SNS COLLEGE OF TECHNOLOGY

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Coimbatore-35

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19MET202 – MANUFACTURING TECHNOLOGY

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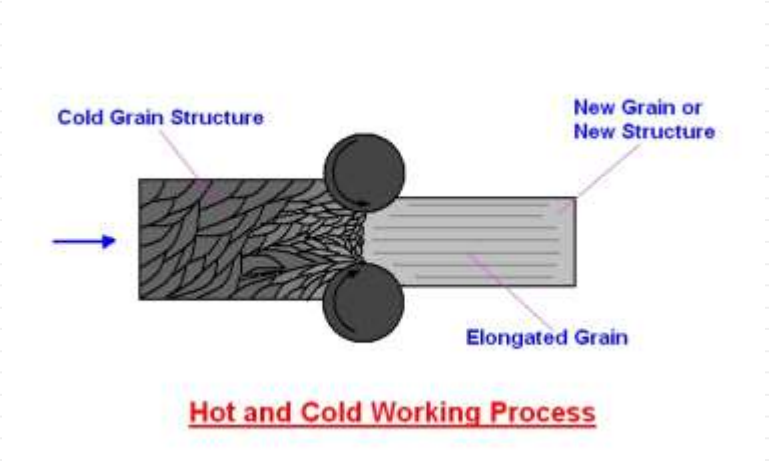
MET, UNIT-2, LESSON-2

Hot Working and Cold Working Metals



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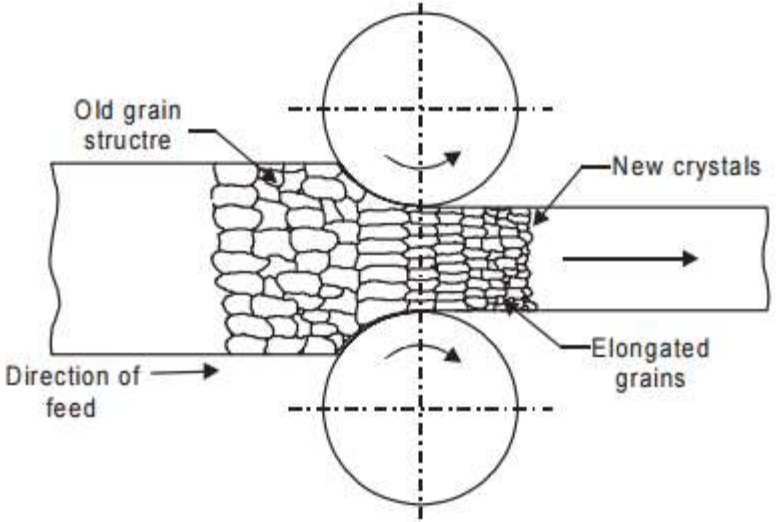
Hot Working of Metals

Hot working is plastically deforming of the metallic material at a temperature above the re-crystallization temperature.

Many kinds of working, including rolling, forging, extrusion , and drawing, can be done with hot metal



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Hot Working of Metals

- No Strain Hardening
- Usually performed at elevated temperatures
- Lead and Tin are exceptions (low melting point)
- Lower limit of the hot working temperature: 60% of the melting temperature

