

5S Implementation Studies in Biomass Processing Unit

K.Ramesh¹, V.R.Muruganatham², N.R.Arunkumar³

¹P.G Student, Department Of Mechanical Engineering, Kumaraguru College Of Technology, Coimbatore, India

² Senior Grade Assistant Professor, Department Of Mechanical Engineering, Kumaraguru College Of Technology, Coimbatore, India

³ P.G Student, Department Of Mechanical Engineering, Kumaraguru College Of Technology, Coimbatore, India

Abstract: This paper presents an application of 5S in technology in a Bio-mass processing unit. Due to increased demand, high product variety, and a push production system, the plant has suffered from excessive wastes, unorganized workstations, and unhealthy work environment. This has translated into increased production cost, frequent delays, and low workers morale. Under such conditions, it has become difficult, if not impossible, to implement effective continuous improvement studies. Improving plant layout, and organizing workstations. 5S lean technology is utilized for achieving project diagnosing the production process, streamlining the workflow, removing/reducing process waste, cleaning the production environment. The work was a combination of both culture changes and tangible/physical changes on the shop floor. The “5S” technique represents a fundamental technique which allows the enhancement of efficiency and productivity, while ensuring a pleasant organizational climate. The project has drastically changed the plant and developed the infrastructure for a successful implementation of continuous improvement as well as other best practices and quality initiatives.

Keywords: 5S Techniques, Work Standards.

1.0 INTRODUCTION

IN a highly competitive global marketplace of decreasing profit margins, waste reduction has become an essential element in companies' effort to thrive and in some cases to just survive. Waste has a broad meaning that ranges from the unnecessary or excessive use of materials, space, and production resources to any incurred costs that add no value to the product such as overproduction, inventory, set-up, transportation, delay, and rework. It is any effort or cost beyond delivering the right product to the right customer at the right time and at the right price. The hidden cost of such wastes significantly contributes to increased production cost, reduced profit margin, and loss of competitiveness. Reducing process waste is the primary mission of lean manufacturing which was started by the Japanese industry, mainly Toyota, in the 1950s. Toyota production system and lean manufacturing in general are focused on pinpointing waste sources and using tools of proven effectiveness to eliminate or reduce waste. Lean defines the major types of waste as: overproduction, over processing, defects, inventory, transportation, motion, underutilization, and delay.

1.1. 5S TECHNOLOGY

5S is a lean method and a system of process improvement that is adopted to reduce waste, clean workplace, and improve labour productivity. To this end, 5S maintains an orderly workplace and utilizes visual cues to achieve more consistent operational results. As an infrastructure for a culture of continuous improvement, 5S is typically the first lean method which organizations implement to facilitate the application of other lean techniques that improve/optimize process structure and parameters.

The 5S components include Sort (Seiri), Set in Order (Seiton), Shine (Seiso), Standardize (Seiketsu), and Sustain (Shitsuke). Together, they provide a methodology for organizing, cleaning, developing, and sustaining a productive work environment.

The 5S lean technique includes:

1. Sort: Removing wastes and clearing the work area
2. Set in Order: Designating and labeling locations of work tools
3. Shine: Cleaning and improving the appearance of the workplace
4. Standardize: Documenting the work method, using standard tools, and populating the best practices
5. Sustain: Maintaining improvement, controlling work methods, and integrating the 5S's into the culture

The 5S's lead to improved processes in terms of many aspects including:

- Transparent process flow
- Clean workplace
- Reduced set-up times
- Reduced cycle times
- Increased floor space
- Lower safety incident/accident rate
- Less wasted labour time
- Better equipment reliability

