Productivity Improvement in Pressure Vessel Manufacturing unit

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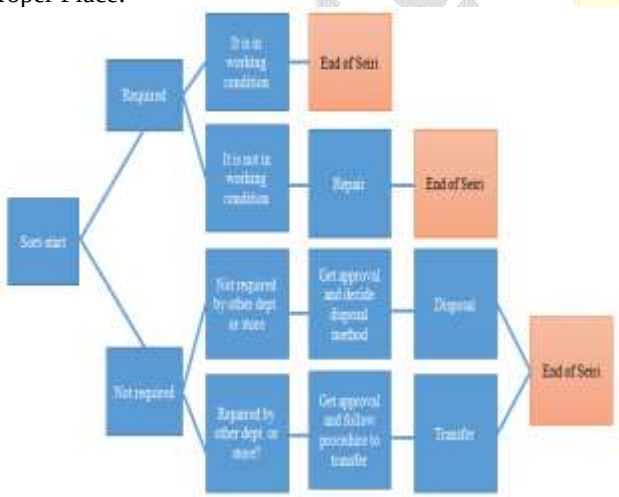
Abstract—The Project work carried out to apply the 5S and Kaizen Methodology of lean Manufacturing to solve the problems of a Pressure Vessel Manufacturing industry. The aim is to improve the productivity, solving several problems encountered in the production system, such as: long lead times, unnecessary motions, material handling, dead inventory and a non-standardized working environment. 5S and Kaizen is a basic lean Manufacturing Tool used for cleaning, sorting, organizing and providing necessary groundwork for work place improvement and reducing cycle time or long lead time

Keywords—5S, Work Place Improvement, S.O.P, Productivity, Reducing Lead Time;

1.1 INTRODUCTION

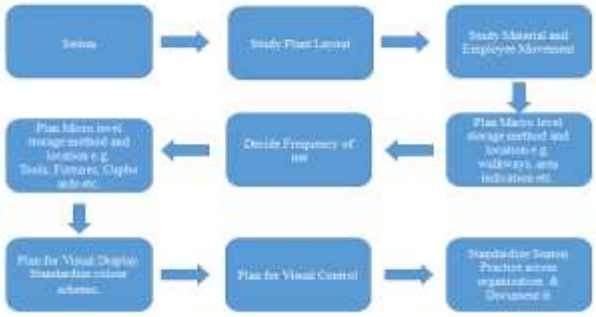
This Paper Present The 5S And Kaizen Implement In Pressure Vessel manufacturing Industry. The 5S Methodology First developed in the japan. The Founder of The 5S Methodology is Hiroyuki Hirano.5S The Five Element are As Follow

[1] SEIRI (Sort) Means Unnecessary items Remove from the Work Place And Necessary item Are Placed to the Near Of The Work Place. Using Red Tag For Remove Item , Yellow Tag Used for Reworking of The Job and Blue Tag are Used For Completing The Job And Job placed in Proper Place.



Flow Process Of Sort

[2] SEIRI (set in Order) means All The Equipment, Material and Tools are arrange Such Manner It Can be easy Available When Ever We Will Need. Advantage Of 2S is reducing Searching Time And Delay.

