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To Development of New Hot Padding Portion and Their Important of Hot Padding Operation in Forging Process

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Abstract— that research gets to develop new operations for controlling forging defects. Rolling blocking finishing is used to complete forging operations in a standard procedure. In that study, successfully preventing some forging defects needed adding one more procedure during blocking and finishing. Certain products with uneven shapes, including suspension arms and y-arms, are generated during the forging process. As a result, flaws like twisting and bending arise. That study found that adding a new operation to the forging process helped control these kinds of errors. Because of the operation, coning operation flaws are also controlled, and the die life of coning operation is improved.

Key word- Bending, twisting, Hot padding, Conning operation, Surface defects.

INTRODUCTION

FORGING OPERATION'S

1. **Forging operations:** following are the operation which are used in regular base formation of metal in forging process. All are explained one by one.

- Flantner
- Blocker
- Finsher
- Trimming

Flattener or Upseter: - A circular forging work formation is used to do this process. No matter how long the project takes, the majority of the space is required for forging; flatteners are then required. Additional equipment and con rod forging process flatteners are required. A flattener operation is carried out for B/E and S/E thickness, providing the specific tolerance and dimensional difference for the work. [1]

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I Blocker:-

Fig. 01 depicts the commercial impression-die forging process. An ingot gradually changes into its final form by passing it through operational cavities in a die. The blocker initial impression, also referred to as an edging, fullering, or bending impression, is used to distribute the metal into a rough shape by the specifications of later finishing cavities. Because the Workpieces is being shaped into a shape that increasingly resembles the final product, the following set of cavities are called blocking cavities. [2]

Fig .01 Blocking Operation

II Finisher-

Large fillets and generous bends are usually the consequence of the phases shown in Fig. 02 on the work piece. To form the final shape, a final or finisher impression cavity is utilized. If a short run of components needs to be manufactured, it could be more economical for the die to machine the final features rather of having a final impression cavity.

Fig.02 Fishing Operation

III Trimming-

Fig. 3 shows the process of trimming the extra material flowing around the product with a parting line. The primary advantage of this approach is a decrease in metal loss via flash. Flash could account for 20–45% of the initial content.

Among the disadvantages of the technique were increased expenses due to a more

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complex die design, the need for better lubrication, and better work piece placement. Trimming lessens that flash action.

Fig.03 Trimming Operation

Process Parameters: - In forging operation defects are carried which are consider of research parameters of that paper. That defects classified into three main types which are following. [3]

I Surface defects: -

1) Burr lap (Operation defects)
2) Scale Pit (Manual defects)
3) Under Fill (Location, Operation defects)
4) Dent Mark (Manual defects)
5) Punch Mark (Location or misalignment of die)
6) Under Cut (Trimming defects)

II Inspection defects:-

1) Mismatch (Die shifting)
2) Size Variation (Temperature variation)
3) Bend
4) Crack (Overheating and force)

III Process Wastage: -

1. Cutting operation (End piece)
2. Flash wastage (After Trimming)

Dies

Classification of die – In forging operational die basically classified in to three types which are as following.

1. **Open die**
2. **Closed die**

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3. Trimming die (Cutting die)

II Open-Die Forging: -

Open-die forging, also known as hand, smith, hammer, and flat-die forging, is primarily distinguished from most other deformation techniques by providing uneven material flow as opposed to continuous flow. Forgings are created when this process is used.

An upsetting tool that collects material in accordance with a work profile's criteria is called an open die. Material is divided according to work characteristics in disruptive operations. [4]

III Closed-Die Forging: -

In the blocking and fishing stages of the forging process, closed-die forging—also referred to as impression-die forging is used, as shown in Figure 4. The heated metal is completely shaped using the matching die cavities of two dies that unite to enclose the product from all sides. One die may contain the entire forging impression, or it may be divided between the top and bottom dies.

The forging stock, generally a round or square bar, is cut to length to supply the necessary amount of metal to fill the die cavities along with an additional margin for flash and, on occasion, a projection for forging support.

The flash allowance functions as a release valve to alleviate the elevated pressure produced within closed dies. Additionally, a flash serves as a brake to reduce the rate at which metal flows outward, allowing the appropriate design to fill. [5]

Fig.04 Closed Die Profile.

