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OPTIMIZING FORGING PROCESS PRODUCTION TO PRODUCT WASTE CONTROLLING METHODS ANALYSES

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ABSTRACT

In these researched analyses of different forging product for controlling the forging waste in forging process. In forging process forging waste are carry with forging operation which identify by parting line of products. Parting which defines the product upper and lower die meshing area. Those extra material are used in forging operation which goes to outside of die that material is called as waste of forging. The foraging waste are not use for further any product manufacturing process for their hardness. Thire for such waste are to controlled for increasing the product utilization any minimising the production cost. In that paper we concentrate to minimising waste of forging by amylases of different products.

Keywords: Forging Waste Flash, Trimming Operation, Shearing Operation

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INTRODUCTION

In the forging process of complicated parts, the use of appropriate preform shapes is crucial. It can prevent various defects such as under filling and fold over of material. In addition, it will produce more uniform strain distribution through the final forging product. Thus, the superior metallurgical and mechanical properties are expected. In addition, it can reduce the material waste and die wearing. Traditionally, engineering design of forging dies has employed trial & error methods which are a time consuming process and expensive. However, in the recent years a significant increase of computer and numerical simulations are reported based on finite element (FE) analysis of forging process. Moreover, traditional techniques have been substituted into numerically based analysis. Therefore, more robust and efficient computer based approaches has been introduced recently. As a result, a great number of investigations have been reported by different scientists in the preform design field. A finite element based preform in the forging process any one the of complicated parts, are to be give appropriate preform shapes is crucial. It can carry various defects such as under filling and fold over of material crack, and it will produce the uniform strain distribution through the final forging product. The forging process are to be produced, the superior metallurgical and mechanical properties are expected to product. In that researched, can be reduce the material waste of products. To controlling such forging waste, we study about forging manufacturing process and analyses of product with their different products.

The basis for the development of forging industry is a continuous perfection of the product, improvement of its quality and reduction in the production costs by controlling forging waste which are indirectly connected to the reduction product cost. This process is possible due to continuous improvement of the waste controlling methods. There are many imperfections of that can be considered as being defects, ranging to the starting materials to those caused by one of the forging processes or by post forging operations. In forging process, main defects like unfilling, mismatch, scale pits, surface cracking, fold and lap, improper grain flow etc occur which are responsible for high rejection rate (Aju Pius, Sijo, et.al 2013). Sometime unfilling defects occurs due to metal does not fill the recesses of the die cavity completely during the forging process. It causes due to improper design of the forging die, die wear, improper use of forging techniques, less raw material, poor heating of raw material inside the furnace, etc. Christry Mathew et.al (2013) studied the forging analysis to explain how the defects occur and how to prevent them. The effect of unfilling defect is that the job dimensions cannot be filled; ultimately the required final job weight cannot be filled completely as per the requirements of company standards (Rathi et. al, 2014)

1.1. **Problem definition**: In forging processes most of the rejection take place due to process defects and waste of forging process that occurs due to improper process parameters i.e. billet weight, billets length, heating temperature, heating time etc.

1.2. **Objective:** The main objective of that researched to controlled such defects and controlling or minimising waste of forging process through the process parameter identification improves the quality of the forging components by identifying and reducing the source of defects so that automatically the cost of the product will decrease.

