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# IMPLEMENTATION OF KAIZEN AND 5S IN A SMALL SCALE INDUSTRY

**Aniket Shirgaonkar[1], Akshay Shiudkar[2], Manthan Patil[3], Chirag Sule[4], Rajkumar Devkar [5]**

*[1-4]Student, Dept. of mechanical Engineering, VIVA Institute of Technology, Mumbai University, Maharashtra, India*
*[5]Professor, Dept. of mechanical Engineering, VIVA Institute of Technology, Mumbai University, Maharashtra, India*

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**Abstract -** *The purpose of this paper is to use KAIZEN activities to help small scale manufacturing organization to enhance the productivity, safety and efficiency. Increase productivity by eliminating the errors in machines with small KAIZEN activities in the required section of the process. Semi-automation of the selected required process is done thereby removing the errors caused by the employee; reducing their physical strain. Standardization for most of the production processes is done to maintain the same way of doing a task. In addition, unwanted scrap was eliminated using appropriate techniques to occupy more space for better utilization of area as well as sort and arrange tools and equipment for easy and quick retrieval. KAIZEN sheets and 5S audit sheet comparing utilization of time, rate of rejection, the strain on employees, and work environment before and after implementation will validate the success of the implementation of KAIZEN.*

***Key Words***: **KAIZEN, 5S, 5S audit sheet, red tag, small scale industry.**

## 1. INTRODUCTION

A small-scale industry plays an important role in Indian economy. In an organization, the prime importance is given to the quality and productivity. Since a problem come across due to the defects in materials, down time in production, working conditions, housekeeping etc. Though there are many problems, few of them are similar and can be resolved by implementing techniques like KIAZEN and 5S.

Our project focuses on minimizing the time loss by using 5S methodology, and eliminating the rejection of products by modification in machines. The main aim was to increase the productivity by eliminating the errors in machines with small KAIZEN activities in every section of process. This is done by semi-automation to every process thus removing the errors caused by the employee; reducing their physical strain, make standardization for every production process to maintain the same way of doing a task. Also getting rid of unwanted scrap to occupy more space for better utilization of area as well as sort and arrange tools and equipment for easy and quick retrieval.

The Company selected for this purpose is Synergy Automations, which is located at Bhoidapada, Vasai East, established in 2010. It is listed in Trade India's list of verified sellers offering supreme quality of Horizontal Coilers, Decoiler, Strip Straightening Machine, etc.

## 2. PROBLEM STATEMENT

These are the following problems encountered after studying the workflow of the company:

- **Rejection in output of Straightening machine:**

a) There was a huge rejection ratio in lot of aluminum strips due to process errors in straightening machine.

- **Sensor position in Tapping machine:**

a) The sensor attached to the machine was unable to sense the work piece when the worker disturbs the sensor while placing and removing the work piece.
b) During changeovers, there was an unnecessary effort in removing the sensor

- **Low productivity in Punching machine:**

a) The effort of the worker in pressing the pedal for blanking operation was high resulting in stain on legs.
b) Lead-time was more due to manual feeding.

- **Poor inventory management:**

a) The company was facing difficulties in production due to inability to use required space.
b) Also, struggling with low productivity due to the utilization of less space for actual production and loss of time in search of tools and materials due to improper workplace management.

- **Poor work environment:**

**a)** There were lot of useless scrap and waste materials laying around which reduced the overall aesthetics of the company and decreasing employee morale.

## 3. METHODOLOGY

In order to overcome problems mentioned in previous Chapter a brief study was carried out and implementation of KAIZEN Philosophy was finalized in order to improve the Productivity. The following steps were followed for proper Implementation of KAIZEN:

