REVIEW OF ABRASION MACHINING PROCESS PARAMETERS AND THEIR EFFECTS ON SURFACE FINISH

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Abstract: There are hundreds of abrasives and types of honing tools are available in market. Achieving the best optimized results are going to depend on the type of need surface, as well as its application. There are basically three types of abrasives are available use for honing: silicon carbide, aluminum oxide, and diamonds. Each type is bonded in honing sticks called stones, each with a place in honing. Nothing of the three can be called the general purpose of sharpening all kinds of materials. In this paper an effort has made to summarize the quality of stones and their compatible materials. The quality of surface finish has great significance of stone grit size and their bonding material. Due to grit locking phenomena heat generating rate also increase. There by affect surface quality. This effort will help to chose proper types of abrasive stone without adverse affect on performances.

Index Terms –Abrasive grain size, Honing lubricant, speed of Hone, Lubricant Temperature.

I. INTRODUCTION

The process of bore honing has become increasingly important in the course of time. Increased processing needs in terms of the surface quality, shape and dimensional accuracy and especially the high profitability of honing compared with other processing methods. Since surface finishing measurements have become known and standardized in mechanical engineering specifications, more and more finishes are determined based on actual measurement. Similarly, screening sections are now equipped to verify surface finishes by actual measurement. There are many brands of surface analyzes used. In general terms, such a tool is an oscilloscope. With honing you can edit almost all materials really cost-effective. Through the honing process (i) open bores (ii) blind holes (iii) short bores (iv) Interrupted bores (v) profiled bores (vi) long bores are optimized. Some other defects which are generally found in boring operation such as (i) non-circular bores (ii) bores with bell mouth (iii) wavy bores (iv) holes that are too short (v) taper bores (vi) conical bores (vii) bores with scratches on the surface and banana shape holes .are corrected in their dimensions. Proper selection of honing stone directly or indirectly affects the operation performance as well as life of tools. So it is great challenge for on growing manufacturer to choose proper types of hone stone to get optimized honing operation.

II. CHARACTER OF WORK MATERIAL

Abrasives are used extensively for more material removal rate app as well as for the production of the predetermined shape, size, finish, and accuracy for a wide range of work materials including metals soft versus hard, ferrous alloys versus nonferrous alloys , ceramics, glasses, wood, concrete, stone, and composites. Both hard and soft material, are resistant to shearing and having most steels as well as some non-ferrous alloys, and most metals and metal-like materials that produces a long chip when drilling or turning. Economical and effective honing of such materials requires an abrasive grain that is more or less shatter proof by the nature of its general shape and crystal structure.

- Aluminum oxide has such specification. It has a lumpy shape something like crushed stone, and any point of the grain always has a negative rake angle above its cutting point. Ceramic lathe tool bits inserts are made of Aluminum Oxide and these bits are as a rule set with a negative top rake. Brittle Materials or stringy materials having a low shear resistance cannot be cut Aluminum Oxide as they can be cut with Silicon Carbide.
- Silicon carbide crushes into splinters of jagged, glasslike grains .A good percentage of these very sharp, splinters like points, when pushed into the work surface will have a decidedly positive rake angle. For honing a material that does not offer too much resistance to shear Silicon Carbide has been found to be most effective, cutting such materials with less applied force both as to penetration and shearing. . These points will stand up while plowing furrows in brittle materials like cast iron and low-shear materials like aluminum, plastics, etc . It has found that in a comparison of Aluminum Oxide and Silicon Carbide of the same grain size, the latter produces a somewhat better and more uniform surface finish. For this reason Silicon Carbide is generally used in most materials when very fine finishes are desired.

