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INVESTIGATION ON PERFORMANCE OF EXTRUSION HONING PROCESS ON QUALITY OF SURFACE TEXTURE

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Abstract — **The EH approach overcomes this limitation of conventional finishing method. The present study focus on the impact of number of passes at the specimen's entry and exit sides of the carrier media. The improvements in surface finish (R_a) on both side i.e entry and exit are evaluated as well. A dimensionless expression for R_a is also developed. The relation is implemented using Buckingham's π theorem and comparison of developed model is performed with experimental results. SEM analysis is made to portray surface texture produced by selected process parameters such as number of passes, volume fraction and grit size of abrasive grains.**

Keywords — **Microstructure, Surface, Texture and Viscoelastic**.

I. INTRODUCTION

Finishing is due to the abrasion reaction of the flow of pressurized polymeric media infused with SiC particles across the constrained path. Throughout this process, abrasive dough is made to flow across substrate to be processed. The AFM technology is regulated by variables such as extruding pressure and flow velocity of media, distribution of SiC inside the media, as well as the number of carrier media passes.

This finishing approach guarantees the process geometric precision, applicability and effectiveness which are crucial for mechanization. For first pass itself this technique accomplishes significant development in surface morphology with changing dimensions. Finishing methods generally acquire 15 % of machining costs in production cycle. While finishing value reduces below one micron the marginal cost ramps up.

Jain et al. 2000 investigated AFM, which improve surface texture of unreachable areas and effect of parameters such as distribution and size of abrasive grains with media flow speed were performed on brass and aluminium. The investigated SF and MR responses were in agreement with the experimental values [1].

Extrusion honing (EH) is an excellent method for processing stiffer materials having complex profiles. From the available literature it is witnessed that several researchers have tried this method for processing class of materials.

Ravi Sankar et al. 2010 studied abrasion on Al/SiC MMCs by R-AFF method. There is a considerable improvement on R_a when extruding pressure, rotational speed, cycles and % of lubricating oil (wt %) in carrier media are considered [2].

Sudhakara et al. 2020 experimented AFM on hollow cylindrical civilities. These specimens were made of Al 7075/SiC NMMCs produced by stir casting [3].

Mohammad Yunus et al. 2020 sought to anticipate the impact of factors like extruding pressure, grit size and number of cycles on responses R_a and MR. Al/SiC particulate MMC with a high SiC % has been considered by constructing Box Behnken design of RSM [4].

Several scholars repeatedly tried AFM processing on a variety of materials that are softer or harder. For instance, Mejar Singh et al.2015 carried out studies on Al-6061[5], Amir et al.2018 and Ibrahim et al.2014 on stainless steel 304 [6] and low carbon steel [7].

Raju et al.2005 studied from material viewpoint of this deburring technology which has polished a wide range of materials. Furthermore, out of roundness, bearing area and residual stresses of spheroidal graphite Fe has investigated by the authors [8]. Besides evaluating material removal [9-10] and producing the glazed surface texture in the given ferrous material [11-12].

II. MATERIALS AND METHODS

The specimens were pre machined by drilling, having the bore diameter 7 mm. The EH passes were performed on these passage diameter using the carrier media is a mixture of SiC and silicone. The carrier media having the abrasive of 36 and VF of 35 % is utilized for experimentation purpose. The factors considered in the study are detailed in Table.1

As there are number of factors that decide the quality of surface while in the current study R_a is considered for evaluation. The surface roughness parameters were measured using Surfcom 130A at entry and exit side of carrier media.

The surfaces of the specimen after each pass were measured regularly. The surface roughness values were noted initially as well as before and after each pass till fifteenth pass of carrier media. Fig. 1 and 2 depicts changes in R_a, R_z, R_t and R_{pk} at both entry/exit region of carrier media in WP of bore dia 7 mm for the considered process parameters.

Table - 1 Extrusion honing parameters considered in present study

SL.No	Parameters	Value
1	Extruding pressure (bar)	60
2	Flow speed of media(m/min) F_s	0.3
3	Length of stroke (mm)	600
4	Number of passes N	15
5	Volume fraction (Abrasive %) C_a	35
6	Grit size of abrasive (microns) M_e	36
7	Temperature	Ambient
8	Dynamic viscosity of media (Pa. S)	20250
9	Density of media (Kg/m^3) ρ_m	1.13 ×10
10	Modulus of elasticity(Kg/m^3) E	2 ×10^{11}

Fig. 2 and 3 also illustrates the influence of 36 grit size of SiC in 35 %, volume fraction of SiC on surface roughness parameters on both entry/exit side of specimen for 7 mm passage diameter. It is noticed that when contrasted to entry side the surface roughness parameters for all passage dia reduces at exit side significantly as shown in Fig. 1 and 2.