METHODOLOGY

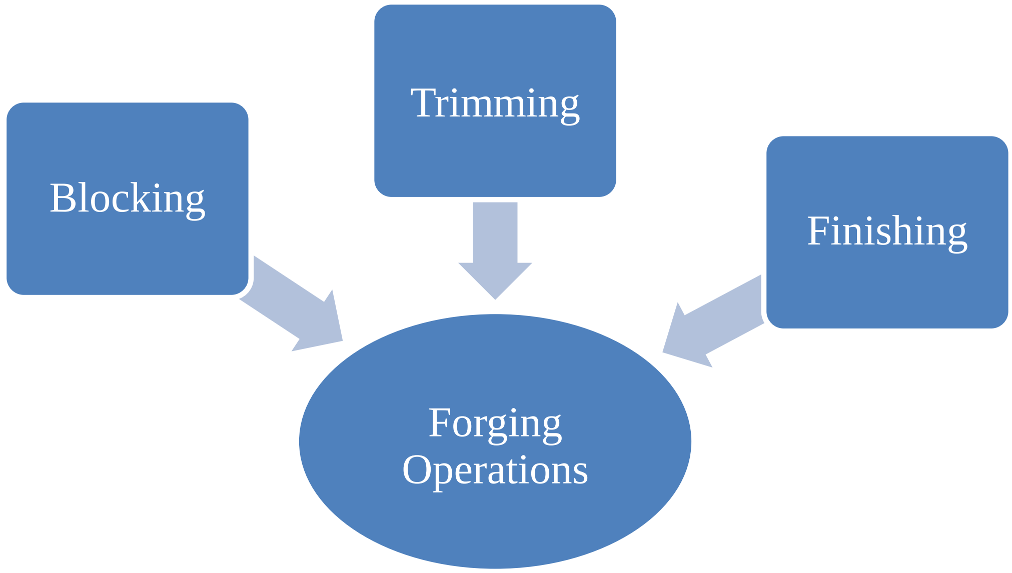


Fig 01 Shows Basic Forging Operations.

Fig 01 shows basic forging operations done by step by step which are related to each other blocking, finishing and trimming. that operation creating the profile of products by using closed die. Basically, in forging operation three types of dies are to be used open die, closed die and trimming die.[6] [8]

Blocking operation – That operation done by closed die which creating basic profile of product before the finishing operation of products.

Finishing operation – It also carry by closed die operation it provides final shape to products that one final profile operation.

Trimming operation – that operation done last stage operation in forging process it also known as martial cutting operation, in that due to blocking and finishing operation extra material gather by parting line that material gets trimmed so it is called trimming operation.

Forging die – Fig 02 are represent the basic classification of forging die**.**

1. Open die
2. Closed die
3. Trimming die.

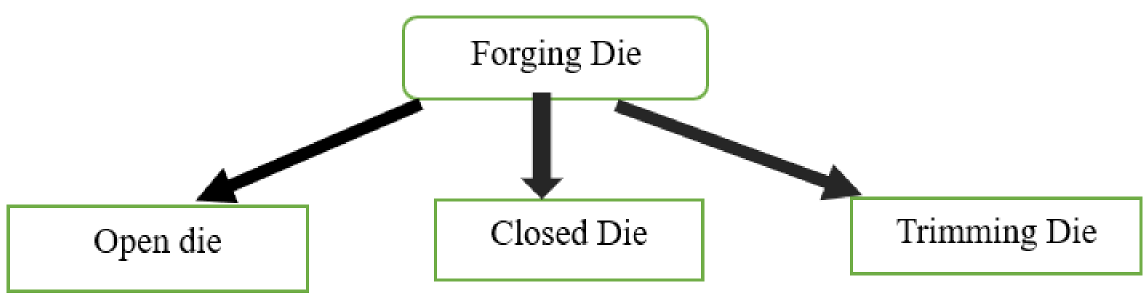


Fig .02 Dies Used in Forging Operation.

In operation dies are used having different function and different design process according their functions in fig 02 shows different types of die.[5]

Open die- open die having maximum clearance between two dies, no material flow limitation flat structure die. open die is used when are of job required and upsetting operation aer carried by open die operation.

Closed die- Closed die having minimum clearance between two dies having limitation of material flow condition profile carry structure. Closed die is used to blocking and finishing operation in forging operation, showing fig.03.

Fig 03 Closed Die

Trimming Die- Trimming dies are also called as cutting die, die is used to cutting extra material flow around the products. Such cutting material is called flash of material. Which present around the product represented by prating line, fig 4 show trimming die.

Fig 04 Trimming Die

EXPERIMENTAL SET-UP

Forging Waste Analyses Method

Basically, two types of forging process waste.[5] [6]

1. End piece waste.
2. Flash waste

In that paper considerable that waste of forging defects and analyse of that two-forging waste with following considerable factors in which operational factors and measuring factors.

Factor Consider

Measuring Factors

- Cutting Length of Job.
- Process Temperature of Job.
- Rolling Operation. (Gap Between In)
- Die Temperature, (Thermal Heating)

Operations consider

1. Shearing operation
2. Finishing operation
3. Trimming operation.

Waste formation carry of cutting and trimming operation, in cutting operation end piece are waste and in trimming operation flash be a waste. Cutting operation are carried with Shearing machine is one of first operation in which billet formation are done. Coming material get identify using material grade, heat code, diameter of bar.

