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STUDY OF KAIZEN IMPROVEMENT WITH LEAN TOOL SMED FOR WELDING CELL

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***Abstract*— Setup Reduction or SMED (Single Minute Exchange of Die) is a process for dramatically, logically & methodically reducing setup time. We have identified Welding Cell for the study and Kaizen as the demand on it has increased in this year due increase in the customer demand to reduce the losses and increase the productivity. One of the contributors for availability loss of welding machine is setup changeover, hence SMED is to be practiced to reduce setup changeover to improve productivity of the machine. Currently it is observed that the loss of machine availability due to set up change over is around 30 minutes.**

***Keywords*— Kaizen Improvement, Lean Tool, SMED, Welding Cell**

I. INTRODUCTION

The Kaizen is to study the line flow, identify waste and implement the improvement opportunities to eliminate the waste and High set-up time for changeover on welding machine from 32.8 minutes to 10.8 minutes.
One of the primary challenges facing many manufacturing facilities today is diversified, low-volume production - This type of production demands frequent setups, or changeovers, in order to maintain product availability.

OBJECTIVES: The Kaizen is being undertaken to meet the annual Productivity Improvement Initiative and remove the wastes.

II. PROPOSED METHODOLOGY

A. Setup Reduction Steps–

Step 1: Observe and document current setup - Identify piece of equipment for improvement - Select members for setup kaizen team - Video the setup process - Break down setup process using Setup Operations Analysis - Prepare a pareto chart showing each time category.
Step 2: Separate Internal and External Activities - This second step of Setup Reduction, we assure that those activities that SHOULD be external are ACTUALLY completed prior to the machine stopping … this has an immediate positive impact on the time the machine is stopped. - Use checklists to ensure that necessary tooling, materials, and information are ready . - Make them appropriate to the machine and the setup.
In addition to ensuring that the correct parts and tools are on hand, we must verify that they are all in working order - We satisfy this requirement by performing functional checks as part of external setup: o Are gauges working? o Are jigs accurate? o Have outstanding repairs on molds and dies been completed? - Transport large fixtures to minimize the amount of time a machine sits idle.
Step 3: Convert Internal activities to External Where POSSIBLE - Setting Operating Conditions in Advance: o Setting conditions in advance includes such activities as: Pre-heating of dies and molds .Pre-assembly of fixturing . Preloading/offline editing CNC programs . Ask yourself what you currently run up to a normal operating condition during a machine setup; then ask how you can get to that condition before the setup even begins.
Step 4: Improve Internal activities - Standardizing the Function of Setup Steps: o Decreases internal setup time by standardizing functions of setup steps (e.g., clamping, centering, dimensioning, expelling, grasping, maintaining loads, etc.) Ask: How can we standardize clamping, centering, dimensioning, expelling, grasping, maintaining loads, etc. in the simplest manner possible.
Step 5: Improve External activities: - Every minute spent looking for tools, dies, jigs or other materials adds to set up time - A strong 5S foundation will ensure that all required materials are in place when needed, clean, and in working condition.
Step 6: Observe and standardize new setup: List each element on the Setup Operations Standard Chart (after Kaizen) .Make Video of the new set-up procedure. Record the time for each element . Note areas for future improvement. The Setup Operations Standard chart will become the basis for the new setup Standard Work and Job Breakdowns . Assure that all appropriate personnel are trained in the new procedure. New standard should be reflected in visual controls (e.g., hour by hour chart) used to run the cell/area where the setup was improved . If effective visual controls are not in place, you may need to measure and track setup time separately to assure sustainment.
Step 7: Continue to apply kaizen to setup: 99% of people at the work site will not believe SMED is possible due to the "common sense" of the existing methods and their own paradigms. Generally speaking, setup time can be reduced by >50% every time it is focused upon .Shigeo Shingo believed that Any setup time can be reduced by 59/60ths!.