The initial surface induced due to drilling process has a higher value of surface roughness. The surface with enough number of peaks offers more resistance to flow of carrier media and hence most of the peaks get abraded at the early stage of extrusion honing passes. Consequently it results in high rate of reduction in surface values. Irrespective of VF and mesh size of abrasives R_a reduces at first pass itself due to macro irregularity correction. It is presumed that it is because of elimination of leading peak asperities, wear debris, burrs across the passage length.

The slow progress of carrier media at entry side creates a dead zone and this result in dull abrasion. As carrier media traverse across the passageway the media relaxes rapidly the abrasives makes enough contact at the exit side and yields better surface finish.
It is concluded from the Fig. 1 and 2 significant surface finish values are achieved on both entry and exit side of WP. For WP of Φ 7 mm by 36 mesh size in 35 % VF at exit side of 0.01 µm and entry side of 0.0064 µm is achieved.

Fig.3 shows the typical SEM illustrations acquired before and after the EH. A machined mark caused by drilling is apparent and illustrated in Fig.3(a). The macrograph after five pass can be seen in Fig.3(b), which also notifies scrubbing of boring lay, path of particle movement and abrasion dents. Additional trial of EH as shown in Fig.3(c), glazing pattern can produce a fairly consistent texture with a steady lay pattern. With additional EH trials, as seen in Fig.3(d) this materials possess an unique glazing structure and uniform texture after 15 passes