Trimming Die –

Fig. 05: The operating die for trimming. The material that flows alone with a parting line is removed using a die. The excess material is cut using a flash trimming die.

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Fig. 05 Trimming Die Profile.

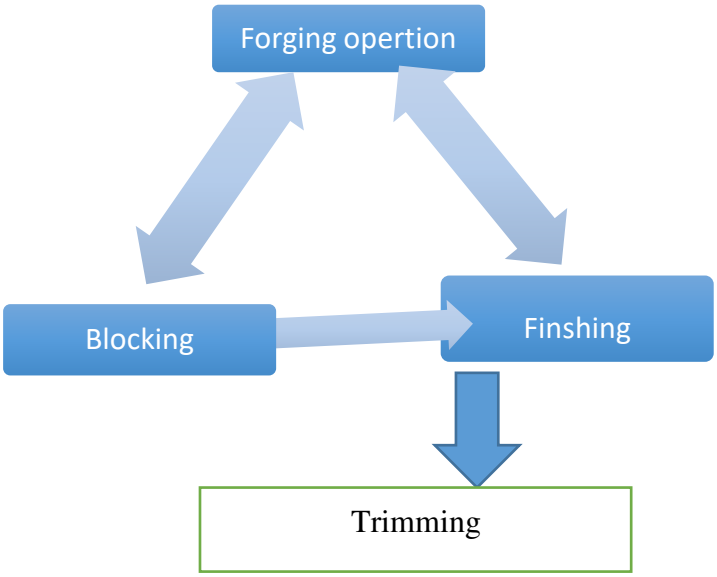

Fig .06 Forging Operation Flow Diagram.

Methodology

For the paper's methodology, Fig. 07 offers a forging defect categorization that represents inspection faults. One more forging operation has been included to control inspection flaws. They are intended to regulate the forging process's twisting and bending faults. Many faults are discovered during the forging process, some of which are severe and include size fluctuations, bending, and twisting. These kinds of faults can be controlled by such inventive approaches.

Inspection defects:-

1. Mismatch (Die shifting)
2. Size Variation (Temperature variation)
3. Bend
4. Crack (Overheating and force)

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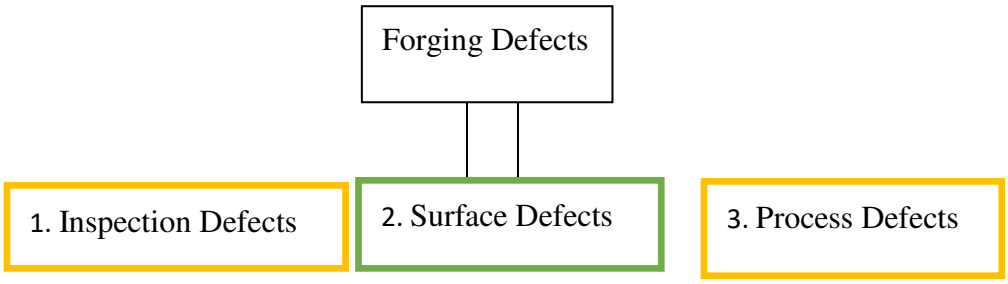

Fig.07 Forging Operation Defects

Experimental set up

Step I. Process of forging operation which are done by in forging process one by one according to their job profile. Rolling and upsetting operation are done by job profile, depend on length and area of job requirement. And introducing the new operation having operational location indicating in fig.08. And analysing the data of forming process before including hot padding and after hot padding operation.

Different position of hot padding operation- 1. In-between blocking and finishing

