

Finishing Process



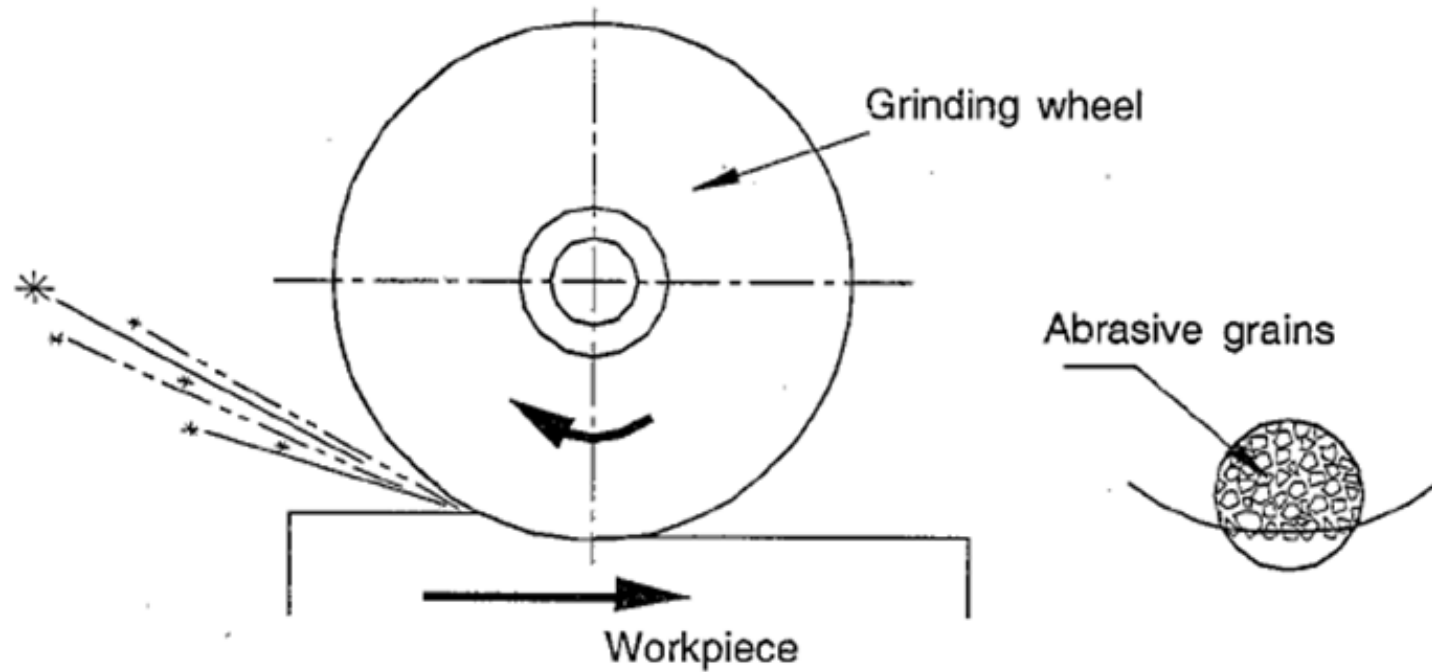
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Introduction

- Finishing processes are different from other manufacturing processes.
- The distinction between the finishing processes and other manufacturing processes is that the finishing processes are intended to improve the surface smoothness and do not significantly change the dimensions of the part. Rather they are meant to achieve the closer dimensional tolerance.
- The machining and finishing processes for these objectives include abrasive machining, honing, lapping, super finishing, burnishing, buffing and polishing.

Abrasive Machining

- Abrasive machining or grinding is a chip forming metal cutting operation.
- For grinding, generally, a rotating wheel is used as a tool.
- The grinding wheel and sand paper consists of bonded abrasives.
- The abrasive grains have sharp edges that project out and cut the chips.
- In grinding, the high circumferential speed of the grinding wheel causes high friction and chips become red hot and fly as sparks.



The grinding process and an enlarged view of a grinding wheel.

- Machine tools used for grinding are called grinding machines.
- In grinding and other machining processes, a very large number of tiny cutting edges simultaneously cut the surface, each taking a very minute cut. This means that the depth of cut in grinding is very small and hence, grinding can produce surface finish up to 2 microns and dimensional tolerances as small as 0.0025mm.

