Machining

1.3 Machining

Machining is the broad term used to describe removal of material from a work piece, it covers several processes, which we usually divide into the following categories: Cutting, generally involving single-point or multipoint cutting tools, each with a clearly defined geometry. Abrasive processes, such as grinding.

Purpose of machining

Most of the engineering components such as gears, bearings, clutches, tools, screws etc. need dimensional and form accuracy and good surface finish for serving their purposes. Preforming like casting, forging etc. generally cannot provide the desired accuracy and finish. For that such preformed parts, called blanks, need semi-finishing and finishing and it is done by machining and grinding. Grinding is also a machining process. Machining to high accuracy and finish essentially enables a product • fulfil its functional requirements • improve its performance • prolong its service

Principle of machining

A metal rod of irregular shape, size and surface is converted into a finished rod of desired dimension and surface by machining by proper relative motions of the tool-work pair.

Definition of machining

Machining is an essential process of finishing by which jobs are produced to the desired dimensions and surface finish by gradually removing the excess material from the preformed blank in the form of chips with the help of cutting tool(s) moved past the work surface(s).

1.4 Cutting fluid application

Cutting with low strength tools, like high speed steels, demands the use of cutting fluid. This is due to the fact that the heat generated during cutting increases a lot the tool temperature, reducing its mechanical strength and, thus, making easier the occurrence of plastic deformation and complete failure. In this case, cutting fluids reduce the temperature, not allowing the tool to loose its strength and making possible the use of relatively high cutting speeds. Drilling, broaching, milling, threading with high speed steel tools are typical examples of these operations where the use of cutting fluids is essential.

Another important application of cutting fluid is in operations where low surface roughness and/or tight dimensional tolerances are required. In these cases, the lubricant guarantees a good surface finish and the cooling fluid guarantees the tight tolerances, because it avoid thermal expansion of the work piece.

When drilling materials that generate discontinuous chips, like grey cast iron, cutting fluid application becomes fundamental, mainly in deep drilling. In this case, the main cutting fluid

function is to carry the chips away from the cutting zone, what other wise could cause chip jamming and, consequently, a possible tool breakage.

Usually continuous cutting (turning, boring, etc.) of any metal (and also several non metallic materials) with carbide tools (with or without coating) is carried out with application of a cutting fluid. In such cases, the fluid increase tool life and, therefore it may reduce costs. Machado et al. (1997) showed how cutting fluids are important in turning AISI 8640 steel with cutting speeds up to 400 m/min and P35 carbide tools coated with three layers of TiC, Al2O3, TiN. They experimented several kinds of cutting fluids. Figure 7 shows the tool life results obtained by them. It can be seen in this figure that when dry cutting is used tool life is much shorter than when any kind of cutting fluid is used.

Purpose of employing cutting fluid

The basic purposes of cutting fluid application are :

• Cooling of the job and the tool to reduce the detrimental effects of cutting temperature on the job and the tool

• Lubrication at the chip–tool interface and the tool flanks to reduce cutting forces and friction and thus the amount of heat generation.

• Cleaning the machining zone by washing away the chip – particles and debris which, if present, spoils the finished surface and accelerates damage of the cutting edges

• Protection of the nascent finished surface – a thin layer of the cutting fluid sticks to the machined surface and thus prevents its harmful contamination by the gases like SO2, O2, H2S, NxOy present in the atmosphere. However, the main aim of application of cutting fluid is to improve machinability through reduction of cutting forces and temperature, improvement by surface integrity and enhancement of tool life.

Major aspects of cutting fluid application

The principal criteria for selection of a cutting fluid for a given machining operation are:

- Process performance :
    - Heat transfer performance
    - Lubrication performance
    - Chip flushing
    - Fluid mist generation
    - Fluid carry-off in chips
    - Corrosion inhibition
    - Fluid stability (for emulsions)
- Cost Performance
- Environmental Performance
- Health Hazard Performance