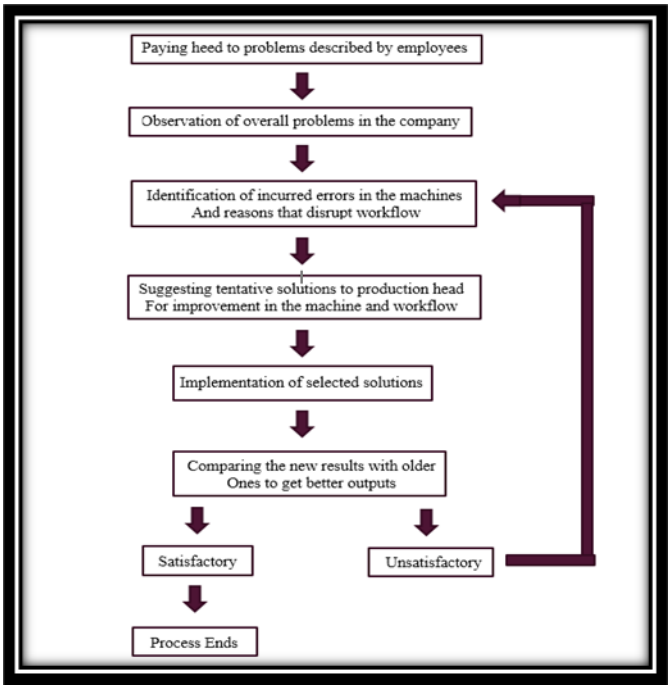



**Fig -1**: KAIZEN Implementation Methodology

## 4. IMPLEMENTATION AND RESULT

The proposed methodology directly targets at the elimination of the mudas (losses). The parameters to be considered for measure of successful implementation of KAIZEN and 5S philosophy are productivity, on time deliveries, reduction in lead-time and reduction in inventories. The problems discussed in the methodology are solved into two sections with KAIZEN and 5S philosophy. The following results were obtained after implementing KAIZEN and 5S philosophy:

### 4.1 KAIZEN IMPLEMENTATION

#### a) Straightening machine:

The different types of bends of the strip were changed to a particular calculated bend by using rollers assembly.

After measuring, the path of strip way the alignment of the guideways to the rollers and through the output guide was slightly deviated by approximately 2mm, which was a manufacturing and assembly error. Therefore, we added washers between the rollers and plates between the guideways. A roller bearing 816/8zz selected being the smallest available bearing in the market. This is done to increase the contact points between the rollers and strip while passing through the pressurized path by decreasing the size of rollers. We provided groove inside both the upper and lower roller. This reduced the bend in the z-plane significantly and thereby eliminated it.

The feed rollers were attached to a single block, which made them bend due to cantilever effect. This was the main cause for bending of the strip in the z plane. For that, support from both the sides was provided to the feed rollers such that the gap could stay constant along z-axis eliminating the cantilever effect.

