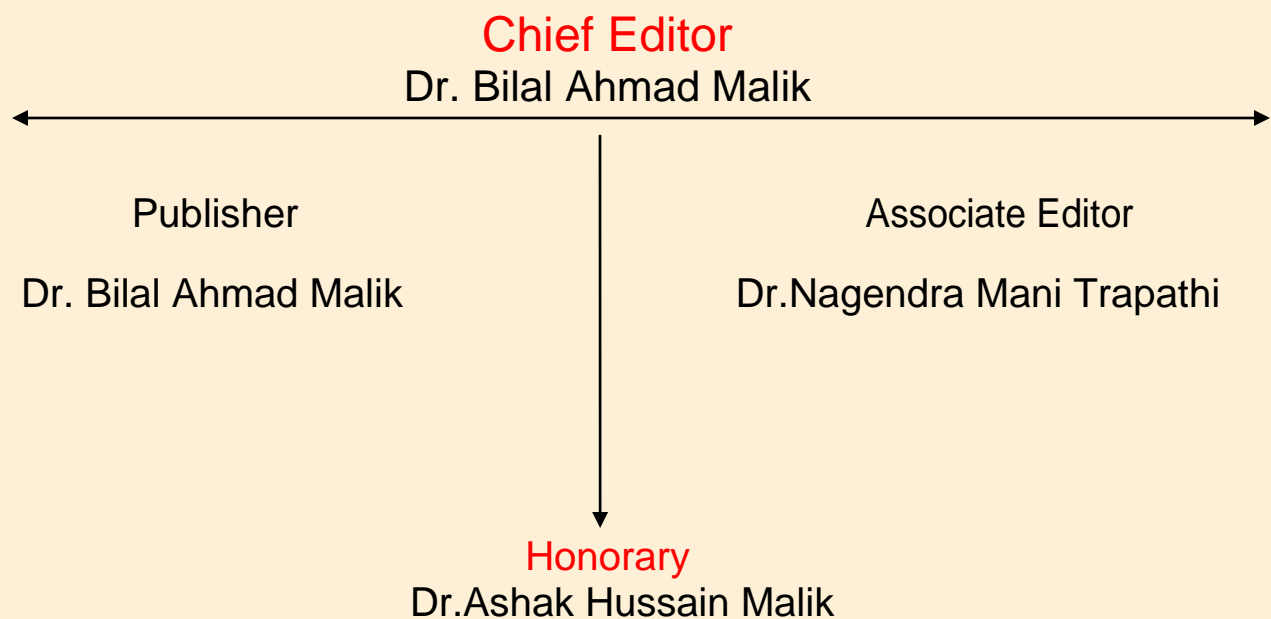


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SETUP TIME REDUCTION ON COLD FORGING MACHINE IN A FASTENERS MANUFACTURING COMPANY BY USING SMED TECHNIQUE

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ABSTRACT:

The present manufacturing scenario demands low quantity and high variety parts. This can be achieved only through lean manufacturing. The present production system like Just-in-Time manufacturing demands smaller production quantities which in turn mean more setup times (non-productive time). Companies should focus on reducing non-productive time in order to remain competitive. Thus quick change over is a critical element in lean manufacturing. Quick changeover is also known as setup reduction which focuses on eliminating or reducing non value added activities during the setup.

This work presents a simplified approach to reduce setup time on forging machine in a fasteners manufacturing company by using SMED technique. The initial step was gathering information about the present setup times. SMED primarily consists of analyzing the external and internal setup activities in terms of their need (i.e. preparation, replacement or adjustment), time taken and the way these could be reduced, simplified or eliminated.

Keywords: *Set-up reduction time, Single Minute Exchange of Dies (SMED)*

1. INTRODUCTION:

In the past years it has been observed that there is increased need for product in right time and with appropriate quality. The other hand due to globalization and current scenario in the market the companies need to increase their production and increase product flexibility by manufacturing the product in small batches size. Due to manufacturing of products in small batches there is need for companies to increase the frequency of setup for such condition it is necessary to entertain quick changeover processes in order to reduce the production losses.

Single Minute Exchange of Dies is one of the many lean producing methods for reducing waste in a manufacturing process. It provides a rapid and efficient way of converting a manufacturing process from

running the current product to running the next product. This rapid changeover is a key to reducing production lot sizes and thereby improving flow. The SMED technique is applied to reduce the setup time on cold forging machine in the fasteners section.