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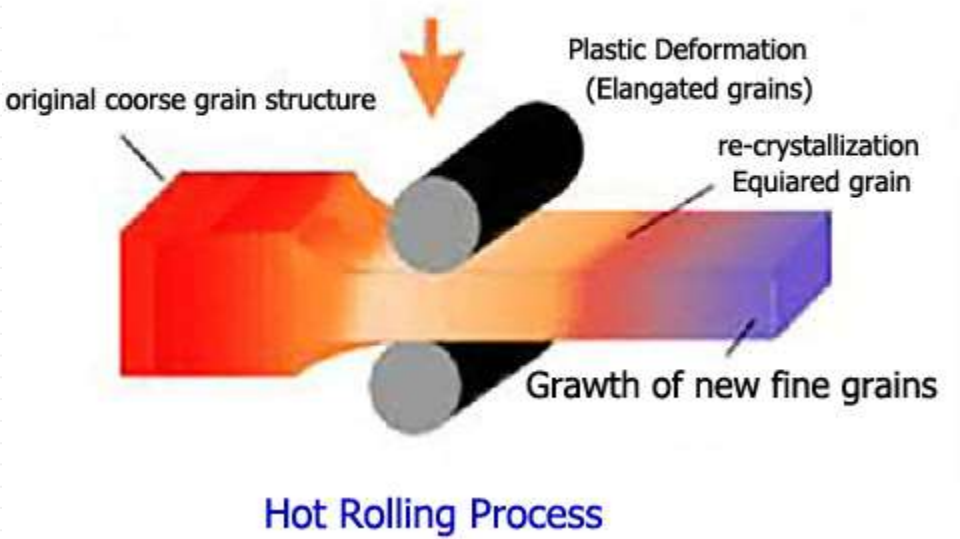
Hot Working of Metals

The lower limit of the hot working temperature is determined by its re-crystallization temperature. As a guideline, the lower limit of the hot working temperature of a material is 60% its melting temperature.

The hotter the tooling the less heat lost to it, but as the tooling temperature rises, the tool life decreases. Therefore the tooling temperature must be compromised; commonly, hot working tooling is heated to 325–450 °C [2]



Hot Rolling Process

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Hot Working of Metals

EFFECT OF HOT WORKING ON MECHANICAL PROPERTIES OF METALS

1. This process is generally performed on a metal held at such a temperature that the metal does not work-harden. A few metals e.g., Pb and Sn (since they possess low crystallization temperature) can be hot worked at room temperature.
2. Raising the metal temperature lowers the stresses required to produce deformations and increases the possible amount of deformation before excessive work hardening takes place.
3. Hot working is preferred where large deformations have to be performed that do not have the primary purpose of causing work hardening.
4. Hot working produces the same net results on a metal as cold working and annealing. It does not strain harden the metal.

Hot Working of Metals

EFFECT OF HOT WORKING ON MECHANICAL PROPERTIES OF METALS

5. In hot working processes, compositional irregularities are ironed out and nonmetallic impurities are broken up into small, relatively harmless fragments, which are uniformly dispersed throughout the metal instead of being concentrated in large stress-raising metal working masses.
6. Hot working such as rolling process refines grain structure. The coarse columnar dendrites of cast metal are refined to smaller equi-axed grains with corresponding improvement in mechanical properties of the component.
7. One has to be very careful as regards the temperatures at which to start hot work and at which to stop because this affects the properties to be introduced in the hot worked metal.
8. Too high a temperature may cause phase change and overheat the steel whereas too low temperature may result in excessive work hardening.

Hot Working of Metals

CLASSIFICATION OF HOT WORKING PROCESSES

The classification of hot working processes is given as under.

1. Hot rolling
2. Hot forging
3. Hot extrusion
4. Hot drawing
5. Hot spinning
6. Hot piercing or seamless tubing
7. Tube Forming and
8. Hot forming of welded pipes

Hot Working of Metals

The advantages are:

- Decrease in yield strength, therefore it is easier to work and uses less energy or force
- Increase in ductility
- Elevated temperatures increase diffusion which can remove or reduce chemical in-homogeneities
- Pores may reduce in size or close completely during deformation.

Hot working improves the engineering properties of the work piece because it replaces the microstructure with one that has fine spherical shaped grains. These grains increase the strength, ductility, and toughness of the material.

