

**Influence of Coolant in CNC machining**Gaurav M. Gohane¹, Atish kr.Gupta², Atulya R. Sharma³, G. Rohit Pillai⁴, Shubham V. Khade⁵¹Asst. Professor, Dept. of Mechanical Engineering, JD College of Engineering and Management, Nagpur
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Abstract — cooling is simply the process of taking some of the heat energy away. There are different ways to cool the things. In machining operations cooling plays very important parameter. Without cooling various operations cannot perform efficiently. In the study, the machining process is carried out by insert folder material as stainless steel with insert. The machining operations were carried out in the different machining environments. As we had studied the effects of cooling with CO₂ by dry and conventional wet machining in spite cutting temperature. Then we found that cryogenic machining is an effective matter to minimize the cutting temperature found during the machining process. The conclusion of this study is very helpful for the industry and also it improves the productivity.

Keywords- machining, surface finish, oil, tool life, temperature, heat energy, lubrication, cooling

I. INTRODUCTION

In machining operations, heat energy plays very important role. Because of heat energy various unwanted effect observed on tool and work piece. The resultant heats as the temperature produce during machining which is a resultant factor for the machined specifications of the work piece. Cryogenic cooling is applied for the lubricating as well as the cooling the work piece while performing machining process. High cutting temperature is mostly detrimental in various respect since it is must to control or reduce the cutting temperature as for as possible. The quality of machined product can be observed with respect to how near they are with finishing and its properties for the reliability, performance and life of any engineering product following three factors are essential for the manufacturers-tool wear, quality of surface finish and dimensional accuracy for the betterment of any manufacturing industry, employers are having problems regarding quality of product, to achieve higher mass productivity also overall turnover as talk about the filled of production engineering by mainly machining.

It is cleared that a cutting temperature, specially when it is little high, is very detrimental for cutting tool and work piece which is going to machined and since need to be controlled that is it reduced as for as possible without losing the quality of product and productivity. Heat resistant material as well as high strength are mainly including in the high productivity of job machining. Because of these creation of cutting temperature and large amount of heat energy.

In machining friction generated because of which large amount of heat is evolved and in metal removal is always detrimental. for provide proper shape, size and good surface finish machine coolant properly fulfill two important cutting functions-lubrication and cooling. the cooling effect provided by machining coolants is required to remove heat energy from the tool, work piece and chip. This cooling is result as the tool life increases primarily free from the tool from its critical temperature during cutting. The basic function of coolant is to control the temperature through cooling and lubrication.

II. Purpose of Coolant**2.1. Cooling**

During machining operation huge amount of heat is liberated give to the friction in between tool and work piece and energy lost is obtained. Air can also be used as coolant but for very light cuts and low duty cycle. But during production heavy cutting operation is been done for over a long period of time. So for doing production in continuous way tool has to be cooled using liquid coolant to remove heat more rapidly and can help doing speed cutting and lower the friction and tool wear.

2.2. Lubrication

Rather than cooling cutting fluid is also been used as lubricants in the interface between chip and cutting edge of tool. Lubrication helps chips to not to be welded on to the tool due to the heat generated during machining.

III. Delivery method of coolant

There are many preferable method of applying cutting fluid which majorly depends upon application and the availability of equipment. In the metal cutting operation usually the coolant is being pumped by high pressure, high volume directly to the chip-tool interface, with valves being surrounded by the machine to contain the splatter and some to catch filter and recirculation of fluid.

With advancement of technology flooding paradigm is decreasing day by day. And now the new practice is done by permutation of liquid, aerosol and gas delivery. For example minimum quantity lubrication and through the tool tip cryogenic cooling.

Through tool coolant system which is also known as through-spindle coolant system which are used to deliver coolant with the help of passages present in the spindle and through the tool, directly to cutting interface. High-pressure coolant systems are also used in which operating pressure is being obtained between hundreds to several thousand psi pressure.

IV. TYPES OF COOLANT

4.1. Liquid

Usually there are four types of liquid coolant straight oil, synthetic oil, soluble oil and semi-synthetic oil which are combined with the best property of water by suspending emulsified oil and water base. The major properties of liquid coolant are rust prevention, ability to work with many metals, thermal resistivity.

➤ Straight oils

Straight oils are those oils which are non emulsifiable and they are used in machining operation where they function in undiluted form. Generally, its composition is base mineral or petroleum oil. It also contains polar lubricants like vegetable oil, fats and esters .

They may also contain additives like sulphur chlorine phosphorous.

