GRINDING MACHINES (UNIT - 5)

Introduction:-

Grinding is metal cutting operation performed by means of a rotating abrasive wheel that acts as a tool. This is used to finish work pieces which must show a high surface quality, accuracy of shape and dimension.

Mostly grinding is the finishing operating because it removes comparatively little metal, 0.25 to 0.50 mm in most operations and the accuracy in dimensions is in the order of 0.000025 mm. Grinding is also done to machine materials which are too hard for other machining methods that use cutting tools.

Many different types of grinding m/cs have been developed for handling various kinds of work to which the grinding process is applicable.

KINDS OF GRINDING:-

Grinding is done on surfaces of almost all conceivable shapes & materials of all kinds. Grinding may be classified broadly into two groups.

i) Rough or non-precision grinding
ii) Precision grinding.

ROUGH GRINDING:-

The common forms of rough grinding are snagging and off hand grinding where the work is held in the operators hand. The work is pressed hard against the wheel or vice-versa. The accuracy & surface finish obtained are the secondary importance

Snagging is done where a considerable amount of metal is removed without regard to accuracy of the finished surface. Examples of snag grinding are trimming the surface left by sprues & risers on castings, grinding the parting line of left on castings, removing flash on forgings, the excess metal on welds, cracks and imperfections on allow steel billets.

PRECISION GRINGING:-

This is concerned with producting good surface finish and high degress of accuracy. The wheel or work are guided in precise paths.

Grinding, in accordance with the type of surface to the ground in classified as:-

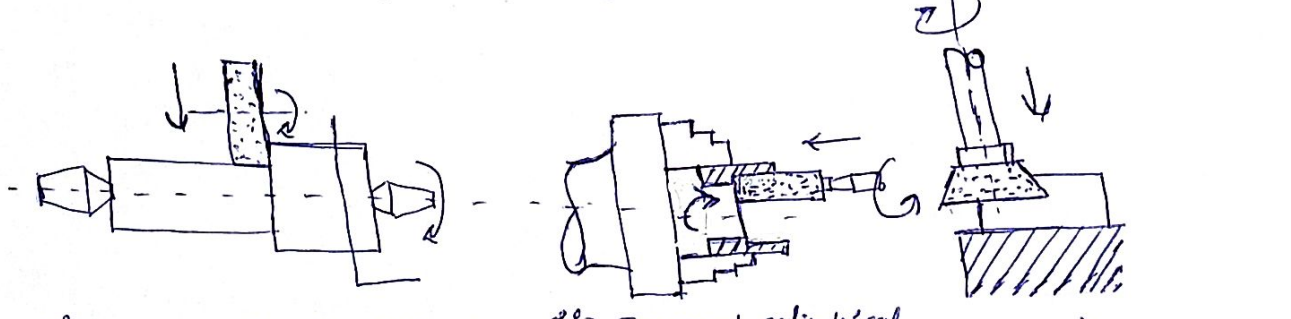
i) External cylindrical Grinding
ii) Internal cylindrical Grinding
3) Surface Grinding
4) Foom Grinding.

i) External cylindrical Grinding:- produces a straight or tapered surface on a work piece. The work piece must rotated about its own axis between centres as it passes lengthwise across the face of a revolving grinding wheel.

ii) INTERNAL CYLINDRICAL GRINDING:- Produces Internal cylindrical holes and tapers. The work pieces are chucked & precisely rotated about their own axis. The Grinding wheel or, in the case of small bore holes, the cylinder wheel rotates against the sense of rotation of the work piece.

iii) SURFACE GRINDING:- produces flat surface. The work may be ground by either the periphery or by the end face of the grinding wheel. The work piece is reciprocated at a constant speed below or on the end face of the grinding wheel.

iv) FORM GRINDING:- is done with specially shaped grinding wheels that grind the formed surfaces as in grinding of gear teeth, threads, splined, shafts, holes, & spheres e.t.c.



(i) external cylindrical Grinding

(ii) Internal cylindrical Grinding

(iii) Surface Grinding

GRINDING MACHINES.