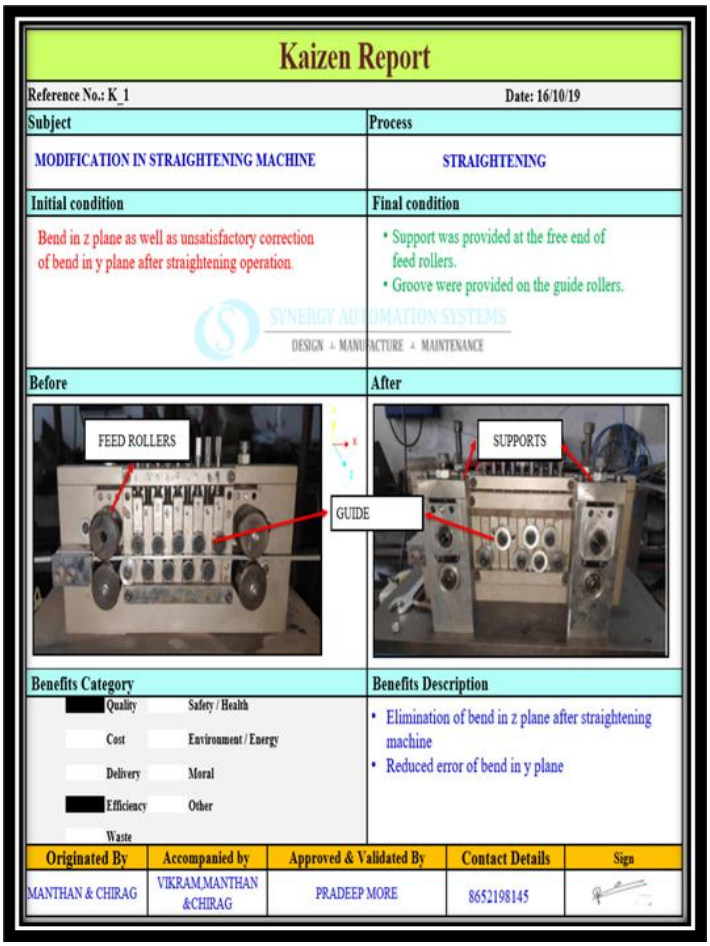


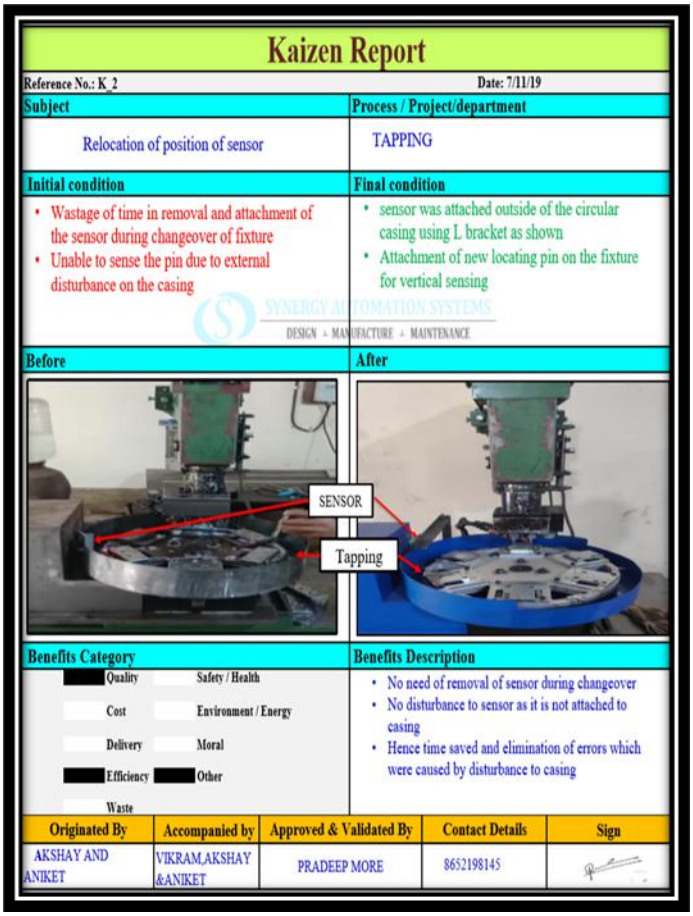

**Fig -2**: KAIZEN Report of Straightening Machine

**Outcome of KAIZEN:**

After KAIZEN implementation (shown in figure 5.8), the magnitude of bend in y-plane was still greater than the permissible range. The excessive arrangement of guide rollers required increase in holding force by feed roller for it to pass the strip through the straightening machine. This caused reduction in the thickness of strip, which was unwanted and thus hindered the reduction in bend of y-plane. In addition, due to restraints, further tentative solutions for reducing the bend was not feasible.

### b) Tapping machine:

To eliminate the wasted effort, of removing the fixture whenever there is change in fixture, we changed the sensor position. The sensor will be attached to an L bracket, which will not be in contact with the casing and will sense the pin from top so that there are no fluctuations in sensing the work piece. Therefore, the need for removing the sensor while disassembly and assembly will be resolved. To change the position of the sensor the fixture was changed according the new sensor position. In addition, the pin for sensing was changed to a new design.



Kaizen Report

Reference No.: K_2 Date: 7/11/19

| Subject | Process / Project/department |
|---|---|
| Relocation of position of sensor | TAPPING |
| **Initial condition** | **Final condition** |
| • Wastage of time in removal and attachment of the sensor during changeover of fixture<br>• Unable to sense the pin due to external disturbance on the casing | • sensor was attached outside of the circular casing using L bracket as shown<br>• Attachment of new locating pin on the fixture for vertical sensing |

SYNERGY AUTOMATION SYSTEMS DESIGN ▵ MANUFACTURE ▵ MAINTENANCE

Before / After



| Benefits Category | Benefits Description |
|---|---|
| ■ Quality, Safety / Health, Cost, Environment / Energy, Delivery, Moral, ■ Efficiency, ■ Other, Waste | • No need of removal of sensor during changeover<br>• No disturbance to sensor as it is not attached to casing<br>• Hence time saved and elimination of errors which were caused by disturbance to casing |

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**Fig -3**: KAIZEN Report of Tapping Machine

### Outcome of KAIZEN:

The earlier design had an error due to which it caused the operator to adjust the sensor on an average of six times in one hour. Which took approximately one minute to fix each time. Also, the die is changed two times a day in which the removal of sensor took additional one minute and twelve seconds each time.