Hot Working of Metals

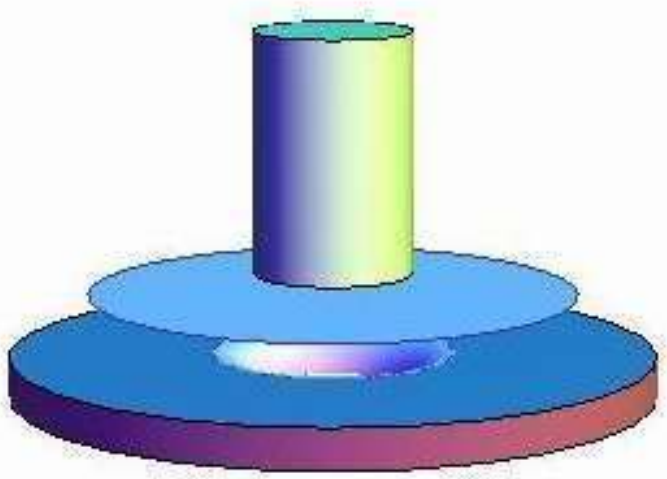
The disadvantages are:

- Undesirable reactions between the metal and the surrounding atmosphere (scaling or rapid oxidation of the work piece)
- Less precise tolerances due to thermal contraction and warping from uneven cooling
- Grain structure may vary throughout the metal for various reasons
- Requires a heating unit of some kind such as a gas or diesel furnace or an induction heater, which can be very expensive

Cold Working of Metals

Cold working or **cold forming** is any metalworking process in which metal is shaped below its recrystallization temperature, usually at the ambient temperature.

Cold forming techniques are usually classified into four major groups: squeezing, bending, drawing, and shearing.



Deep Drawing of aMetal

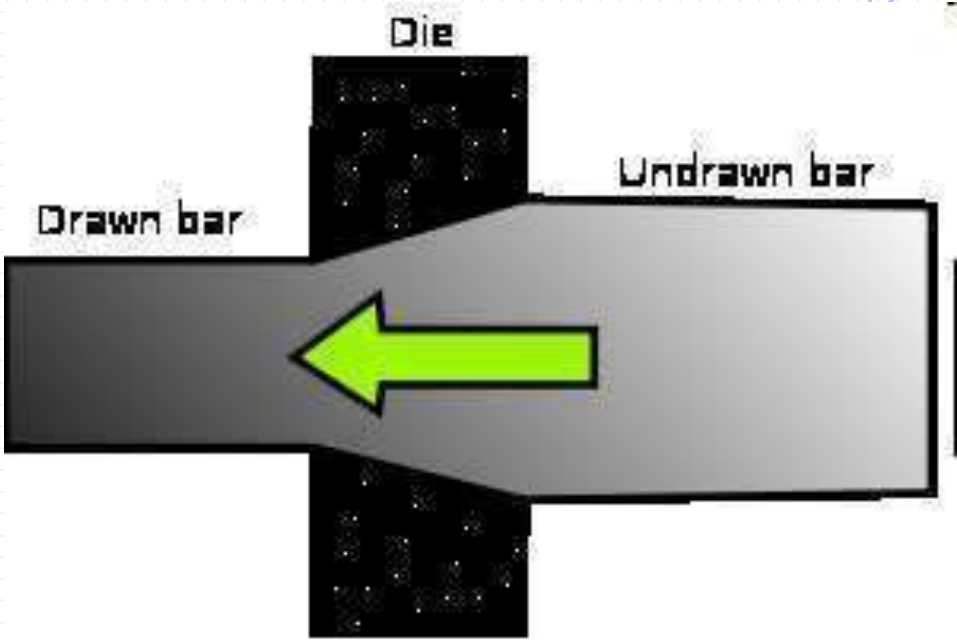
Cold Working of Metals

Cold working produces additional dislocations within the metal structure.

Initially the dislocations can move through the metal structure.

As the working continues, however, the movement of the dislocations becomes more difficult.

The metal becomes less malleable and less ductile.

