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Research Article

Set-up time Reduction of a Manufacturing Line using SMED Technique

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Abstract

Nowadays, forging industries are adopting new tools and techniques to increase productivity, operational availability and better overall efficiency of the production line. This research describes the improvement in the set-up time process of a straightening cell on Axle Beam line. SMED is one of the many lean production techniques for reducing waste in a manufacturing process. The Single-Minute Exchange of Die (SMED) methodology and other Lean Production tools (5S, Visual Management, Kaizen and Standard Work) were applied to reduce the setup time. As a result, the process setup time was significantly lowered (from 52 to 24 minutes). The percentage reduction in the set-up time 53.85%.

Keywords*: Setup Reduction, Single Minute Exchange of Die (SMED), bottleneck, Internal and External Activity.*

1. Introduction

Lean manufacturing is a production practice that considers the expenditure of resources from any goal other than the value for the end customer to be wasteful, and thus a target for elimination. Working from perspective of the customer who consumes a product or a service Value is defined as any action or process that a customer would be willing to pay for. SMED is one of the techniques from lean manufacturing.

The need for short setup times is not new; it has been around for quite a while. Indeed, the time between producing the last product of a series, and producing the first product of a new series that meets all quality requirements; has always been considered as a production waste. More recently, in all types of industries, there is an increased focus on reduction production waste, so the need for short setups is now bigger than ever. A setup can be defined as the elapsed time between the last product A leaving the machine and the first good product B coming out. The SMED project work is carried out in forging industry.

2. Literature Review

B. Suresh Kumar, S. Syath Abuthakeer (2012) provided a rapid and efficient way of converting a manufacturing process from running the current product to running the next product in a fagor press involved in the machining of evaporator plates. Eric Costa, Rui Sousa, Sara Bragança, Anabela Alves (2013) developed a solution for SMED technique with the help of 5S, Visual Management and Standard Work. Mr. Rahul.R.Joshi, Prof.G.R.Naik (2012) reduced the cycle time by using SMED technique and increased output and reduced quality losses in an automotive industry. Silvia Pellegrini, Devdas Shetty and Louis Manzione (2012) used combination of SMED technique, Deming's PDCA (Plan-Do-Check-Act) cycle and idea assessment prioritization matrix for reducing cycle time during an Kaizen event. S. Palanisamy, Salman Siddiqui (2013) in there research using SMED with MES (planning system interface) improvement programme, the company achieved much reduction on changeover time which led to the increase in high productivity. Yashwant R.Mali, Dr. K.H. Inamdar (2012) chosen the SMED technique for the machines having utilization less than 80% and reduced change-over time significantly. Varsha N. Karandikar and Shriram Madhukar Sane (2013) proposed a new method of postural analysis by which setup time can be reduced with improvement in safety. Varsha N. Karandikar and Shriram Madhukar Sane (2014) proposed job difficulty index (JDI) with the help of which the severity of work and time required can be studied and improved.

3. Methodology

3.1 Data Collection and Analysis

Data collection is done for Straightening Press setup time in Axle processing line. An operation was used in this study to summaries and describe the data. After Studying the Production process flow identification of bottleneck, set-up time and standard operation procedure are reviewed briefly before setting up the data collection table is done. Based on the present production, data was collected and recorded on a daily basis.

From the Figure 1, it can clearly identify that the set-up time of the Straightening Press is a bottleneck process. Therefore to reduce line set-up time, Straightening Press set-up time should be reduced. A detailed process study of

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Table 1: Detailed set-up process of Straightening Press

