CUTTING FLUIDS

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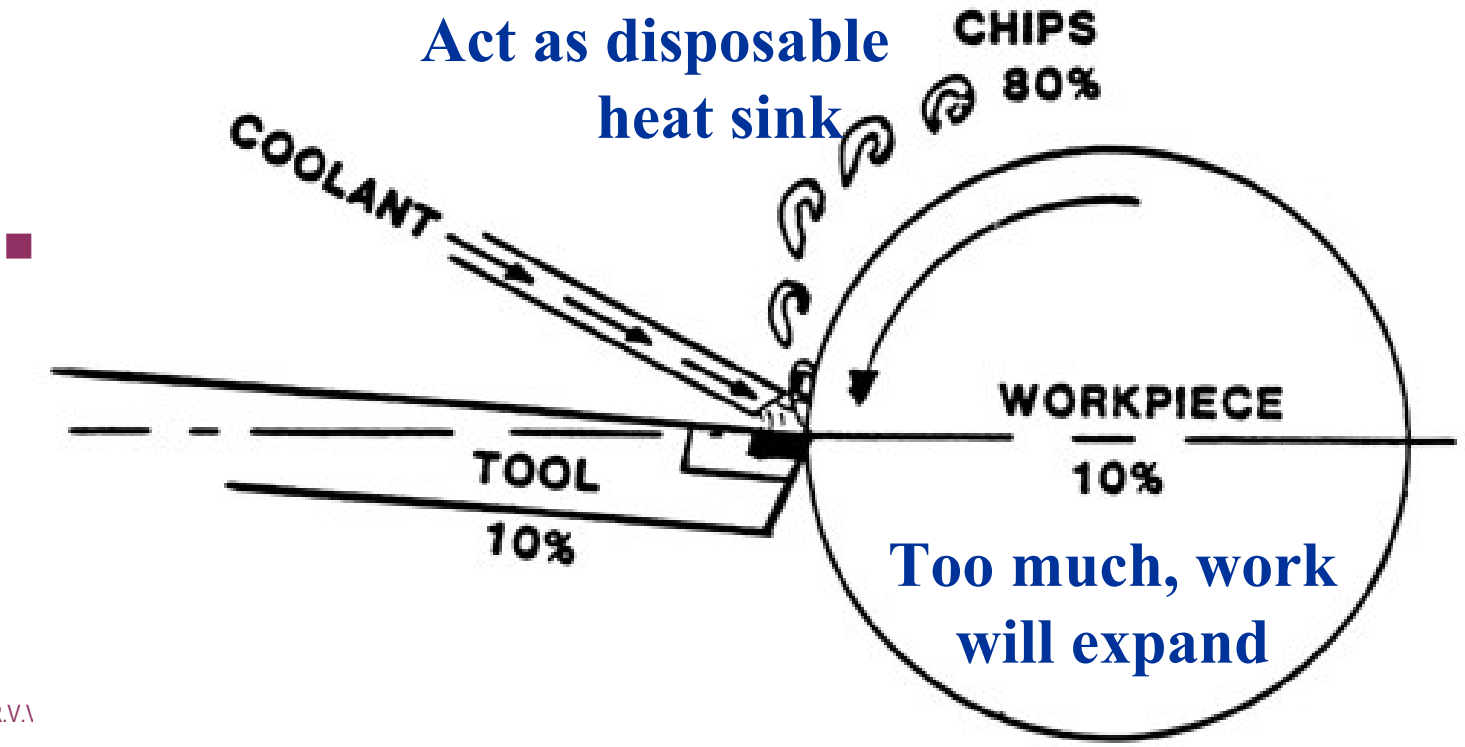
- Essential in metal-cutting operations to reduce heat and friction
- Centuries ago, water used on grindstones
- 100 years ago, tallow used (did not cool)
- Lard oils came later but turned rancid
- Early 20th century saw soap added to water
- Soluble oils came in 1936
- Chemical cutting fluids introduced in 1944

ECONOMIC ADVANTAGES TO USING CUTTING FLUIDS

- Reduction of tool costs
  - Reduce tool wear, tools last longer
- Increased speed of production
  - Reduce heat and friction so higher cutting speeds
- Reduction of labor costs
  - Tools last longer and require less regrinding, less downtime, reducing cost per part
- Reduction of power costs
  - Friction reduced so less power required by machining

HEAT GENERATED DURING MACHINING



CHARACTERISTICS OF A GOOD CUTTING FLUID

1. Good cooling capacity
2. Good lubricating qualities
3. Resistance to rancidity
4. Relatively low viscosity
5. Stability (long life)
6. Rust resistance
7. Nontoxic
8. Transparent
9. Nonflammable

TYPES OF CUTTING FLUIDS

- Most commonly used cutting fluids
  - Either aqueous based solutions or cutting oils
- Fall into three categories
  - Cutting oils
  - Emulsifiable oils
  - Chemical (synthetic) cutting fluids

CUTTING OILS

- Two classifications
  - Active
  - Inactive
- Terms relate to oil's chemical activity or ability to react with metal surface
  - Elevated temperatures
  - Improve cutting action
  - Protect surface

ACTIVE CUTTING OILS

- Those that will darken copper strip immersed for 3 hours at temperature of 212°F
- Dark or transparent
- Better for heavy-duty jobs
- Three categories
  - Sulfurized mineral oils
  - Sulfochlorinated mineral oils
  - Sulfochlorinated fatty oil blends

INACTIVE CUTTING OILS

- Oils will not darken copper strip immersed in them for 3 hours at 212°F
- Contained sulfur is natural
  - Termed inactive because sulfur so firmly attached to oil – very little released
- Four general categories
  - Straight mineral oils, fatty oils, fatty and mineral oil blends, sulfurized fatty-mineral oil blend

EMULSIFIABLE (WATER SOLUBLE) OILS

- Mineral oils containing soaplike material that makes them soluble in water and causes them to adhere to workpiece
- Emulsifiers break oil into minute particles and keep them separated in water
  - Supplied in concentrated form (1-5 /100 water)
- Good cooling and lubricating qualities
- Used at high cutting speeds, low cutting pressures

CHEMICAL CUTTING FLUIDS

- Also called synthetic fluids
- Introduced about 1945
- Stable, preformed emulsions
  - Contain very little oil and mix easily with water
- Extreme-pressure (EP) lubricants added
  - React with freshly machined metal under heat and pressure of a cut to form solid lubricant
- Reduce heat of friction and heat caused by plastic deformation of metal

ADVANTAGES OF SYNTHETIC FLUIDS

1. Good rust control
2. Resistance to rancidity for long periods of time
3. Reduction of amount of heat generated during cutting
4. Excellent cooling qualities

FUNCTIONS OF A CUTTING FLUID

- Prime functions
  - Provide cooling
  - Provide lubrication
- Other functions
  - Prolong cutting-tool life
  - Provide rust control
  - Resist rancidity

CUTTING FLUID'S EFFECT ON CUTTING TOOL ACTION

1. Lowers heat created by plastic deformation of metal
2. Friction at chip-tool interface decreased
3. Less power is required for machining because of reduced friction
4. Prevents built-up edge from forming
5. Surface finish of work greatly improved

APPLICATION OF CUTTING FLUIDS

- Cutting-tool life and machining operations influenced by way cutting fluid applied
- Copious stream under low pressure so work and tool well covered
  - Inside diameter of supply nozzle ¾ width of cutting tool
  - Applied to where chip being formed