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KEY DELIVERABLES (Prioritized):
1 Set-up a SOP(Standard operating procedure) for changeovers
2 Horizontal deployment of the actions which are common for other machines
Outputs and outcomes:
Reduction in the changeover time:Before implementation of Kaizan,changeover time was 32.8 minutes which is reduced to 10.8 minutes.Percentage improvement in changeover time was 67%

Stage wise Project task details:	
Stage -0	1. Current state data capturing (OEE) and analysis 2. Current state video capturing
Stage-1	1. Complete the setup analysis by observing video 2. Final Pareto 3. Brainstorming for improvement plan
Stage-2	1. Continue brainstorming, 2. Prepare improvement plan & try storming
Stage-3	1. Try storming & final proposal (after Kaizen), 2. Preparation of setup operations
Stage-4	1. Re-Videotaping after kaizen analysis, 2. Kaizen newspaper
Stage-5	1. Training of operators & concern stakeholders, 2. Report out

Table 1.Stagewise Project task details

B. DATA ANALYSIS AND INTERPRETATION

We made a survey statistics to emphasize on our research. We Draw out a Data Analysis with interpretation for that Analysis. We make graphical representation with flowcharts.

Portescap				KAIZEN CHARTER and EVENT TRACKING FORM	
KICK-OFF DATE:	12-Jun-23	REPORT OUT DATE:	16-Jun-23	TOOL(s):	SMED
KAIZEN TITLE:	Set-up time reduction kaizen for cup & plate welding machine			Record ID #:	
GEMBA:	Canstack welding line	PROCESS OWNER:	[redacted]	TEAM LEADER:	Abhishek Dhuri
TTI/KPI IMPACTED:	Productivity			STAFF CHAMPION:	
LEVEL:	L3	PD TTI or DM KPI OWNER:	[redacted]	FACILITATOR:	Amey Mendjoge

PROBLEM SOLVING PROCESS (KAIZEN EVENTS SUPPORT THE DHR PSP - DEFINE THE PROBLEM USING "TAGS")				
Problem Statement	Standard/Goal	Actual (Current)	Gap	Trend
High set-up time for changeover on welding machine	10.8 mins	32.8 mins	67%	Inconsistent

WHY IS THIS KAIZEN NECESSARY : (RATIONALE for solving this problem)
One of the contributor for availability loss of welding machine is setup changeover, hence SMED is to be practiced to reduce setup changeover to improve productivity of the machine. Currently it is observed that the loss of machine availability due to set up change over is around 30 mins.

GEMBA BOUNDARIES			
PROCESS STARTING POINT:	Loading of cup & plate on machine	WHAT IS IN-SCOPE:	Resistance welding machine
PROCESS ENDING POINT:	Unloading of cup & plate on machine	WHAT IS OUT-OF-SCOPE:	Riveting machine & dimpling machine

	EVENT GOALS/ TARGETS (Improvement Metric)	Pre-Kaizen Actual	Kaizen Improvement Goal	% Change JOP vs Target
1	Reduce the changeover time	32.8 mins	10.8 mins	67%

Table 2 Snapshot of Charter

GOALS:
1.Reduce changeover Time from 32.8 to 10.8 Mins (67%Improvement, 2/3rd of Time Reduction).
2. Eliminate Hazards of Falling of Heavy Die-set on legs.
3. De-skilling of changeovers by making it Operator friendly process: Non dependency on Technicians for basic changeovers

CURRENT STATE MAPPING:

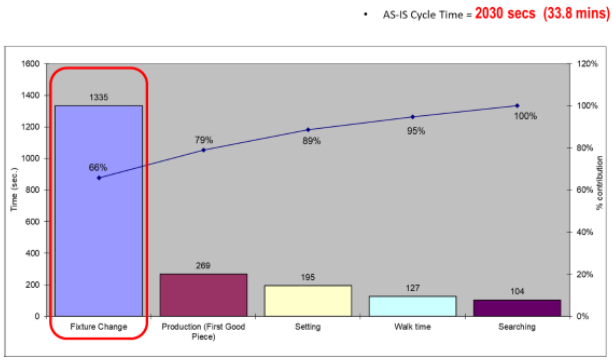

Table 3:Current State Mapping

III. EXPERIMENT AND RESULT

Improving the Current State:
3.1 Change in Fixture Design to Quick Release and Tightening of Allen Bolt as it required to open multiple plates for changing top and bottom electrode. Total Saving of Time 1136 sec. achieved with these improvements.

Fig.1 Change in Fixture Design

3.2 Relocating pressure gauge in arm's reach from working area. Pressure gauge was not in arm's reach from operator's position. Pressure gauge can now be accessed from the operator's position.

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Fig.2 Relocating pressure gauge in arm's reach from working area

The above change has resulted in time saving of ~117 sec. • 3.3 Tooling kit box : Searching for every tool was the case reduced by having all tools in one shadow box at a nominated location which eliminated cycle time of 104 sec.