2. LITERATURE REVIEW:

[1] Shashikant Shinde, et al (2014) described the improvement in the setup process of a straightening cell on Axle Beam line and reduced the setup time from 52 to 24 minutes. [2] Gaurav J. Pawar, et al (2014) provides an analysis of current changeover methods of bearing ring grinding machine in a manufacturing plant having line layout and reduced the setup time using SMED and ECRS tools. [3] Rajesh Dhake, et al (2013) focused on the application of SMED and Quick changeover philosophy for reducing setup time on Solder Paste Printing machine in an electronic speedo –cluster manufacturing company. [4] Mr. Sanket P. Gaikwad, et al (2015) discussed the implementation of SMED technique for moulding of rubber to metal phosphate components for production of anti vibratory mountings which requires frequent changeover and reduced setup time from 2 hours to 8 minutes with minimum investment. [5] Deros B.M. et al (2011) achieved 35% of setup time reduction by applying SMED in an Automotive Battery Assembly line. [6] S. Palanisamy, et al (2013) addressed setup time reduction through SMED with an integration of MES (Planning System Interface) and achieved much reduction on changeover time which led to the increase in high productivity. [7] Yash Dave, et al (2012) covered the literature review of SMED tool to develop an overview of the conceptual frame work of SMED tool.

3. METHODOLOGY:

There are different interpretations of the SMED method all aiming towards the same end, to reduce setup times. The implementation of SMED uses different steps to improve production and reduce waste. Setup reduction projects don't require a significant investment, and can be accomplished in a matter of weeks.”

3.1 Phases of set-up reduction:

- Observe the current methodology
- Separate the internal and external activities
- Shift internal activities to external activities
- Streamlining all aspects of the operation

The four phases mentioned above, are explained in detail with the data collected during the setup process on cold forging machine in the fasteners manufacturing company.

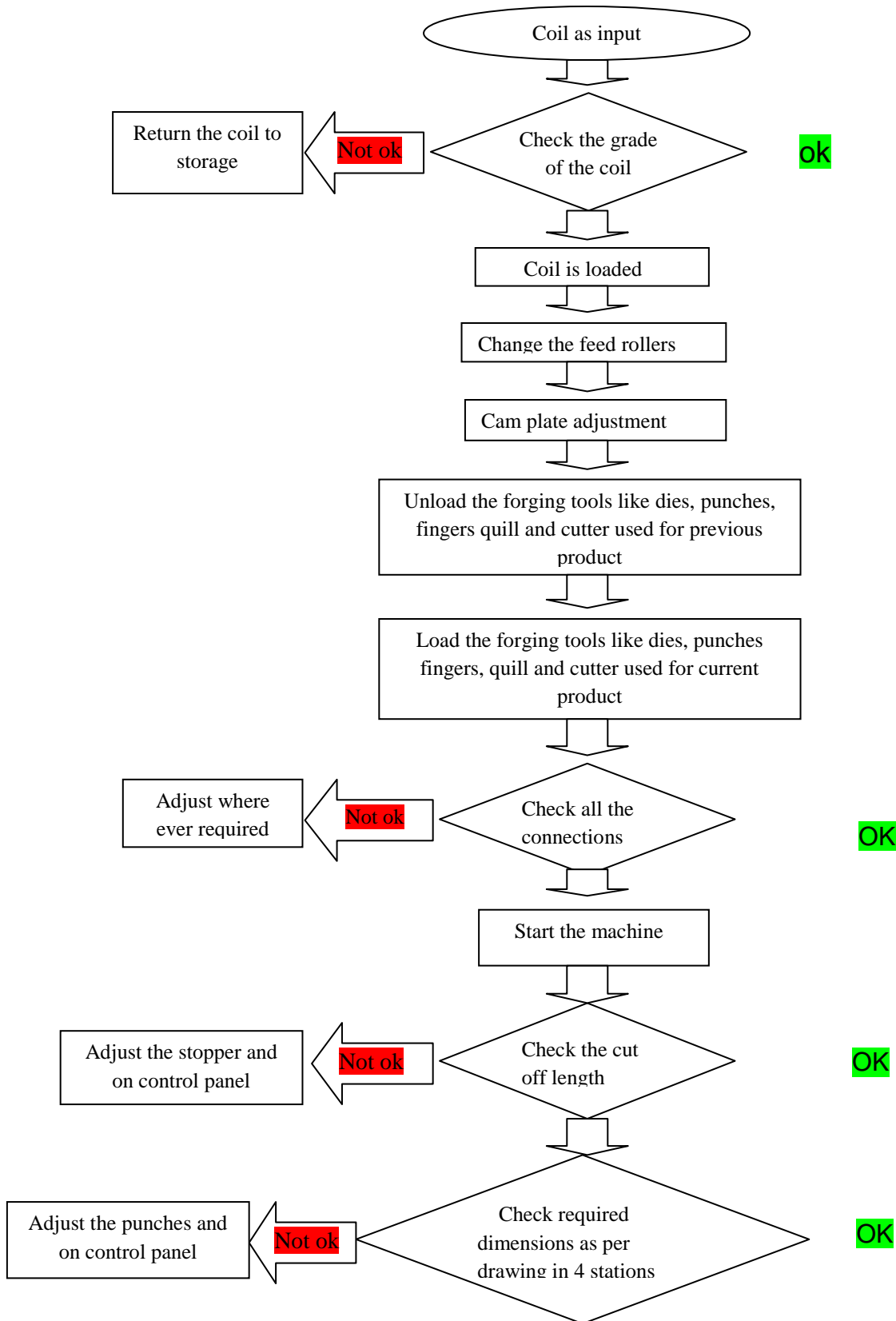
Phase1. Observe the current methodology:

