

Fig. 4.3(a) Reduction in Energy Losses

Figure 4.3(b) highlights the reduction in electricity consumption after the implementation of kaizen idea. Before implementation electricity consumption was 46 units and it is reduced to 40.8 units after the implementation of kaizen idea i.e. 11% reduction.

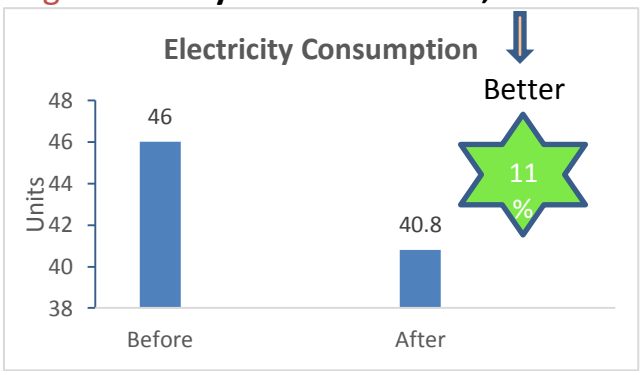

Fig. 4.3(b) Reduction in Electricity consumption

Figure 4.3(c) highlights the energy consumption and energy saving kaizen performed for the year of 2008-13. The energy consumption /tractor in 2008 were 471units and is reduced to 390 units to the year 2013. The number of energy saving kaizen performed in 2008 was 4 and it further increase up to 45 to the year 2013

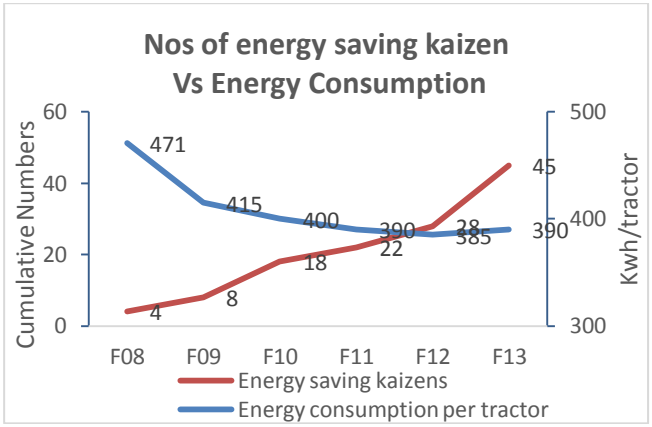

Fig. 5.3(c) Energy consumption & Energy saving kaizen's

4.4 Results for Obtained OEE

Figure 4.4(a) highlights the increase in overall equipment effectiveness after the implementation of kaizen idea. In 2010 the OEE was 63% and the target was to achieve 84% up to year 2013. So after the implementation of kaizen idea the OEE was 70% up to 2011 and increased to 84% up to 2013 i.e. 25% increase.

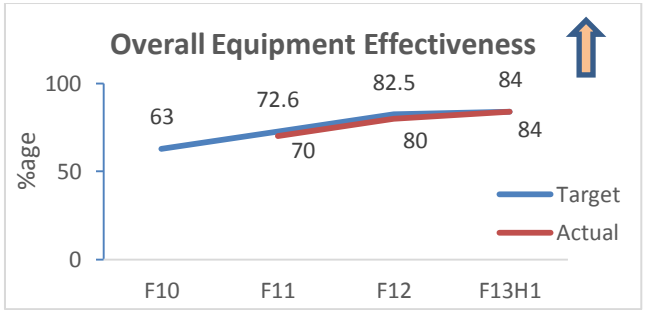

Fig. 5.4(a) Increase in Overall Equipment Effectiveness

4.5 CONCLUSIONS

The implementation of focused improvement pillar remained very successful and the overall result achieved after focused improvement pillar in terms of P, Q, C, D, S, M are conclude as:

Productivity

1) OEE Greater than 85%

Quality

1) Quality improves by achieving zero losses and defects.
2) Reduce Rework

Cost

1) Manufacturing cost reduction.

Delivery

1) Faster delivery of the components by reducing the lead time
2) Reduction of product changeover time by 10 mins

Safety

1) Achieve up to 95%

Morale

1) Kaizen/ team/ year increase by 8 times.

1) 5.6.1 P, Q, C, D, S, M for TPM

2) The results of TPM achievement obtained after Implementation of KK pillar named as

3) Productivity:-

4) 1) Increase in Tractors /man/month by 1.7 times
5) 2) Breakdown incidences/month reduced by 89%

6) Quality:-

7) 1) Field Quality improved by 27%
8) 2) Machine shop scrap and rework reduced by 83%

Cost:-

1) Manufacturing cost reduced by28%
2) Tool cost reduced by 31%

Delivery:-

1) 100% schedule adherence
2) Equipment development lead time reduced by51%

Safety:-

1) Zero Accidents
2) First Aid incidents improved by95%

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