Vanadium additions to high manganese austenitic steels for wear applications in stone crushers

The background for this project is the need for developing an improvement in Strømhard, an austenitic manganese steel from Scana Steel Stavanger. Strømhard is used in large scale crushing plates and crushing cones for stone and ore crushing. This alloy was developed in Norway in the early 1970s as an improvement of the tenacious Hadfield steels alloyed with 12 % manganese and 1,2 % carbon.

The Strømhard steel had increased wear resistance compared with the Hadfield steels, and is alloyed with 20 % manganese, 1,5 % carbon and 2,5 % chromium. Both alloys are fully austenitic, single phased steels after heat treatment. To increase economical and environmental gain by making the crushers more durable, an alloy with even more wear resistance is wanted. A new patent will ensure a Norwegian enterprise and jobs.

One part of the project is to introduce a hard phase in the austenitic steel in order to increase the abrasive wear resistance of the alloy. Different additions were tried, but the most promising was vanadium. By introducing different heat treatments, a structure of austenite with finely dispersed vanadium carbides is gained.

Fig. 1 shows Strømhard with a single phase, austenitic microstructure. The wear resistance is obtained by deformation of the surface which gives work hardening and increased hardness. Fig. 2 shows Strømhard with the addition of 2 % vanadium after a not optimized heat treatment. The grain boundary is covered with carbides giving a poor toughness. Fig. 3 shows the same alloy with a better heat treatment, giving finely dispersed carbides in the grain.

Fredrik Haakonsen and Jan Ketil Solberg

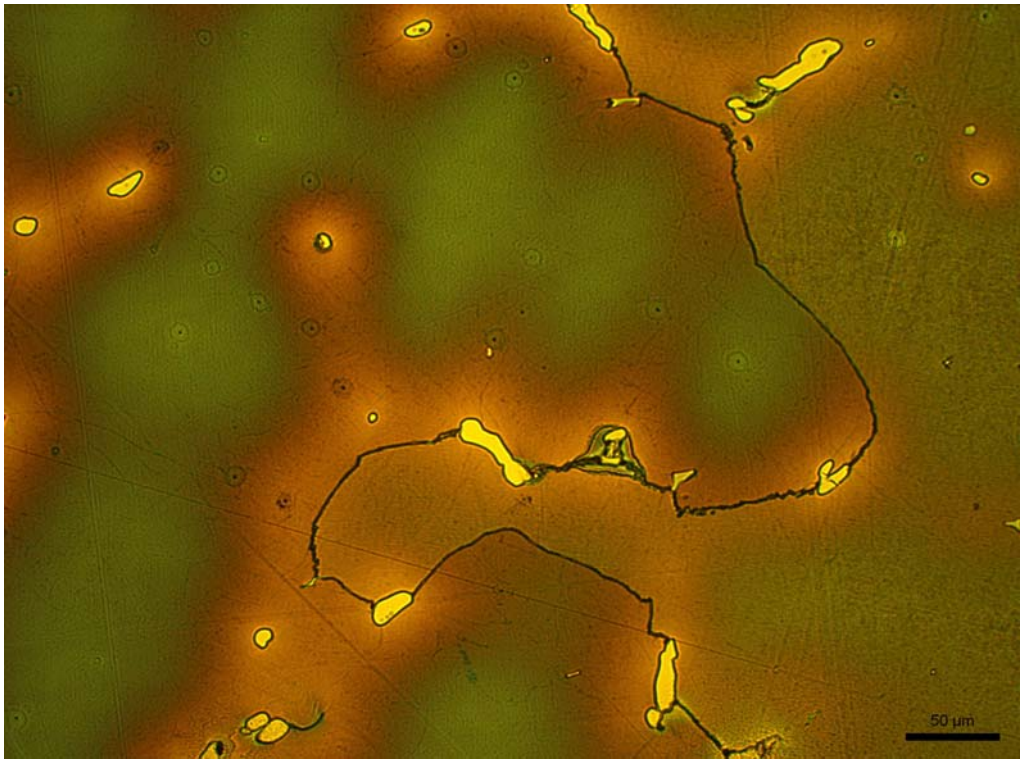
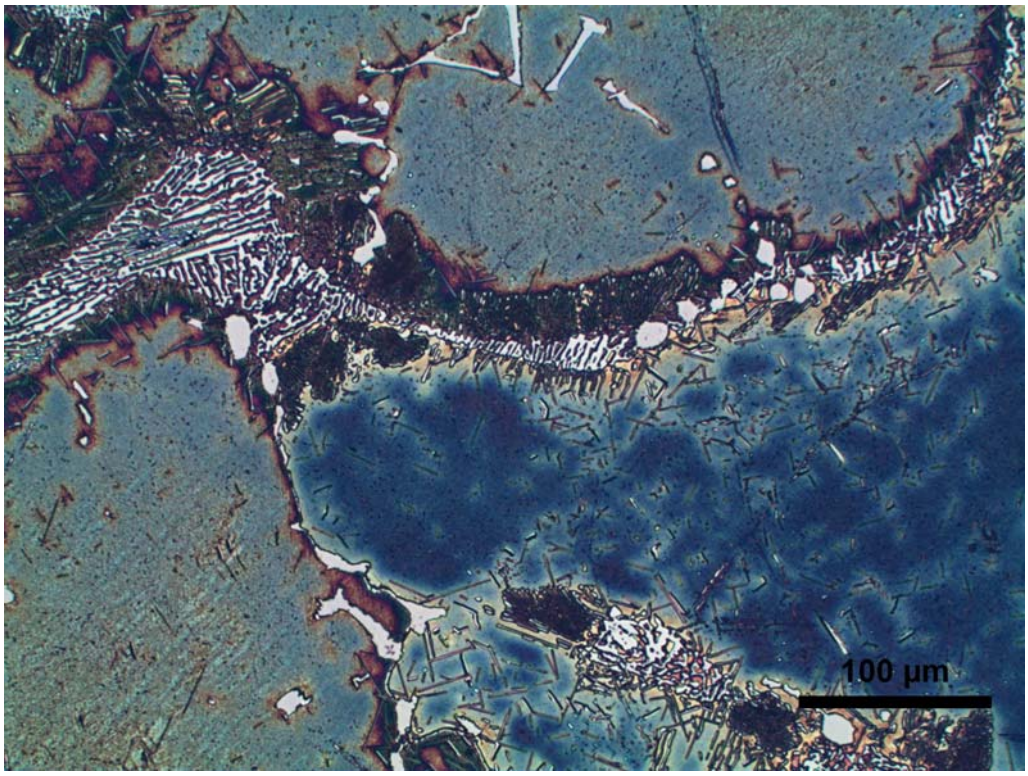