This is the very first step in the SMED method. By observing the existing procedure in the fasteners manufacturing company, the activities and their corresponding time during the changeover is noted. The present study involved observing and analyzing the current changeover process by manual means employing time study, using activity breakdown and time observation sheets. The activities and their corresponding time during the setup are shown in Table1.

Table1: Activity chart- Existing method

S.no	Description of activity	Time in minutes
1.	Unloading the previous coil used in production if it is remained	3
2.	Transporting the coil to the coil storage	4
3.	Transporting the required coil from wire drawing section to the cold forging section	4
4.	Loading the required coil	4
5.	Transporting the previous product collected bin for secondary operations	5
6.	Changing the feed rollers	3
7.	Adjusting the cam plate	2
8.	Unloading the forging tools like dies, punches, fingers, quill and cutter used for previous product	25
9.	Transporting the forging tools currently used to the tools room and getting the required tools from the tools room	10
10.	Loading the forging tools required for current product	25
11.	Fingers centering or adjustment	20
12.	Setting time of the product in 4 stations as per drawing	60
13.	Setup approval	10
	Total time	175

The process for setup on the cold forging machine is shown in Fig.1



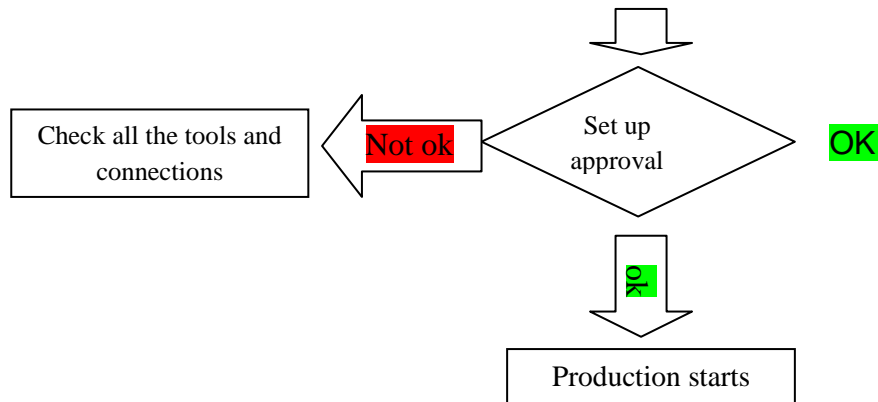


Fig.5.1 Process flowchart of setup process

Thus the process, the activities and their corresponding time are represented by the process chart and the activity diagrams. After studying the current methodology, the next step is to separate the internal and external activities which is the second phase of SMED.

Phase2. Separating internal and external activities:

By using SMED technique the most important point to be considered is separation of internal and external activities. There are two types of setup namely internal setup and external setup.

- **Internal setup** – setup operation that performs only when the machine is stopped such as mounting and removing of dies etc. during that period the machine does not perform useful work.
- **External setup** – setup operation that completes while the machine is running such as transportation of dies collecting spanners, bolts, forging tools etc.

During this classification phase, the activities recorded in the activity lists are reviewed and every task in the changeover process is challenged in a brainstorming and task evaluation activity to categorize them as Internal, and External.

Phase 3. Shifting internal activities to external:

This stage consists of the analysis of the current setup operations and determining means for converting activities in to internal setup to external, wherever possible. The idea is to move as many tasks as possible from internal time to external time because fewer tasks with in internal time will reduce the setup time.

In this process all the external activities are strictly done externally, provision is made to allot a helper to the machine operator for setup operations. The helper is responsible for performing all external activities. A standard setup procedure is prepared to guide the helper in performing the external setup activities and ensuring that these are strictly done while the machine is running.

Table 2. Activity chart for changeover after improvement

S. no	Description of activity	Time in minutes	
		Internal	External
1.	Unloading the previous coil used in production if it is remained	3	
2.	Transporting the coil to the coil storage	4	
3.	Transporting the required coil from wire drawing section to the cold forging section		4
4.	Loading the required coil	4	
5.	Transporting the previous product collected bin for secondary operations		5
6.	Changing the feed rollers	3	
7.	Adjusting the cam plate	2	
8.	Unloading the forging tools like dies, punches, fingers, quill and cutter used for previous product	25	
9.	Transporting the forging tools currently used to the tools room and getting the required tools from the tools room		10
10.	Loading the forging tools required for current product	25	
11.	Fingers centering or adjustment	20	
12.	Setting time of the product in 4 stations as per drawing	60	
13.	Setup approval	10	
	Total time	156	19

The proposed method with their activities and time are detailed in the Table2. With the proposed method the setup time is reduced to 156 minutes from 175 minutes. By this the machine up time increases and the production also increases, which in turn increase the profits to the company.

