Topic : Applications of Heat Treatment

The application of heat treatment is numerous and are used to make such objects which benefit us one way or the other. So let us look at some of them :

- Automotive industry
  - Aerospace industry
- Metalworking industry
  - Glass industry
- Defence sector
- Forging industry

In this topic there will be a brief explanation of how heat treatment is used in the aerospace industry and glass industry.

1. Aerospace Industry : In the aerospace industry, stress reduction on metal parts to enhance component strength and fatigue life is critical to ensure components stand up to the extreme demands of aerospace applications. To enhance strength and meet the precise demands and specifications required by aerospace applications, heat treating is an essential step in the production process.

At many heat treating industries, there are at least two full-time heat treating units — aluminum heat treating and vacuum heat treating.

➢ Aluminum in many forms has been used in aircraft since the early beginning. This is because aluminum alloys can be

heat-treated to relatively high strengths, while maintaining low weight. It is easy to bend and machine, and cost of material is low.

▶ Aluminium castings after post air-heating.

Aluminum heat treating operations include:

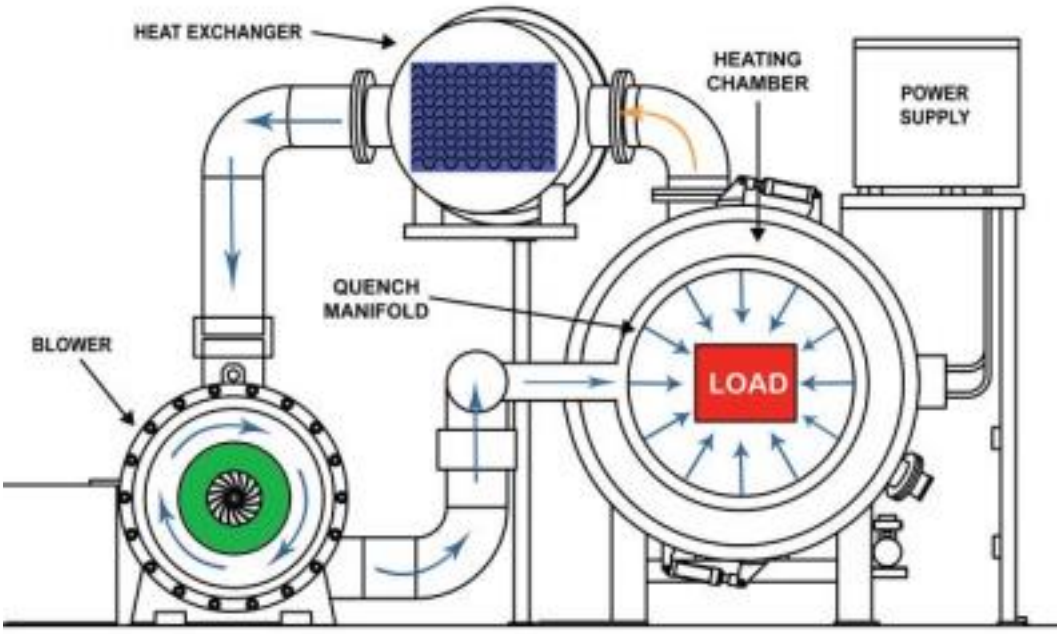
- aging
- air quenching
- hot and cold water quenching
- annealing
- hardening
- stress relieving
- Metal tempering
- stabilizing

Because of these advantages, it is the most common material used in aerospace today. Along with aluminium, titanium is also used with some steel brackets alongside.

➢ Vacuum heat treating furnaces are used for a wide range of applications. However, one of the most important uses is for the heat treatment of aluminum alloys used in aircraft structures. While the type of alloy an aircraft designer chooses is important, when it comes to aircraft design, the heat treatment used on that metal is just as crucial.

▶ A vacuum capsule used for heat treating in Embraer.