The grinding m/cs, according to the quality of surface finish, may be classified as. i) Rough Grinding
ii) Precision Grinding.

i) ROUGH GRINDERS:— Rough grinders are those grinding m/cs whose chief work is the removal of stock without any to the accuracy of the result. They are mainly of following types.

a) Floor stand and bench grinders.
b) Portable and flexible shaft grinders.
c) Swing frame grinders.
d) Abrasive belt grinders.

ii) PRECISION GRINDERS:—

Precision grinders are those that finish parts to a very accurate dimensions.

(a) cylindrical grinders.
  i) centre type (plain)
  ii) centre-type (universal)
  iii) centreless.

(b) Internal grinders.
  i) chucking type.
    (a) plain (b) universal.
  ii) planetary.
  iii) centreless

(c) Surface Grinders.
  i) Reciprocating type.
    (a) horizontal spindle (b) vertical spindle

(d) Tool & cutter Grinders.
  (a) universal (b) special.

(e) Special grinding m/cs.

GRINDING WHEEL

A grinding wheel is a multitooth cutter made up of many hard particles known as abrasive which have been crushed to leave sharp edges which do the cutting. The abrasive grains are mixed with a suitable bond, which acts as a matrix or holder when the wheel is in use. The wheel may consists of one piece or of segments of abrasive blocks built up into a solid wheel. The abrasive wheel is usually mounted on some form of m/c adapted to a particular type of work.

ABRASIVES:—

An abrasive is a substance that is used for grinding and polishing operations. It should be pure and have uniform physical properties of hardness, toughness, & resistance to fractures to be useful in manufacturing grinding wheels.

Abrasives may be classified in two important groups.

(1) Natural
(2) Artificial ~~and~~ or Manufactured.

1) NATURAL:- The natural abrasives include Sand stone or solid quartz, emery.

Sand stone or solid quartz:- is one of natural abrasive stone from which grindstones are shaped. The quartz cutting agent is relatively sharp that material harder than quartz cannot be abraded or ground rapidly.

Emery:- is a natural aluminium oxide. It contains from 55 to 65% alumina, the remainder consists of iron oxide and other impurities.

Corundum:- is a natural aluminum oxide also. It contain 75 to 95% aluminium oxide; the remainder consists of Impurities.

Both emery and corundum have a greater hardness and better abrasive action than quartz.

Diamonds:- of less than gem quality are crushed to produce abrasive grains for making grinding wheels to grind cemented carbide tools and to make lapping compounds.

ARTIFIAL;-

Artificial or manufactured abrasives include chiefly (a) Silicon carbide and (b) Aluminium oxide.

(a) SILICON CARBIDE:- (SiC) abrasive is manufactured from 56 parts of Silicon Sand, 34 Parts of powdered coke, 2 Parts of Salt, and 12 Parts of Sawdust in a long, rectangular type electric furance of the resistance type that is built up of Loose brick work. Sand furnishes Silicon, coke furnishes carbon, Sawdust makes the charge porous, Salt helps to fuse it and gases may escape through the open joints in the brick work. The abrasive wheels are denoted by 'S'.

There are two types of Silicon carbide abrasives Green grit which contains at least 97% Silicon carbide, and black grit which contains at least 95% Silicon carbide This form is harder but weaker than the later.

Silicon carbide follows the diamond in order of hardness, but it is not as tough as Aluminium oxide. It is used for grinding material of low tensile strengths such as cemented carbides, Stone & ceramic materials, grey cast iron, brass, bronze, copper, Aluminium, Vulcanised Rubber, etc. The name of the manufacturers manufacturing Silicon carbide grinding wheel and the trade name is given below.

Manufacturer	Trade name	Manufacturer	Trade name
(1) The carborundum co.	carborundum	(3) Macklin company	Silicon Carbid
(2) The Norton Company.	crystolon	(4) Abrasive company	Electrolon

ALUMINIUM OXIDE (Al_2O_3) :- Manufactured by heating mineral bauxite, a hydrated aluminium oxide clay containing silica, iron oxide, titanium oxide, etc, mixed with ground coke and iron borings in a arc-type electric furance.

Aluminium oxide is tough and not easily fractured, so it is better adopted to grinding materials of high tensile strength, such as most steels, carbon steels, high speed steels. annealed malleable iron, wrough iron, tough bronzes. The wheels are denoted by 'A'. The names of manufacturers and their trade names are given below.