2. Before trimming operation

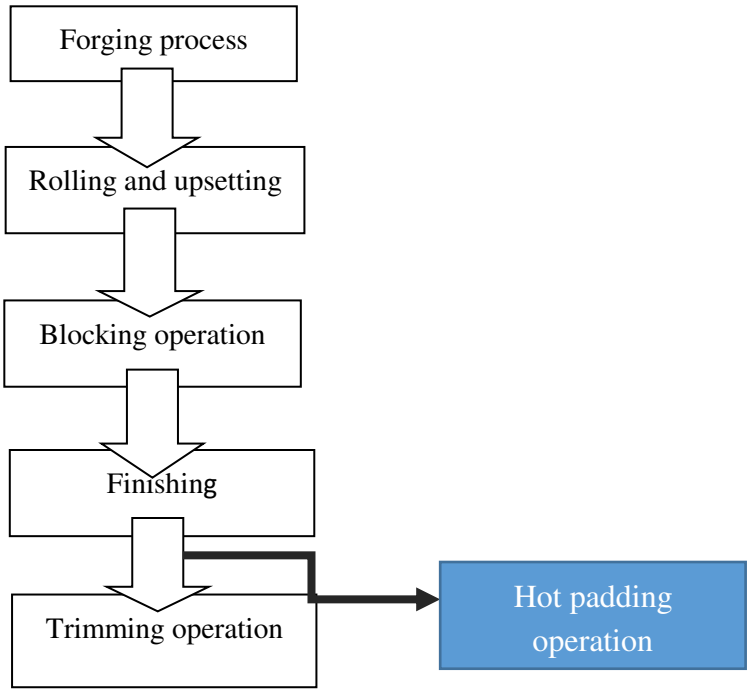

Fig .08 Forging Process Flow Process.

Forging operation and defects are carried on forging operation step which are list as following.

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- **Rolling operation defects-**
  1. Crack formation.
  2. Folding of material.
  3. Underfilling of job.

That defects are carry with rolling operation which are inspected by visual inspections and some defecates get found by magnetic plus induction methods (MPI).

- **Upsetting operation defects** –
  1. Folding edge.
  2. Crack formation

It one of open die operation done by required material gather operation as per requirement of job profile. In that operation those defects get found that all are inspected by visual as well as by measurement process.

- **Blocking and finishing operation defects-**
  1. Miss match
  2. Underfilling of profile
  3. Bending
  4. Twisting
  5. Size variation

This all defects are get found by after measurement and such defects are get blocking and finishing operation.

Fig.09 Crack Formtiom Job Profile.

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Fig.10 Bending And Twsting Profile Job

Step II- Crake underfill and mismatch defects are to be control by applying corrective action in forging operation. But size variation and twisting defects not be controlling with corrective action. So, research that problem and to controlling such problem to introducing new operation in forging process which is known as hot padding operation. Location of that operation get find some experimental analyses done with before trimming job and after terming job.

Product measurement done in two different positions of forging process after finishing operation but before terming the job and after cutting of job. Both measurements done small, big and I- section of job after analyses size variation are found so controlling that size variation of job carry one additional operation in forging process. To controlling such effects of job after addition of new operation that can analyse by different measurement process in table 01.

Table 01 Job Measurement before Hot Padding Operation

Trim Component												
Section	Small End				I-Section			Big End				
Sr.No.	1	2	3	4	1	2	3	1	2	3	4	Remarks
1	38.9	39.1	39.1	38.9	19.4	19.2	19.5	39	39.1	39	39.3	Not ok
2	38.5	38.8	39.0	38.8	19.3	19.4	19.6	38.8	39	38.9	39.1	Not ok
3	39.2	39.4	39.6	39.1	20.2	20.1	20.4	39.9	39.7	39.6	39.8	Not ok
4	38.8	39.0	39.0	38.8	19.5	19.5	19.5	38.	38.9	38.7	39.	Not ok

								8			2	
5	38.8	38.8	38.8	38.8	19.1	19.0	19.2	38.8	38.8	39	39	Not ok
6	38.8	38.9	39.1	38.8	19.4	19.2	19.4	38.9	39.1	38.9	39.2	Not ok
7	38.8	38.9	39.2	38.8	19.5	19.5	19.5	39.2	39.1	39	39.3	Not ok
8	38.8	39.0	39.1	39.9	19.4	19.3	19.5	39.1	39	39	39.2	Not ok
9	39.3	39.3	39.4	39.2	19.5	19.4	19.4	39.3	39.2	39.1	39.4	Not ok
10	38.8	38.7	39	38.8	19.3	19.1	19.4	38.9	39	38.8	39.1	Not ok
Untrimmed Component												
Section	Small End				I-Section			Big End				
Sr.No.	1	2	3	4	1	2	3	1	2	3	4	Remarks
1	39.6	39.9	39.7	39.7	19.9	19.9	19.9	39.8	39.4	39.7	39.7	Not 0k
2	39.6	39.6	39.6	39.7	20.1	20.1	20.1	39.9	40.0	39.7	39.7	Not ok
3	39.7	39.8	39.8	39.7	19.8	20.0	20.1	39.3	39.8	39.6	39.7	Not ok
4	39.4	39.2	39.5	39.4	19.7	19.8	19.7	39.4	39.6	39.7	39.7	Not ok

Above table 01 are indicating connecting rod measurement having different part position such as small end, I-section and Big end thickness measurement having two conditions after finishing but before trimming operation and after trimming operation. That two different operational position measurement are consider for experimental analyses of that paper. After measurement analysed before trimming job having maximum size variation of very section small end 0.3 to 0.8 mm I-section having 0.3 to 0.6 mm and big end 0.3 to 0.7mm variation are found.