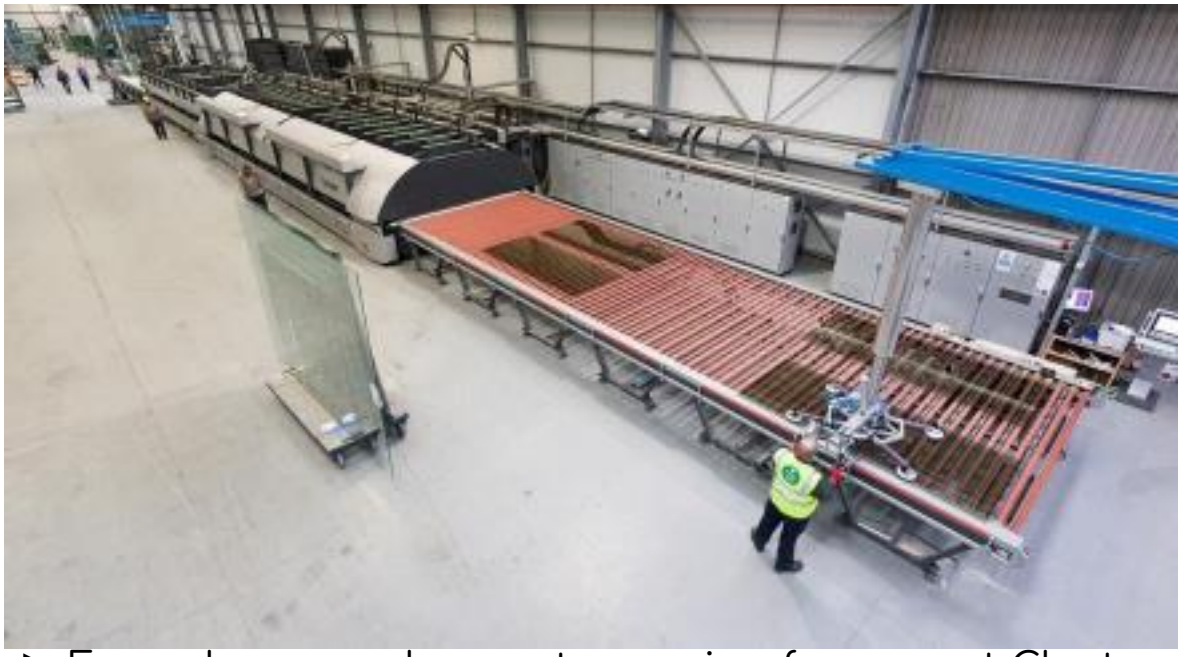
For obvious reasons, aircrafts need to function at optimum levels and environmental conditions have everything to do with the strength and life of a plane. A plane's life is dependent on the grain structure of its alloy which in turn, is totally dependent on vacuum heat treating.
A vacuum heat treating furnace is used to heat metals to extremely high temperatures through high consistency and low contamination of gases. The vacuum blocks oxygen which reduces rapid oxidation. Vacuum heat furnaces improve the overall condition of the metal alloy in that they cover the area more evenly, make the cooling process quicker, and improve the overall life and functionality of the metal.



So, to answer the question, why is vacuum heat treating important for aerospace?

It's because this type of alloy heat treatment is essential in that it allows the designer to build planes that have higher strength materials, giving the plane better functionality in that there are fewer repairs and a longer overall lifespan of the aircraft.

2. Glass Industry : Heat treatment of glass is a group of industrial and metalworking processes used to alter the physical, and sometimes chemical, properties of glass. Heat treatment techniques include annealing, case hardening, tempering, normalizing and quenching.