Phase 4. Streamlining all aspects of the operation:

In this phase the systematic improvement of each basic internal and external setup is performed. These developing solutions are to accomplish the different tasks in an easier, faster and safer way. In the final stage all the improvement studies are done and the checklists are formed. Finally the time delay is eliminated with proper records and well planning leads to proper customer satisfaction. The further scope of improvement in the setup process is explained in the Table 3.

Table 3. Detailed setup process and scope of improvement

S. no	Description of activity	Time in minutes	Improvement	Effects
1.	Unloading the coil used in producing previous product if it is remained	3	Better to use all the wire if the wire is almost used or else that work can be done in parallel by the helper while the operator unloading the forging tools	Unloading time of coil can be eliminated or else Setup time reduction due to simultaneous activity
2.	Transporting the coil to the coil storage	4	Work done by the helper while the operator unloading the forging tools	Setup time reduction due to simultaneous activity
3.	Transporting the required coil from wire drawing section to the cold forging section	4	Work done by the helper when the changeover is about to start while the previous product is running on the machine	Setup time reduction. Internal activity becomes external.
4.	Loading the required coil	4	Work done by the helper while the operator unloading and loading the forging tools	Setup time reduction due to simultaneous activity
5.	Transporting the previous product collected bin for secondary operations	5	Work done by the helper while the operator unloading and loading the forging tools	Setup time reduction due to simultaneous activity
6.	Changing the feed rollers	3	Work done by the helper while the operator unloading and loading the forging tools	Parallel operation reducing setup time
7.	Adjusting the cam plate	2	Work done by the helper while the operator unloading and loading the forging tools	Parallel operation reducing setup time
8.	Unloading the forging tools like dies, punches, fingers, quill and cutter used for previous product	25	Using pneumatic tools to remove bolts rather than manual tools	Unloading the forging tools time can be reduced
9.	Transporting the forging tools currently used to the tools room and getting the required tools	10	Required forging tools can be arranged in a trolley and can be transported before the changeover just starts and previous used tools can be transported back later	Setup time reduction. Internal activity becomes external
10.	Loading the forging tools required for current product	25	Using pneumatic tools to fix the bolts rather than manual tools	Loading the forging tools time can be reduced
11.	Fingers centering or adjustment	20	Finger centering jig is used to centering the fingers	Fingers centering time is reduced
12.	Setting time of the product in 4 stations as per drawing	60	No action	No effect
13.	Setup approval	10	No action	No effect
	Total time	175		

3.2. Parallel activities:

The primary purpose of these parallel operations is scheduling building phase to develop a standardized method for performing the changeover with two operating personnel by strategically organizing the activities among them. This eliminates any chance of redundancy and helps to coordinate tasks to perform a standardized changeover. To develop these schedules, activity dependency charts are constructed. The activities are distinguished in to internal, external and parallel as shown in the Table 4.

Table 4. Activity chart for changeover - proposed method:

S. no	Description of activity	Time in minutes		
		Internal	External	Parallel activities
1.	Unloading the previous coil used in production if it is remained			3
2.	Transporting the coil to the coil storage			4
3.	Transporting the required coil from wire drawing section to the cold forging section		4	
4.	Loading the required coil			4
5.	Transporting the previous product collected bin for secondary operations		5	
6.	Changing the feed rollers			3
7.	Adjusting the cam plate			2
8.	Unloading the forging tools like dies, punches, fingers, quill and cutter used for previous product	25		
9.	Transporting the forging tools currently used to the tools room and getting the required tools from the tools room		10	
10.	Loading the forging tools required for current product	25		
11.	Fingers centering or adjustment	20		
12.	Setting time of the product in 4 stations as per drawing	60		
13.	Setup approval	10		
	Total time	140	19	16

By separating internal, external and parallel activities, the setup time is reduced to 140 minutes from 175 minutes. Therefore, the total setup time on the cold forging machine is 140 minutes.

4. CONCLUSIONS:

Implementing Lean principles in any process will bring huge results to the organization. By applying the SMED technique, the total time taken to perform setup activities on the forging machine is reduced from 175 minutes to 140 minutes i.e. 35 minutes reduced per changeover. In a month, by an average 20 changeovers are done on one forging machine. So 700 minutes are saved per month. The production rate is increased from 2664693 pieces to 2731193 pieces i.e. 66500 pieces increases in a month. Total of Rs.2, 23,440 per month on a single machine is saved by applying the SMED technique.

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