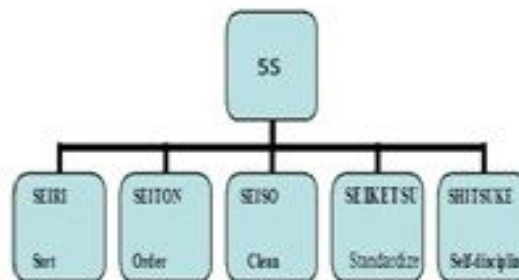


Fig. 1: 5S TECHNOLOGY

1.1.1. Project Objectives

The Hari Bio-Mass Processing Unit is keen on increasing the effectiveness of their manufacturing and assembly operations through a better workflow and an enhanced layout of the workplace. This is essential step in the company's effort toward attaining excellence at all aspects and activities. Hence, this project aims to study the current workflow at Hari Bio-Mass Processing Unit, pinpoint existing flow issues, and analyze the overall impact on the effectiveness of the production system. From a managerial perspective, the project will work on developing a flexible layout for a streamlined production flow and reduce layout changes and setup costs leading to easier plant management and better floor control. They were less worried about optimizing process parameters (resources, layout, sequence, cycle time, etc.). From a shop floor perspective, this project will organize the workplace and create a better work environment for line workers to improve morale and facilitate the execution of work orders and improve floor communication.

Based on the plant state analyses, the project will identify the process and come up with a set of measures to streamline workflow, reconfigure the manufacturing and assembly process elements, and reorganize the workplace. 5S techniques are used attain improvement in the overall process effectiveness.

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2.0. Methodology

A simple yet effective methodology is followed for attaining project objectives. Project scope is defined after touring the facility and tracking the production process along with discussions with plant management, engineers, supervisors and general labour. The project need was obvious to all parties and the project value was found to be significant to the company. The difficult part was how to carry out floor changes and make a tangible difference in the process flow. To this end, this project followed a simple yet practical approach to stir a change on the shop floor, clean the flow, and start a momentum for continuous improvement. The methodology can be summarized in the following:

- Observe floor operations at the facility and diagnose current workflow and work organization problems.
- Identify and develop a structure of the current manufacturing process
- Investigate workplace organization problems from shop floor observations, labour, and line supervisors.
- Use 5S techniques to improve existing workflow and process configuration.
- Discuss improvement measures with plant management.
- Document analyses and results in formal report and present to plant management.

The main expected project outcome is to improve the overall process effectiveness at the plant. Other benefits include a better organization of workplace and work activities to streamline operations, simplify floor control, and improve workers morale. Implications on the Hari Bio-Mass Processing Unit bottom lines include increasing effectiveness, reducing excessive flow, reducing setup time and cost, and improving the utilization of expensive assets and resources. This is also tied with the employee incentive program to further improve productivity and profitability. The project has started by defining process layout and dividing the plant into 10 production areas. This step was essential to identify layout, define flow areas, and prepare for 5S application at all plant areas. This was followed by conducting a lean and 5S awareness at the facility through meetings and seminars held for plantengineers, supervisors, and workers. Once all are familiar with the project objectives, lean technology, and the project timeframe and work plan, a cleaning campaign has started inside and outside the plant. Cleaning the plant floor and backyard was necessary to clear the aisles, improve the environment, and make a visible change in the work place to both workers and visitors. These three steps made it easy to start the application of 5S approach at the defined areas in the plant. Each area took an average of a week to make a tangible difference. Several meetings were held with plant management to discuss progress and exchange ideas. Special 5S forms were developed to assure sustainability. All project actions were documented and a final report is issued to plant management.

3.0 5S APPLICATION

It is often simple to talk about how lean approaches work and about 5S in particular. However, the implementation of lean tools on the floor is totally different. This is because 5S is not just a methodology; it is a culture change that involves all parties to drive the organization towards effectiveness and continuous improvement. Thus, we had to first make it clear to all project parties why we are adopting the 5S lean technology. The diagnostic study conducted at the Hari Bio-Mass Processing Unit plant revealed the following issues that collectively call for 5S application in the plant to identify process and improve layout and flow:

- Space is crowded with parts and tools
- Unneeded items are stacked between workers
- Excess inventory on the floor
- Excess items and machines make it difficult to improve process flow
- Equipment is dirty and a collection point for miscellaneous materials
- Needed equipment such as tools are difficult to find