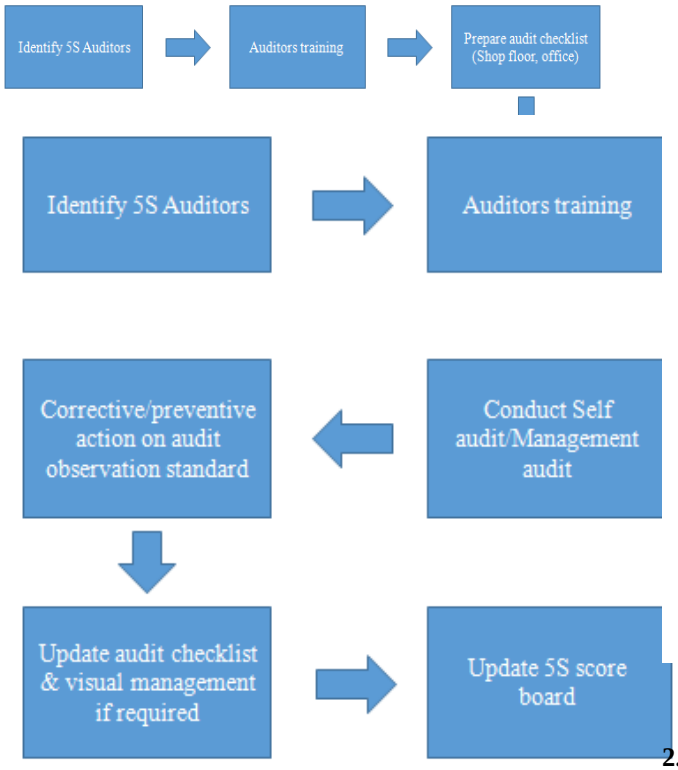


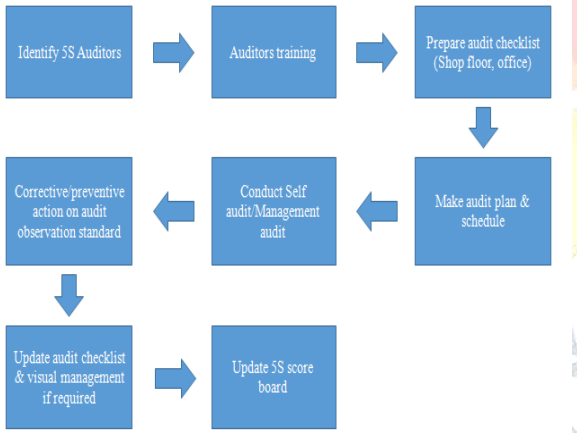
Flow Process of Set in Order

[3] SEISO (Shine/Cleaning) Cleaning is the Necessary because It is Reducing The Chance of Accident And Improve The Moral of The Worker. in This Step We will using The Cleaning Sheet And Give The Responsibility to the Worker.

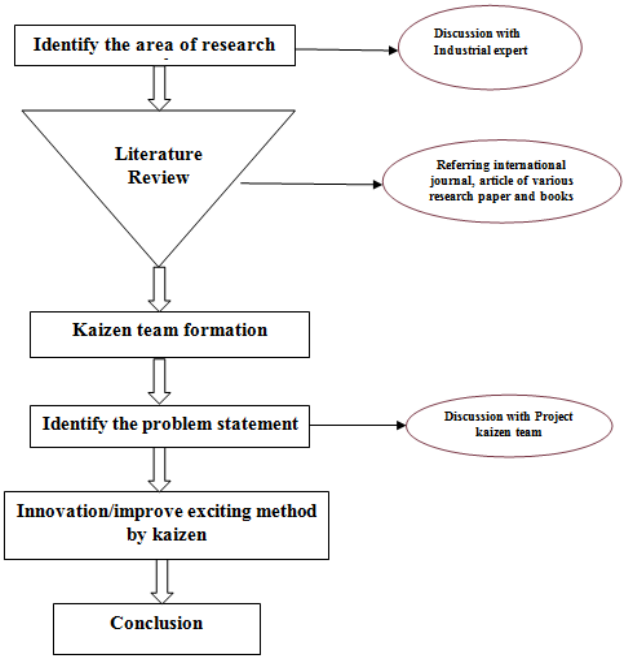
Flow Process Of Cleaning.

[4] SEIKETSU (Standardize) Standard should be communicative and easy to understand in all Manufacturing Process. In This Step We Will provide The Standard Producer For every Work Process. In this Step we will Also Using The gamba chart.





Flow Process Of Sustain



Flow Process Of Kaizen

KAIZEN METHODOLOGY

Kaizen is a Japanese word that indicates a process of continuous improvement of the standard way of work. It is a compound word involving two concepts: Kai (change) and Zen (for the better).

P.M.Rojasra [4] Krishna Plastic Company, Udhyog nagar, Amreli, Gujarat. Out of the available various lean manufacturing techniques, 5S offers good potential for required improvement. Ten week study is carried out in the case Study of company. The results after the 5S implementations states that production system efficiency is improved from 67% to 88.8% in the successive week.

2.1 LITERATURE REVIEW

Ben Ruben R et al. [1] This paper Study I did Find Out Bottle neck Operation and implement 5S in the Work place and Operating Standardize Working Process And Also Implement The Layout Configurations. This Activity We Are Achieving Cycle time of Welding Process Reducing from 500 litters Capacity 36 minutes from 48 minutes, and 220 Litter Capacity reduced to 40 minutes from 54 Minutes.

Kshitij Mohan Sharma et al.[2] This Paper Present The 5S Implement In Copper Wire Drawing Company. It is a universal tool which can be applied in any situation and any where starting from machine shop to the accounts department and head office. visual management system which creates a work environment that is 'self-explaining', self-ordering' and' self-inspiring'

Cristina vereset et al. [3] This paper I Did Observe That Positive Correlation Between 5S Evolution and Productivity in this Method which develop discipline and cleanness workplace and maximizing efficiency and ProductivityMiroslava

Prof. Saad Shaikh.et al. [6] The Quality and Productivity is the Prime Important to the Any Industry. The Problem come across due to the defective materials, down time in production, working conditions, housekeeping etc. The 5S Implement is an effective to manage tools and materials which can improve housekeeping, environmental conditions and health and safety standards and increase

productivity and quality. effectiveness of material searching is taken 0.7 out of 1 before implementation of 5S after it is 0.9 out of 1, similarly the effectiveness reading is given to other processes. From that comparison we conclude that overall change is 75% means we have increased it up to 20% after implementation of 5S.