Table 01- Raw material identification table before cutting

Sr. No.	Material grade	Heat No	Heat Code	Dia. Φ(mm)	Bar Length mm	Total Bar weight KG	Total Bar Qty.	Total Balance Qty.
1	41CR4	OSY		60Φ	5512	11760	84	NIL
2	16MNCR5H	M104921	H4.1	60Φ	5521	13870	110	50
3	16MNCR5H	M104921	H4.1	60Φ	5521	15565	125	125
4	42CRMO4	M102475		75Φ	5462	13320	67	67
5	16MNCR5H	M104464	C9.2	75Φ	5410	19355	95	95
6	42CRMO4	M102475		75Φ	5462	25480	129	129

Table 02 billet formation record after cutting.

Die No	Material grade	Heat No	Heat Code	Dia. Φ(mm)	Cut Picas Length(mm)	Cut Picas weight(kg)	Cut Picas Qty.
118	16MNCR5H	H96045	D8.1	60Φ	162	3.616	5272
105	C70S6	K102795	AU	56Φ	165	3.222	6666
115	42CRMO4	K102473	B5.1	75Φ	267	9.46	434
116	42CRMO4	K102473	B5.1	75Φ	250	8.74	1736
106	C70S6	K102795	AV	56Φ	175	3.44	6606
117	16MNCR5H	M100586	C8.1	75Φ	116	4.046	5516
106	C70S6	K103221	AW	56Φ	175	3.44	7561
135	SAE1541	23494	AA	60Φ	182	4.11	459
128	16MNCR5H	M102998	G7.1	60Φ	121.5	2.71	6013
105	C70S6	k102820	AX	56Φ	165	3.222	2889
106	C70S6	K103221	AW	56Φ	175	3.44	4564
119	41CR4	OIS	JE	60Φ	167	3.74	2743
105	C70S6	K102820	AX	56Φ	165	3.222	7700

Above table 01 and 02 give information about coming raw material utilization. Table 01 giving information about the raw material storage identification with colour coding system are used for identification of heat cods. Table 02 showing information about the raw material convert into billet formation having cut picas wight and length, with their die number.

Table 03- Product requirement cutting weight and length.

Die No	Part Name	Customer	Material Grade	Stok Size *Φ*	Cut Weight (Kg)	Cut Length (mm)	Net Weight (kg)
101	Crank Shaft-Kubota	Siddheshwar Industries	SCM 435	60	5.687	293	5.00
103	Steering Knuckle	RSB Transmission	EN 19	60	4.995	220	4.00
104	Rotor 003 -Etec	Ducati Energia	EN 19	60	3.67	165	3.50
105	Connecting Rod-4sp	Lokesh Machines Ltd	C70S6	56	3.332	170	2.23
106	Connecting Rod -697	Lokesh Machines Ltd	C70S6	56	3.528	181	2.45
108	Connecting Rod #28	Adico Forge	42Crmo4	60	3.326	144	2.39
111	Connecting Rod #25	Adico Forge	42CrMo4	60	3.13	142.5	2.41
112	Gear -Ratchet	Poona Forge	MS	50	1.30	86	1.10
117	BIG Dampar	Sanjeev Auto	16mncr5	75	4.046	116	3.25
118	Small Dampar	Sanjeev Auto	16mncr5	60	3.616	161	2.90
119	Suspension Arm -Front	Saraswati Auto Components	41CR4	60	3.74	167	2.84

For experimental set up for observing various products having table03 showing experimental parameters cutting length, cut weight, and net wight of products. It also showing the differences between cut wight of billet and after finishing operation net wight of job.

Table 04 analyses parameters of resc

Sr.no	Die No	Part Name	Cut Weight (Kg)	Cut Length (mm)	Net Weight (kg)
1	101	Crank Shaft-Kubota	5.687	293	5.00
2	103	Steering Knuckle	4.995	220	4.00
3	104	Rotor 003 -Etec	3.67	165	3.50
4	105	Connecting Rod-4sp	3.332	170	2.23
5	106	Connecting Rod -697	3.528	181	2.45
6	108	Connecting Rod #28	3.326	144	2.39
7	111	Connecting Rod #25	3.13	142.5	2.41
8	112	Gear -Ratchet	1.30	86	1.10
9	117	BIG Dampar	4.046	116	3.25
10	118	Small Dampar	3.616	161	2.90
11	119	Suspension Arm -Front	3.74	167	2.84

Analyse of above table 04 find out the loss of material in formation of flash and end pieces of product. For maintaining final product weight, it is important parameter to maintain constant and controlling forging defects such underfill and under cutting is measure parameters to maintain that experimental set up.