III. LITERATURE REVIEW

Honing is a type of abrasive process typically used to finish the interior of a cylinder. A hone uses several flat stones arranged around a mandrel that moves in and out of the hole. The abrasive material is used in the form of sticks. Since honing is a slower process than grinding, heat and pressures are lower. That why honing provides better size and geometry control at low cost. All type honing tools basically grouped in four types (I) Flexible Hones**:** it contain abrasive beads attached to the segmented end ends. These are suitable to make smoother surfaces both internal and external. (II) Honing Sticks**:** This Honing stack is used for providing a finishing touch to the bores. (III) Sharpening Stone**:** This normal abrasive stone fit for sharpen the edges (IV) Hand hones: These are known as diamond hones. These types of honing tools are designed to hone the edges of ground cutting tools.

Selection hone stone: The Abrasive tool materials used for honing sticks are generally Sic, Al_2O_3, CBN, and diamond. Selection for the particular type of abrasives tool depends on type's material. In this regard, SiC is used for honing cast iron and nonferrous materials and Al_2O_3 is widely used for honing of steel. Diamond abrasives are prescribed for chrome-plated and extremely hard carbides and ceramics.

Table 1 shows, The size of abrasive grains varies within a wide range from 14 to 400 μm. The type of bond does not play an important role in the honing process. However, the bond determines the permissible rotational speed and the number of strokes per minute. The phenolic resins are popular bond material because their strength is high as compare to other bonding material. Regarding the hone life, Al_2O_3 or SiC hones are capable of performing 100–500 operations depending on the honing allowance and the other process factors generally, a higher hardness is suitable for large machining allowances, rigid work pieces, with higher unit pressures. For high accuracy requirements and un-rigid work pieces, lower hone hardness is chosen.

Table1 Selection of Honing Stone Characteristics

Work Material	Hardness BHN	Grain Size for Surface Finish (μm)					
		Abrasive	Grade	0.01	0.025	0.3	0.4
Steel	200-300	Al_2O_3	R	600	500	400	320
	330-470		O	600	500	400	320
	60-65 RC		J	500	400	320	280
Cast iron	200-470	SiC	Q	500	400	280	280
	60-65 RC	SiC	J	400	280	220	150
Aluminum		SiC	R	600	500	400	320
Copper	120-140	SiC	R	600	500	400	320
	180-200	SiC	R	600	500	400	320

The development of latest engineering materials made cutting and abrasion machining very difficult because these processes are mainly involve in removing materials using cutting or abrasion tools that are harder than the work piece. Traditional was ineffective for machining complex shapes, low-rigidity structures, and micro machined components at high degrees of accuracy and surface quality. An effort has made for classifying the modern machining process as follow. In Figure 1

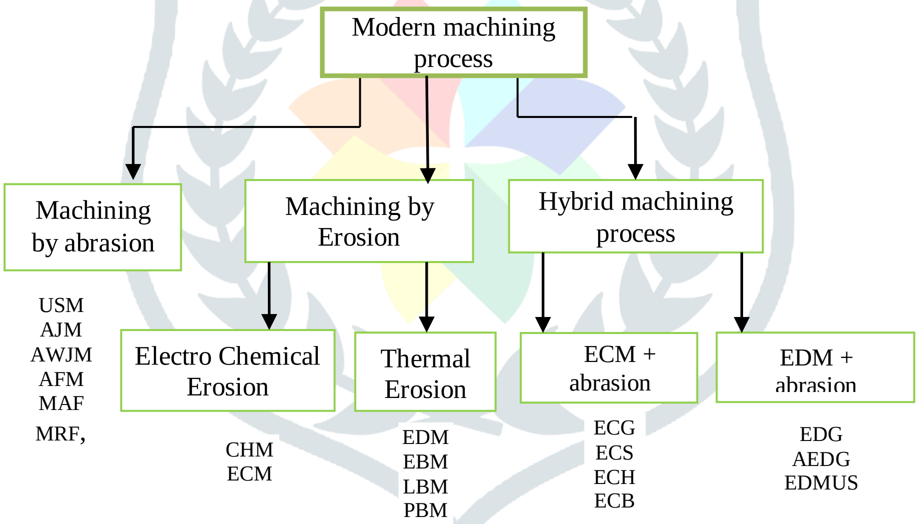

Fig1 classification of modern manufacturing process

IV. PROCESS PRINCIPAL OF EROSION PROCESS

The electrolytic material removal in erosion process is based on Faraday's laws of electrolysis, [1, 3]. However, many process variables affect the intensity and composition of electrolytic dissolution. These variables include changes in valency of electrochemical dissolution and preferential valence mode of electrochemical dissolution during the process.

