Application of Lean Concepts in Molding Department

Premananda R1, Dr. M Shilpa2

1 MTech Student, Ramaiah Institute of Technology, Bengaluru, Karnataka, India
2 Assistant Professor Professor, Ramaiah Institute of Technology, Bengaluru, Karnataka, India

Abstract - The Kaizen and 5S management originated in the best Japanese management practices and is dedicated to the improvement of productivity, efficiency, quality and, in general, of business excellence. The KAIZEN methods are internationally acknowledged as methods of continuous improvement, through small steps, of the economical results of companies. The small improvements applied to key processes will generate the major multiplication of the company’s profit, while constituting a secure way to obtain the clients’ loyalty/fidelity. The KAIZEN management represents a solid, strategic instrument, with a view to reach and surpass the company's objectives. The “5S” technique represents a fundamental technique which allows the enhancement of efficiency and productivity, while ensuring a pleasant organizational climate. The scientific paper presents in a concrete way a study regarding the application of these concepts in a real organization.

Key Words: 5S, Continuous Improvement, Kaizen, Moulding Division

1. INTRODUCTION

1.1 Kaizen

Kaizen is a japans word means “continuous improvement”. In business, kaizen refers to activities that continuously improve all functions and involves all employee from CEO to assembly line worker. Kaizen as some guiding principles:

- Good processes bring good results
- Go see for yourself to grasp the current situation
- Speak with data, manage by facts
- Take action to contain and correct root causes of problems
- Work as a team
- Kaizen is everyday’s business

1.2 5S

Seiri (Sort): The first step is doing Seiri, i.e.; separating the necessary items. This helps in removing clutter, reducing inventory, piling up of stuff. The unnecessary items must be disposed off.

Seiton (Set in order): Seiton means putting things in order, maintaining them so that they are fit for use when required. Good Seiton implies each item and work area has identification, tag or label, and address to enable anyone to quickly search and retrieve the item, and put it back in the same place after use.

Seiso (Shine): Seiso is cleaning. Seiso is to be done to make the equipment, structure, piping, floor, walls; roof, fixtures, lighting, stairs, etc look new like they were when purchased originally. Seiso does not mean simply painting the equipment without doing the cleaning and repairs. Seiso is to keep the work place spotlessly clean, shining equipments, clean containers, clean garbage bins and clean uniform of employees.

Seiketsu (Standardize): 5S Seiketsu or standardize is the process of ensuring that what we have done within the first three stages of 5S become standardized; that is we ensure that we have common standards and ways of working. Standard work is one of the most important principles of Lean manufacturing.

Shitsuke (Sustain): Shitsuke means discipline, without shitsuke, 5S is not possible. This means commitment to time, to promises, to systems, to standard operating process. It means sticking to the rules of the company.

2. PROBLEM STATEMENT

The lean implementation is the key to success of improving quality, being competitive in the market place, reducing wastes, reducing costs and etc. So the concepts that come in lean implementation are Kaizen and 5S. Kaizen 5S is methodology will enable company to continuously improve process and 5S will help to sustain the improvements. In the present study of the industry show the criticality of improving the process and improving production environment. So the industry industrial productivity and competitiveness will enhance.

Problems faced in Manufacturing Facilities, Which will be considered for improvement:

- Materials or stock piled up on floor resulting in congested movement of materials as well as workers.
• Searching of items or materials taking more than 30 seconds.
• Work tables or other equipments not cleaned daily resulting in a shabby look as well as small accidents taking place.
• Waste motions of workers and material.
• Limited flexibility of robots used for automation.
• Fanuc robot or Epson robot stops without any alarm.
• Epson robot does not pick up all the parts and the Fanuc robot puts the next parts on top of the left-over parts.
• Fanuc robot does not pick up the parts from some cavities and the Machine stops.
• Out of cycle work: Feeding regrind to granulator, Feeding mix to the hopper, Writing shift-end reports, Green weight checking and entry, Bringing SS trays to the Machine, Reporting problems to the supervisor; Mould cleaning
• Operator movement high as the loading / unloading trays for the Machines is far apart.
• Tray feeding / removing point from the conveyor is high (difficult for shorter operators).
• Possible injury to operators when trying to remove stuck trays.