Classification of grinding machines

- Grinding machines – Precision and Non-precision
 1. Precision grinding for getting close dimensional accuracy.
 2. Non – precision grinding for machining hard material.
- Grinding machines also cylindrical and surface grinding machines.
 1. cylindrical grinding for grinding cylindrical surfaces
 2. surface grinding for grinding flat surfaces.

Abrasives

- An abrasive is a substance that is used to make cutting tools for grinding (grinding wheels), lapping, polishing, and other finishing operations.
- An abrasive is non metallic hard material crushed in to irregular shaped small particles with sharp edges. This particles act as cutting tool.
- A good abrasive should be pure with uniform physical properties of hardness, toughness, and resistance to fracture to be useful in manufacturing of grinding wheels and other finishing tools.
- Abrasives may be classified in to two principal groups:
 - 1. Natural Abrasives**
 - 2. Synthetic Abrasives**

Natural Abrasives

- Natural abrasives are found in nature and include sandstone or solid quartz, emery, corundum and diamond.
- The characteristics of these abrasives are
 - **Sandstone** is one of the natural abrasive stones from which grindstones are made. It contains quartz as the abrasive or the cutting agent.
 - **Emery** is natural aluminium oxide. It contains 55 – 65% aluminium and the remainder consists of iron oxide and other impurities.
 - **Corundum** is also a natural aluminium oxide. It contains 75 – 95% aluminium oxide and the remainder consists of impurities.
 - **Diamond** is the hardest material known so far. Diamonds are crushed to produce abrasive grains for making grinding wheels to grind cemented carbide tools and to make lapping compound.

Synthetic Abrasives

- **Synthetic abrasives** are artificial abrasives manufactured by processing different materials to produce abrasives. These include silicon carbide and aluminium oxide.
- **Silicon carbide** is a hard and brittle abrasive and is most efficient for grinding materials of low tensile strength such as cast iron, brass, copper and aluminium, etc., this abrasives are designated by the letter 'C' and is available in trade names of 'Crystolon' and 'Unirundum'.

- **Aluminium oxide** is tougher than silicon carbide.

Aluminium oxide is suitable for grinding metals of high tensile strength such as steel.

This abrasives are designated by the letter 'A' and is available in the trade names 'Aloxite', 'Alundum' and 'Bauxite'.

- Other synthetic abrasive materials like synthetic diamonds, cubic boron nitride are produced which are used for specific situations.

The Grinding Wheel

- The tiny abrasive particles are bounded together to form the grinding tool known as the grinding wheel.

Construction of Grinding Wheel

- The abrasive grains or grits are held together by a bonding material that acts as the supporting post between the grains.
- some porosity is essential in bonded wheels to provide clearance for the minute chips being produced and to provide cooling.
- The maximum depth of cut is of the order of 0.25 – 0.5mm.

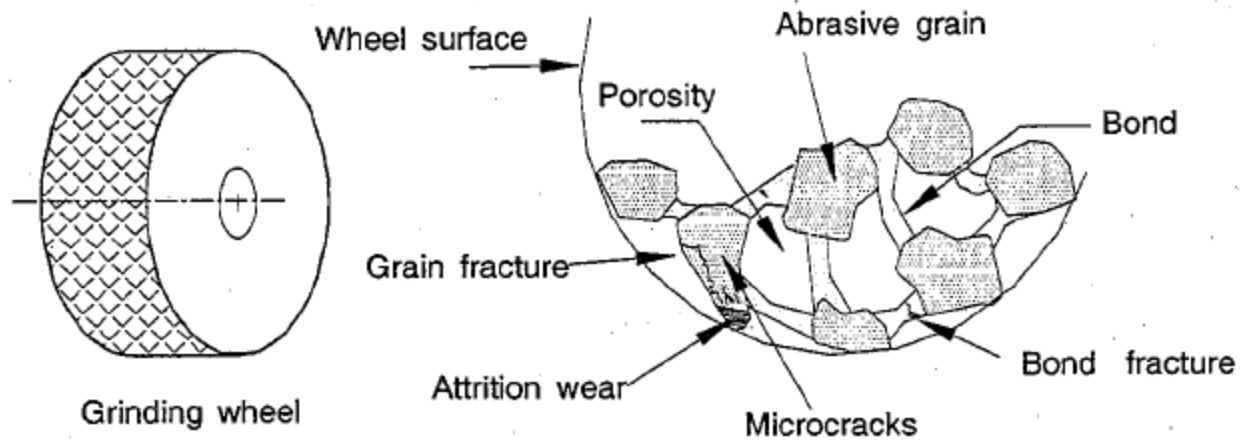


Figure 9.2 Grinding wheel and its structure showing grains, bond, and porosity.