Daniel Arefayne Legesse et al. [14] Traditionally operated garment industries are facing many problems. The problems are include production lead time, rework, poor line balancing, lack of standardized work process and performance measurement system for the employee, high work-in-process, low production capacity, high labor (operator) absenteeism, high fabrication waste and poor Space utilization. 5'S Implementation after The outputs have been increased to 292 pieces a day with 25 labours which was previously recorded to 250 pieces a day with 32 labour per line. Hence, after line balancing 21 labours are required to produce equal amount of pieces per line in a day.

Kishore B. Lad et al [7] The objective of this study is to understand and improve the productivity by applying kaizen methodology in the industry. Plant Layout and Flow of material is Also Impact on the Production. The proposed kaizen layout is increases the 1,248 final output of production per year and near about more than 15% productivity with respect the old layout. The distance of the production flow can be reducing from 103.2 m to about 68.5 m. that is distance reduced by 34-35m.

Amit Shaha et al [8] In this Paper Represent the Objective discussing the implementation Kaizen in the industry. we saw that Stacking of components at pre-grinding stage consumes more manpower. Therefore, application of new process will eliminate the stacking process and no more manpower is required. As current deburing process is totally eliminated, one more manpower is saved. As of total, 10 manpower required is reduced to 6.

Dipak P guari et al [9] This paper represent kaizen is implemented in Bajaj Steel ltd. In this industry there are many problems which affect the productivity and production. Such As no painting Shop, Improper handling of material, improper inventory of materials, less safety measures and Environmental hazardous. The problems observed during kaizen implementation are solved with better working efficiency, better working environment, and continuous work on production. The implementation of lean tool kaizen, improves the production environment with minimum investment.

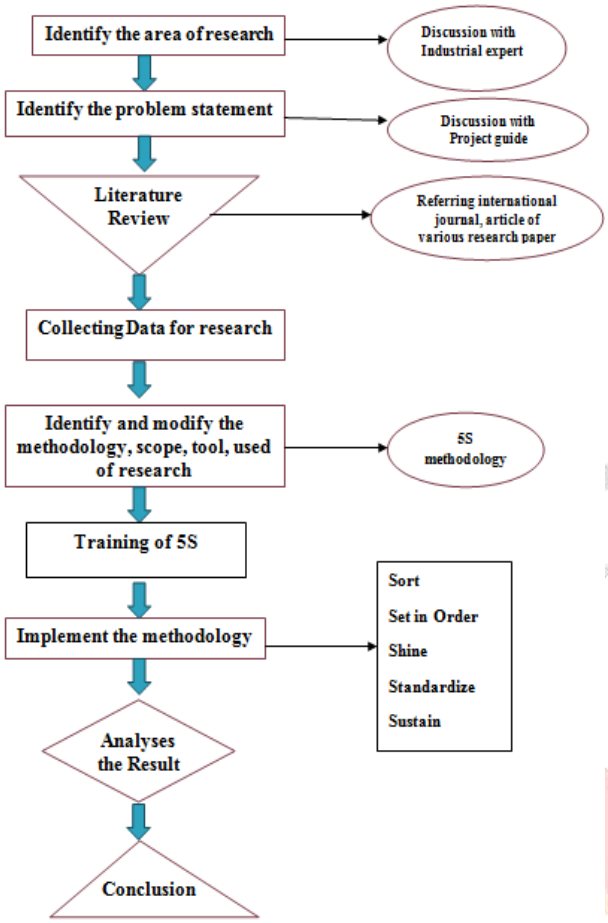
Pavan Kumar et al [10] Total Productive Maintenance (TPM) is an arrangement which focuses on add up to organization of everybody from top administration to all employee to actualize a far reaching maintenance program for all equipment for the duration of its life. This Paper present the focus on the implementation TPM with the additions of Kaizen,5s, Jishu Hozen, Planned Maintenance, Quality maintenance and Safety, Health & Environment. Overall Equipment Effectiveness has improved from 49.76% to 67.27 % indicating the improvement in productivity and improvement in quality of product

2.2 RESEARCH GAP

From The Study of The Research papers I did Observed That Not Only Using the 5S Technique to Improve the Productivity but It is Also Depends upon the Ergonomics Structure of The Work Place, Line Balancing, Work Force Diversity, Worker Stress, Worker Fatigue, Bottle neck And Non Value Add Activity Adversely Effect on The Productivity. Kaizen is Also Part Of The 5S Technique and Kaizen Also Improve the Production Process. 5S Implementation in Industry is Also Depend on Moral of the Worker, Awareness, knowledge, Employ Training and Main Role of involvement of Top level Management to Bottom Level Management is necessary.

3.1 METHODOLOGY

I Will Three Methodology Are used in this Project Work 5S, Kaizen And Preventive Maintenance Give to The machines. This Below Methodology We Will Used in Kaizen and 5S.



Project Work Methodology

- 1st- Step is to Identify Area of The Research Work. In this Step I will Conduct the Visit The Company Many time and I will Identify the Area of Research work is Fabrication Departement.