3. OBJECTIVES

The lean concepts implemented should sustain for a long time to achieve some benefits from it. Benefits may be like improving the quality of the product, improving customer service and satisfaction, reducing the rejections or wastes.

Primary Objectives

• Improve ergonomics, safety and reduce operator movement
• Find causes of robot stoppages and implement countermeasures
• Convert out-of-cycle work to in-cycle work
• Ensure all 4 Machines are able to run continuously without any operator attention for at least 30 minutes.

Production Requirements

• The 4 Machines should run without stop 24 x 7
• Only 1 operator

4. METHODOLOGY

Plan-Do-Check-Act Approach to 5S

Methodology of Kazien

5. Data Collection and Analysis

Moulding department is considered for the study and for implementation of contentious improvement, as the departments have loading issues which is causing damage to the work piece. As the department is considered for improvement the process was studied for a period of 1 month. The data collected as shown below Table 6.1
Table 5.1 Data Collected over a period of one month

<table>
<thead>
<tr>
<th>Date 18.2.2017</th>
<th>Machine:DM-46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mould hours time in minutes</td>
<td>Idle time in minutes</td>
</tr>
<tr>
<td>Shift-1</td>
<td>Moulded hour-0</td>
</tr>
<tr>
<td>Shift-2</td>
<td>Moulded hour-480 minutes</td>
</tr>
<tr>
<td>Shift-3</td>
<td>Moulded hour-480 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date 19.2.2017</th>
<th>Machine:DM-46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mould hours time in minutes</td>
<td>Idle time in minutes</td>
</tr>
<tr>
<td>Shift-1</td>
<td>Moulded hour-300 minutes</td>
</tr>
<tr>
<td>Shift-2</td>
<td>Moulded hour-420 minutes</td>
</tr>
<tr>
<td>Shift-3</td>
<td>Moulded hour-405minutes</td>
</tr>
</tbody>
</table>

Likewise the data is collected for each day.

In moulding department some of the Machines are manually staged and some are semi-automated. The parts staging is the biggest task. Even care has to be taken while staging the part to avoid damages to the parts. For staging of parts the required man-power is high. So the main aim of the automation department is to reduce the man power. To automate the process, using of robots is suitable option. The below picture shows the manual staging of the moulded parts in Fig 5.1.

![Fig 5.1 Manual Staging of Parts](image)

Table 6.4 Summarized data present state

<table>
<thead>
<tr>
<th>Impact Measures</th>
<th>Pre-Event</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-S Score</td>
<td>6 / 10</td>
<td>9 / 10</td>
</tr>
<tr>
<td>Safety Audit Score</td>
<td>335</td>
<td>100</td>
</tr>
<tr>
<td>Time lost due to want of mix</td>
<td>6.3%</td>
<td>0</td>
</tr>
<tr>
<td>Time lost due to robot problems</td>
<td>4.1%</td>
<td>1%</td>
</tr>
<tr>
<td>Operator work content to run 2 Machines for 150 min</td>
<td>92 min</td>
<td>36 min</td>
</tr>
</tbody>
</table>

5.1 Corrective measures

Results show that the time lost due to the robot is about 4.1% and the company aim was to eliminate manual handling. Epson 6 Axis robot is proposed as solution for eliminating the manual handling.
Specifications of Epson 6 Axis Robot

<table>
<thead>
<tr>
<th>Model specifications</th>
<th>C3-A60HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>27kg</td>
</tr>
<tr>
<td>Max payload</td>
<td>45kg</td>
</tr>
<tr>
<td>Reach max</td>
<td>700mm</td>
</tr>
<tr>
<td>Motor power</td>
<td>2.4:100w, 3:150w, 4.5:60w, 50w</td>
</tr>
<tr>
<td>Controller</td>
<td>RC 70+</td>
</tr>
</tbody>
</table>

Epson Robot was installed for eliminating the manual handling as shown before, Figure 6.3 shows the Epson Robot installed in line for picking and placing parts manufacture on the plates for storing.

Sweeping mechanism installed for eliminating the automation of conveyor system by eliminating the fall of green part from the try and collecting the green parts which are misplaced as shown in Fig 5.4

Spring plunger is added to the robot for eliminating the tray height variation as shown in fig 5.5.