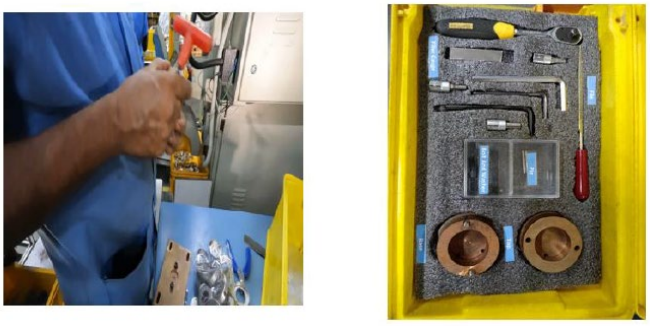

Fig.3 Relocating Tooling kit box

3.4 Quick Releasing of Allen Bolt at Pull Tester: It needed to loose Allen bolt multiple times with Allen key for strength checking setup. We Made a easy attachment for loosening the Allen bolt with hand. This saved the cycle time of ~70 sec.

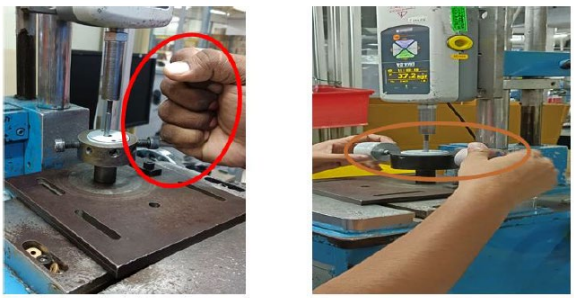

Fig.4 Quick Releasing of Allen Bolt

3.5 Obstructing Front Guard: Obstruction of the front guard was eliminated by implementation of multi layered Engineering Safety Poka Yoke with tigheter hinged door, which resulted in 10 seconds of set up time.

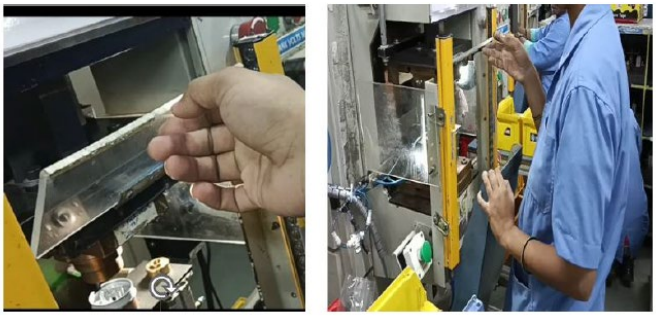

Fig.5 Obstructing Front Guard

In addition to ensuring that the correct parts and tools are on hand, we must verify that they are all in working order - We satisfy this requirement by performing functional checks as part of external setup: Are gauges working? Are jigs accurate? Have outstanding repairs on molds and dies been completed? - Transport large fixtures to minimize the amount of time a machine sits idle.

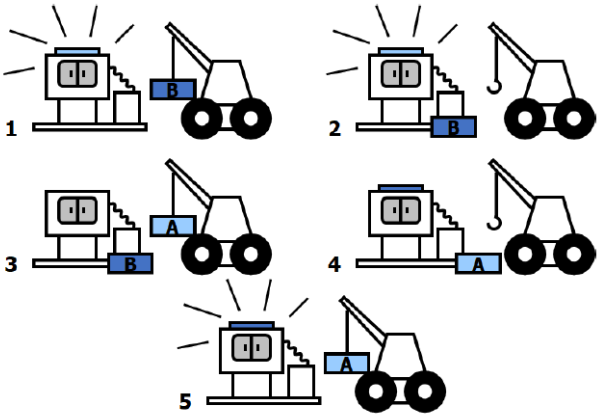

Fig.6 Functional checkups

Ask yourself what you currently run up to a normal operating condition during a machine setup; then ask how you can get to that condition before the setup even begins.

Standard Fixed Tools :
Decreases internal setup time by reducing number of tools that need to be changed during a setup

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Fig.7 decreasing internal setup time

Quick Change Hardware: Decreases internal setup time by reducing steps to install fixturing or tooling.

Fig.8 Quick Change Hardware

Quick Clamping: Decreases internal setup time by reducing or eliminating turns of screws and bolts, since only the last turn tightens and the first turn loosens.

