SUSCEPTIBILITY OF CREEP AGED MATERIAL TO STRESS RELIEF CRACKING DURING REPAIR WELDING

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by

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My mother and the rest of my family

Elri

GOD

When standing to close to the tree
One tends not to see the flowers.

GT

Susceptibility of creep aged material to stress relief cracking during repair welding

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ABSTRACT

The repair welding of main steam pipelines, which involves the welding of new material onto service-exposed material, are investigated. This paper investigates the literature and experimental work surrounding this subject. The introduction provides a background to the applicable welding technology. In section two the heat-affected zone is discussed with emphasis on the residual stresses that develop in this zone. The mechanical properties of the heat-affected zone are also investigated. This includes the tensile, toughness and hardness properties as well as inspecting the relevant microstructures. The effect of post weld heat treatment on these properties is also investigated. Section three investigates the phenomenon of creep. Not only is this important due to the high temperatures at which these pipelines operate, but creep is also associated with some failures of these weld during post weld heat treatment. The creep properties of the heat-affected zone are investigated in detail with the use of weld simulation. Sections four and five detail reasons for weld failure after welding due to hydrogen and reheat cracking. Hydrogen cracking is investigated with the use of slow strain rate tensile tests during cathodical charging the specimen with hydrogen. The phenomenon of reheat cracking is investigated with the use of high temperature tensile tests as well as a novel approach in which the stress relief of a welded joint is simulated while measuring crack growth and stress relieved.

SAMEVATTING

Die herstelsweis van die hoofstoompyplyne noodsaak die verbinding van nuwe materiaal aan diens verouderde materiaal. Die oorsig ondersoek die literatuur beskikbaar oor die besondere sweis. Die inleiding verskaf inligting in verband met die omgewing waarin die besondere sweis gemaak word. In afdeling twee word die hitte invloedsone bespreek met klem op die resspannings in hierdie sone. Die sterkte, hardheid en taaiheid eienskappe van die sone word ook ondersoek, asook die effek wat nasweishittebehandeling op dit het. Afdeling drie bespreek die kruipeienskappe van die basismateriaal materiaal en die besondere sweisnaat. Dit word moontlik gemaak deur die intensiewe gebruik van sweis simulasie. Afdeling vier en vyf ondersoek twee moontlike redes vir die faling van die sweislas direk na sweising of gedurende nasweis hittebehandeling. Dit sluit in waterstof kraking asook herverhit krake. Waterstof krake word ondersoek deur gebruik te maak van stadige trektoetse onderwyl die monster katodies gelaai word met waterstof. Die voorkoms van herverhit krake word ondersoek deur gebruik te maak van hoë temperatuur trektoetse asook die simulasie van nasweis hittebehandeling. In hierdie toets word die die spanning verlig asook die kraakvorming gedurende nasweis hittebehandeling gemeet.

KEYWORDS

½CR-½MO-¼V; CREEP RESISTANT MATERIAL; REHEAT CRACKING; HYDROGEN CRACKING; STRESS-RELIEF; MAIN STEAM PIPELINE REPAIR WELD

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