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Studi evolusi struktur mikro dan sifat mekanik pada baja tahan karat super dupleks UNS S32750 akibat proses pengelasan perbaikan berulang = Study of microstructure evolution and mechanical properties of super duplex stainless steel UNS S32750 due to repeated weld-repairs

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Abstrak

Penelitian ini dilakukan untuk mengevaluasi pengaruh dari proses pengelasan perbaikan berulang terhadap evolusi struktur mikro dan sifat mekanik dari super duplex stainless steel(SDSS) UNS S32750. Enam sampel di las dengan proses pengelasan gas tungsten arc welding(GTAW). Sampel pertama disiapkan sebagai original weld(OW), kemudian daerah lasan di eksavasi dengan grinda, dan di preparasi kembali pada area yang sama yang selanjutnya di lakukan pengelasan kembali dengan variasi masukan panas, yaitu masukan panas rendah dan tinggi 1,0 and 1,75 kJ/mm. Sampel repairpertama diberi identifikasi R1-LHI & R1-HHI kemudian proses repairkedua di lakukan sama dengan proses repairpertama dengan identifikasi R2-LHI & R2 HH1 begitu juga dengan R5. Sampel-sampel tersebut selanjutnya di-uji untuk mempelajari perubahan struktur mikro, kandungan ferrit, dan sifat mekanik hasil lasan. Pengujian impak dan kekerasan dilakukan untuk mengkarakterisasi sifat mekanik hasil sambungan, stuktur mikro dan analisa patahan dari sampel impak di teliti menggunakan mikroskop optik (OM) dan Scanning Electron Microscopic-Energy Dispersive X-ray Spectroscopy(SEM-EDS).
Hasil penelitian proses pengelasanrepairyang berulang menunjukan terjadinya perubahan yang signifikan terhadap struktur mikro dan sifat mekanik material SDSS. Ukuran butir ferrit pada area HAZ sampel HHI terlihat lebih kasar dibandingkan LHI, mengakibatkan penurunan kekuatan impak hingga 12 J pada sampel R5. Mode patahan ulet terjadi pada sampel OW, R1-LHI, R2-LHI & R1-HHI sedangkan patahan getas terjadi pada sampel R2 HHI & R5, presipitat Cr2N dan fasa sigma juga ditemukan pada foto struktur mikro R5 dimana keduanya dapat menurunkan kekuatan impak hasil lasan. Hasil analisa kandungan ferrit menunjukan pengelasan dengan masukan panas tinggi dapat menurunkan kandungan ferrit dibandingkan dengan masukan panas yang rendah, dan nilai kekerasan rata-rata sampel R1-LHI & R2-LHI terlihat lebih tinggi dari batas kekerasan yang diperbolehkan. Secara keseluruhan pembatasan pengelasan repair hingga repair pertama dengan masukan panas yang sama menghasilkan hasil yang optimal.
.....This research is performed to evaluate the effects of repeated weld-repairs on the microstructure evolution and mechanical properties of super duplex stainless steel (SDSS) UNS S32750. Six specimens were welded using gas tungsten arc welding (GTAW) process. The first specimen was prepared as original weld (OW), then weld area was ground, re-beveled on the same location and re-welded with different parameters, low and high heat input 1,0 and 1,75 kJ/mm respectively. The first repair with low heat input and high heat input were called as R1-LHI & R1-HHI and the second repairs were prepared as same as the first repairs and called as R2-LHI & R2 HH1 and also for R5. Specimens with the different condition were studied by examining the changes in microstructures, ferrite content, and the mechanical properties. Impact and hardness test were carried out to characterize the mechanical properties of welded joints, the microstructural and fractography of raptured impact specimens were investigated using optical microscopy

(OM) and Scanning Electron Microscopic-Energy Dispersive X-ray Spectroscopy (SEM-EDS).
The results showed that microstructures, mechanical properties of SDSS weldments were changing significantly as the effect of repeated repair heat cycle by differences heat input. Ferrite grain size on HHI HAZ specimen was found coarser than LHI, which affected in the reduction of impact value up to 12 J on R5 specimen. Ductile mode fracture was reported occurred on OW, R1-LHI, R2-LHI & R1-HHI and brittle fracture on R2 HHI & R5, Precipitate Cr2N and Sigma phase are also found on R5 microstructure, which may reduce the impact properties of the materials. From ferrite content report shows that welding with HHI reduced the ferrite content compare to LHI samples, and the average hardness values for R1-LHI & R2-LHI were found higher than acceptance. From the results of the examination, limited repair up to the first repair with the same heat input as the original weld was given the optimum results.