Lecture 12

Chapter 21
Fundamentals of Machining
(continued)

Temperature in Cutting

- The energy dissipated in cutting is converted into heat
Effects of Heating

- Excessive temperatures
  - Lower strength (hardness)
  - Lower stiffness
  - Lower wear resistance of tool
  - Thermal damage
    - Cracking
  - Metallurgical changes
    - Localized heat treatments
- Uneven heating
  - Dimensional accuracy and tolerances

Factors Influencing Machining Operations

a) Heating along the flank of the tool
b) Heating along the tool-chip interface
Where does the energy (heat) go?

- Most heat leaves via the chip
  - Up to 90%

Lowering the Heat

- Lowering the heat in the cutting process
  - Proper design of cutting surfaces
  - Sharp tool
  - Workpiece material
    - Thermal conductivity
  - Cutting fluid
- Increasing cutting speed
  - Increases relative amount of heat carried away in chip
Tool Life and Wear

• Tool life is affected by
  – High stresses at the tip
  – High temperatures
  – Sliding of the chip along the rake face
  – Sliding of the tool along the newly cut workpiece
Hardness of the Workpiece and Cutting Tool

- Tool Hardness

Workpiece hardness

Types of Wear

- Normal Wear
- Catastrophic failure
**Crater Wear**

- Influencing factors
  - Temperature at the tool-chip interface
  - Chemical affinity between the tool and chip
- Crater wear is a diffusion mechanism
  - Diffusion rate increases with temperature
- Prevention
  - Lower temperature
  - Coating of tools

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**Flank Wear**

- Influencing factors
  - Rubbing of the tool along the machined surface
  - High temperatures
Machinability

• Factors usually defining machinability
  – Surface finish and integrity
  – Tool life
  – Force and power required
  – Level of difficulty in chip control

• A material with good machinability gives a good surface finish and integrity, long tool life, low force and power requirements, and a controllable chip.