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After trimming operation job size variation small end found 0.2 to 0.5mm I-section 0.2 to 0.4 mm big end 0.2 to 0.5 mm variation are to be controlled but they not under consideration so include one operation hot padding operation.

Product analyses after hot padding operation.

1. **Process analyses are done by three stage –**

- In process temperature measurement
- In process after hot padding operation before trimming
- In process after hot padding after trimming job.

So according to analyses we are developing the hot forging die which are shoeing CAD diagram fig 11.and don some analyses of die.

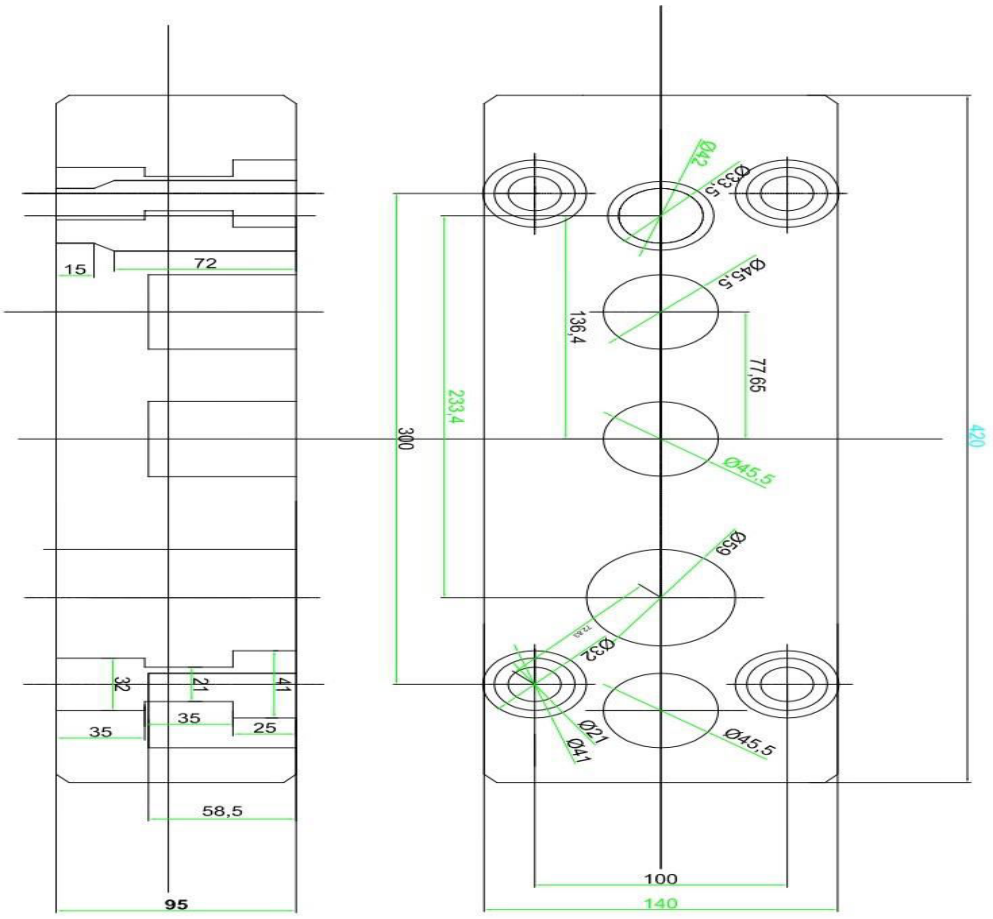

Fig. 11. CAD Diagram Hot Padding die.

2. **In process temperature measurement**
3. **Temperature measurement done different stage.**

1. In process measurement blocker and finisher die output.

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2. After trimming of job.
3. Conveyer entry and exit temperature of job.