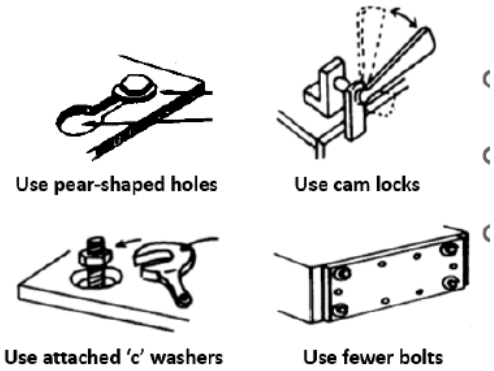

Fig.9 Quick Clamping

Internal Setting Tray: Reduces internal setup time by presenting objects closer to point of use.

Fig.10 Internal Setting Tray

Adjustment Elimination:
Definitions: A setting is a necessary (and usually gross) change to the operating condition of a machine. Adjustments are incremental changes used to "dial-in" a setting to a correct value. Endeavor to eliminate all adjustments! Reduces internal setup time by eliminating or reducing the time consumed by adjustment (trial run) cycles needed to get a good part. Continually perform Adjustment Analysis: What function is being served by an adjustment? What conditions create the need for the adjustment? What is the current adjustment method employed? How can we eliminate the need for the adjustment?

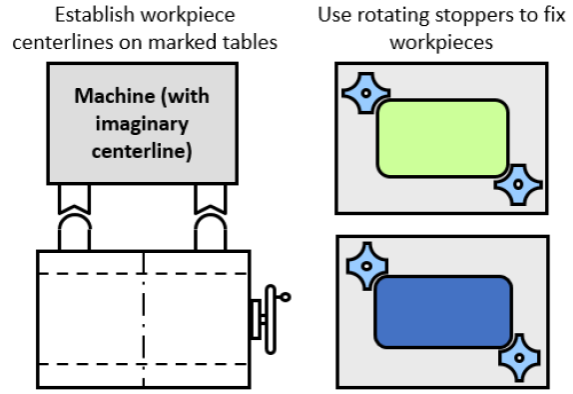

Fig.11 adjustment elimination

Results:

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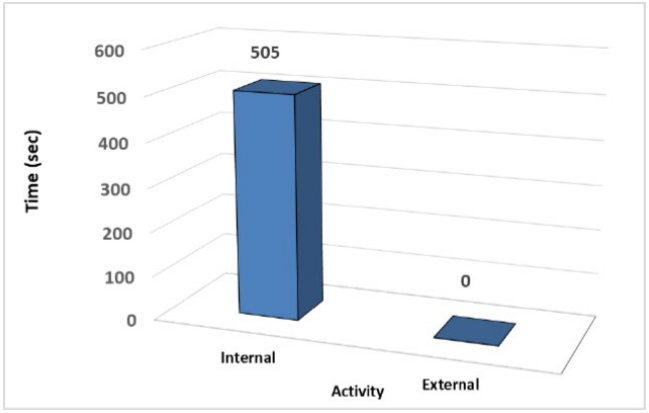

Table 4:Result

The time required to complete internal activities before implementation of SMED was 2016 second & after implementation of SMED is wad reduced up to 505 seconds. It means there is improvement in time saving by 75%.Also for external activities, the time required to complete external activities before implementation of SMED was 14 second & after implementation of SMED is wad reduced up to 0 seconds. It means there is improvement in time saving by 100%.