Process of making a grinding wheel

- STEPS:

1. The abrasive material is crushed to reduce it to small – sized particles by using roll and jaw crushers.
2. The crushed abrasive particles are passed through magnetic separators to remove iron compounds.
3. Grains are classified into different sizes and selected grains are mixed with the bonding material, moulded or cut to proper shape, and heated. Different bonding processes and bonding materials are used for the bonding of grinding wheels. Few of them are vitrified bonding process, shellac bonding process, and resinoid bonding process. The type of bonding process used depends on the type of abrasive material, structure, and application for which the grinding wheel is to be used.
4. The wheel are trued, tested, and given a final inspection.

Characteristics of Grinding wheel

- Grit or Grain Size:
 - Abrasives particles are very small as compared to the size of the other cutting tools.
 - Abrasive particles have sharp edges, thus allows the removal of very small quantities of material from the work piece surface. Consequently, very fine surface finish and dimensional accuracy can be obtained.

- A number identifies the size of an abrasive grain or grit. The smaller the grain size, the larger is the number.
- Ex: a grain size of 10 is regarded as very coarse, 100 as fine and 600 as very fine.

Grade:

- The term grade as applied to the grinding wheel refers to the tenacity or hardness with which the bond holds the cutting points or abrasive grains.
- The grade indicates the bonds and processes used by a letter of the English alphabets A to Z, with 'A' denoting the softest and 'Z' the hardest grade.

- Structure:

- Abrasive grains are not packed tightly in the grinding wheel but are distributed throughout the bond.
- The relative spacing is referred as the structure and denoted by the number of cutting edges per unit area of the wheel face as well as by the number and size of void spaces between grains.
- The primary purpose of the structure is to provide chip clearance.
- It is also to provide space for the coolant to flow.