No. of work piece tapped = 18 work piece/min

No. of work piece that can be tapped in the wasted time = 799 work piece/day

Therefore, no. of work piece tapped before KAIZEN Implementation = 6761work piece/day

No. of work piece tapped after KAIZEN implementation = 7560 work piece/day

Therefore, percentage increase in production = 11.8 %

### c) Punch machine:

To overcome the sensing problem, we used a flap at the end hinged on the top so that when the strip passes the flap raises and the sensor senses it.

However, the flap did not have enough elevation for the output sensor to sense it so to overcome this we provided an angle of approximately 15 degrees. This allowed the surface of flap to come close enough for the sensing by output sensor. There was also a problem that after punching operation the strip used to hit the upper output roller rather than passing between them. To avoid this, we provided a guide plate in between the die and the output rollers. This allowed the strip to pass through the guide plate and then in between output rollers leading in smooth operation.

After trails we found that the strip needed to feed in a proper alignment otherwise, the strip does not enter the punch. To overcome this problem, we provided guideway for proper alignment of strip while passing through the machine.

Kaizen Report

Reference No.: K_3 Date: 14/12/19

| Subject | Process |
|---|---|
| MODIFICATION IN PUNCHING MACHINE | PUNCHING |
| **Initial condition** | **Final condition** |
| • Output sensor unable to detect flap<br>• Unwanted hitting of strip on the output roller | • Modified the flap<br>• Provided guide plate between die and output rollers |

SYNERGY AUTOMATION SYSTEMS DESIGN ▵ MANUFACTURE ▵ MAINTENANCE

Before / After



| Benefits Category | Benefits Description |
|---|---|
| ■ Quality, Safety / Health, Cost, Environment / Energy, Delivery, Moral, ■ Efficiency, ■ Other, Waste | • Enabled detection of flap by the sensor<br>• Smooth movement of strip from die to the output roller |

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**Fig -4**: KAIZEN Report of Punching Machine

### Outcome of KAIZEN:

Number of 350mm strips punched before semi-automation = 8 strips/ min

Number of 350mm strips punched after semi-automation = 30 strips/ min

Therefore, percentage increase in production = 275 %

### 4.2 5S IMPLEMENTATION

We selected two zones for 5S implementation named as Z1 and Z2 for paint shop and welding area respectively. The steps taken are as follows:

#### a) SORT:

First, all the materials in zone Z1 and Z2 identified and classified into waste and scrap with help of department head. The waste like ruined paper, plastic and scrap material, which mostly contained small metal blocks were disposed of and collected in a box for selling purpose respectively. The other unwanted items in the zones were identified for red tag. After identification the unwanted items in the zones, the items are tagged by red tag. Red tags shows details about the item tagged such as category in which the item comes under, Reason for its removal, Action taken for that item, individual who tagged it as well as comments so that it can be recognized by new employee. For future reference, entries of the entire item, which are tagged, are made in red tag log sheet. This sheet also helps in identification and retrieval of tagged item, which was not useful in past but needed in the present.

**Fig -5**: Red tagged items

**Table -1:** Cost saving due to space clearance at company

| Zones | Space Saving (sq. Feet) | Cost Saving ( Rs ) |
|---|---|---|
| PAINT SHOP AREA | 63.195 | 5,05,560 |
| WELDING AREA | 16.14 | 1,29,120 |

Note: Cost is calculated in above table considering rate of 8000Rs/sq. ft

#### b) SET IN ORDER:

Set in order refers to assignment of a definite place to all the equipment, machines, tools and raw material thereby reducing its time for retrieval. There was a shelf but all the fasteners were kept randomly without any discipline. To reduce this wastage of time in searching of fasteners we assigned each type of fasteners in a definite place. After changing, the layout and deciding on paint shop all the paints and varnishes were allotted a definite place in the shelf. Similarly, the toolboxes were present but all the tools and equipment were randomly placed. For this, all the tools, equipment were categorized and arranged in the toolbox in neat manner.