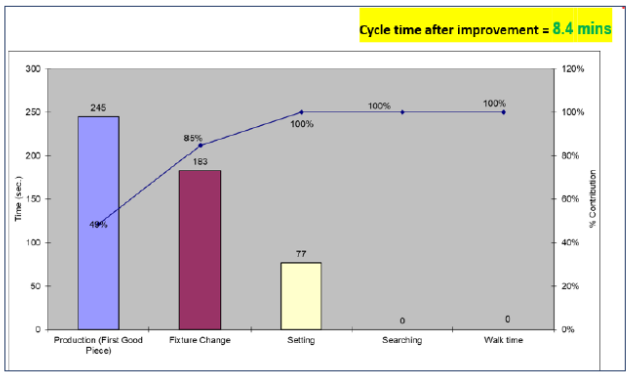

Table 5:CycleTime after improvement

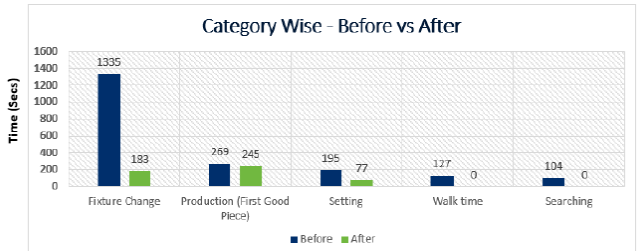

Table 6:Categorise time

Fixture change time before implementation of SMED was 1335 seconds & it was 183 seconds after implementation of SMED. First good piece production time before implementation of SMED was 269 seconds & it was 254 seconds after implementation of SMED. Setting time before implementation of SMED was 195 seconds & it was 77 seconds after implementation of SMED. Walktime before implementation of SMED was 127 seconds & it was 0 seconds after implementation of SMED. Searching time before implementation of SMED was 104 seconds & it was 0 seconds after implementation of SMED.

IV.CONCLUSION

This project help to improve the productivity and also eliminate or reduce the fatigue of the working people. This SMED project will get read across for other production lines on the shop floor. This can be implemented for all other lines and cells and departments of the organization. There was improvement in timesaving in internal activities which is by 75%.Also for external activities, there is improvement in time saving by 100%. Fixture change time was improved by 86%. First good piece production time was improved by 9%.Setting time was improved by 9%.Walktime was improved by 100%. Searching time was improved by 100%.

V. REFERENCE

[1] Joshi R.R and Naik G.R. 2012 Application of SMED Methodology- A Case Study in Small Scale Industry. International Journal of Scientific and Research Publications, Volume 2, Issue 8, Page No.-1 to 4

[2] Palanisamy S. and Siddiqui Salma,2013, Changeover Time Reduction and Productivity Improvement by Integrating Conventional SMED method with Implementation of MES for Better Production Planning and Control. International Journal of Innovative Research in Science, Engineering and Technology, Volume 2, Issue 12, Page No.-7961 to 7974

[3] Gaikwad Sanket P , Shivprasad S. Avhad, Pawar Swapnil and Thorat Pradnya,2015, Reduction in Setup time on Rubber moulding machine using SMED technique. International Journal of Engineering Research & Technology, Vol. 4 Issue 04, Page No-169 to 173

[4] Pablo Guzmán Ferradás, Konstantinos Salonitis.2013, Improving Changeover time: a tailored SMED approach for welding cells. Procedia CIRP, Volume 7, Pages 598–603. DOI: /10.1016/j.procir.2013.06.039

[5] Patel Chintan Kumar,2013, Setup reduction – a perfect way of productivity improvement of computer numerical control(CNC) setup in manufacturing company ,Journal of Mechanical Engineering research,PP.166-170;IISN:2141-2383.

[6] Goubergen, D.V., Landeghem, H.V., 2002. Rules for integrating fast changeover capabilities into new equipment design. Robotics and Computer Integrated Manufacturing 18, pp. 205 – 214.

[7] Gest G., Culley, S.J., McIntosh, R.I., Mileham, A.R., Owen, G.W., 1995. Review of fast tool change systems.

Computer Integrated Manufacturing Systems 8, pp. 205-210.

[8] Coimbra, E. A., 2009. Total Flow Management: Achieving Excellence with Kaizen and Lean Supply Chains. Kaizen Institute.

[9] Shingo, S., 1985. A revolution in manufacturing: The SMED system. Productivity Press, Stanford, CT.

[10] McIntosh, R.I., Culley, S.J., Mileham, A.R., Owen, G.W., 2001. Changeover improvement: A maintenance perspective. International Journal of Production Economics 73, pp. 153 – 163.

[11] Liker, Jeffrey L., 2006. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. Free Press division from Simon & Schuster, Inc., New York.

[12] McIntosh, R.I., Culley, S.J., Mileham, A.R., Owen, G.W., 2000. A riti al evaluation of hingo' ' MED' (ingle Minute Ex hange of Die) methodology. International Journal of Production Research 38, pp. 2377 - 2395.

[13] Reik, M.P., McIntosh, R.I., Culley S.J., Mileham, A.R., Owen, G.W., 2006. A formal design for changeover methodology. Part 1: Theory and background. Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture 220, p. 1225.

[14] McIntosh, R.I., Culley, S.J., Mileham, A.R., Owen, G.W., 2001. Improving changeover performance. A strategy for Becoming a Lean, Responsive Manufacturer. Elsevier, Ltd.