its dependence on electrolyte temperature, variation of temperature along the electrolyte flow path, effect of passivity owing to metal oxide film, and so on. In the metallic conduction while electrons are the charge carriers, electrolyte solutions conduct electrical energy by migration of ions between the two electrodes. In this process no electrolyte is consumed except for flow losses and vaporization. [1, 2].

- **Effect of time and grain size on of erosion process**

  The rate of material removal in honing diminishes with time in a hyperbolic way, independently on the grain number as shown in

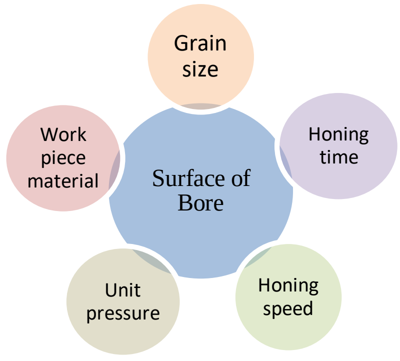

Figure 2. Factors affecting honing performance.

For any grain size, as you see the mean total height of surface roughness decreases with honing time, until, as a result of wear, some burning and surface scratching occur, which raises the surface roughness. The use of fine-grained hones yields lower rates of material removal and improved surface finish.

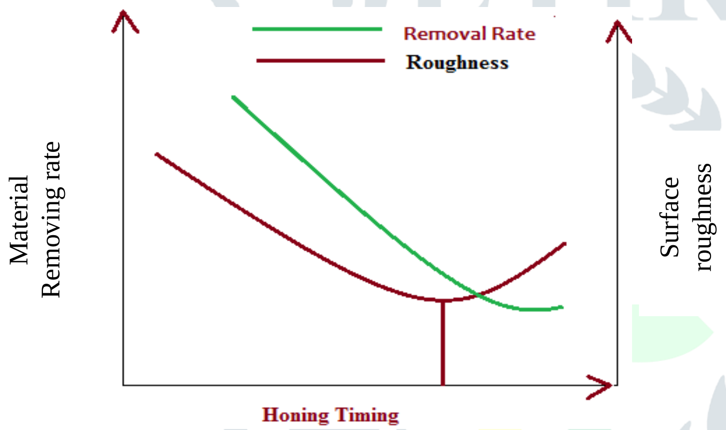

Fig 3 Effect of time on removal rate and roughness of honed parts.

- **Effect of unit pressure***:* Normal way honing pressures are maintained between 1.0MPa and 3.2 MPa. It is observed the material removal rate increases with increment pressure. At low pressures, the surface roughness of material remains unchanged. Above a certain value of unit pressure, its effect gradually decreases. In the normal working range, the increase of unit pressure deteriorates the surface roughness. Higher unit pressures are suitable when the machining allowance is relatively high and the surface quality requirements are low. In such a case, hones are hard, grains are coarse, and the speed of reciprocation is high.