Manufacturer	Trade name	Manufacturer	Trade name.
(1) The carborundem co.	Alo xite	(3) Macklin Company	Aluminium Oxide
(2) The Norton company	Alundum.	(4) Abrasive Company	Boolon.

BONDS AND BONDING PROCESSES :—

A bond is an adhesive substance that is employed to hold abrasive grains together in the form of sharpening stones or grinding wheels. Bonding materials and processes are :-

1. Vitrified bond used for making verified Grinding wheels.
2. Silicate bond used for making silicate wheels
3. Shellac bond for making elastic wheels
4. Resinoid bond used for making resinoid wheels
5. Rubber bond used for making Vulcanized wheels
6. oxychloride bond for making oxychloride wheels.

1. VITRIFIED BONDING PROCESS :- Vetrified wheels are made by bonding clay melted to a glass like consistency with abrasive grains. The clay and abrasive grains are thoroughly mixed together with sufficient water to make a mixture uniform. The fluid mixture is then poured into moulds and allow to dry. when it has dried to a point where it can be handled, the material is cut trimmed to more

perfect size and shape. It is then heated or burned in a kiln in much the same manner as brick or tile is burnt. when the burning proceeds, the clay vitrifies, that is it fuses and forms a porcelain, or glasslike substance that surrounds and connects the abrasive grains. The high temperature employed in this process tends to anneal the abrasives to some extent.

Vitrified bond gives the wheel good strength as well as porosity to allow high stock removal with cool cutting. It is affected by heat, cold water or acids. Disadvantages of vertified bonded wheels are their sensitivity to impact and their low bending strength. About 75% of the wheels now manufactured are made with this bond. A vitrified bonded is denoted by the letter 'V'.

2. SILICATE BONDING PROCESS:—

Silicate wheel are made by mixing abrasive grains with silicate of soda or water glass. The mixture is packed into moulds and allowed to dry. The moulded shapes are then backed in a furnace at a temperature of 260°C for several days.

The silicate bond releases the abrasive grains more readily than the vitrified bond, the abrasive grains are not annealed as in the vitrified process, and silicate wheels are water proof. These characteristic make silicate wheels valuable for grinding edged tools and other operations where heat must be held to a minimum with or without the aid of coolant. A silicate bonded wheel is denoted by the letter 'S'.

3. SHELLAC BONDING PROCESS:— Shellac bonded wheels are also known as elastic bonded wheels. In this process, the abrasive and shellac are mixed in heated containers and the rolled or pressed in heated moulds. later the shapes are backed a few hours at a temperature of approximately 150°C.

The elasticity of this bond is greater than in other types and it has considerable strength. It is not intended for heavy duty. Shellac bond is COOL cutting on hardened steel and thin sections, and it is used for finishing chilled iron,

cast iron and steel rolls, hardened steel cams and aluminium pistons, and in very thin section, for abrasive cutting of m/cs. A shellac bonded wheel is denoted by the letter "E".

4. RESINOID BONDING PROCESS;-

Resinoid wheels are produced by mixing abrasive grains with synthetic resins and other compounds. The mixture is placed in moulds and heated at about 200°C At this temperature, the resin set to hold the abrasive grains in wheel form.

wheels bonded with synthetic resin, such as Bakelite and Redmanol, are used for purposes which require a strong, free high speed wheel. They can remove stock very rapidly. They are useful for precision grinding cams, and rolls requiring high finish. A resinoid bonded wheel is denoted by the letter 'B'.

5. RUBBER BOND WHEELS:-

The Rubber bonded wheels are more resilient, less heat resistant, and more dense than resinoid bonded wheels. They are used where good finish is primary requisite. They are strong and tough enough to make extremely thin wheels. A rubber bonded wheel is denoted by the letter 'R'.

6. OXYCHLORIDE BONDING PROCESS:-

This process consists of mixture of abrasive Grains with oxide and chloride of magnesium. The mixing of bond and abrasive is performed in the same way as for Vitrified bonded wheels.

oxychloride bonds are employed in making wheels and wheels segments for use in disc-grinding operations. The bond ensures a cool cutting action. So grinding is best done dry. An oxychloride bonded wheel is denoted by the letter 'O'.