- 2ed Step is one Time I Will Identify the Area of Research work. I will Observed All of Process and Working Method that base I will Find out the Problem Statement in particular Research Area. my Problem Statement is More Time Consume in Process Time or Cycle Time Reeducation

- 3ed Step is to Related to my Problem Statement I Found The Regarding International Journal., Article, Research paper And Review Paper Found and Find Out the Particular Salutations of the problem Statement and Method.

- 4th Step is After Read and Analysis of Research Paper I Gating The Idea About Time Study For Data Collection for Research Work. With The Help of Stop Watch I Will Measured The Actual Process Time of All Process From Raw Materials To Disphace From Fabrication.

- 5th Step is During The Time Study I Observed That Which Tools Are Used To Achieve My Objective Of Research Work. I Will Find Out The Three Methodology or Tools For my Research Work Namely **5S, Kaizen and Preventive Maintains** to The All Machine,

- 6th Step is Training Is Necessary For All Tools Because of Worker Not Aware About Process Any Tool Not Implement. We Wil Give The Training of The 5S, Kaizen And Preventive Maintains by Poster Presentation. We will Increase the Moral of The Worker And Increase The Awareness' of All Process. Some Time Periodically We Will Conduct The Exam Of The 5S, Kaizen And Preventive Maintains and Some Price Of Give The Winner Candidate.

- 7th Step is To Implement the Methodology in The Area of Research work(Fabrication) 5S, kaizen And Preventive Maintains.

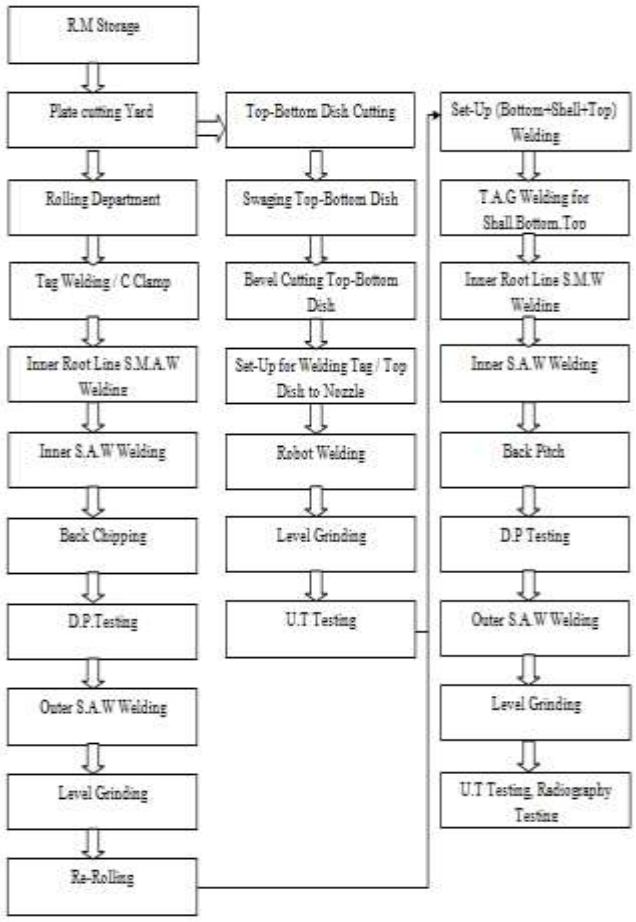
- 8th Step is to After Implementation Of Tools .After We Will Measured The Actual Process Of All Time or Repeat The Step of Time Study And Analysis The Result Before Implementation Actual Time And After Implementation Actual Time.

- 9th Step is We Will Calculate the Data Difference between before & after Implementations of Tools and Conclude the Result of the effectiveness of the Tools. The Result Are Good We Will Repeat the cycle Again And Again.

- This Method are Similarly Are Used in All tools like 5S, Kaizen, DIMIC, PDCA Cycle

4.1 FLOW PROCESS OF COMPANY

I will observe and analyze all of process are carried out in four department like raw material, plate cutting yard, dissent department and fabrication department. After understanding the all process thoroughly the whole process was broken down into small measurable activities for time study.



Flow Process of company

4.2 Product Costing Table

This is calculation only for top Department and its complete product during year and its Total monitory gain. All Of the Data Collocation Actual Process Timing of One standard 5000/63000 Litters Capacity AE/CE job.