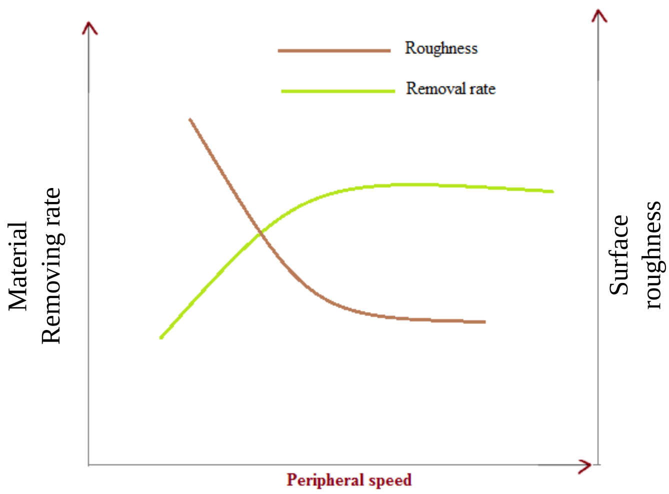

Fig 4 Effect of peripheral speed on removal rate and roughness of honed parts.

- **Effect of speed**:

Generally, higher cutting speeds are used for honing metals that shear easily such as cast iron and nonferrous materials. The honing speed should be decreased when the contact area between grains and the bore increases. Higher speeds produce fine surface finish and raise the removal rate; it decreases the dimensional accuracy, overheats the work piece, and dulls the abrasives. Table 2 shows the rotary and reciprocating speeds of honing some engineering materials. An increase in that speed improves the self-dressing characteristics of the abrasive sticks, which improves the material removal rate .Increasing the peripheral speed of hones causes a linear growth of the material removal rate. On the other hand, surface roughness becomes

Table 2 Selection of Honing Process Parameters

Work Material	**Hardness RC**	**Rotary Speed** (Rough Honing)	**Reciprocating Speed** (Rough Honing	**Rotary Speed** (Finish Honing)	**Reciprocating Speed** (Finish Honing)
Cast iron	15–20	23–28	10–12	32	13.5
Steel	15-35	18-22	9--11	25	12
	35-60	14-21	12--15	28	17.5
Alloy Steels	25-50	23-28	10--12	31	12
Bronze	8--15	21-26	12--26	30	17.5
Aluminum		21-26	12--26	31	17

- **Effect of Cutting fluid*:***

For materials which make long string like chips the honing oil have additional lubricating effect. Water-based cutting fluids are quite commonly used, the most popular being soluble oil (suds or slurry), in which soluble oil (1%–5%) is mixed with water to form an emulsion. These fluids have excellent cooling properties at low cost and there is also some lubricating effect between the tool and the chip, which reduces tool wear Soda solutions are often used on grinding operations, as they exhibit good flushing action and cooling effects. Water itself is seldom used as a coolant as it causes rust and corrosion of both the work piece and the machine. High viscosity of lubricant is desired there. These fluids are usually mineral or synthetic based. Sometime biological or water-soluble fluids are seldom used for honing;. There is a direct relationship between the viscosity of the fluid and the cutting ability of the honing stones. The choice of fluid has great effect on stone wear and honing time per part. It depends on many variables, such as material, abrasive, cutting speed and the amount of stock removal per part. in case of honing, the use of cutting fluids facilitate lubrication and washing the work and hone surfaces. Paraffin mixed with spindle oil is the most commonly used as shown in Table 4. Proper filtration is essential to achieve a surface roughness of less than 0.02 μm *R*a.

Table 4 Common honing Lubricants

Work piece Material	**Lubricants**	
	Paraffin (%)	Oil (%)
Non-hardened steel	70	30
Hardened steel	85	15
Cast iron	90	10
Nonferrous materials	80	20

CONCLUSION

As, the technology developed in manufacturing sector the requirement of surface accuracy increases parallel to it. The precision work in manufacturing sector become possible only due to develop in surface finishing operation. In modern time there are a lot of surface finishing process and technique are available. Out of them the abrasive and erosion machining process has their own importance and recognition in this sector. The abrasive material removing process can involve in machining of electric conductor material as well as some their alloys. When, it is considered as surface accuracy AM provides with great accuracy as compare to other finishing process. For getting better results and optimized operation now a day's Hybrid manufacturing technique (combination of mechanical as well as electrochemical process) are being adopted in high precision Work .

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