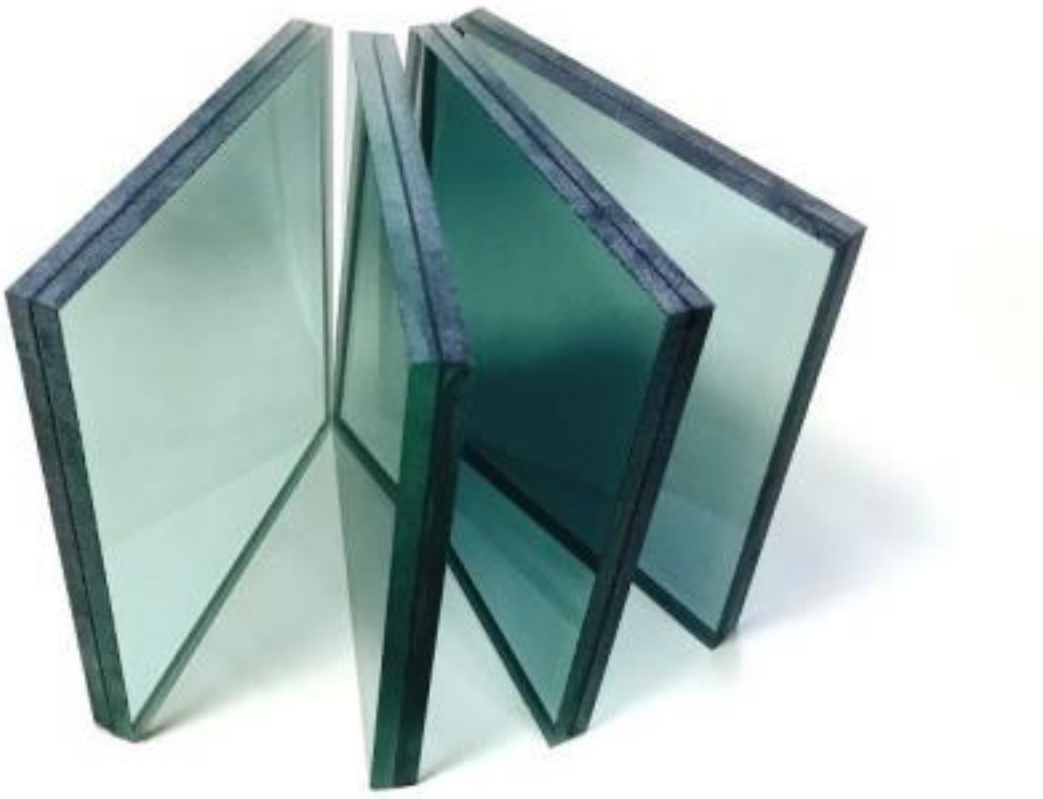


► Four glass panels on a tempering furnace at Glaston.

Nowadays glasses are produced in 3 different forms. Each form/processes have their unique properties and are used for different applications :

Annealing :

Raw glass that has not been heat treated is annealed glass.Annealed glass is the weakest of the three types, and care should be given when choosing a location for this glass. Sometimes called standard glass is a softer glass that has been thermally treated and then slowly cooled to relieve any internal stresses. Annealed glass tends to break into longer, jagged shards which can cause significant injury.



Tempering :

Tempered glass is tempered in order to make the glass significantly more resistant to blunt impact such as a distracted person who is on their phone bumping their head onto a glass panel The process involves heating the glass to its melting temperature and then quickly air cooling it, creating an internal tension in the glass. This treatment modifies certain properties of the glass, notably making it crumble in case of breakage rather than breaking into sharp fragments. Tempered glass will have about four times the mechanical strength of an annealed glass of the same thickness, which makes it more resistant to thermal stress, as well as wind load and snow.

Heat-strengthening :

This method modifies the internal structure of the glass, but in a different way than tempering.Annealed glass is heat strengthened so that it can tolerate more rapid and uneven temperature swings during its service life,to heat strengthened glass, first cut to size, place in tempering until it reaches 1100-1500 degrees F, then cool rapidly. Heat strengthened glass is about twice as strong as annealed glass. In case of breakage, this process will cause the glass to form a breakage pattern that

will be held in place by the frame.Even though it is stronger than annealed glass, you still must be careful where this glass is used.

Heat-strengthened glass and tempered glass both are approximately 2X stronger than annealed, or untreated glass. Heat-strengthened glass provides a better surface quality as compared to tempered glass, whereas tempered glass has higher compression factor than heat-strengthened glass.

Why is heat treatment of glass done?

Glass is heat-treated for two reasons:

- the first is to increase its strength to resist external stresses such as wind and snow loads, or thermal loads caused by the sun's energy.

- The second is to temper glass so that it meets safety glazing requirements defined by applicable codes or federal standards.

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