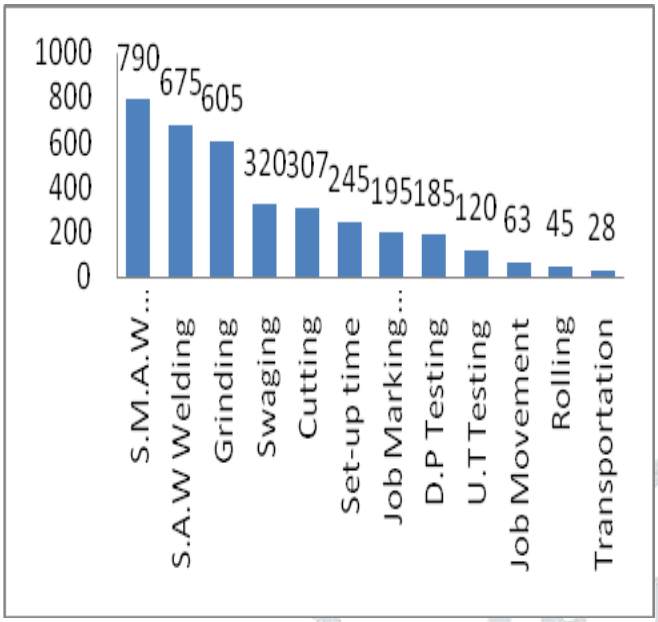
Objective	Value	Unit
Actual Time (One job completion Time)	3578	Min
Standard Time (one Job Completion Time)	2928	Min
Production Loss	650	Min
Lead Time	8760	Min
Total min per year	144480	Min
Yearly Manufacturing Product	41	Product
Current Productivity	81.83	Productivity

Product Costing Table

Actual Process Timing

Total 70 Process Are carried out In Completing For One Job. Similarly All Of Process Time Are Addition in One Table.

Process	Time In min
S.M.A.W Welding	790 Min
S.A.W Welding	675 Min
Grinding	605 Min
Swaging	320 Min
Cutting	307 Min
Set-up time	245 Min
Job Marking And Measurement	195 Min
D.P Testing	185 Min
U.T Testing	120 Min
Job Movement	63 Min
Rolling	45 Min
Transportation	28 Min
TOTAL	**3578 Min**



5.1 5S, Kaizen And Preventive Maintains Implementation Methodology

5S Training

Training Is Necessary For All Tools Because of Worker Not Aware About Process Any Tool Not Implement. We Wil Give The Training of The 5S, Kaizen And Preventive Maintains by Poster Presentation. We will Increase the Moral of The Worker And Increase The Awareness' of All Process

1S Sort

Sort means to remove all unnecessary items from workplace which are not required. First components are identified. They classify in necessary and unnecessary items. Necessary items are placed in the shop flore

Before & After Sort Activity

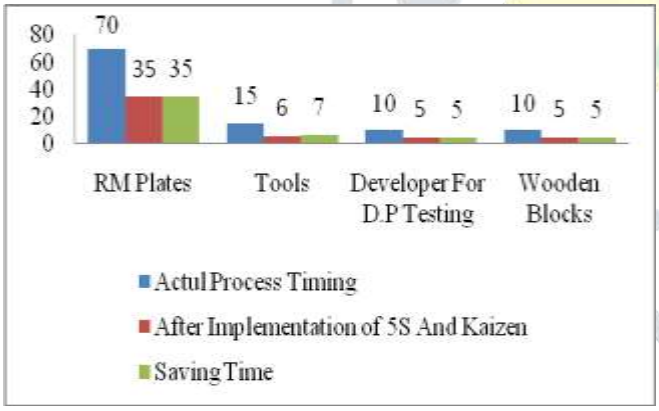
5.2 TANGIBAL BENEFITS OF SORT

Department	Area In Square Foot
Plate Yard And Raw Material	2260
Dished End	804
Glass Lining Zone	400
Fabrication Bay 1	1032
Fabrication Bay 2	10
Assembly	250
Total	**4756**

2S SET IN ORDER

Set in order means to arrange the required items to a particular place or Place of items is defined. Colors are used to mark different areas. Items are arranged in such a way that they are easy to use. Set in order used to labeling and shadow board so it can eliminate the searching time of tools, equipment and material

Before & After Set in Order Activity



Before & After Searching Time Graph

Before and After Conducting this Activity Searching Time for Require Plate was Calculated which Was Most Frequently thing Which every Employee need Before It was About 70 Min/Employee per Day. After it was 35 Min/Employee per Day.

- Saving Time = 70 - 35 = **35 Min**
- Saving time in Month = 35 × 30 = **1050 Min**
- Salary of Employee / Day = Rs 300/8 hrs ×60 = **0.62 R.s /Min**
- Cost Saving / Months = **(1050 × 0.62) = Rs 651**
- Total Labor cost saving / Month = 651 × 10 = **Rs 6510 (10 Employees in plate yard)**
- Total Cost saving / Year = Rs 6510 × 12 = **Rs 78120**
- Total Cost Saving For Tools, Developer for dP Testing And Wooden Blocks (550) = **Rs 1,73,910**

3S SHINE (Cleaning)

Shine means to keep everything clean maintain in order. In this step cleaning of the workplace is done. All Machines and Tools are cleaned properly. Practicing Shine also provide the cleaning sheet. Each worker everyday cleaning process carried out and there are everyday field the sheet. So it is easy to identify which time cleaning process are carried out in days,