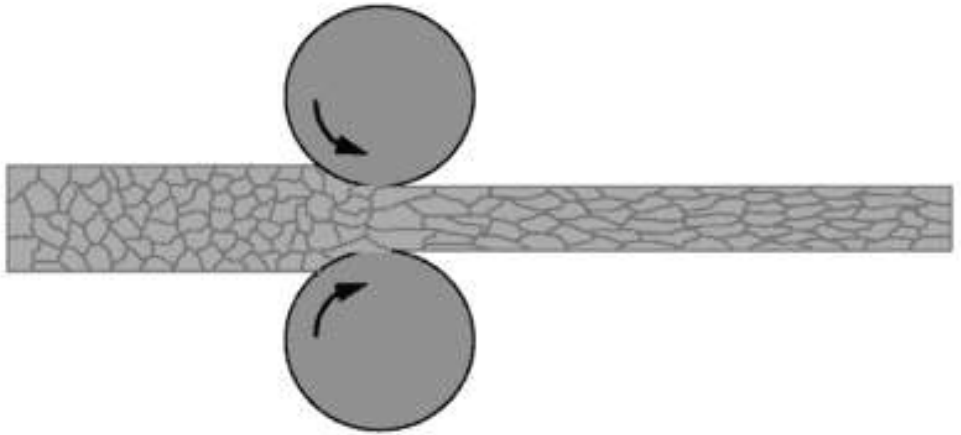


Drawing of a metal

Cold Working of Metals

The following properties are affected by cold work significantly:

- Tensile Strength
- Hardness
- Yield Strength
- Ductility

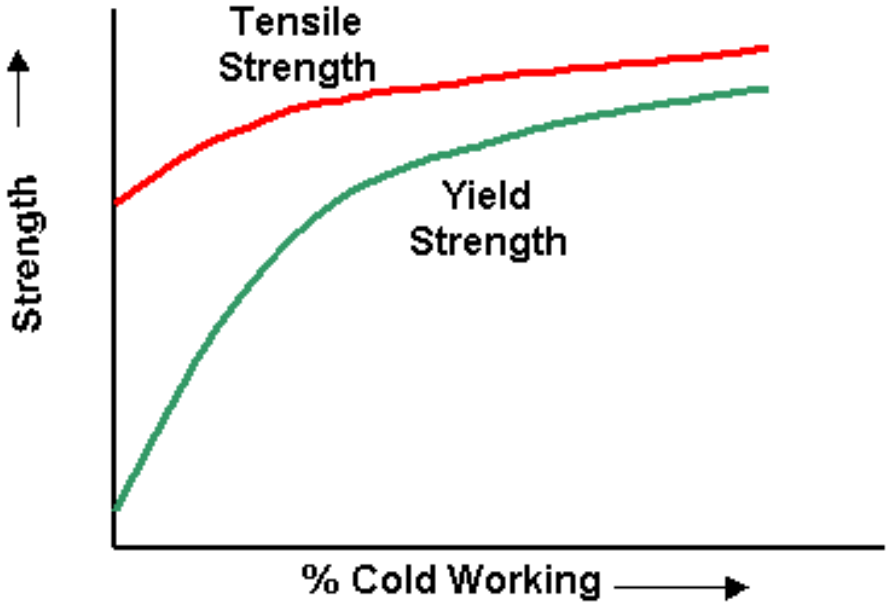


Cold work being rolled into copper alloy strip.