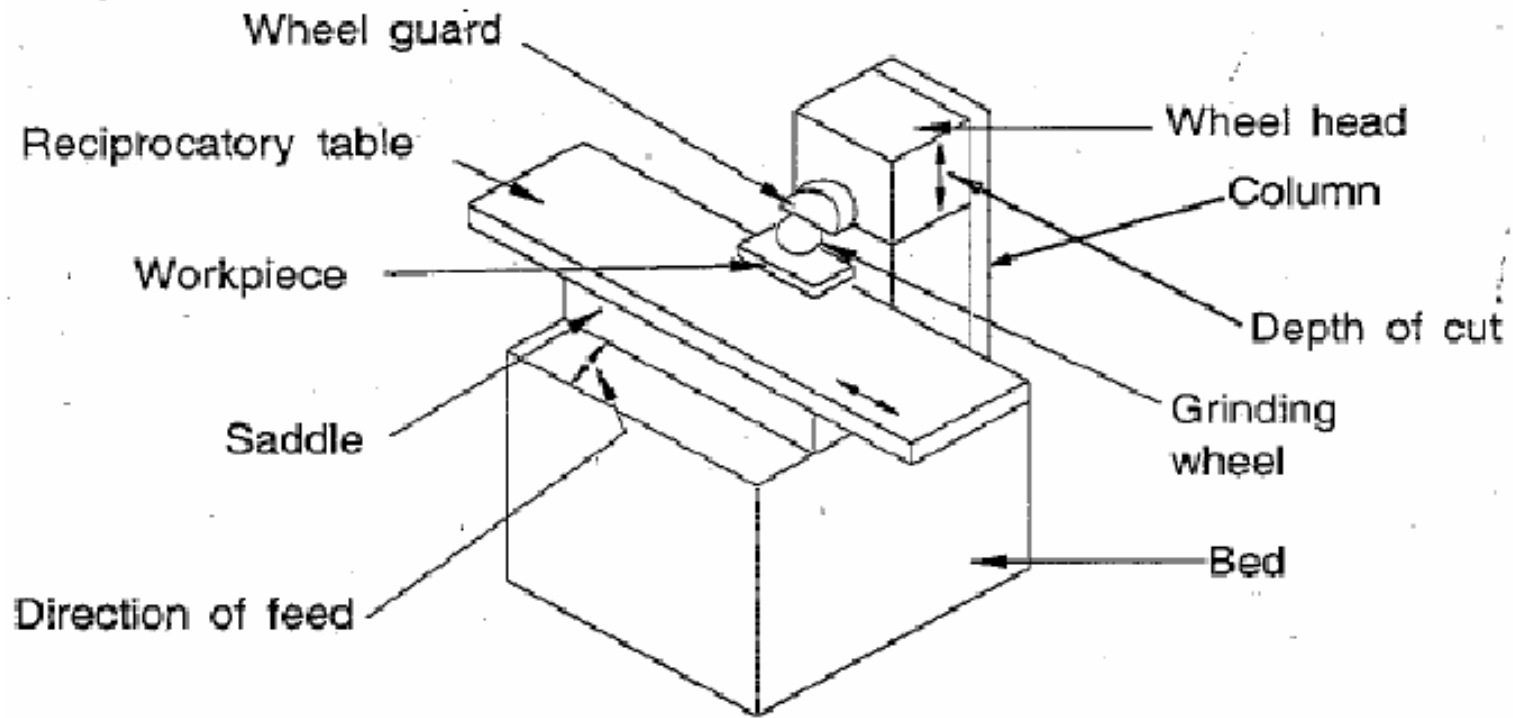
Selection of a grinding wheel

The selection of a grinding wheel for a particular application depends on various factors:

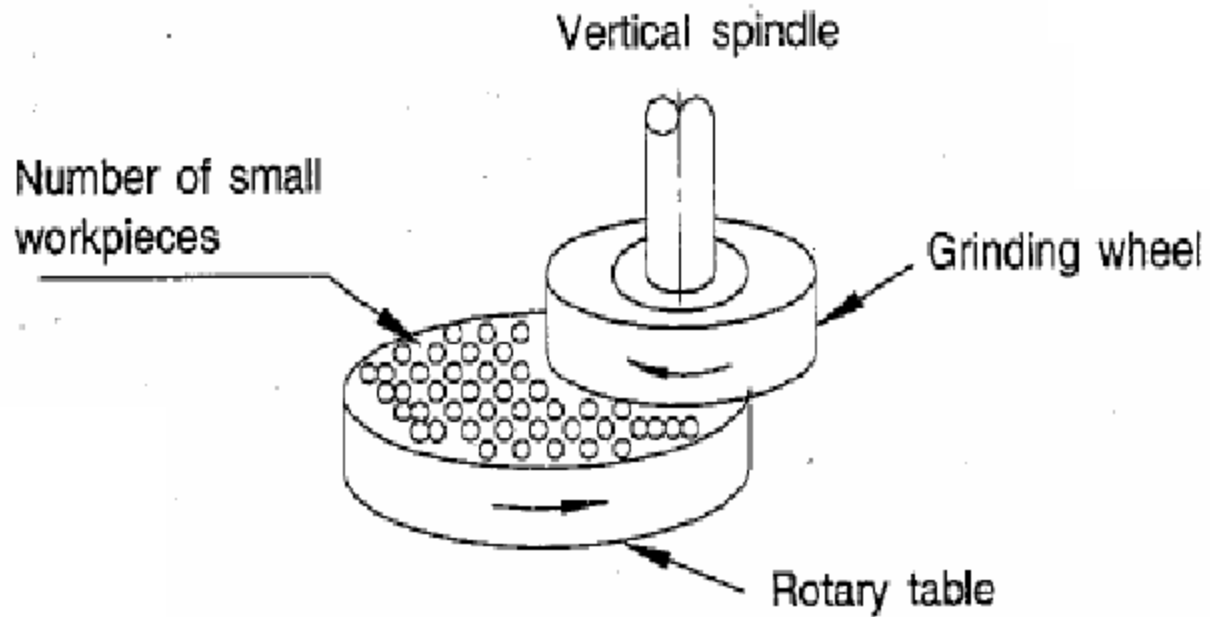
- The size and shape of grinding wheel is directly dependent on the job to be done.
- The choice of abrasive depends on the work piece material to be ground.
- A coarse grit is used for rough finish and faster grinding while a fine grit gives smooth finish and slow grinding.

GRINDING MACHINES

- To carry out the finishing operation on work pieces, grinding machines are used with grinding wheel as the cutting tool.
- Surface grinding Machine:
 - Grinding of plane surfaces, known as surface grinding or flat grinding is done on surface grinding machine.
 - These are of three types based on the axis of spindle: horizontal, vertical and universal.



A horizontal surface grinding machine.



Vertical spindle surface grinding machine.