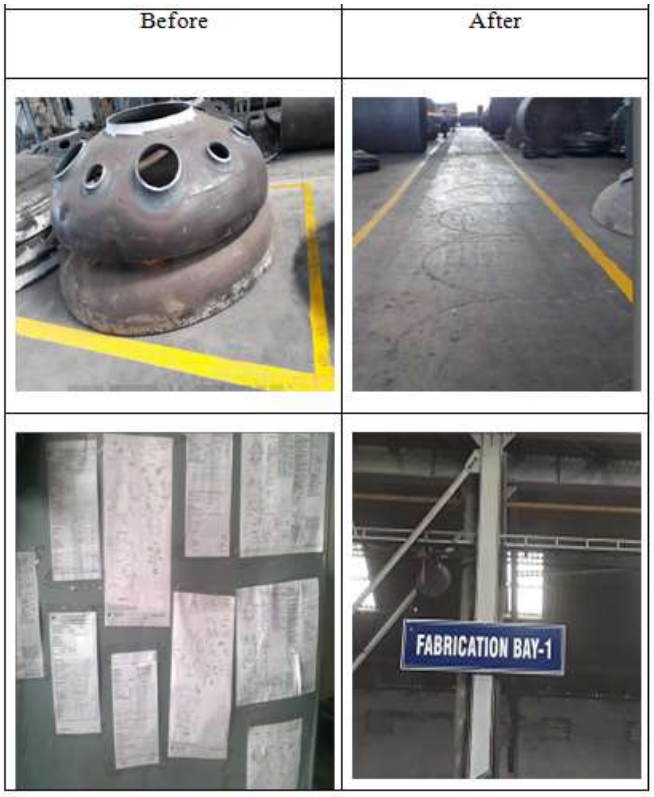
Before & After Shine or Cleaning

Cleaning Sheet

4S Standardize

Standardize means to create a consistent way of doing tasks and procedures. Create a set of standards for both organization and processes. it includes making of the checklist, SOP, follow the daily procedure.We have prepared the standard operating procedures (i.e. SOP's) for

machines and all instrument used method for workers in english and in their local language also. This is just to avoid mistakes which lead to rejection of final product



Standardized Activity

5s sustain

Sustain means to make it habit of properly maintaining a correct plan. Sustain new practices and conduct audits to maintain discipline. This means the previous four S's must be continued over time. For sustaining the '5S' technique effectively and to strictly adhere to it in the organization, internal audits as well as surprise audits are conducted periodically.

Before Implementation OF Audit List Score Is 28 After Implementations Of 5S, Kaizen And Preventive Maintains Total Score is 117.

5S CHECKLIST WORKPLACE EVALUTION				DATE						
WORK AREA				CHECKER						
1(VERY POOR)	2(POOR)	3(AVERAGE)	4(GOOD) 5(VERY GOOD)	MARKS						
5S	NO	CHECKING LIST	EVALUATION CRITE	0	1	2	3	4	5	REMARKS
SORT	1	Break Age Rods				2				
	2	Extra Unusual Tools					3			
	3	Scrape on floor						4		
	4	Under Maintanance				2				
	5	wastage					3			
SET ON ORDER	6	proper place		0						
	7	storage labs		0						
	8	lebels for documents			1					
	9	easy of uses		0						
	10	sequence of uses			1					
SHINE	11	Floor			1					
	12	Dust and Dirt			1					
	13	Cleaning Responsibility			1					
	14	Beam for Scrap			1					
	15	Leakage		0						
STANDARDIZ	16	All of know about 4s			1					
	17	implemantation standard		0						
	18	standard procedure and use				2				
	19	standardize way for frook			1					
	20	standardize all department			1					
SUSTAIN	21	5s training		0						
	22	improvement		0						
	23	Meeting at the end of week			1					
	24	interaction of Worker			1					
	25	Ruals and Regualation			1					

TOTAL SCORE - 28

1-50 IMPROVEMENT IS MENDITORY 51-75 : IMPROVEMENT REQUIRED 76-100 : COULD BE BETTER 101-125 DOING WELL MAINTAIN IT.

Before Implementation of 5S And Kaizen Audit List

5S CHECKLIST WORKPLACE EVALUTION				DATE						
WORK AREA				CHECKER						
1(VERY POOR)	2(POOR)	3(AVERAGE)	4(GOOD) 5(VERY GOOD)	MARKS						
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	19	standardize way for frook							5	
	20	standardize all department							5	
SUSTAIN	21	5s training						4		
	22	improvement							5	
	23	Meeting at the end of week						4		
	24	interaction of							5	
	25	Ruals and								

TOTAL SCORE - 117

1-50 IMPROVEMENT IS MENDITORY 51-75 : IMPROVEMENT REQUIRED 76-100 : COULD BE BETTER 101-125 DOING WELL MAINTAIN IT.

