IMPROVEMENT IN SURFACE FINISH OF SUS-304L USING MAFB TOOL

Rahul Sharma, Dr. Swastik Pradhan*

Assistant Professor, School of Mechanical Engineering, Lovely Professional University

Phagwara, Punjab-144411, India

ABSTRACT

MAFB is a new method of improving surface finish quality of stainless steel. A special finishing tool has been fabricated and operated inside a thin pipe. Various input parameters has been used to judge the output during experiment. A vertical drill machine has been used and results show that the rotating speed is the leading factor in improving the quality of surface finish.

Keywords: MAFB, Taguchi Method, SUS, Surface Roughness

INTRODUCTION

Manufacturing is totally a process of making any desired product using some manufacturing methods or to improve the quality of existing product. It may be of macro or micro type. In all type of machining material is removed using some cutting or finishing tools in a machine on a workpiece. Sometime workpiece is stationary and job is moving or vice versa.

Magnetic abrasive flexible brush finishing is a new technique to improve the surface finish quality. It is a non-traditional method of improving the surface quality. In this a brush is formed using a magnets may be permanent or electromagnets and a flexible brush is formed using a iron based abrasive material. It is used to finish a non- magnetic or ferrous materials only so that brush must retain against the material and proper rubbing may occur.[2].

When machining is there then there is a gap between the brush formed and material. This gap is filled by a lubricant and it will change the finish quality depending upon the type of lubricant. The sintering process can be used to produce the abrasives mixed with ferrous particles [3]. Shinmura et al. [6] has studied the vibration frequency and flux as main parameter in experiment and recorded the values of finishing output values. H. Yamaguchi and T. Shinmura [7] have used the alumina ceramic tube as working material and performed experiments using magnetic abrasive sintered with diamond particles. They concluded the effect of quantity on output parametrs. Shinmura et al. [8] they vary the type of abrasive by varying size of particles and declared that size of iron particle effect more than the size of abrasive particles in forming the brush and finishing the material. Shinmura [9] proved that the running speed of tool have maximum effect on material removal value. Shinmura and Aizawa [10] concluded the speed of cutting tool is leading factor in finishing.

Yamaguchi et al. [11] done experiment on SUS304 tubes and used aluminium oxide as abrasive. It was mixed with iron under inert gas. Wang and Hu [12] used three material as 316L type for steel, L12 type for aluminium, and H6 for brass. He performed experiments and MRR of aluminium is maximum in all the used parameters of surface finishing. Khangura et al. [13] performed experiments on different type of abrasives but the results were best using sintered abrasives.

EXPERIMENT PROCESS PRINCIPLE

A flexible brush has formed using the permanent magnets on the circumferential surface of tool by drilling holes, there are total 6 magnets, and it can be more. The angle between each of them is taken equals to 120 and these magnets are drilled in two different diametric lines having gap between them. Magnets are attached with epoxy. When abrasive is applied in gap it form a brush or long chain of abrasive. And when tool rotate, these brush also rotate with them.

TOOL AND EXPERIMENTAL SET UP

A tool is first designs taking all parameters of vertical drill machine and then fabricated on a lathe machine. Material is taken as brass. First a spindle having diameter or rot thickness of drill machine is chosen and then same dimensional handle type structure is made for holding the tool by drill machine. After this holes are first drilled on surface making the required angle then magnets are inserted. Total 16 set of workpieces are prepared on lathe machine after cutting a long pipe to do the internal finishing of SUS-304L. Figure 1 shows the prepared workpiece for experimentation.

Fig 1 shows the workpieces prepared for finishing.

EXPERIMENTAL CONDITIONS

To compare the surface finish and weight all the workpieces are measured for these values and then experiment is performed. All the selected parameters are given in table1.

Table1: Table of parameters and their selected range.

Parameters	Range
1. Fixed	
Work Piece	SUS-304L
Work Piece Dim.	Outer Diameter: 70mm Length: 54mm
Lubricating Oil	Vegetable oil
Quantity Of L. Oil	8%
2. Variable	
I.D. of Work Piece	60 - 64mm
Cutting Speed	800 - 1400rpm
Gap	1 - 4.5mm
Grit No of Abrasive	Grit No 100 - 240
Quantity Of Abrasive	6-12gm
Experimental time	30 – 110 min
Flux Density	0.15 -0.45 tesla

PARAMETERS AND THEIR LEVELS

A matrix has been generated with 5 factor. Each factor is having 4 levels of values. Table2. All the selected values of parameters.

Table 2: Values of parameters

Independent Variables				
	Level 1	**Level 2**	**Level 3**	**Level 4**
Tool Speed	800	1000	1200	1400
Gap	1	2	3	4.5
Abrasive Size	100	150	200	240
Abrasive quantity	6	8	10	12
Exp Time	30	45	60	110
Flux	0.15	0.25	0.35	0.45

ARRAY DESIGN

Full factorial require 4 X 4 X 4 X 4 X 4 = 1024 experiments to be conducted. So we reduce that into (4 XX5) means 16 runs only

Table 3: Array Design Data

Taguchi Orthogonal Array Design for Experiments					
	Factors				
Exp. No.	**(A) Tool Speed** (RPM)	**(B) Working Gap** (mm)	**(C) Grit Size** (Grit No)	**(D) Quantity Of Abrasive** (gm)	**(E) Time** (Min)
1	800	1	240	6	30
2	800	2	200	8	45
3	800	3	150	10	60
4	800	4.5	100	12	110
5	1000	1	150	10	110
6	1000	2	180	12	60
7	1000	3	100	6	45
8	1000	4.5	150	8	30
9	1200	1	200	12	45
10	1200	2	100	10	30
11	1200	3	180	8	60
12	1200	4.5	200	6	110
13	1400	1	100	8	110
14	1400	2	150	6	60
15	1400	3	200	12	30
16	1400	4.5	240	10	45

RESULTS AND DISCUSSION

After performing all experiments on vertical drill machine as per the given values or levels of input range, the values of output factors has been tabulated. Given below in table 4 in percentage values. Figure 2 show the measurement of surface roughness using telesurf. Inside the workpiece.