Current Process		Current Time		Improvement	Effects
Sr. No.	**Operation**	**External (Seconds)**	**Internal (Seconds)**		
1	Dismantle the old Die from the Rotary Fixture	0	171	No action	No effect
2	Searching the New Die in the Rack	0	596	1) Systematic arrangement (Keeping Die Tools in labelled boxes in rack.) 2)Making a chart of Die arrangement on Racks	Tremendous time reduction due to systematic labelling & chart display.
3	Fixing the new dies to the Rotary Fixture	0	510	Colour coding to the Die (Inner tool/ Outer tool)	Assembly in the first attempt.
4	Checking the tools according to the job	0	268	Work done by the operator while the free worker is taking the Inspection fixture and Height plates to the rack.	Parallel operation reducing time
5	Dismantle inspection fixture	0	120	Deploy free worker (From Untwisting cell) to do the dismantle of inspection fixture while the operator is dismantling Height plates from Kingpin resting block.	Set-up time reduction because of simultaneous activity
6	Taking old inspection fixture to the rack	0	120	Work done by the free worker while the operator is checking the job in the rotary fixture.	Set-up time reduction due to simultaneous activity
7	Searching for new inspection fixture in the Rack	0	113	Work done by the free worker while the operator is checking the job in the rotary fixture.	Set-up time reduction due to simultaneous activity
8	Bringing new inspection fixture to the machine	0	128	Work done by the free worker while the operator is checking the job in the rotary fixture.	Set-up time reduction due to simultaneous activity. Internal activity becomes external activity
9	Assembly of inspection fixture	0	252	Assembly done by the free worker while the operator is assembling the Kingpin height plates.	Set-up time reduction due to simultaneous activity. Internal activity becomes external activity
10	Checking the Kingpin resting Blocks	0	68	No action	No effect
11	Dismantle Height Plates	0	166	Operator dismantles the Height plates when the free worker dismantles the Inspection fixture	Parallel operation reducing time
12	Taking the old height plates to rack	0	75	Taken by free worker along with the Inspection fixture to rack (Trolley)	Set-up time reduction due to simultaneous activity. Internal activity becomes external activity
13	Searching for new height plates in the rack	0	79	Arrangement of Height plates systematically and displaying a chart of plate thickness according to die used	Finding height plates very easily due to display of reference chart
14	Bringing new height plates to the machine	0	70	Bringing the new height plates along with the inspection fixture in the trolley.	Set-up time reduction due to simultaneous activity. Internal activity becomes external activity
15	Assembling new height plates to the machine	0	120	Work done by operator while free worker assembles the inspection fixture	Parallel operation reducing time
16	Checking the final setup according to the job	0	120	No action	No effect
17	Calibration of inspection fixture	0	120	No action	No effect
18	Starting the production	0	49	No action	No effect
	Total set-up time	0	3155	-	-

setup on straightening machine is carried out. This contains activity number, activity carried out, time required, internal and external activities are sorted. Table.1 below shows the detailed set-up of Straightening Press.

3.2 Improvements carried out for SMED

Following table shows the improvements carried out for SMED project. All the figures are depicts the before and after conditions of activity. Figure1 shows the systematic arrangement of the rack. Figure 2 shows the idle worker of another cell is utilized for set-up purpose. Fig 3 shows the before and after conditions of tools and fixture handling.

Table 2: Proposed and Present Timings of Improved Process

Sr. No.	Improved Process	Proposed Time (Seconds)		Present Time (Seconds)	
		Internal	External	Internal	External
1	Dismantle inspection fixture	180	-	300	-
2	Bringing Inspection fixture & Height plates to machine	-	360	-	240
3	Bringing Rotary fixture tools to Machine	120	-	115	-
4	Assembly of Rotary fixture tools	540	-	540	-
5	Dismantle and assemble Inspection fixtures and height plates	600 (Parallel activity)	-	600 (Parallel activity)	-
6	Checking set-up for new job	300	-	300	-
7	Taking inspection fixtures & height plates to Rack	-	180	-	180
8	Calibration of inspection fixture	120	-	120	-
9	Starting production	60	-	60	-
	Total set-up time	1440		1435	