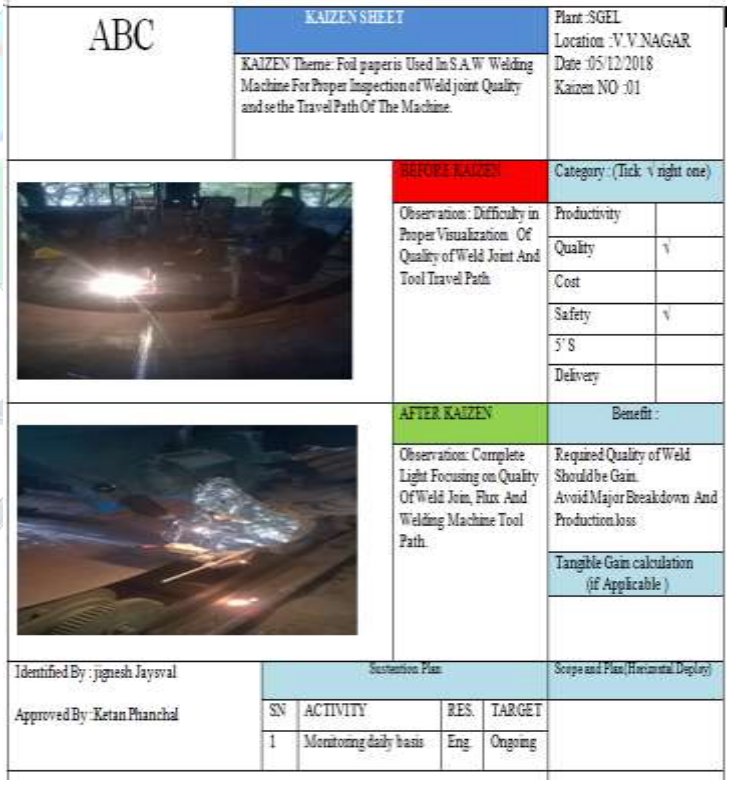
After Implementation of 5s And Kaizen Audit List

5.2 Kaizen Implementation

Kaizen is a Japanese word that indicates a process of continuous improvement of the standard way of work. It is a compound word involving two concepts: Kai (change) and Zen (for the better).

Kaizen Implementations In Swaging Machine And Rolling Machine.

- First Problem is When Ever Swaging Operation Are Carried out More Time Consume in Job Set-up. Problem is Machine Platform are Some of The Height And Also Job Dimension is Very high So more Difficulty in Job Set-up.
- We are kaizen Implement in Swaging Machine Platform Of Swaging Machine is remove And That Place 22 mm Thickness Plate Are used That Because Less Time Consume in Job Set-up. We Are Saving to 15 To 25 Min In Set-up Time.
- Second Problem Is When Ever Swaging Operation Are Carried out we Need of heating The Material. We Are Heating The Material operator take Approximately Time For Heating The Material. It is More time Consumable Process We Are kaizen Implement in This Process We Are Provide Thermo pen. Function of thermo pen is When You Are Used Pen mark on Swaging Location on Top Dish After We Are Heating The Material Required Temperature Approach The Pen Mark Is Slowly Remove And Swaging Operation Are Carried Out. This Thermo Pen Used We Are Saving Time Of 15 to 25 min.
- Third Problem is We Are used Of Rolling Machine For Flat plate Are convert in to Shell. When Ever Rolling Operation Carried out more Brake down Occurred because of Height of Rolling Machine is Very high. We are kaizen implement in Rolling Machine. The Rolling Machine Are Under Ground in Some height So Reducing the possibility Of Breakdown Occurrences Is Less. In This Kaizen Implementation 15 min Saving Per one Shell Rolling



ABC	KAIZEN SHEET	Plant :SGEL Location :V.V.NAGAR Date :05/12/2018 Kaizen NO :01
	KAIZEN Theme: Foil paper is Used In S.A.W Welding Machine For Proper Inspection of Weld joint Quality and se the Travel Path Of The Machine.	

BEFORE KAIZEN	Category : (Tick √ right one)	
Observation : Difficulty in Proper Visualization Of Quality of Weld Joint And Tool Travel Path	Productivity	
	Quality	√
	Cost	
	Safety	√
	5' S	
	Delivery	

AFTER KAIZEN	Benefit :
Observation: Complete Light Focusing on Quality Of Weld Join, Flux And Welding Machine Tool Path.	Required Quality of Weld Should be Gain. Avoid Major Breakdown And Production loss
	Tangible Gain calculation (if Applicable)

Identified By : jignesh Jaysval Approved By : Ketan Phanchal	Sustention Plan			Scope and Plan (Horizontal Deploy)
	SN	ACTIVITY	RES.	TARGET
	1	Monitoring daily basis	Eng.	Ongoing

Kaizen Sheet.

5.3 PREVENTIVE MAINTAINS

- Preventive Maintains Are Best Methodology to Achieve Our Objective. In This Step we Are Give The Preventive Maintamce to the All Machine And Equipment. Before Implementation of This

Method Yearly One Time Maintain the Machine and Equipment. It is Call Plan Maintains. We Are Give The This Preventive And Predictive Maintains To The Yearly 3 Time .That Because All Machine And Equipment Run On Standard Operating Process and Help in Reducing The Cycle time Or Long Lead Time.

