

The current interest has encouraged us to reconsider the possibility and so, we made inquiries in University research institutes, especially at the University of Padua, where research is carried out on materials supplied by the Italian Alpine Club (CAI) and MA. We got in contact with Professor Emilio Ramous who is an expert on material technology, member of the Institute of Materials, Minerals & Mining, (UK) and member of the Metallurgical Society of AIME (USA), last but not least he is a keen alpinist.

What does stainless steel mean?

Stainless steels, like all other steels, are iron based alloys containing at least 12% chrome, enough to ensure their resistance to corrosion from atmospheric agents or oxidizing acid solutions. The definition "stainless" refers to the steels' ability to maintain a shiny surface and resist corrossions, like rust even during long exposures to the air or atmospheric agents. Their corrosion resistance is due to an extremely thin coat of chrome oxide that forms automatically in an oxidising environment on surfaces of steels with at least 12% chrome alloy, it is almost invisible to the human eye.

Have there been any new developments in technology or in alloys that have radically transformed the accepted characteristics of stainless steel?

Stainless steels have been produced and utilised for nearly a century in the three traditional classes that are named after the principal components of their microstructure: austenitic, ferritic and martensitic stainless steels. There has been little change over the years though industry has introduced a wide variety but always within the former three classes, all focussing on improving resistance to corrosion. One innovation, in use for at least 30 years, were duplex steels, an austenitic/ferrite mix, that solved corrosion problems in a marine environment, for example on offshore rigs.

What would be the best choice between the classes of stainless steels to manufacture crampons?

Basically stainless steels were invented and are used to resist corrosion that isn't a problem as crampons are only subject to atmospheric agents. So the only advantage using stainless steels to manufacture crampons would be aesthetic, maintaining a shiny, metallic surface. However there are many surface treatments that give a good appearance even on non stainless steels.

Could it be a good choice from a practical point of view?

Any future use of stainless steels for crampons must be considered from a practical point of view. Crampons can be considered to be tools, though very particular ones. In order to work properly they mustn't give way or be liable to break, the materials for crampons must be user resistant and therefore extremely rigid and non-deformable, whilst maintaining an excellent toughness, meaning resistant to fractures and cracks. This isn't a simple problem because unfortunately in all metallic materials, including steels, extreme hardness and toughness are incompatible characteristics: you can't have a very hard and very tough metal at the same time. So, it is necessary to choose a "compromise" metallic material, which is by its composition a microstructure, attained by suitable technological processes, could be hard enough whilst maintaining its toughness. From this point of view most stainless steels, created and used to solve corrosion problems and not material strength, have totally inadequate characteristics to be used in the manufacturing of tools like crampons. In particular, ferritic and austenitic stainless steels, the most resistant to corrosion, are soft materials and, at least the Austenitics, very tough but easily deformable and therefore almost useless for this type of tools. The Martensitics on the other hand could be suitable from a rigidity and toughness point of view even though there are steels with better mechanical characteristics. But the Martensitics have an inferior resistance to corrosion and rust formation than the other stainless steels, so much, that some technical norms don't even consider them to be stainless steels but only corrosion resistant steels. Basically martensitic stainless steels have a tendency to rust thereby lacking both the mechanical and aesthetic advantages.

It is often claimed that stainless steel weighs less than Chromolly steel - is this true?

No, practically all steels have a similar density: the difference varies by about 1%. So it isn't true that stainless steels are lighter.

It is claimed that stainless steels maintain a better and sharper edge for longer than chromolly steel - is this true?

No, the ability to "maintain an edge" depends mainly on the hardness but this must be weighed up alongside the toughness, the resistance to fractures, which remains the most important feature. With a similar toughness chromolly steel is harder and therefore better preserves a sharper edge than the martensitic steel.

Is it true that the build up of snow under crampons happens less with stainless steel?

No, this claim has no scientific basis. Remember that stainless steels might look like metal but aren't, as they are just covered with a thin layer of chrome oxide

Our past experience and trials showed that it was more difficult to manufacture crampons in stainless steel rather than with chromolly steel. This difficulty was especially encountered during the bending process, as micro cracks tend to form, these can result in“ total fractures” of the metal during future utilization, creating potential risks for the user. Is this still true?

The same consideration goes for this aspect as earlier ones: hardness on the one hand and toughness and deformability on the other are incompatible features for all steels and in general all metals. The treatments and processes that increase the hardness will inevitably reduce the toughness. As the basic rigidity of martensitic steel is inferior to that of chromolly steel , in order to give a suitable hardness to the stainless steel a part of the toughness must be lost, creating a greater risk of cracking during both manufacture and use.

But would the crampons really be stainless?

As we have already seen, martensitic stainless steel, theoretically the only stainless steel suitable for crampons, is the less resistant to corrosion and rust formation and therefore over time would lose its aesthetic advantage.