Based on the diagnostic study, the 5S lean technique is adopted for process identification and workflow improvement at the Hari Bio-Mass Processing Unit factory for the following reasons:

- 5S provides the infrastructure necessary for plant-wide improvement
- 5S is essential for streamlined process flow and layout redesign
- 5S is essential for worker motivation and increased loyalty
- 5S is the key for clean production environment
- 5S is essential to deploy safety measures and reducing accidents
- 5S is key to waste reduction:

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- Minimizing waste and reusing waste materials
- Minimizing effort and time wasted in searching
- Removing excess material and inventory

It is also worth mentioning that 5S is not a list of action items that has to be reviewed at some interval of time. Instead, it has to be practiced consistently in all times. Thus, a practical step-by-step approach should be followed to make 5S attain a successful implementation. The followed project steps are summarized in the following

- Process structure and identification (layout and flow)
- Awareness and training on 5S approach
- Overall plant inside and outside cleanup

- Utilizing checklists for 5S implementation and auditing
- Waste reduction (less waste and reused materials)
- Space utilization (clearing main aisle, providing space for reused items, clearing plant floor, providing space for material handling)
- Cleaner and safer work environment
- Setting a basis for labour incentives

Initially, there were no clear boundaries to plant areas. It was also difficult to move materials from one area to another. A crane is used to transfer heavy materials and parts from one area to another. Final office structures are assembled in an area outside the plant. Workstations were unclean and flooded with excess inventory, rework, and scrap. The improved layout shows cleared main aisle, no flow obstacles, marked in/out areas, and more space for reusing items and material handling. These plant areas are organized and the main plant aisle is cleared and marked.

After identifying and cleaning the process flow, the 5S was then implemented at the industry. An action plan was set and followed as a practical guide for translating 5S method and principles into specific actions that stations operators can take and sustain. This work element presented a great challenge to project team. The team has to work with general labour and stations operators on a cultural change. They have to believe in the actions taken in 5S application in order to make tangible and sustainable changes on the floor. To this end, the team focused the 5S implementation effort on one plant area (woodworks) to create labour awareness in the 5S method and to provide tangible evidence that can convince labour to cooperate with the changes and believe more in the 5S value and benefits.

Standards should be worked out and implemented in the work place. Management should pass instructions in order to set the work place in order. The instructions should be clear and easily understandable to workers. All the workers in the shop floor should be involved in specificity of their own activities and process of elaboration along with the usage gives them the possibility of understanding the importance of each aspect of the operation. The aim of the easy access of the obligatory standards for constant and visible places should be assured. It should be assumed that standards are not only being implemented in typical operational processes like movement of materials, production, maintenance and sorting, but also in administrative processes like Book-keeping, HRM(human resource management), customer service and any other services. The important thing is visualization of work area the painting of the floor helps to identify the storage places of each material or transport ways. The place for each item should be labelled. Each tool, material, supply, or piece of equipment should be kept close to where it will be used – in as an ongoing process for ever. This increases the consciousness if the workers and decreases the number of non-confirming products and defective products. This process also increases the internal communication and human relations in the organization. It is also essential to understand the need and importance of the inspections for 5S. The inspections are executed with the help of Check list prepared on the basis of the radar charts of 5S. This also helps in estimating the work place. The inspection of the realization of 5S standards is executed once in a month by the team. other words, aligning the flow path. Implementing the 2S rule: It means items must be placed in fixed locations so that they are easily attainable and can be easily used. 2S rule proceedings: Make sure that items can be identified by labelling them properly

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Every working method has particular type of order. Identify and filter it. Use lean thinking to make things faster.

- Reduce preparation time for tool setting.
- Reduce waiting time for parts, materials, papers and files
- Reducing processing time and cycle time by improving the plant layout of work area.
- Time and strength spent on looking for jigs, fixture tools etc.
- Run down for parts in stores.
- Searching for files and information in computers.
- Labels are attached so that items can be recognized.
- At a glance and clear.