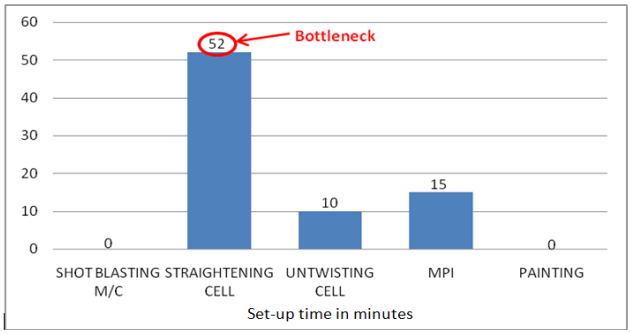

Figure 1: Bottleneck identification

Figure 4 Deployment of idle worker of untwisting cell

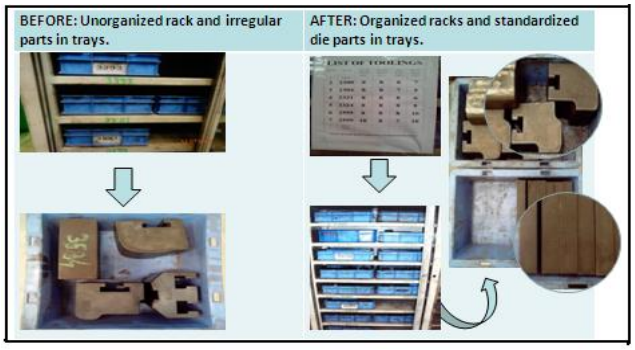

Figure 2 Systematic Arrangements of Dies in Rack

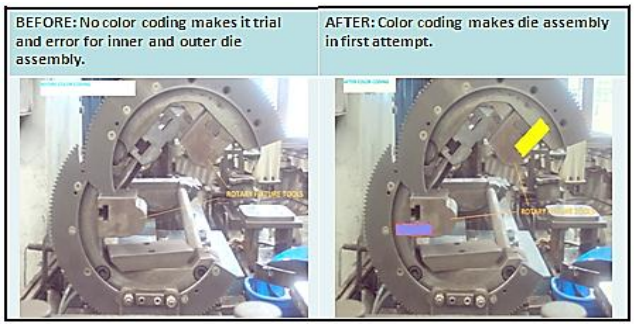

Figure 3 Colour Coding of Tooling

Figure 5 Use of trolley for moving Inspection fixtures &Rotary fixture

In before conditions the worker carries all the tools and fixture by hand which causes wastage of time for set-up process. But in after condition the tools and fixtures are carried by using trolley which resulted in the resulted in set-up time reduction and safety is improved.

4. Results

The goal to reduce machine downtime during the setup operations and reduction in setup time is achieved. By

implementing the SMED techniques, the total time taken to perform setup activities at straightening press was reduced by from 52 minutes to 24 minutes i.e. 28 minutes reduced and the percentage reduction in set-up time is 53.85%. The other details of Internal and External Activities are depicted in the table 3 and Figure 6.

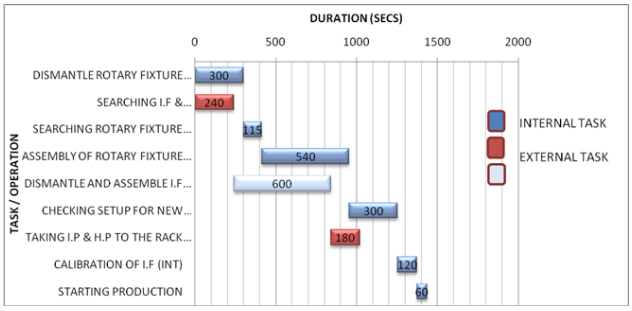

Figure.6 Graph of implemented setup process time for straightening press

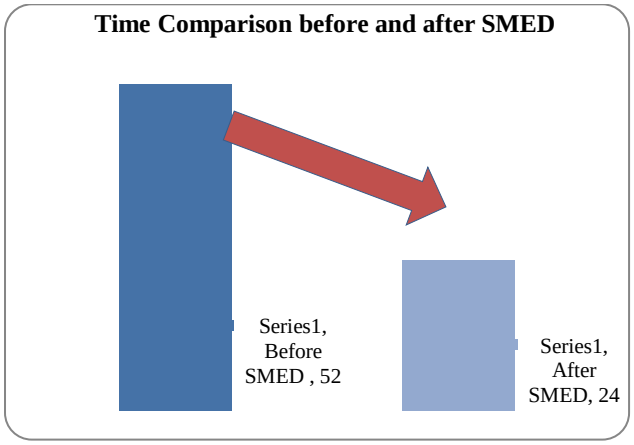

Figure 7: Time Comparison before and after SMED

Conclusion

The lean manufacturing technique implemented and a significant result was achieved. SMED methodology was applied to prepare an optimal standard procedure for changeover operations on straightening press. Based on a series of time study data collected during the setup activities in the straightening press, a comparison of results, achievements before and after the SMED implementation was made to measure the effectiveness of SMED to reduce setup time.

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