AUSTENITIC STAINLESS STEEL

TECHNICAL FIELD

This invention relates to an austenitic stainless steel having a high tensile strength, a high impact strength, a good weldability and high corrosion resistance, particularly a high resistance to pitting and crevice corrosion.

BACKGROUND OF THE INVENTION

When the stainless austenitic steel grade Avesta 254 SMO ®, which contains slightly more than 6% molybdenum (U.S. Pat. No. 4,078,920) was introduced on the market more than ten years ago, it involved an important technical achievement, namely that the corrosion and mechanical strength features were considerably improved in comparison with high alloyed steels existing at that time. Today, ferritic and ferritic-austenitic steels having approximately the same corrosion resistance as grade Avesta 254 SMO ® are also commercially available.

A way of improving the corrosion resistance of an austenitic stainless steel is to include nitrogen in the alloy composition. Nitrogen has been utilized already in the above mentioned steel grade Avesta 254 SMO ®, which contains a little more than 0.2% nitrogen. It is also known that the solubility of nitrogen can be further increased if the content of manganese or chromium is increased in the steel composition.

However, there are many fields of use where the best stainless steels available today have unsufficient corrosion resistance. This particularly concerns the use for corrosive chloride solutions, where the risk of pitting and crevice corrosion is pronounced, and also the use in strong acids. For such applications it is therefore necessary to use very expensive materials, such as nickel base alloys. Therefore, there is a demand for a material which is cheaper than nickel base alloys but which has a corrosion resistance, and particularly a pitting and crevice corrosion resistance, which is at least at a level with the corrosion resistance of nickel base alloys.

In order to achieve the improved corrosion resistance which is desirable for conduits, apparatus, and other devices used for example in the off-shore industry, and for heat exchangers and condensors, it is necessary that the total amount of those alloying elements which improve the corrosion resistance is considerably increased in comparison with the high alloyed austenitic stainless steel existing today, e.g. of type grade Avesta 254 SMO ®. However, high contents of chromium and molybdenum, which are very important alloying elements in this connection, will increase the susceptability of the steels to precipitation of inter-metallic phases. This may, if the precipitation susceptability is pronounced, cause problems in the production of the steels and also in connection with welding, and may also impair the corrosion resistance.

A means of reducing or avoiding the precipitation of inter-metallic phases is to alloy the steel with a high content of nitrogen. At the same time nitrogen may improve the pitting and crevice corrosion resistance of the steel. However, chromium has a high affinity for nitrogen and it readily forms chromium nitrides when the contents of chromium and nitrogen are too high, which creates another problem in connection with these steels. In order to achieve high nitrogen content in austenitic stainless steels, it is also necessary that the solubility to nitrogen in the molten phase of the steel is sufficiently high. An improved nitrogen solubility in the molten phase may be achieved through increased contents of chromium and manganese. High amounts of chromium, however, may give rise to the formation of chromium nitrides, as above mentioned. Previously, very high amounts of manganese to the steel have often been added, i.e. more than 6% manganese, in order to increase the nitrogen solubility of the steel, so that nitrogen contents exceeding 0.4% may be achieved. Such high manganese contents as 6% in turn, however, may cause certain problems. Thus, they may make the decarburisation of the steel more difficult and also cause wear on the lining of the steel converter.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a weldable austenitic stainless steel having high tensile strength, high impact strength and a pitting and crevice corrosion resistance which is comparable with several of today's nickel base alloys.

Particularly, the invention aims at providing a steel which advantageously can be used for example within the following fields:

- in the off-shore industry (sea water, acid oil and gas)
- for heat exchangers and condensors (sea water)
- for desalination plants (salt water)
- for flue-gas purification equipment (chloride containing acids)
- for flue-gas condensing apparatus (strong acids)
- for plants for the production of sulphurous acid or phosphoric acid
- for pipes and apparatus for oil and gas production (acid oil and gas)
- for apparatus and pipes in cellulose bleaching plants and in chlorate production plants (chloride containing, oxidizing acids or solutions, respectively)
- for tankers and petrol trucks (all kinds of chemicals).

It has now been found, according to the present invention, that nitrogen contents exceeding 0.4% may be achieved with significantly lower manganese contents. It has also been found that manganese will reduce the corrosion resistance of the steel. Therefore it is preferably also a specific purpose of the invention to provide an alloy composition of the steel in which the desired high nitrogen content may be achieved together with a comparatively moderate content of manganese in the steel.

The steel of the present invention therefore contains in weight-%:

max 0.08 C
max 1.0 Si
more than 0.5 but less than 6 Mn
more than 19 but not more than 28 Cr
more than 17 but not more than 25 Ni
more than 7 but not more than 10 Mo
0.4–0.7 N
from traces up to 2 Cu
0–0.2 Ce
balance essentially only iron, impurities and accessory elements in normal amounts.

DETAILED DESCRIPTION OF THE INVENTION

Besides the mentioned alloying element, the steel also may contain other elements in minor amounts, provided these elements do not impair the desired features of the steels which have been mentioned above. For example,