The advantages from implementing 5S rules:

1S:

- Process development by cost reduction
- Stock confinement
- Better usage of work place
- Prevention of losing tools

2S:

- Process growth
- Increasing efficiency
- Shortening of time required for searching necessary things

3S:

- Improvised working conditions for workers.
- The number of customers has been increased after maintaining a clean and neat layout.
- Machine maintenance cost has been reduced.

4S:

- The standards of the company came to next level.
- Improvement in safety has supported in reducing the injuries of workers.
- Slips and falls of the material have been reduced.
- Travel time of materials is reduced which led to reduction of work hazards.

5S:

- It gives a scope for Workers participation in the work area design and maintenance.
- Workers absenteeism has been lowered down.

The team started the work on station sorting, ordering, and cleaning while operators watching. We explained to workers that this work is simply to clean and organize their workplace, it is not part of any company certification program, and keeping the station clean and organized will be rewarded through an incentive system. As a result, workers start to help in 5S changes at the first work area (woodworks). Area operators were trained on what exactly need to be done to keep the area clean organized. The 5S procedure was put on a form and posted at the work area.

Figure 3 shows the layout of woodworks area and Figure 4 shows a picture that reflects the results of 5S application to the woodworks area. It is clear from the layout and the actual status of the workstation that the 5S application has resulted in a clean and organized work area. Flow input/output is improved and a cellular layout is adopted to facilitate machines control and supervision. Aisle passes through the area is cleared to allow for easy access of material handling trucks.

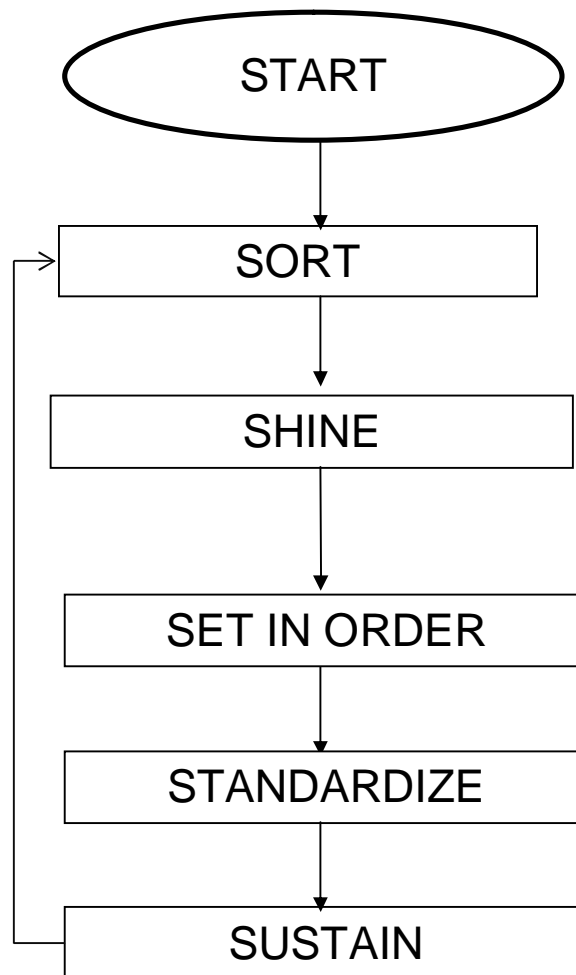
Few days later, everybody at the plant noticed that the woodworks area has become different, clean, organized. The morale and the productivity of the area workers have also improved. It was the right time to explain the approach to all and to start a gradual application of 5S at the other plant areas. The work continued gracefully at all other plant areas. A new layout is developed for each area and all 5S's are applied at the 10 work areas. Combined

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with a drastic clean up of plant floor and plant outside, the picture starts to be clear one month later. The plant significantly looked different. Some said it is like another plant.

In 5S application at Hari Bio-Mass Processing Unit facility, it was necessary to develop a 5S checklist based on the 5S practical guide discussed earlier. The check list helps identifying opportunities and techniques for 5S successful and comprehensive application.

