- ***Increased ferrite content effected atmospheric corrosion of constructions made from 304 stainless steel***

Corrosion resistance and other properties of austenitic stainless steels to very high extent depend on microstructure, mainly on the content and the distribution of δ-ferrite. These parameters are conditioned by the rate of steel solidification, transformation in the solid state and the steel chemical composition.

A rust film was discovered on stored outdoor 304 stainless steel constructions after a short time from their production (Fig. 1). The problem started at a steel construction company after 316 stainless steel was changed to 304. At places where a heat treatment effected recrystallization, that means structure change, the surface was not covered with rust layer. Following this observation a conclusion was drawn that low atmospheric corrosion resistance depends on the steel structure.

Fig.1. A thin rust film on the construction after storing outdoor. Metallic surface visible on the steel surface after local heat treatment that effected recrystallization

An investigation of 316 stainless steel plate used traditionally for a production discovered a coarse grained austenite structure with traces od delta ferrite (Fig.2). The structure of mostly austenite stainless steel was a proper one so that high atmospheric corrosion resistance was assured.

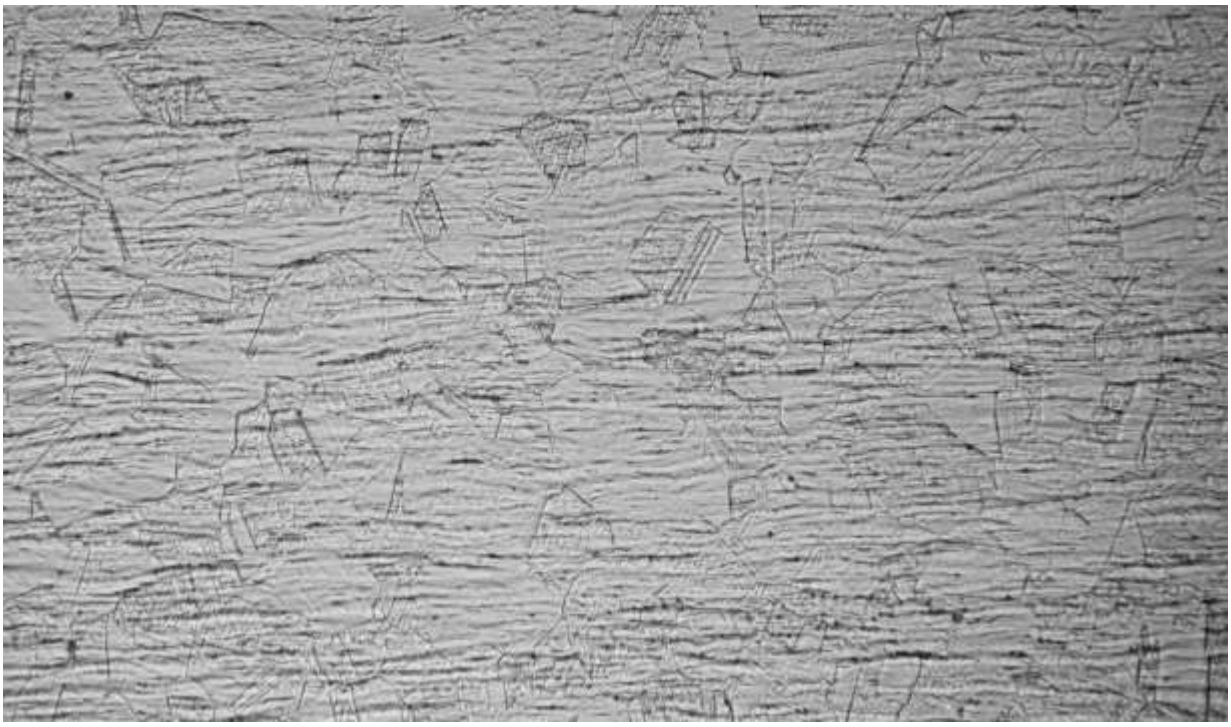

Fig.2. A coarse grained austenite structure of 316 stainless steel that was used traditionally for a production. A tiny presence of ferrite can be found (magnification 400 x)

Stainless steel 304 applied for a production had a mixed structure consisted of fine grained austenite with high concentration of δ-ferrite having the shape of longitude cells situated parallel (Fig. 3). Delta ferrite shaped as longitude cells can be formed during steel fast solidification, before transition into austenite. High quantity of cellular δ-ferrite situated parallel, present together with austenite structure effected lower corrosion resistance and also changed some other steel properties. High quantity of ferrite in stainless steel may be a result of the steel composition. Sulphur and phosphorus being the contaminations are well soluble in a δ-ferrite that is enriched in chromium. Different structures effect micro-cells formation and makes corrosion resistance lower in the case if an electrolyte film is present on a steel surface.
Conditions which support a mixed structure formation that effects lower corrosion resistance are widely described in the literature (Fig. 4).

