

ABSTRACT

DEVELOPMENT OF MECHANICAL PROPERTIES AND IMPACT TOUGHNESS OF AISI P20 STEEL By HOT DIP ALUMINIZING COATING

By:

Rd. TOMMY RIZA PAMEKAS T. A

AISI P20 Steel is low alloy steel with carbon content of ~0.419 wt.% and can be used as the engineering material for boilers, heat exchanger, and hot steam pipes in geothermal power plants (PLTP) and coal-fired plants (PLTU). However, for application at higher temperatures, the steel experiences a decrease in the mechanical strength and impact properties. The coating process Al-dye hot (hot dipping) is applied on the surface of steel with steel dip into a tub of molten Al-Si on 700 °C for 2 minutes. All specimens are given heat treatment at temperature of 750 °C for 1-49 hours (diffusion treatment) to know the change of mechanical properties of steel after the coating process. Mechanical properties and toughness (impact) AISI steel tensile testing performed P20 (ASTM E-8 m) and the impact test (ASTM E-23). Observation through the cross-section surface diffusion aluminide coating process after treatment carried out using SEM (Scanning Electron Microscopy) and characterization of diffusion of results to find out the phases of the intermetallic done using spectral analysis of EDS.

Tensile test results and impact, indicating the length of time diffusion treatment effect of tensile strength and the price impact is generated. The longer diffusion treatment done then getting down the tensile strength (time 1 hour = 1740.109 Mpa and 49 hours = 1375.758 Mpa) and price impact (time 1 hour = 23.0 J and 49 hours = 13.7 J). Phases of the intermetallic formed in layers of aluminide based on test results showed the dominant phase EDS spectrum formed at a time of 1 hour is FeAl_3 and Fe_2Al_5 that have a high level of violence whereas the phase formed at the time of 49 hours is $(\text{Al,Si})_5\text{Fe}_3$, where at the time of 49 hours of the occurrence of the phase transformation causes the formation of voids and voids-void formed expands forming defects cavities (pores). Cavity defects in the formation phase contribute to a decrease in the tensile strength and the impact of Steel AISI P20 that has coated Al dye hot.

Keywords: Hot Dipping, Steel AISI P20, Diffusion Treatment, Tensile Strength, Price Impact, Phase Intermetallic

ABSTRAK

PENGEMBANGAN SIFAT MEKANIK DAN KETANGGUHAN BAJA AISI P20 DENGAN PELAPISAN ALUMINIUM CELUP PANAS

Oleh :

Rd. TOMMY RIZA PAMEKAS T. A

Baja AISI P20 merupakan baja paduan rendah dengan kadar karbon (~0.419 wt.%) dan dapat diaplikasikan untuk komponen-komponen boiler, *heat exchanger*, dan pipa uap panas pada pembangkit listrik panas bumi (PLTP) atau pembangkit listrik tenaga uap berbahan bakar batubara (PLTU). Namun, selama aplikasi pada temperatur lebih tinggi, kekuatan baja akan menurun baik kekuatan mekaniknya maupun ketangguhannya. Untuk meningkatkan ketahanan baja pada temperatur tinggi, proses pelapisan Al-celup panas (*hot dipping*) diterapkan pada permukaan baja dengan mencelupkan baja ke dalam bak Al-Si cair pada 700 °C selama 2 menit. Semua spesimen diberi perlakuan panas pada temperatur 750 °C selama 1-49 jam (*diffusion treatment*) untuk mengetahui perubahan sifat mekanik baja setelah proses pelapisan. sifat mekanik dan ketangguhan (*impact*) baja AISI P20 dilakukan pengujian tarik (ASTM E-8M) dan uji *impact* (ASTM E-23). Pengamatan melalui penampang permukaan lapisan aluminide setelah proses *diffusion treatment* dilakukan menggunakan SEM (*Scanning Electron Microscopy*) dan karakterisasi hasil difusi untuk mengetahui fasa-fasa intermetalik dilakukan menggunakan EDS analisis spektrum.

Hasil pengujian tarik dan *impact*, menunjukkan lamanya waktu *diffusion treatment* berpengaruh besar terhadap kekuatan tarik dan harga *impact* yang dihasilkan. Semakin lama *diffusion treatment* dilakukan maka semakin turun kekuatan tarik (waktu 1 jam = 1740,109 Mpa dan 49 jam = 1375,758 Mpa) dan harga *impact* (waktu 1 jam = 23,0 J dan 49 jam = 13,7 J). Fasa-fasa intermetalik yang terbentuk dalam lapisan aluminide berdasarkan hasil uji spectrum EDS menunjukkan fasa dominan yang terbentuk pada waktu 1 jam adalah $FeAl_3$ dan Fe_2Al_5 yang memiliki tingkat kekerasan yang tinggi sedangkan fasa yang terbentuk pada waktu 49 jam adalah $(Al,Si)_5Fe_3$, dimana pada waktu 49 jam terjadinya transformasi fasa menyebabkan terbentuknya void dan void-void yang terbentuk mengembang membentuk cacat rongga (pores). Cacat rongga yang masuk ke dalam pembentukan fasa berkontribusi dalam penurunan kekuatan tarik dan impak baja AISI P20 yang telah dilapisi Al celup panas.

Kata Kunci : *Hot dipping*, Baja AISI P20, *Diffusion Treatment*, Kekuatan tarik, Harga *Impact*, Fasa Intermetalik

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