Annealing

Benefits

- Increased Ductility and Malleability
- Enhanced toughness
- Relieve stress and strain
- Refine grain size or structure
- Increased machinability

Process

The annealing process involves heating up the material slightly above its austenitizing temperature and then controlled cooling it from there. In annealing, the material can be cooled in the furnace either isothermally or non-isothermally. By controlling the cooling rate the hardness and the ductility of the material can be controlled. Annealing brings the material to its initial strain-free state via three stages - recovery, recrystallization and grain growth.

Stage 1 – Recovery
Recovery involves removal of defects or dislocations caused due to cold or hot working of the material.

Stage 2 – Recrystallization
In recrystallization phase, new strain free grains are formed which replaces the damaged or dislocated grains due to cold or hot working.

Stage 3 – Grain growth
Grain growth involves coarsening of grains after recrystallization stage which further lowers the hardness and further imparts ductility to the material.

Materials

Annealing process has applications in wide-ranging materials such as medium to high carbon steel, tool steel, stainless steel, & titanium.

Applications

The annealing process is mainly used after cold or hot working processes such as forging, rolling, drawing etc. It softens the material and prepares it for further processing such as forming, shaping, stamping, etc. It is employed to bring back the material to its initial strain-free-state so that it can be further processed by lowering its hardness and increasing its ductility. Annealing is mainly used in the components made from medium to high carbon steels where the subsequent processing such as machining, forming etc. is required.

Below are some of the applications and components where this process is predominantly used.

- Crankshafts
- Gears
- Shafts
- Transmission components