

Enhancing the Surface Finish by Polishing of AISI 304 Steel Used for Wet Grinder Rotating Drum

Ragothsingh.R¹, S.Balakumar², K.Kathirvel³, S.Aravind⁴

Karpagam College of Engineering, Coimbatore, India^{1, 2, 3&4}

ABSTRACT: Polishing is a finishing process of creating a smooth and shiny surface by rubbing action of abrasive and a work wheel, leaving a surface with a significant specular reflection. When an unpolished surface is magnified thousands of times, it usually looks like mountains and valleys. " The process of polishing with abrasives starts with coarse ones and graduates to fine ones. The surface of a metallographic specimen is prepared by various methods of grinding and polishing. After preparation, it is often analysed using optical or electron microscopy. In wet grinding machines Buffing is done by different grade of buffing wheels. In an industry, making the surface of the material fine and polished is done using highly sophisticated and automatic surface polishing machines which uses abrasive belts rolling over the metallic rollers and the job is being done on it. In our project we have to fabricate a wet grinding (surface polishing) Machine and test its effectiveness. Here AISI 304 18 grade sheet is used for this work and its surface property is analysed

KEYWORDS: Wet grinding, polishing, buffing, I.

I. INTRODUCTION

Metallography is the study of the internal structure of metals and alloys, and of the relation of structure to composition and to physical, chemical, and mechanical properties. An engineered surface can be defined as a surface of a solid that has been designed and technologically modified or coated with new materials in such a way that the resulting surface has a performance that neither of the involved materials can provides alone. The in our project is to determining the corrosion resistance of the stainless steel surface of the rotating drum. A rough surface finish can effectively lower the corrosion resistance to that of a lower grade of stainless steel.

Many methods have been devised to determine internal structure, but microscopically examinations have always been among the more important. The European standards for stainless steels have attempted to define the most common surface finishes. However, due to the proprietary nature of many suppliers' finishes, it is unlikely that complete standardization is possible. This is a summary of the most common types for each product form. A place for optical microscopy in both industry and research, just as there is still a place for the visual examination offhand specimens and macro-examinations at low magnifications. Polishing is the process of creating a smooth and shiny surface by rubbing or by using a chemical action, leaving a surface with a significant specular reflection.

Mechanical preparation is the most common preparation method; successively finer abrasive particles are used to remove material from the sample surface until the desired surface quality is achieved

Stainless steel AISI 304 is an austenitic grade that can be severely deep drawn. This property has resulted in 304 being the dominant grade used in applications of wet grinding machine rotating drums

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II. PROPERTY OF SS 304

A. The mechanical properties for 304 stainless steel alloys

TABLE 1

Grade	304
Tensile Strength (MPa)	520-720
Compression Strength (MPa)	210
Proof Stress 0.2% (MPa)	210
Elongation A5 (%)	45 Min
Hardness Rockwell B	92

B. Typical physical properties for 304 stainless steel alloys

TABLE 2

Property	Value
Density	8.00 g/cm ³
Melting Point	1450°C
Modulus of Elasticity	193 GPa
Electrical Resistivity	0.072x10 ⁻⁶ Ω.m
Thermal Conductivity	16.2 W/m.K
Thermal Expansion	17.2x10 ⁻⁶ /K

C. Corrosion Resistance of Stainless Steel 304

Stainless steel 304 has excellent corrosion resistance in a wide variety of environments and when in contact with different corrosive media. Pitting and crevice corrosion can occur in environments containing chlorides. Stress corrosion cracking can occur at temperatures over 60°C.

D. Heat Resistance of Stainless Steel 304

Stainless steel 304 has good resistance to oxidation in intermittent service up to 870°C and in continuous service to 925°C. However, continuous use at 425-860°C is not recommended if corrosion resistance in water is required. In this instance 304L is recommended due to its resistance to carbide precipitation.

E. Cold Working of Stainless Steel 304

Stainless steel 304 readily work hardens. Fabrication methods involving cold working may require an intermediate annealing stage to alleviate work hardening and avoid tearing or cracking. At the completion of fabrication a full annealing operation should be employed to reduce internal stresses and optimize corrosion resistance

F. Hot Working of Stainless Steel 304

Fabrication methods, like forging, that involve hot working should occur after uniform heating to 1149-1260°C. The fabricated components should then be rapidly cooled to ensure maximum corrosion resistance

G. Machinability

Stainless steel 304 has good machinability. Machining can be enhanced by using the following rules:

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- Cutting edges must be kept sharp. Dull edges cause excess work hardening.
- Cuts should be light but deep enough to prevent work hardening by riding on the surface of the material.
- Chip breakers should be employed to assist in ensuring swarf remains clear of the work

Low thermal conductivity of austenitic alloys results in heat concentrating at the cutting edges. This means coolants and lubricants are necessary and must be used in large quantities

III. EXPERIMENTAL SET UP

H. ABRASIVE TECHNICAL INFORMATION

Abrasive finishing combines a harder than workpiece abrasive mineral combined with a bonded or coated product that is rubbed or moved with pressure across the workpiece surface. Abrasive finishing can produce a visual or mechanical finish on metals, composites, stone, glass or wood products. The abrasive finishing processes can be achieved by hand, portable equipment, manual or automated machinery. Processes include grinding, polishing, buffing, lapping and honing.

