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Short communication

Failure of steel pipes for hot air supply

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1. Introduction

Different materials can be used in high temperature applications: any low-alloyed Cr–Mo steels, 9–12% chromium ferritic steels, heat-resistant austenitic stainless steels, and nickel-base alloys [1,2]. Heat-resistant austenitic stainless steels have better strength and oxidation resistance at high temperatures than low-alloyed steels and are less expensive than Ni-base alloys. Also, they have a service life of several (sometimes over ten) years [3]. It is generally accepted that ferritic and austenitic steels can be useful at temperatures of up to 625 and 675 °C, respectively, purely from the creep strength point of view at steam pressure of 35 MPa [4]. However, it is well known that heat-resistant steels have a tendency to form different phases, including carbides and intermetallic phases [5]. Carbide precipitates at grain boundaries provide preferential sites for cavity nucleation owing to the stress concentration produced during the fatigue cycle. The hard and brittle sigma phase, which can result in harmful influence on the properties of the alloy, can often arise. Thus, the distribution and morphology of precipitates and the change in the chemical composition of the austenite are considered important factors in determining the mechanical and corrosion properties of steels. The precipitation of carbides and sigma phase promotes sensitisation of steel, i.e. it increases the susceptibility of steel to intergranular corrosion. The highly alloyed austenitic stainless steels with high silicon content are commonly considered excellent heat-resistance materials. Higher silicon contents (between 1 and 3 wt.%) can improve high temperature resistance to oxidation or scaling. Silicon has a beneficial effect on high temperature corrosion of AISI 310 steel due to two reasons [6]. Firstly, silicon forms vitreous silica at the interface between the metal and the scale. This silica layer has a much lower density of defects, thus being a good diffusion barrier for ions (cations and anions) produced through ionisation reactions taking place at the metal/scale and scale/gas interfaces. Secondly, the preferentially formed silica acts as a nucleation site for the subsequent formation of chromia, which renders oxidation protection. In this work, the failure of steel pipes made from heat-resistant stainless steel with 2.27 wt.% of Si is presented.

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