5.2 5S Implementation

5S audit scores shows that the 5S level of implementation is 6 out of 10 by the shop floor workers and supervisors. As the objective of the management is to increase it to 9 out of 10. Methodology of implementations of 5S as follows:

5.2.1 Sort

Step 1

Primarily the current situation was assessed by auditing in knowing the status of the 5S. Proper sorting activities on time-time basis were not done and unwanted items were piled up and also mixed up with the wanted and necessary items. So the items were sorted out from unwanted materials as shown below in fig 5.7
5.2.2 Set in Order

After sorting out the necessary items with unnecessary items the necessary items were set in order according to the frequency of usage. The items which will be daily like tools and other assembly items were kept and named near the work area or the work table. The items which were used on a weekly basis and monthly basis were kept away from the work area so that space was very well utilized. The items were set in order and named as per the frequency of usage. Empty SS trays stored near Machine. These will be loaded once in every 2 hours by a separate person. Staging trolleys provide for standardize the storage and reduce the operator fatigue.

- Staging trolleys kept near Machine at identified location: 1 for each Machine.
- Additional 10 green trolleys have been arranged in an identified location close to Cell.

5.2.3 Shine

After the items were set in order the floor, walls, racks and etc were cleaned and wiped.

5.2.4 Standardize

After the cleaning process the work area was standardized by colour coding for specific areas and also naming them. Also standard procedures and rules were set to maintain the first three 5’s. Standardization of the shop floor and effectively controlling the signal system incorporated for better visual control and improve the response. Advantages are

- Supervisor can concentrate more on this cell.
- Reduces the stoppage of Machine due tool correction, mix, trays ceramics & trolleys and trouble shooting.

Red tap marking for indicating bin space and it will standardise the storage by specifying the storage area. Yellow tap marking for dividing workstations.

5.2.5 Sustain:

The sustenance of improvement activity carried out in first 4S is critical. Factors are implemented for sustainability they are:

- Safety: For the safety purpose of the workers some of the electric hazardous place in the zone was cleared and marked so that anyone in the plant would be cautious hereafter. Some safety equipments such as fire extinguisher and for the people working in the electrical assembly zone, shock resistant gloves were recommended to the workers as well as management people.
- 5S infrastructure: During the re-implementation of the 5S some materials were arranged in plastic boxes and also a separate place for the materials used on monthly basis was arranged.
- Individuality: The activities of each S have been divided and individual roles and responsibilities have been explained.
- Group norms: It has been recommended to hold a zone specific 5S related meetings so that
brainstorming can be done on continuous improvements in 5S and thus leading to a sustainable 5S practices.
- Control: As the time allotted for the 5S activities was not enough on a daily basis, the time for the 5S activities was increased from 10 minutes to 15 minutes.

5.3 The present situation after Re-implementing 5S:

The Safety audit and 5S audit are performed after the improvement and implementation of 5S as shown in Table 6.1

Table 7.1 Results of audit after improvement

<table>
<thead>
<tr>
<th>Impact Measures</th>
<th>Pre-Event</th>
<th>Objective</th>
<th>Post-Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>5S Score</td>
<td>6/10</td>
<td>9/10</td>
<td>8/10</td>
</tr>
<tr>
<td>Safety Audit Score</td>
<td>335</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Time lost due to want of mix</td>
<td>6.3%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Time lost due to robot problems</td>
<td>4.1%</td>
<td>1%</td>
<td>1</td>
</tr>
<tr>
<td>Operator work content to run 2 Machines for 150 min</td>
<td>92 min</td>
<td>36 min</td>
<td>36 min</td>
</tr>
</tbody>
</table>

Tables show the clear deviation between results for process before improvement and after improvement.
- 5S score increased to 9 out of 10.
- Safety Audit Score reduced from 335 to 150.
- Robot problems reduced from 4.1% to 1%.
- Operator work content reduces to 36min from 92 min.

6. CONCLUSIONS

The projects aim was to improve the process using lean tools Kaizen and 5S.

As a part of Continuous improvement (Kaizen) the Epson robot was installed to eliminate operator fatigue. 5S principles were effectively implemented throughout the department for improving the shop floor design and develop ergonomically design of layout.

REFERENCES


Bwemelo, Gordian, “KAIZEN as a Strategy for Improving SSME’s Performance by assessing its acceptability and feasibility in Tanzania”, European Journal of Business and Management, ISSN 2222-1905 (Paper), ISSN 2222-2839 (Online) Vol.6, No.35, 2014


