An investigation of transverse cracks and pitting on the weldment and heat affected zone of AISI321 acid gas transmission pipeline in south Pars gas Complex

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Despite the excellent resistance of stabilized stainless steel grades against sensitization due to high temperatures of welding procedure but sometimes other kinds of failure has been observed on the base metal heat affected zone and weld metal. This paper presents a field study in failure analysis in conjunction with theoretical and laboratory researches of SS321 acid gas transmission pipe in one of the gas refinerie s of South pars gas Complex. During the first operation of this pipe, leakage was observed on some joint welds. Closed visual inspection was done and transverse cracks on some weldments and also pitting in some heat affected zones were observed. After cutting the failed parts of the pipe, some pitting was observed on weld metal and heat affected zone while the other parts of the pipe were intact. Ferrite content of weldment and heat affected zone on failed parts was measured by FERITSCOPE FMP30 to investigate the probability of the occurrence of hot or sigma phase cracking. High content of the ferrite in one of the weldments indicated that the crack can be caused due to sigma phase formation and also reinforced the probability of wrong filler application in welding procedure. Unfortunately due to the ease of welding some welders may apply carbon steel fillers in welding stainless steel joints instead of stainless steel fillers as root pass which is non-standard and shall be avoided because this procedure will change the weldment composition and adversely affect on the corrosion resistance properties. In order to simulate the effect of applying this wrong filler material on the corrosion resistance of heat affected zone and weldment, some pieces were cut from SS321 plates and then joined together by applying GTAW procedure. One sample was TIG welded by carbon steel filler material as root pass and SS347L as hot pass. Another sample was TIG welded by SS347L filler material for both root and hot passes. Light microscopic examination revealed different microstructure on the weldment and heat affected zone of simulated samples. Potentiodynamic polarization measurements based on ASTM G61 were conducted in 3.5% wt NaCl solution at ambient temperature on these simulated samples. Results indicated that the sample with wrong filler material was more susceptible against pitting corrosion in both heat affected zone and weldment area. Applying hy drostatic leak test with high levels of chloride and not having suitable draining can cause pitting corrosion on stainless steel material especially in areas with weaker passive layer. Executing hydrostatic leak test with waters containing high levels of chloride and not having suitable draining, application of wrong filler material as root passes in welding stainless steel joints, iron contamination and rust staining on stainless steel weldment, being located by the sea and exposing to humid weather with high content of chloride can be regarded as root causes of this kind of failure.