Heat Treatments of Metal
General Introduction
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Heat Treatment of Metals

Introduction

. Heat Treatment

- *Heat Treatment process is a series of operations involving the **heating and cooling** of metals in the solid state. Its purpose is to change a mechanical property or combination of mechanical properties so that the metal will be more useful, serviceable, and safe for definite purpose. By heat treating, a metal can be made harder, stronger, and more resistant to impact, heat treatment can also make a metal softer and more ductile. No one heat-treating operation can produce all of these characteristics. In fact, some properties are often improved at the expense of others. In being hardened, for example, a metal may become brittle.*

The types of Heat Treatment:

1. Softening.

2. Hardening.

1. Softening

- *Done to reduce strength or hardness*
- *Remove residual stresses*
- *Improve toughness*
- *Restore ductility*
- *Refine grain size or change the electromagnetic properties of the steel.*

- *Restoring ductility or removing residual stresses is a necessary operation after a large amount of cold working have been performed, such as in a cold-rolling operation or wiredrawing.*

- *Annealing, normalizing and tempering are the some of principal ways by which metals are softened .*

1.1. Annealing

- *A technique used to recover cold work and relax stresses within a metal.*
- *Annealing typically results in a soft, ductile metal.*
- *Annealing involves recovery, recrystallization and grain growth.*

- *When an annealed part is allowed to cool in the furnace, it is called a "full anneal" heat treatment.*

- *When an annealed part is removed from the furnace and allowed to cool in air, it is called a "normalizing" heat treatment.*

1.2. Normalizing

- *It is a type of heat treatment applicable to ferrous metals only.*
- *It differs from annealing in that the metal is heated to a higher temperature and then removed from the furnace for air cooling.*
- *The purpose of normalizing is to remove the internal stresses induced by heat treating, welding, casting, forging, forming, or machining.*

2. Hardening

- *It is done to increase the strength and wear properties. One of the pre-requisites for hardening is sufficient carbon and alloy content.*

- *If there is sufficient carbon content then the steel can be directly hardened. Otherwise the surface of the part has to be carbon enriched using some diffusion treatment hardening techniques.*

2.1. Quenching

- *To harden by quenching, a metal (usually steel or cast iron) must be heated into the austenitic crystal phase and then quickly cooled. Depending on the alloy and other considerations (such as concern for maximum hardness vs. cracking and distortion), cooling may be done with forced air or other gas (such as nitrogen), oil , polymer dissolved in water, or brine. Upon being rapidly cooled a hard brittle crystalline structure. The quenched hardness of a metal depends upon its chemical composition and quenching method.*

2.2. Case Hardening

- *Case Hardening is the process of hardening the surface of a metal, often a low carbon steel, by infusing elements into the material's surface, forming a thin layer of a harder alloy.*

- *What we will do is to see the affect of different heat treatment processes of the metal specimens by measuring the specimen hardness before and after each heat treatment process.*