The project deliverables to each area in the plant is summarized in a 5S table as summarized in the forms developed for each area and a detailed layout is developed for each area. Results collectively revealed a better process flow, a transparent production process, and a cleaner work environment. Specific actions on the floor were taken to save space, create and label storage areas, mark aisles and increase safety, and streamline the flow of production operations.

**Fig. 11: 5S APPLICATION AREA**

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TABLE - 5S RATING

Week No	Duration	Material availability rating 0 or 1	Defective goods Rating [1- $\{Y-X\}$]	Operating condition on Rating 0 or 1	Relative Information Rating 0 or 1	Elimination of waste rating [1- $\{M-N\}$]	Total rating
Week 1	Dec 09-14,2013	1	0.20	1	1	0.2	3.4
Week 2	Dec 16-21 ,2013	1	0.40	1	1	0.2	3.6
Week 3	Dec 23-28,2013	1	0.40	1	1	0.4	3.8
Week 4	Dec 30-Jan 4,2014	1	0.40	1	1	0.4	3.8
Week 5	Jan 6-11,2014	1	0.60	1	1	0.4	4
Week 6	Jan13-18,2014	1	0.60	1	1	0.4	4
Week 7	Jan 20-25,2014	1	0.60	1	1	0.60	4.2
Week 8	Jan 27-feb01,2014	1	0.60	1	1	0.6	4.2
Week 9	Feb 3-8,2014	1	0.80	1	1	0.6	4.4
Week 10	Feb 10-15,2014	1	0.80	1	1	0.8	4.6

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S1-SEIRI-Sort

- Red labels have been applied to all marks which were not necessary during the activity within the tin service shop;
- All useless things have been sorted and eliminated
- Approximately 700 kg of scantlings have been thrown away;
- The causes that led to the scantling accumulation have been analyzed;
- Rules specific to this activity have been stated and are to be implemented.

S2-SEITON-Order

- All objects which were placed inappropriately have been taken inventory of;
- The locations of all objects necessary in the workshop have been defined and marked
- Colors have been used to mark the different areas;
- The arranging way has been set according to destination and degree of usage.
- The location of all objects necessary in the activity within the sales area have been defined;
- Visual standards of arrangement and order have been set

S3-SEISO-Cleaning and disturbance detection

- All floors in the areas have been washed;
- All walls have been cleaned;
- The electrical wiring on the control panel of the elevator has been rewired;
- The supply wiring of the plug used for the blowpipes has been rewired;
- All storing shelves have been cleaned;
- All machines and tools have been washed and cleaned;



Fig. III: 5S SEISO APPLICATION AREA

S4- SEIKETSU - Standardizing

Before	After
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Fig.IV: 5S SEIKETSU APPLICATION AREA

S5- SHITSUKE – Disciplining

- Maintaining improvement, controlling work methods, and integrating the 5S's into the culture.

A project is, therefore, aimed at cleaning, identifying, and streamlining the process. 5S lean technology is utilized to develop an infrastructure for continuous process improvement. A practical 5S methodology is implemented to 10 areas in the plant during the project period of 3 months to clean up the process and improve overall plant operations. At each area, a thorough clean up process is started, a new layout is developed, and all 5S's are implemented using clear forms and procedures. Results showed tangible changes on the plant floor along with improved worker morale and increased productivity. The approach can be adapted to other types of manufacturing processes as well as offices and service processes.

4.0. CONCLUSION

This paper has presented an industry application of 5S lean technology at a Hari Bio-Mass Processing Unit. Several plant conditions have called for the improvement of the manufacturing process (a combination of job shop and assembly operations). The process flow at the Hari Bio-Mass Processing Unit is not streamlined due to the wide variety in product specifications, the growing demand, the push production policy, and the nature of heavy metal and woodwork operations. As a result, the plant has turned into a jungle of dirty machines and excess materials, scrap, and rework spread all over plant floor creating a plenty of flow complications and causing space and production issues.

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