**Fig -6**: Toolbox before and after set in order

**Fig -7**: Machine parts and tool compartment after Set in order

#### c) SHINE:

Shine refers to cleaning of the zones. Before 3S cleaning was done in an irregular manner such as there used to lay a lot of scrap before proper cleaning, washrooms were less frequently cleaned, etc. To improve the cleaning system a cleaning schedule was prepared. This schedule includes places to be cleaned, the frequency at which cleaning is to be done as well as the employee by which the cleaning of that particular place is to be done.

**Fig -8**: Welding area before and after Shine

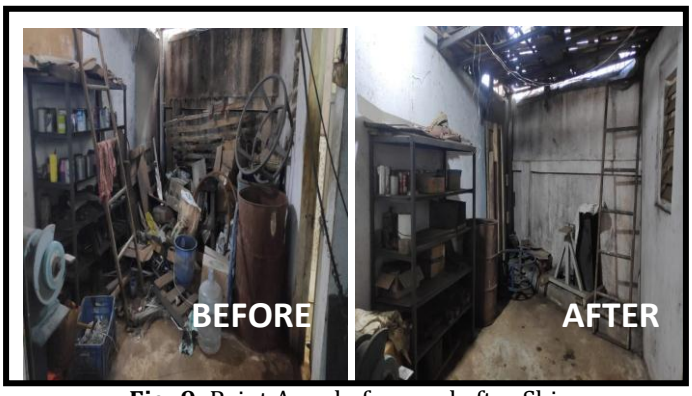


**Fig -9**: Paint Area before and after Shine

### d) STANDARDIZED:

After assignment of fasteners to its place in the shelf, each drawer was named with respect to the name of type of fasteners it contains. In addition, plastic bags were provided with the size of fastener indicated on it. This reduced the average time to retrieve fasteners by up to 10 seconds. Similarly, after arranging the tools in the toolbox in neat manner printed names of the types of tools were tapped on the compartments of the toolbox thereby reducing the time for retrieval of tools by average of 3 seconds. In addition, warning and caution posters were nailed on wall at the zones.

There was also confusion in bidirectional starter switches n machine such as drilling machine and lathe machine. To eliminate this confusion arrow for starting the machine in desired direction were tapped on starter. Due to this, there will not be any accidents or rejection due to confusion in future by any new employees.


**Fig -10**: Posters

### e) SUSTAIN:

After the implementation of 4S: operators, supervisors and floor managers were asked to continue this process. Previously implemented 4S areas were inspected to find out the incongruities with the proposed system. An Audit sheet was developed for this purpose and the result had been found to be satisfactory. Two Audits were conducted one was Preliminary and another was Final. This was done to make sure that there was improvement. Senior workers kept focus on maintaining 5S as a habit. The Audit results were discussed with all workers and demerits noted down. Departments who were scoring lesser than others were motivated.


**Fig -11**: Final 5S audit sheet

## 5. CONCLUSION

In this study, the problem faced by the company analyzed using KAIZEN approach. The various problems such as production delays are sorted with the help of implementation of 5S and KAIZEN for betterment of the company. The conclusion after implementation of 5S and KAIZEN in the company are as follows:

- Increase in effectiveness of straightening machine:

a) Obtained an elimination of bends in z plane and reduction of bend in y plane to permissible limit. Thereby minimizing the rejection ratio of strip after straightening operation.

- Improved inventory management:

a) Due to 5S implementation on the zones Z1 and Z2, the freed space is used as paint shop and welding area respectively. Thereby efficiently utilizing area in the company.
b) Due to 5S implementation, the retrieval of tools and equipment by the workers took significantly less time.

- Reduction in time loss in Tapping machine:

a) KAIZEN implementation by changing the position of sensor completely eliminated the problem of deviation in sensor position caused due to worker interruption.
b) Unnecessary effort of removing the sensor during changeovers eliminated.

- Increase in productivity of Punching machine:

a) Due to semi automation of punching machine the need of the worker to press on the pedal for punching operation is eliminated by using pneumatic cylinder.
b) In addition, the need to manually feed the strip for every punching operation is eliminated.

- Improved work environment:

a) The 5S implementation in the company improved the overall aesthetics of the company, as the work environment is much cleaner. This increased the moral in employee.
b) Labeling of toolboxes, shelf drawers and bidirectional switches as well as posters for caution and indication of area increased to the overall standardization in the company.

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