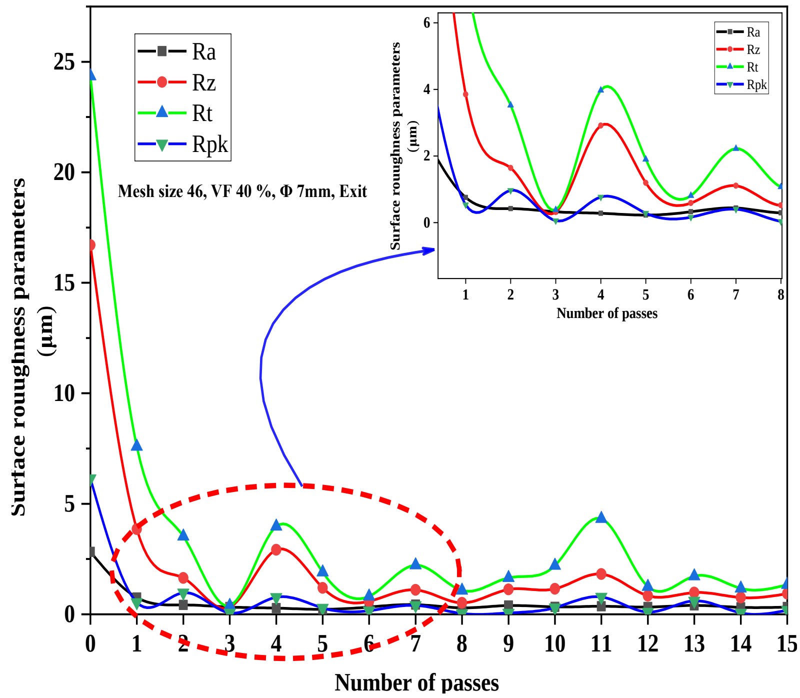

Fig. 1. Effect of number of passes on R_a at entry side

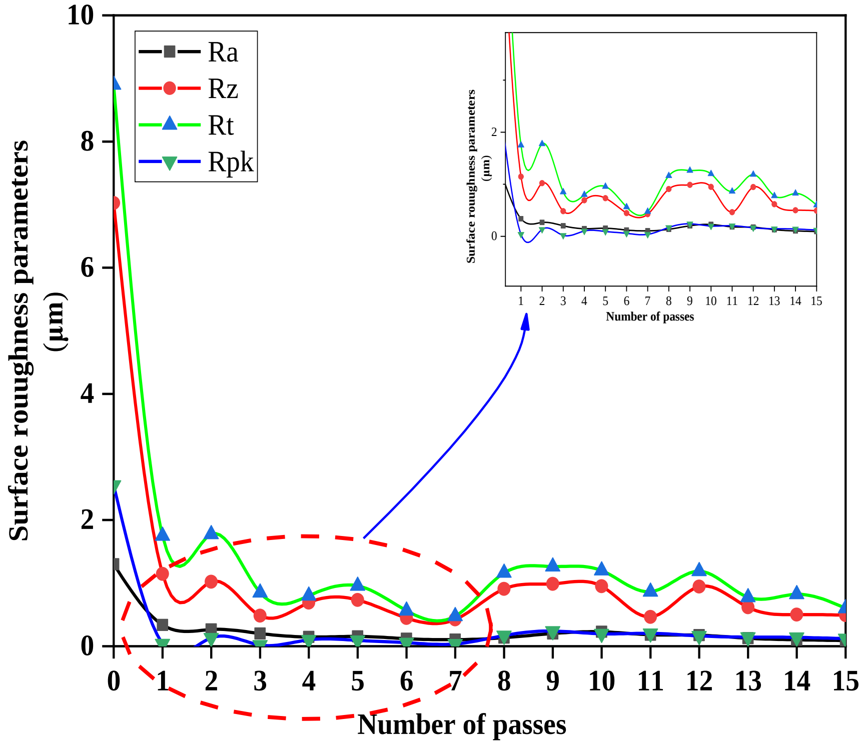

Fig. 2. Effect of number of passes on R_a at exit side

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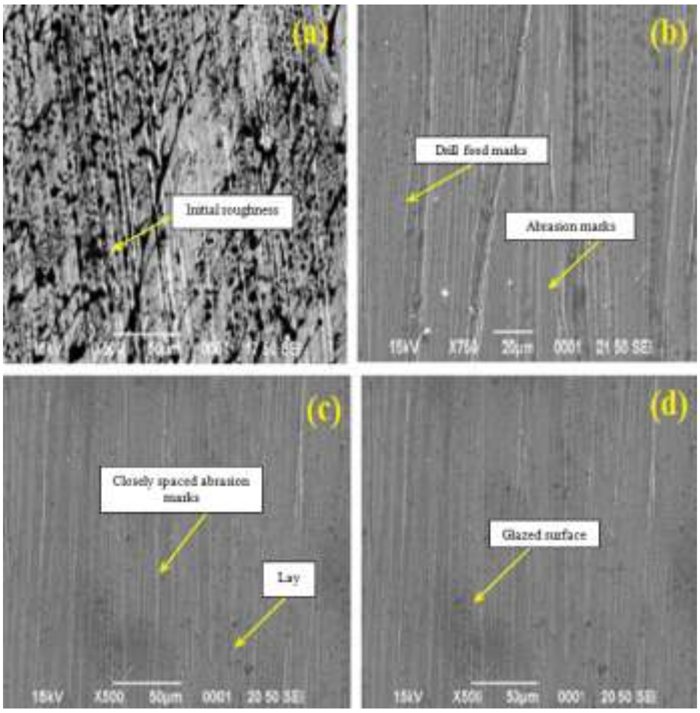

Fig. 3. SEM images of EH textures (a) As bored surface (b) after 5 passes (c) After 10 passes and (d) After 15 passes.

III.CONCLUSION

Challenging stiff material like Inconel-625 alloy is finish-machined using EH process by a select grade polymer. It is evident that the R_a reduces significantly at the early phase of EH process i.e at first and second pass itself. This is due to shearing of asperities and surface irregularities.

The EH process at pressure of 60 bar, abrasive grit size of 36 and 35 % VF, 15 number of passes and in 7 mm bore dia reveal appreciable results when interior surface of Inconel-625 alloy is extrusion honed.

EH trials is carried out for given grit number and VF of abrasive for the given passage diameter on both entry/exit sides of carrier media. There is an extreme decline in surface finish. This happens from second pass after which there is a stable improvement in surface roughness up to fifteenth pass with a diminishing surface with further number of passes.

After first pass surface roughness at both entry and exit side exhibits extensive abnormality in the surface texture generated by pre-honing. The sudden reduction in surface quality is due to removal of peak asperities.

SEM photographs of EH surfaces illustrate progress in quality of surface texture and uniform lay pattern of surface texture can be visualized.

The surface finish factor R_a has significantly reduced from higher values to the lower values for the process parameters considered.

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