To considering all factor get experimental set up with suspension arm front product goes to analyses. Factor consideration to length of job and net weight of job. For experimental set up considering two product coenacting rod and suspension arm both are automobile job show in fig 05. both jobs required same operation performing and after trimming have to produces flash waste after trimming.

Fig 05 Product Consider (Connecting Rod and Suspension arm)

PARAMETERS USED TEST

- Stock Length
- Reducer Rolling Gape.
- Length and Weight of Products.

Stock Length

Stock length consider to design experiment set up playing important role in researched experimental set up which us full by increasing utilization of raw material those wastage in form of end pieces. Such utilization increasing up to 80 to 90%.

Table 5 Show Cutting Length and End Pieces.

Stock Utilization				
Sr.no	**Cutting Length**	**End Pieces Weight**	**Utilization %**	**End pieces length (mm)**
1	170	1.5 Kg	----	109.43
2	167	1.7Kg	65	111.97
3	165	2.20Kg	80	112.47
4	163	2.50Kg	90	113.69

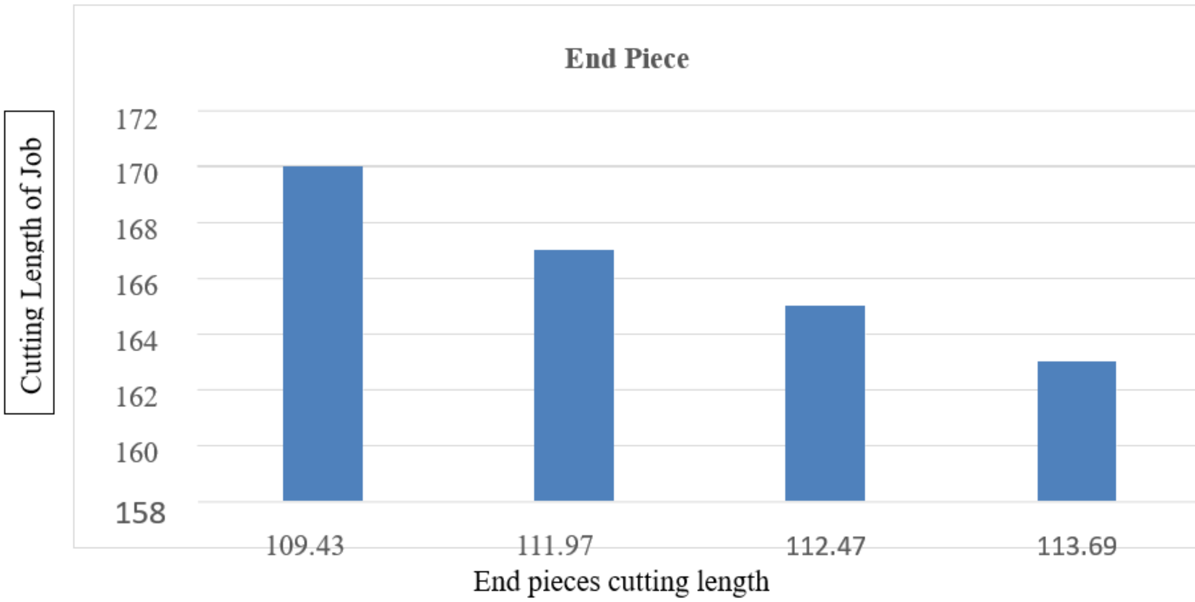


Fig 06 End Piece Formations

Reducer Rolling Gape

Four pass rolling processes are used in both job manufacturingprocesses so job length and area of job depend on rolling, rolling gap measured by filler gauges, gap get more area get more and gap get less length of job get more. So that we gap of roll get reduces step by step.