Experimental setup1



ALUMINUM OXIDE (Al_2O_3) is a man made heat treated fused alumina bauxite produced in electric-arc furnaces at temperatures exceeding 4,000 degrees Fahrenheit. After heating and then cooling, the mineral is crushed and sized and is available in grit sizes from 6 to 1200 and finer. Aluminum oxide (A/O) has a blocky structure that when fractured maintains a sharp edged blocky shape. A/O's hardness is 9 on the Mohs scale. A/O is one of the widest used abrasive mineral because of its toughness and durability. It's used to finish metals, composites, and wood.

SILICON CARBIDE (SiC) or carborundum is a naturally occurring but mainly man made abrasive produced by heating or fusing silicon and carbon in vast outdoor facilities. Silicon carbide (S/C) has a sharp slivery shape and is more friable than aluminum oxide. S/C hardness is 9.5 on the Mohs scale. S/C is widely used for finishing hard metal, glass and ceramic surfaces

CERAMIC ABRASIVES is a man made non metallic crystalline structure produced by heating and cooling ceramic matrixes. Ceramic abrasives are very tough, hard and long lasting with a life of 2-3 times that of aluminum oxide. Ceramic abrasives are used on hard metals and long abrasive life requirements. Higher pressures are required to fracture the ceramic abrasives.

ZIRCONIA ALUMINA is a man made aluminum oxide enhanced with approximate 20% zirconium oxide. The zirconia increases the strength of the aluminum oxide by stress induced transformation toughening. Zirconia is stronger, tougher with life up of 1-1/2 to 2 times that of aluminum oxide. Zirconia is blocky or cubic in structure and is a good choice when longer life or tougher abrasives are required. Most applications are in the coarser grits between 24 and 120 grits. The finish is coarser than that of the same grit size of aluminum oxide.

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DIAMOND And CBN ABRASIVES are naturally occurring and can be produced synthetically in a high pressure and high temperature process. Most diamonds that are mined are used industrially and most diamonds used in industry are synthetic. Diamond abrasives are used because of their hardness which is a 10 on the Mohs scale and because of their thermal conductivity. Diamonds have a face cubic structure. The diamond abrasives are used in hard grinding wheels, powders and coated abrasives and are used on hard steels, ceramics and interrupted cutting of composites.

Properties of Abrasive Materials

GRIT SIZE FOR BONDED ABRASIVES ANSI(8-240 grit) are sized to ANSI B74.12 1976 (R1982) and ANSI table 2 (240-1200 grits) to ANSI B74 . 10-1976 are utilized for sizing for abrasive grains in grinding wheels.

Surface Feet Speed Chart / Feet per minute RPM

Wheel Diameter (inches)

FIXTURE FOR MOUNTING THE DRUM

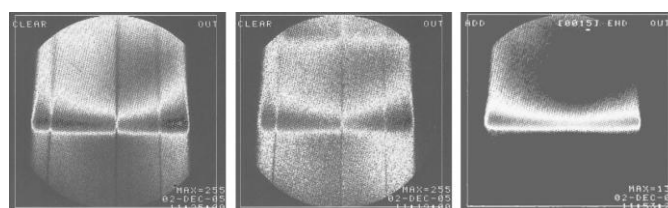


After polishing



Surface morphology

In order to study the surface morphology and roughness of the steels before and after polishing and in an attempt to quantify

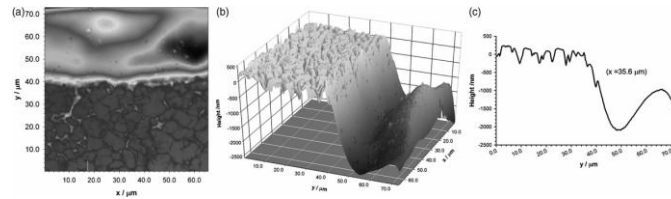


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XPS images of the sample, Fig.4 (a) and (b) recorded in a direction perpendicular to the patterned stripes in the Fe(2p 3/2) and Cr(2p 3/2) spectral regions, respectively, (c) recorded on a homogeneous polished part of the sample in the Fe(2p 3/2) region. Distance traversed along the sample (ca. 4 mm) is recorded on the x-axis of the image.



Resonant mode (ca. 300 kHz) AFM images (recorded in air at a scan rate of 0.5 Hz, 256 lines) of the sample, Fig. 4, at the interface between polished and unpolished regions, (a) tip-height contrast projection and (b) 3-D surface map showing the corresponding height scale, (c) slice through the surface at X = 35.6 μm showing the tip height data for a single line scan.

Sample surface	Surface roughness, R, (area difference ratio)/%	Z max/nm
Unpolished	10.3	2410
10 min. polish	4.1	2380
25 min. polish	2.2	2560

IV.CONCLUSION

This test proves that Probe microscopy studies in combination with SEM have given both a qualitative and a quantitative insight into the polishing mechanism. Interestingly the unpolished surface was much flatter, although rougher, than the resultant polished finish. speed and feed are important

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