- We are Prepaid The Preventive Maintains tag And Put On Every machine And Equipments. All The Producer of Maintains Instruction Write In Local Language Gujarati and English on Tagg

- Preventive Maintains Big Impact in S.M.A.W. Welding And S.A.W welding. When Ever The Welding Process Are Carried Voltage Flaucation Occurred in Every Pass This Voltage Fluction Because Some Time Fat Welding joint Or Some Time Thin Welding Joint Are Carried out. This Types Welding Joint Consume More cycle Time And Also Consume More Time in Grinding Operation For Repair The Welding Joint.

- The big Resion of Voltage Flucation is Old Welding Machine And Faulty Rolling Fixture. Some Machine or Fixture Are Faulty That Because Vibration of Machine is Occurred. So that the Preventive Maintains is Necessary to All of Machine And Equipments

Preventive Maintains Tag

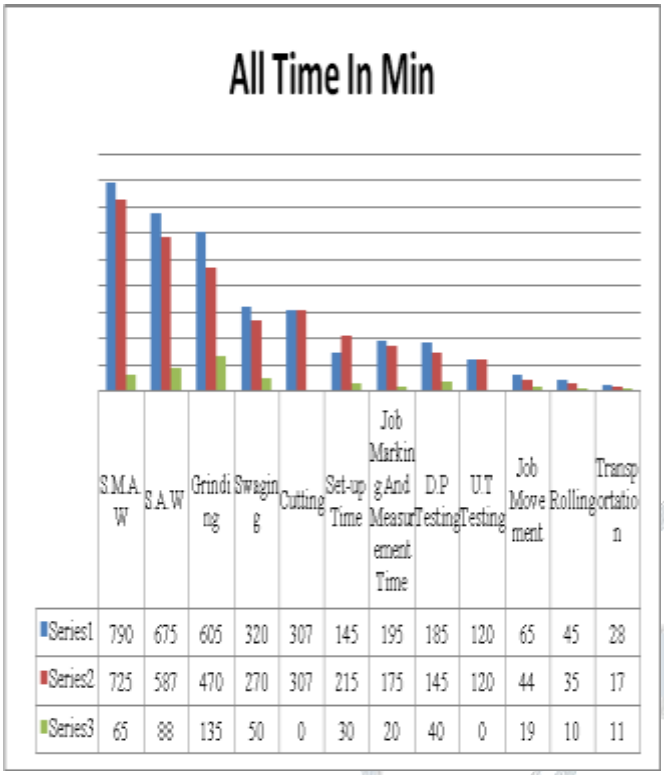
6.1 RESULT AND DICUSSION

We Are Implementation Of 5S We Achieving Our Objective Clearly.

- First Step of SORT is Carried Out Improve The Area Utilizations 4756 Square Foot. That Because Improve The Necessary Ground Work And Reducing The Transportation Time 10 to 15 min.
- Second Step of SET IN ORDER carried out Reducing The Searching Time 40 To 50 min.
- Third Step Of SHINE Increase the Moral of The Worker And Reducing The Chance of Accident.
- Fourth Step STANDARDIZE , KAIZEN AND PREVENTIVE MAINTAINSE Reducing Cycle time Or Long Lead Time.
- Last Step SUSTAIN Improve The Score Of the 5S Rating is 28 To 117 Means Well Maintain.
- Swaging Operation Reducing The Time of 25 to 40 Minutes
- Rolling Operation Reducing The Time Of 15 TO 25 Minutes.

6.2 Product Costing Table

Objective	Before Process	After Process
Actual Time (One job completion Time)	3578 Min	3110 Min
Production Loss	650 Min	182 Min
Lead Time	8760 Min	7884 Min
Total min per year	144480 Min	144480 Min
Yearly Manufacturing Product	41 Product	47 Product
Current Productivity	81.83 Productivity	94.14 Productivity



	S.M.A.W	S.A.W	Grinding	Swaging	Cutting	Set-up Time	Job Marking And Measurement Time	D.P Testing	U.T Testing	Job Movement	Rolling	Transportation
Series1	790	675	605	320	307	145	195	185	120	65	45	28
Series2	725	587	470	270	307	215	175	145	120	44	35	17
Series3	65	88	135	50	0	30	20	40	0	19	10	11

Before And After Implementation 5s And Kaizen Time

7.1 CONCLUSION

The following major conclusions are drawn from the review of application of 5S , Kaizen And Preventive Maintains methodologies to improving manufacturing Process And Work Place Development.

- Productivity Improve From 81.83% to 94.14%
- Yearly manufacturing Product Increasing From 41 Product to 47 Product.
- 5S Audit List rating or effectiveness of 5S Increasing From 28 Lower Level To 117 Well Maintain Level.
- Reducing The Different types Of Waste like Transportation, Delay, rework, Motion And Inventory
- Increasing The Productivity in The Industry.

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