

Korosi Retak Tegang Material Stainless Steel AISI 304 di Lingkungan MgCl₂

Gadang Priyotomo, author

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Abstrak

Baja tahan karat jenis austenitik AISI 304 mempunyai kerentanan terhadap korosi retak tegang di dalam larutan korosif klorida. Baja tipe ini juga rentan terhadap temperatur sensitasi antara 580°C - 815°C. Kerentanan tersebut jelas terjadi pada korosi batas butir. Batas butir mengandung krom karbida. Kombinasi antara internal material logam dan lingkungan memberikan efek korosi retak tegang. Lingkungan MgCl₂ merupakan lingkungan korosif yang berperan dalam jenis korosi ini. Pengujian korosi retak tegang dilakukan dengan metode beban konstan (creep) melalui beban 20 kg/mm², 25 kg/mm², 30,5 Kg/mm², dan 40 Kg/mm² di larutan 42wt% MgCl₂ bersuhu 106°C. Perlakuan material dibagi dua yaitu anil 1100°C, tahan 1 jam, kemudian celup cepat air dan tanpa anil. Kedua perlakuan tersebut disensitasi (600°C, 700°C, 800°C). Pengujian kualitatif karbida, pengujian komposisi bulk, larutan uji (AAS), pengujian kekerasan Vickers, metalografi (foto makro) dan pengujian SEM EDS dilakukan. Hasil menunjukkan pengujian kekerasan vickers pada suhu sensitasi 7000C mengalami penurunan berkisar 152,06 Hv (anil 1100°C) dan 199,1 Hv (non anil 1100°C) dibandingkan suhu sensitasi 600°C dan 800°C. Tren sama juga terjadi pada pengujian SCC beban konstan, pada temperatur sensitasi 700°C, waktu patah (tf) lebih pendek dibandingkan suhu sensitasi 600°C & 800°C di dua kondisi material berbeda. Waktu patah tercepat pada beban 25 Kg/mm² 3 detik di kondisi anil 1100°C, suhu sensitasi 700°C dan terlama pada beban 30,5 Kg/mm² 86400 detik di kondisi tanpa anil, suhu sensitasi 6000C. Laju pemuluran (iss) tertinggi pada beban 25 kg/mm² 4,80 mm/detik di kondisi anil 11000C, suhu sensitasi 700°C dan terendah pada beban 30,5 Kg/mm² 3.10-8 mm/detik di kondisi tidak anil 1100°C. Bentuk patahan SCC berbentuk intergranular (tidak dianil 11000C). Bentuk patahan transgranular dengan banyak struktur dimple (void-void) nampak banyak di material anil 1100 berbagai suhu sensitasi. Prosentase peningkatan kelarutan Fe kedalam larutan uji antara 484% hingga 2050% , Kation Cr antara 750% hingga 3540%, dan Kation Ni hingga 110%.

.....Austenitic Stainless steel (AISI 304) has a susceptibility of stress corrosion cracking inside corrosive chloride solution. This material also is susceptible from sensitizing temperature (580°C-815°C). This susceptibility of material clearly is undergone in intergranular corrosion. Grain boundaries contain chromium carbide. The combination of internal material and environment can contribute a great effect of stress corrosion cracking (SCC). MgCl₂ circumstance have main role for SCC as corrosive solution. SCC test was conducted with constant load method (creep) of 20 Kg/mm², 25 Kg/mm², 30,5 Kg/mm², and 40 Kg/mm² in 42 wt% MgCl₂ solution and constant temperature of 1060C. Material treatment is divided two sides : (1) annealing process (1100°C); holding 1 hour then quenching process and (2) without annealing. These two treatments were sensitized at 600°C, 700°C and 800°C. The qualitative test of carbide, the test of bulk chemical composition, solution test (AAS), Vickers hardness test, metallography, and SEM EDS test conducted. Test results show Vickers hardness value on sensitizing temperature of 7000C that was undergone the decreasing of range 152,06 Hv (annealing of 11000C) and 199,1 Hv (non annealing) by comparing sensitizing temperature of 600°C and 800°C. The same trend also was happen at the test of SCC.

On sensitizing temperature of 700°C fracture time (t_f) is shorter than sensitizing temperature of 600°C and 800°C in two different material conditions. The shortest fracture time is happened at load of 25 Kg/mm² that is t_f of 3 seconds in annealing condition of 1100°C and sensitizing temperature of 700°C. The longest fracture time is also happened at load of 30,5 Kg/mm² that is t_f of 86400 seconds without annealing process and sensitizing 600°C. The Highest Elongation rate (iss) at load of 25 Kg/mm² is 4,80 mm/s in annealing condition of 1100°C for sensitizing temperature of 700°C. The lowest one at load of 30,5 Kg/mm² is 3.10⁻⁸ mm/s without annealing condition of 1100°C. The average shape of fracture of SCC is intergranular form without annealing process of 1100°C. The shape of transgranular fracture with surface structure of dimples was undergone at annealing material of 1100°C with various sensitizing temperatures. The increasing of dissolution percentage of Fe ions to test solution between 484% to 2050%, from 750% to 3540% (Cr ion), and up to 110% (Ni ion).