Fig.07 Rolling Operation

Table 06 Reduce Rolling Gap effects in suspension arm

Reducer Rolling Gap		
Sr. No.	**Stock Length mm**	**Gap Roll mm**
1	167 mm	9.5 mm
2	165 mm	8.5 mm
3	163 mm	6.7 mm

In table 06 shows reducer rolling operation gap effects on elongation of job length get reducing gap get increasing.

Length and Weight of Products

For that analyses we considering only suspension arm job we carry cutting process of billet having three different stage and measuring parameters for experimental setup are to be billet length, job weight, flash formation weight.

Fig 08 Flash Formation Around Job.

I. Cutting length of suspension arm will be Cut length-167mm and Cut weight-3.74kg

Table 07 Flash Analyses Stage First

Sr. No.	Job weight kg	Flash Weight kg
1	2.864	0.932
2	2.861	0.925
3	2.863	0.926
4	2.853	0.927
5	2.856	0.912
6	2.870	0.856
7	2.891	0.859

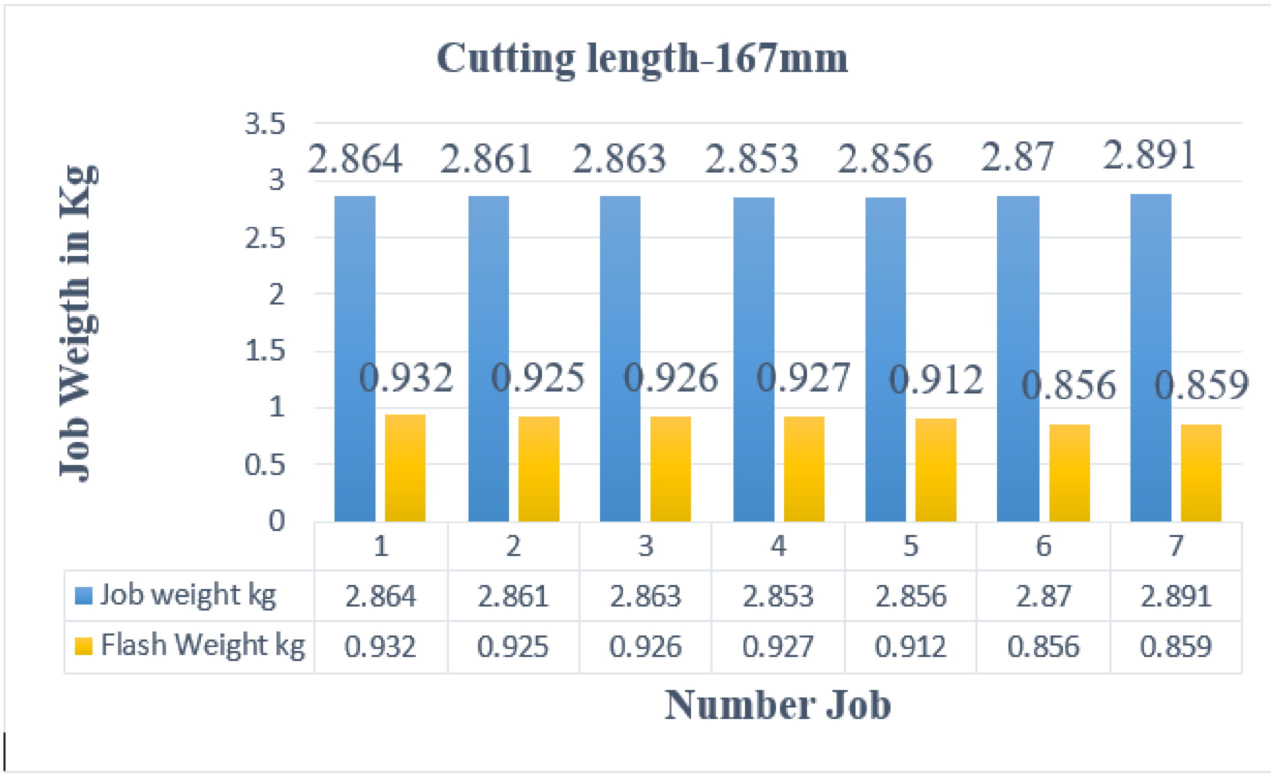


Fig 09 Relation Job Weight and Flash Weight

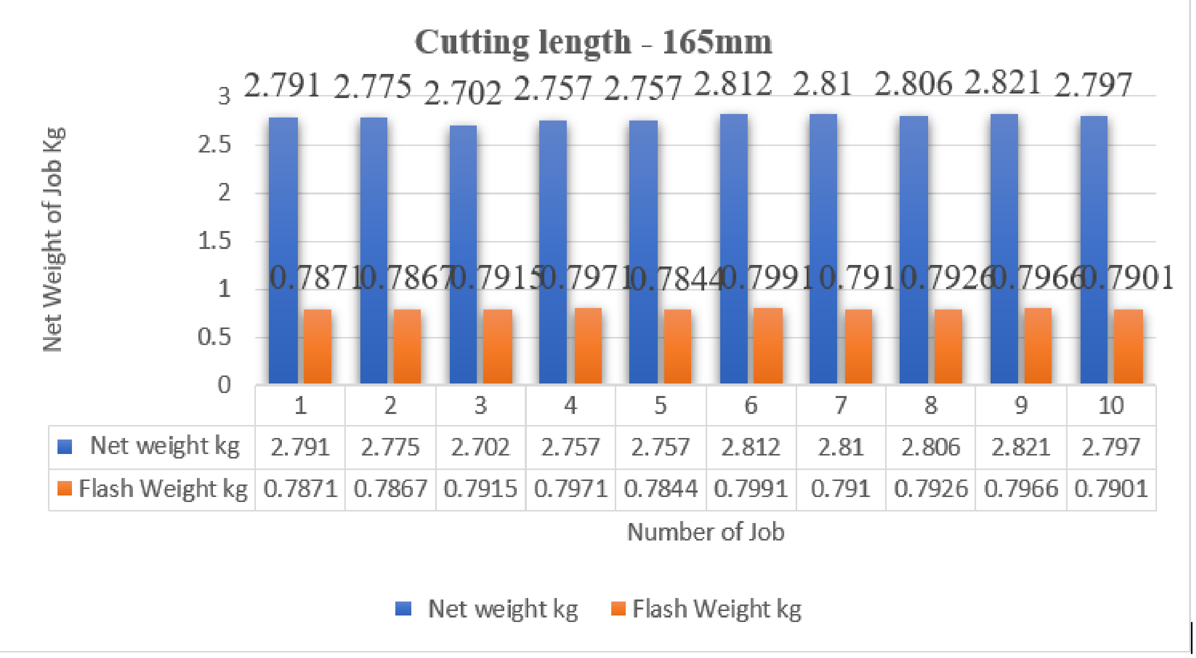
Frist condition of cutting operation observation after that job weight get maintain but flash waste weight get up to 1 kg per job and end pieces length 111.97 mm that not use full any other operation of job so waste of flash get maximum show in table 07 and fig.09**.**

II Cutting length of suspension arm will be Cut length-165mm and Cut weight- 3.54kg.