It was stated as an expertize conclusion that 304 stainless steel applied for a production was not resistant against atmospheric corrosion due to δ-ferrite presence, besides austenite, in the plate structure. The reason of an improper structure formation could be too high solidification rate. Recrystallization heating could be used to improve the structure.

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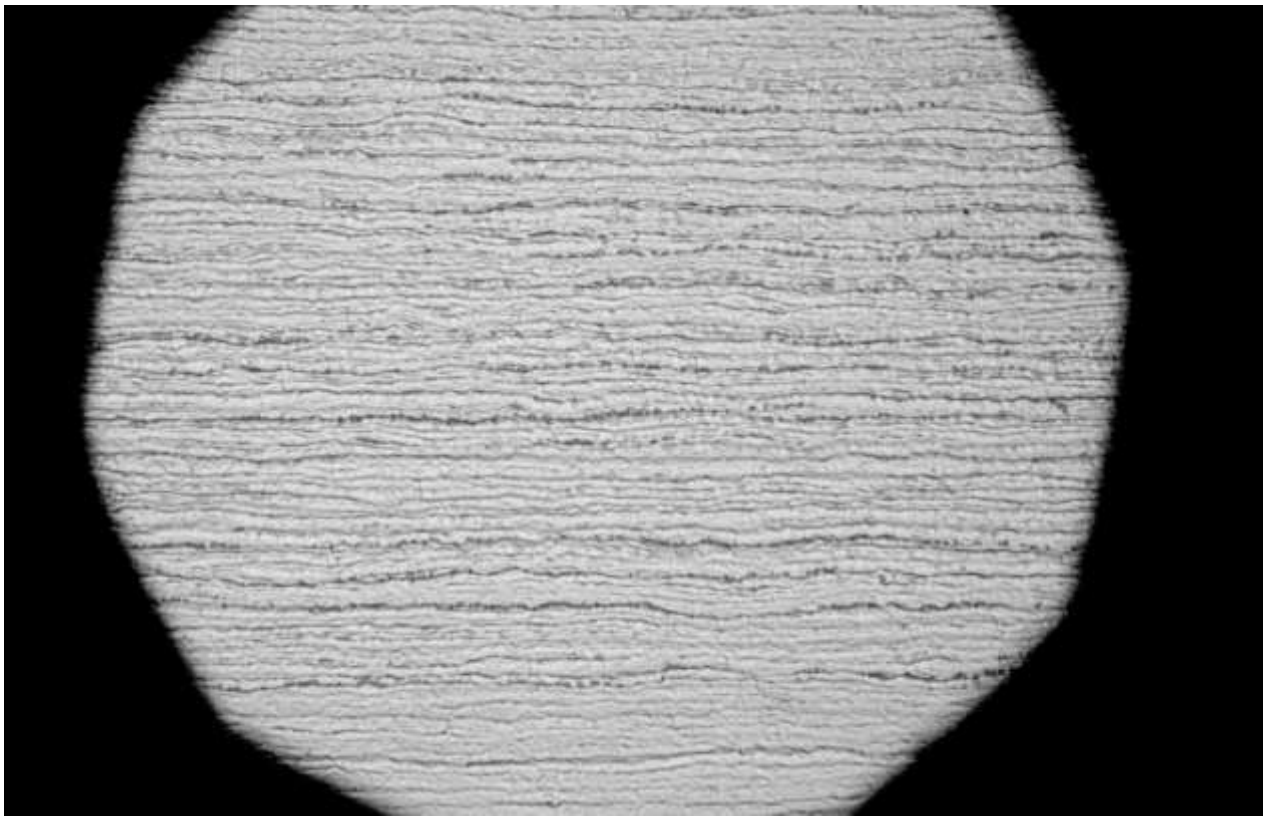

Fig. 3. Fine grained austenite structure of 304 stainless steel with high quantity of parallel thin chains of delta ferrite cells (magnification 500 x)

Fig. 4. Microstructure of δ-ferrite that may be formed during 304 stainless steel crystallization (Mizukami H, Suzuki T, Umeda T, Kurz W., Mater Sci Eng., **17,** 363, 1993,)