https://tinyurl.com/y2mfuen6

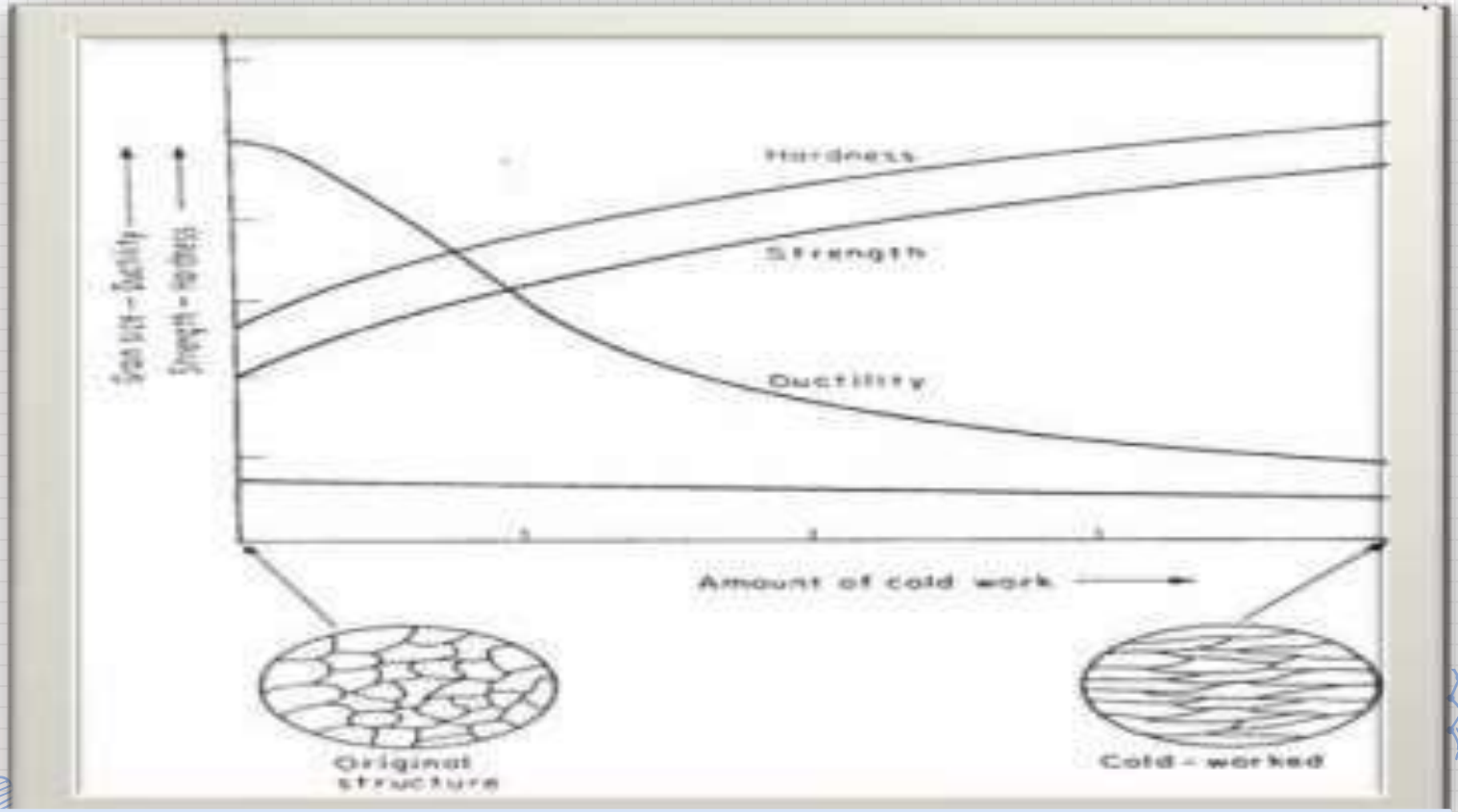
Cold Working of Metals

Effect of Cold Working on Yield and Tensile Strength



Cold Working of Metals

- **Effect of Cold Working**



ASSESSMENT

1. The plastic deformation of metal takes place when the stress induced in the metal, due to the applied forces, reached the

a) Yield point
b) Proportional limit
c) Fatigue strength
d) Ultimate strength

2. The process of formation of new grains is known as

a) Pre-crystallization
b) Re-crystallization
c) Crystallization
d) Post-crystallization

ASSESSMENT

3. Which of the following is not improved by cold working of metals?

a) hardness
b) toughness
c) surface finish
d) corrosion resistance

4. Which of the following is not true for cold working of metals?

a) residual stresses are set up in the metal
b) stress required to cause deformation is less than hot working of metals
c) it reduces the corrosion resistance of the metal
d) distortion of grains takes place in most of the cold working processes

THANK YOU