Table 08 Flash Analyses Stage Second.

Sr. No.	Net weight kg	Flash Weight kg
1	2.791	0.7871
2	2.775	0.7867
3	2.702	0.7915
4	2.757	0.7971
5	2.757	0.7844
6	2.812	0.7991
7	2.810	0.7910
8	2.806	0.7926
9	2.821	0.7966
10	2.797	0.7901

Second condition of cutting operation observation after that job weight get maintain but flash waste weight get up to 0.7900 kg per job and end pieces length 112.47 mm that not use full any other operation of job so waste of flash get to controlled, show in table 08 and fig.10 respectively.



	1	2	3	4	5	6	7	8	9	10
Net weight kg	2.791	2.775	2.702	2.757	2.757	2.812	2.81	2.806	2.821	2.797
Flash Weight kg	0.7871	0.7867	0.7915	0.7971	0.7844	0.7991	0.791	0.7926	0.7966	0.7901

Fig 10 Relation Job Weight and Flash Weight

II. Cutting length of suspension arm will be Cut length-163 mm and Cut weight-3.245kg

Table 09 Flash Analyses Stage Third

Sr No.	Job Weight Kg	Flash Weight Kg
1	2.808	0.627
2	2.81	0.634
3	2.806	0.624
4	2.807	0.615
5	2.814	0.715
6	2.808	0.722
7	2.806	0.733
8	2.808	0.731
9	2.805	0.718
10	2.807	0.714

Third condition of cutting operation observation after that job weight get maintain but flash waste weight get up to 0.627 kg per job and end pieces length 113.69 mm that not use full any other operation of job so waste of flash get to controlled, show in table 09 and fig.11 respectively.