➤ Synthetic fluid

It doesn't have mineral oil base or petroleum. In place of it they are formulated from alkaline organic and inorganic compounds along with additives to prevent corrosion. It gives best results in diluted form. It believes that synthetic fluid gives best cooling performance out of different cutting fluids.

➤ Soluble oil

Soluble oil usually forms an emulsion after being mixed with water. The resulting concentration contains emulsion and a base mineral oil to give a suitable emulsion. It gives good performance while present in diluted form and gives good lubrication in addition to heat transfer performance. Soluble oils are cheap in price and mostly used fluid in industry.

➤ Semi-synthetic fluid

When soluble oils and synthetic fluids are mixed semi-synthetic fluid is obtained. Besides the heat transfer performance and cost of semi synthetic fluid falls between those of the soluble and synthetic fluid .

4.2. Gels

In some of the applications cutting fluid can also be taken in the form of paste or gel, particularly in operations such as drilling and tapping. In sawing metal with a band saw one has to periodically run a stick of paste against the blade. It is usually as similar as lipstick or beeswax is present.

4.3. Aerosols

Aerosols can be defined as cutting fluid in which air with tiny droplets of liquid is scattered throughout. The delivery of aerosols is done directly through the flutes of the tool. Aerosols delivery is being done with respect to location and timing which is almost like dry machining from the operators point of view. The chips which are generated are very close to dry machine chips which require no draining

4.4. CO₂ coolant

Carbon dioxides is used as coolant in which application is done through pressurize liquid CO₂ is alloy to expand which helps in dropping the temperature, which is enough to change the phase into solid. These crystals are then spread on to the cutting zone with the help of external nozzle or through the spindle delivery to give temperature control cooling of the cutting tool and work piece.

V. Health and safety

For the past decade, to increasing concern over safety and health hazards in the workplace a number of approaches have been put forward in response. These approaches come from government agencies holding a congressional mandate for these activities.

To those in the cutting fluid and lubricant production areas, for more than 40% of all reported occupational diseases it comes as no surprise that of all occupational injuries and illnesses, skin disease and disorders account. Use of cutting fluid causes illness and injury in workers; it can also cause cardio vascular disease. It can also cause skin diseases externally or could cause breathing problem when it enters the mouth or through the nose.

The toxicity or irritating ability it not so high but times it is enough to create problem for skins or the tissues of respiratory track or elementary track. Usually bacterial growth is observed in petroleum based cutting fluid. Tramp oil along with human hair or skin oil

Prevention can be achieved by the following practices:

- Fluids at use concentration should not be excessively irritating.
- Fluids should not exceed recommended concentration levels.
- Hypersensitive operators should be prescreened or transferred.
- Fluids should be physically cleaned—fines and tramp oil removed.
- Suitable barrier cream should be provided. These are not universal; water-insoluble cream should be used for water-miscible fluids. And water-soluble cream for oils.
- Protective gloves should be provided.
- Mildly abrasive cornmeal soap with low ph should be provided.
- The work force should be educated as to (about 5.6) he value of good personal hygiene.

VI. Properties of coolant

The main purpose of a coolant is to provide cooling effect on grinding wheel and work piece at the time of machining process and also is to lubrication the work piece surface. Cooling of the tool and the work piece is very important terminate the unnecessary effects of heat on the work piece and tool also it cures the work piece from corrosion.

Most Important Properties of Coolants are as follows:

- For the better lubrication and cooling purpose
- It also prevent from corrosion of work piece surface
- It helpful for the Chemical, Physical and technical stability while use
- No excessive forming.



Figure no:-2.1 – coolant being used in machining (CNC)

VII. RECYCLING AND DISPOSAL OF CUTTING FLUIDS AND LUBRICANTS

The recycling of metalworking fluids is a topic that has commanded increasing interest in recent years, spurred by the impact of more stringent local, state, and federal environmental regulations and the increasing cost of oil. Today, manufacturers are faced with increasingly complex fluid recycling and disposal problems. The following is a list of definitions associated with the topics of oil disposal and recycling:

- Used oil. Oil whose original characteristics have changed during use whether or not it has thereby been rendered unsuitable for further use for the purpose for which it was intended.
- Waste oil. Oil which through use, storage, or handling has become unsuitable for its original purpose due to the presence of impurities or loss of original properties and which is not considered recyclable.
- In service oil. Used oil that is suitable for further use for the purpose for which the original oil was intended.
- Oily waste. A mixture of oil with substances, such as water, solvents, dirt, debris, and/ or other materials.
- Recycling. The generic term for re-refining, reclaiming or reprocessing used oil for reuse. The product is recycled oil.

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