Heat resistant high alloy furnace rolls for manufacture of duplex stainless steels

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ABSTRACT

Duplex stainless steels with a ferritic-austenitic microstructure in equal amounts have been successfully used in various industries due to adequate mechanical strength as well as corrosion resistance. The processing route for the manufacture of flat products made of duplex stainless steels consists of continuous casting, slab reheating, hot rolling, coiling, hot band heat treatment, cold rolling and recrystallization annealing. This process necessitates the usage of soaking furnaces where slabs are brought to temperatures of up to 1250 °C prior to rolling to realize the necessary thickness reduction. Additionally, final heat treatment temperatures of 1050 °C and above are common to realize the 50 % ferrite – 50 % austenite phase balance. Such high temperatures involved in the processing of duplex stainless steels necessitate the usage of heat resistant materials for critical components of the heat treatment furnaces. Furnace rolls manufactured using the centrifugal casting processes are a capital intensive and critical constituent of furnaces and their functionality and reliability has a significant impact on the process economics. The key property requirements for materials used for such rolls are high temperature mechanical strength (creep resistance) as well as oxidation resistance.

High carbon cast Ni-Cr-Fe alloys with an austenitic matrix and strengthened by addition of carbide forming elements are used for realizing the creep strength necessary for operational temperatures of 1000 °C - 1250 °C. The surface protection is normally realized by chromia scale. The lower stability of chromium oxide surface layers at temperature more than 1150 °C can be offset by the application of cast high alloy solutions based on alumina. There are various heat resistant grades available. The influence of alloying elements on the microstructure development is described. The properties realized for the various cast heat resistant grades shall be presented and compared. A description of the centrifugal casting and the property improvements that can be attained by using this process are highlighted.