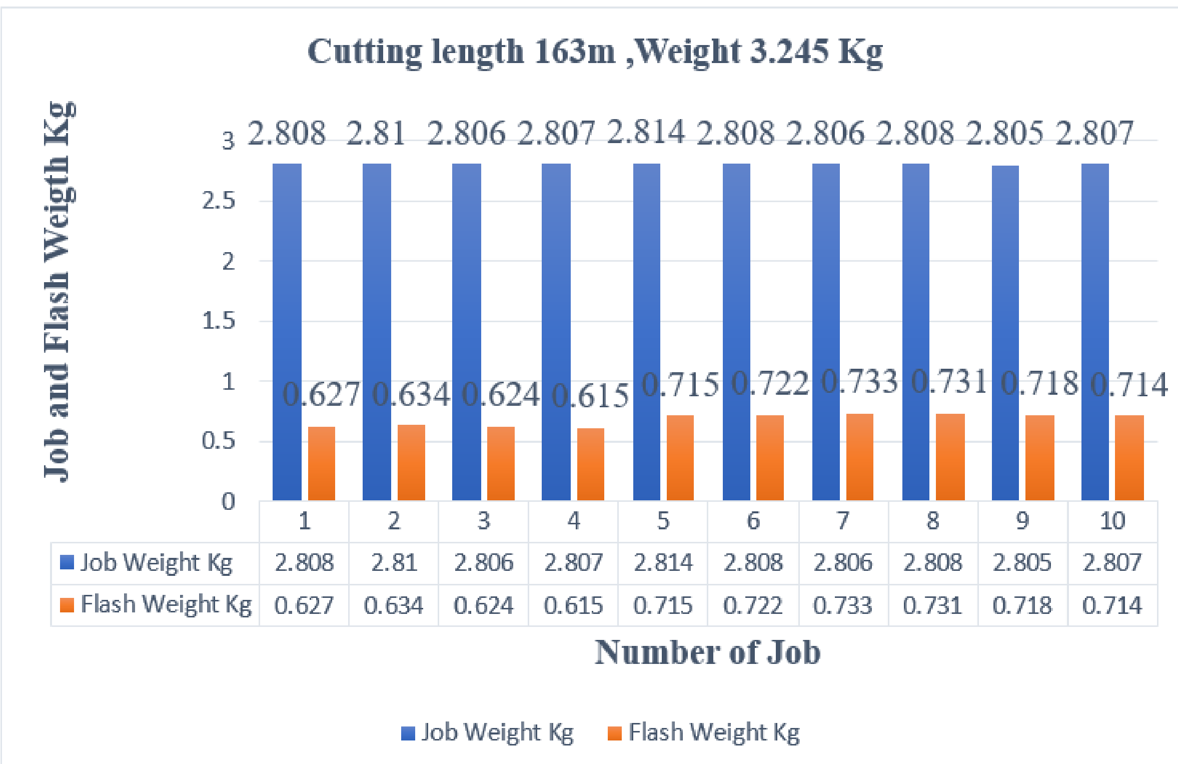


Fig 11 Relation Job Weight and Flash Weight

RESULT AFTER EXPERIMENTAL ANALYSES

Table 10 Final Result of Flash Wight

Sr. No.	Cutting Length of Job MM	Flash Waste of Job
1	170mm	1.283kg
2	167mm	0.985gm
3	165 mm	0.754gm
4	163mm	0.624gm

After those experimental analyses reducing the cutting length of billet up to 7mm and improving shearing blade life as well as reducing the flash waste of job up to 0.400 gm approximately with cutting length 163mm.

CONCLUSION

This researched paper presents the detailed description of the raw materials billet length is the important parameter are used in research paper work with the suspension arm product. To record the inspected for forging defects as per standard procedure, as set for trail is recorded for statistical analysis. To change in billet cutting length to increasing productivity of product and reduce wastage of raw material.

Product weight and length also maintain for any forging operation at time that analyses some operational defects also considering to control basically those goes in term of length such as unfilled of product, undercutting of job at time of trimming. so, conclude that we controlled the forging waste by controlling the job length.

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