Analyses of job after Hot padding operation

Small end thickness measurement of after introducing hot padding operation size variation get controlled up to 0.1 mm to 02.mm which shows in table 02.

Table 02 Small End of Job

No. reading (mm)	1	2	3	4	5	6	7	8	9
Job 1	40.200	40.000	39.900	40.200	40.200	40.200	40.300	40.200	40.000
Job 2	40.000	40.200	40.200	40.200	40.000	40.100	40.100	39.900	40.200
Job 3	39.900	40.000	40.100	40.000	40.200	39.900	40.000	40.200	40.100
Job 4	40.000	39.900	40.200	39.900	39.900	40.000	40.200	40.000	39.900

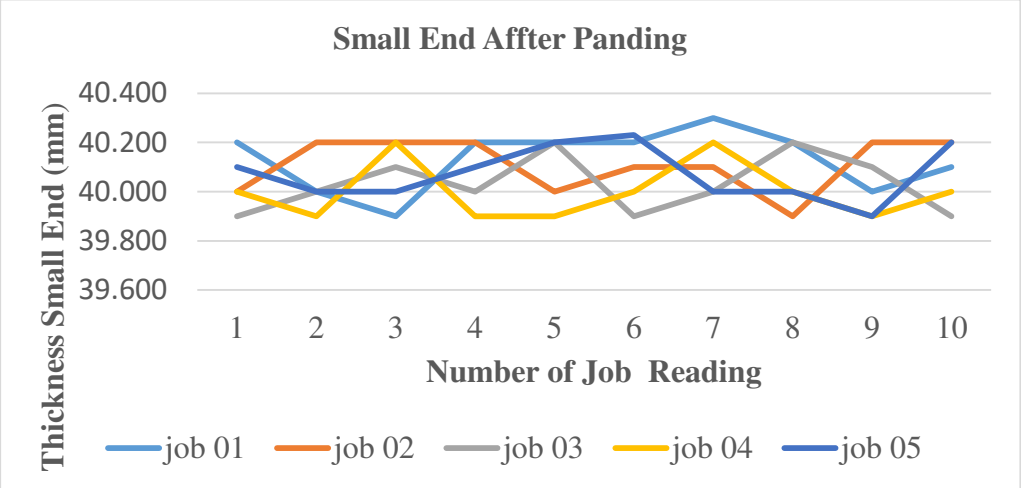

Fig. 12 Small End Measurement

Big end measurement of job after hot padding which get size variation within control up to 0.2 to 0.1 mm which are within limit and bending and twisting get control show in table 03 and fig.13.

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Table 03 Big End of job

No. reading (mm)	1	2	3	4	5	6	7	8	9
Job 1	40.200	40.000	39.900	40.100	40.100	40.100	40.100	40.100	40.000
Job 2	40.000	40.200	40.200	40.400	40.000	40.100	40.100	39.800	40.200
Job 3	39.900	40.000	40.100	40.000	40.200	39.900	40.000	40.200	40.100
Job 4	40.000	39.800	40.200	39.900	39.800	40.000	40.200	40.000	39.900
Job 5	40.100	40.000	40.000	40.100	40.200	40.230	40.000	40.000	39.900
Job 6	40.200	40.000	39.900	40.100	40.100	40.100	40.100	40.100	40.000

Conclusion

After conducting a thorough analysis, we have concluded that hot padding is a critical and essential step in the forging process that controls forging process defects. Which requires management in order to avoid bending and twisting defects throughout forging. It also minimizes the substantial size variation in forging, which is additionally regulated by the hot padding procedure.

CONFLICT

This section asks for information about the work "**To Development of New Hot Padding Portion and Their Important of Hot Padding Operation in Forging Process"** that you have submitted for publication "**International Journal of Material Forming** ".The time frame for this reporting is that of the work itself, from the initial conception and planning to the present. The requested information is about resources that you received, either directly or

indirectly, to enable you to complete the work. Checking "No" means that you did the work without receiving any financial support from any third party.

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3. Aneesh Somwanshi
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Credit authorship contribution statement

Vijay Baban Jadhav: Investigation, Methodology, Writing original draft. Abhishek Kumar Jain: Supervision, Writing review and editing. ArifKhan: Conceptualization, Formal analysis.

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