

Adding Value Through Experience

September 2009



ALLOYS FOR HIGH TEMPERATURE APPLICATIONS - continued

*This is the fourth in a series of notes on Alloys for High Temperature Applications.
See - www.multialloys.co.za/teknitalk for the preceding issues*

ROLE OF THE ELEMENTS - ENHANCING HIGH TEMPERATURE STRENGTH

In the previous issue the role that certain elements have in resisting high temperature corrosion was covered. Mechanisms for ensuring strength at service temperatures are important and alloying element additions have a role to play in this regard as well. The effects of the elements can conveniently be grouped as follows:

Solid solution strengthening - the nature of the deformation process is such that the addition of alloying elements will always have a strengthening effect when compared with a pure metal. This will be true at elevated temperatures as well and specific elements may have a more pronounced effect than others in this regard. Molybdenum, Niobium, Tungsten and Tantalum are used to enhance elevated temperature strength by a solid solution mechanism.

Precipitation strengthening - a second common method of enhancing the strength of alloys for use at ambient and elevated temperatures may be by the formation of precipitates in the structure. For this purpose Aluminium plus Titanium or Niobium may be added to nickel alloys whilst Aluminium, Titanium and Copper may be added in stainless steels.

It is noteworthy that many precipitates that may form in stainless steels and nickel alloys and specifically those grades used at elevated temperatures, are undesirable. They may be embrittling or affect corrosion resistance and these precipitates must not be confused with those that result from deliberate alloy additions designed to improve strength. Thermal stability, the maintenance of stable properties at elevated temperatures over time, is the manifestation of a stable microstructure and is an important characteristic of alloys intended for high temperature use but unfortunately is not always present.

Carbon, an "undesirable" in stainless steels and nickel alloys because of the effect that it may have on corrosion resistance if carbides are able to form, is known to improve creep strength in alloys intended for high temperature service. Thus there are specifications for "H-Grades" eg 304H in which the carbon content is controlled above a certain value. Nitrogen will have benefits similar to Carbon in respect of creep strength.

For most high temperature applications solid solution strengthened alloys are chosen because they are useful over a larger temperature range and are more amenable to welding. Precipitation strengthened alloys are used extensively for gas turbine applications. However the strength requirements for many applications in this industry are such that mechanically alloyed grades may have to be considered but that is another topic!!!

Our next Seminar will be on 4th November and should you be interested in attending, please send an e-mail to kenp@wwtrade.co.za
Find out more about nickel alloys, titanium and stainless steels.
IT'S FREE!!!

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