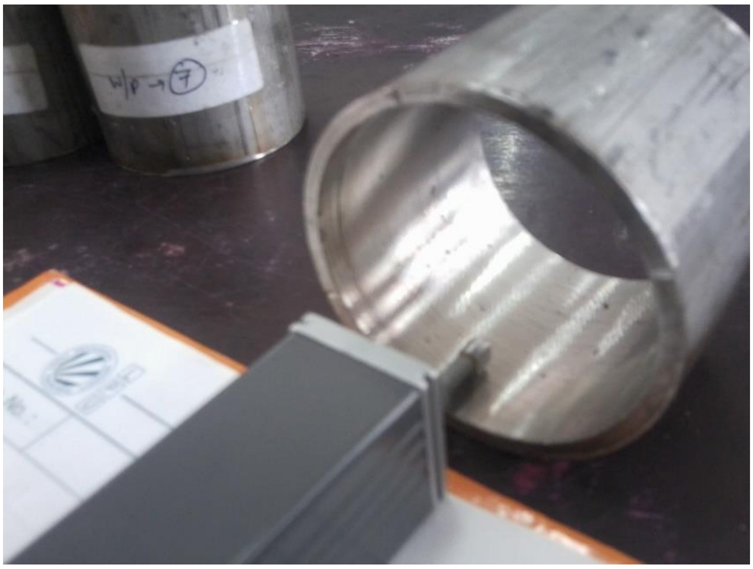

Fig 2: Surface roughness measurement using telesurf.

Table 4: Table of Results.

Run	**Factors Number**					**Improvement in surface finish in percentage**
	A	B	C	D	E	(%)
1	1	1	1	1	1	55.45
2	1	2	2	2	2	75.04
3	1	3	3	3	3	51.85
4	1	4	4	4	4	65.22
5	2	1	2	3	4	73.54
6	2	2	1	4	3	62.09
7	2	3	4	1	2	68.18
8	2	4	3	2	1	71.05
9	3	1	3	4	2	76.93
10	3	2	4	3	1	54.22
11	3	3	1	2	4	62.5
12	3	4	2	1	3	68.99
13	4	1	4	2	3	78.92
14	4	2	3	1	4	67.10
15	4	3	2	4	1	50.07
16	4	4	1	3	2	64.44

GAP VS. IMPROVEMENT IN SURFACE FINISH

To calculate the value of percentage of improvement in surface finish the gap has been taken from 1 - 4.5mm. The best result of improvement is obtained at gap 1mm, speed 1400rpm, 240 grit number of abrasive, 8gm of abrasive and when experiment is done for 60min. The graph has been drawn between gap and improvement in surface finish. Figure 3 shows the variation of values of surface improvement with respect to gap taken.

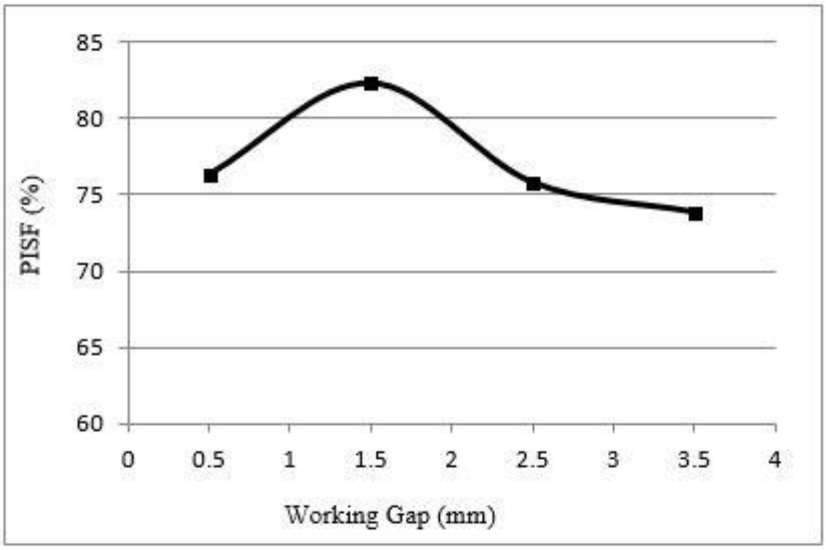

Fig. 3. Gap vs. Improvement in surface finish.

CONCLUSIONS

1. Surface finish with the help of brush made by abrasive material using a magnetic tool is an innovative method and can be used for all nonferrous metals.
2. Working gap is the leading factor and best results are obtained when gap is less, size of abrasive is more. Speed is taken up to highest level.

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