Photo: Torunn Stubmo

Fig. 1
Strømhard with an austenitic microstructure after homogenisation.



Phtot: Fredrik Haakonsen

Fig. 2
Strømhard with 2 % vanadium additions. The grain boundary is covered with carbides, after a not optimized heat treatment.

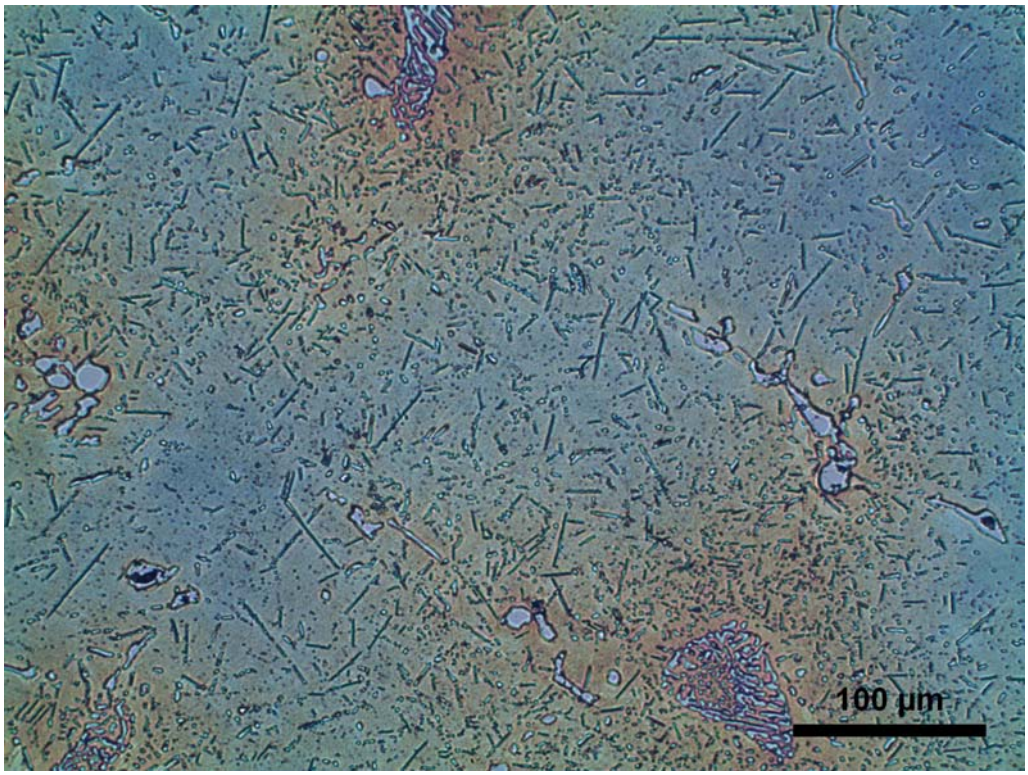


Photo: Fredrik Haakonsen

Fig. 3
Strømhard with 2 % vanadium additions. The grain contains finely dispersed carbides after an optimized heat treatment.