Pengaruh jenis isolator terhadap kecepatan pendinginan dalam pembentukan lapisan kulit dan sifat mekanis besi tuang nodular dinding tipis = The effect of insulator types towards cooling rate on skin effect formation and mechanical properties of thin wall ductile iron

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Abstrak

Penggunaan energi yang tidak terbarukan seperti minyak bumi dan batu bara secara perlahan telah membawa dunia ini ke dalam krisis energi, sehingga diperlukan upaya penghematan energi. Isu dunia mengenai penghematan energi tersebut sangat berkaitan erat dengan industri otomotif. Industri otomotif dituntut untuk menghasilkan produk dengan emisi kendaraan yang rendah dan kendaraan yang hemat bahan bakar. Material TWDI (thin wall ductile iron) yang dapat dilakukan pemrosesan lanjut menjadi TWADI (thin wall austempered ductile iron) menjadi kandidat yang paling menarik karena sifat mekanisnya yang baik serta biaya yang lebih murah jika dibandingkan dengan aluminium. Tantangan yang dihadapi pada proses pembuatan material TWDI saat ini yaitu kecenderungan terbentuknya lapisan kulit (skin effect) pada permukaan logam hasil pengecoran yang dapat menurunkan sifat mekanis.
Penelitian ini dilakukan untuk mendapatkan pengaruh penggunaan isolator berupa glasswool, kayu, dan rockwool dengan ketebalan 40 mm terhadap kecepatan pendinginan. Pengujian yang dilakukan adalah pengujian komposisi kimia, pengamatan makro, pengamatan struktur mikro, dan pengujian tarik. Pengamatan struktur mikro dilakukan secara kualitatif dan kuantitatif, dengan bantuan program image analysis. Sedangkan analisis kecepatan pendinginan didapatkan secara kualitatif.
Hasil dari penelitian ini diketahui bahwa kecepatan pendinginan merupakan fungsi dari jumlah nodul, karbida, nodularitas, dan diameter rata-rata nodul. Kecepatan pendinginan tercepat hingga terlambat yaitu pada penggunaan isolator rockwool (P9M1), kayu (P8M1), dan glasswool (P6M1). Untuk ketebalan lapisan kulit rata-rata terbesar hingga terkecil yaitu P8M1 32,58 m, P9M1 25,59 m, dan P6M1 25,45 m. Dari karakteristik nodul, P8M1 memiliki nodularitas tertinggi sebesar 81% lalu diikuti P6M1 sebesar 79% dan P9M1 sebesar 76%. P6M1 memiliki 1605 nodul/mm2, P9M1 1274 nodul/mm2 dan P8M1 1141 nodul/mm2. Sedangkan, diameter nodul P6M1 10,20 m, P8M1 9,71 m, dan P9M1 9,09 m. Matriks yang didapatkan adalah ferit dan karbida dengan tingkat keparahan karbida tertinggi hingga terendah yaitu P9M1, P8M1, dan P6M1. Nilai kekuatan tarik P6M1 367 MPa, P9M1 329 MPa, dan P8M1 146 MPa. Sedangkan elongasi P6M1 2%, P9M1 1,1%, dan P8M1 1%. Sifat mekanis yang didapatkan masih berada di bawah nilai standar.
<hr><i>Nowadays, the use of unsustainable energy such as petroleum and coal subsequently has brought us to the energy crisis. So that the effort of saving energy is crucial. World issues regarding energy savings is very closely related to the automotive industry. The automotive industry is required to produce products with lower emissions and fuel-efficient vehicles. TWDI (thin wall ductile iron) which can be processed to TWADI (thin wall austemperd ductile iron) became the best candidate due to good mechanical properties and lower cost comparing to aluminum. The challenge confronted in the process of TWDI making is the tendency of skin formation on the surface of the metal casting reduced its mechanical properties.
This research is conducted to obtain the effect of insulators utilization such as glasswool, wood, and rockwool with the thickness of 40 mm towards the cooling rate. Methods performed are chemical

composition, visual observation, microstructure observation, and tensile testing. While, microstructure observation is conducted qualitatively and quantitatively using image analysis program, the analysis of the cooling rate is obtained qualitatively.

The cooling rate, from the fastest to the slowest, is rockwool (P9M1), wood (P8M1), and glasswool (P6M1). Where as, for the average skin thickness, from the biggest to the smallest, is P8M1 32.58 m, P9M1 25.59 m, and P6M1 25.45 m. For nodule characteristics, P8M1 has the 81% nodularity and then followed by P6M1 with 79% and P9M1 with 76%. While, P6M1 has 1605 nodule/mm2, P9M1 and P8M1 has 1274 and 1141 nodul/mm2, respectively. While, the biggest nodule diameter is P6M1 with 10.20 m, the next is P8M1 with 9.71 m and then P9M1 with 9.09 m. Ferrite and carbide is found in the matrix. The severity level of carbide, from the highest to the lowest, is P9M1, P8M1 and P6M1. From mechanical aspects, the highest ultimate tensile strength is obtained by P6M1 with 367 MPa, then followed by P9M1 with 329 MPa and P8M1 with 146 MPa. Where as, for the elongation, P6M1 is 2%, P9M1 is 1.1% and P8M1 is 1%. The mechanical properties obtained don't fulfill the standardfollowed by P6M1 with 79 and P9M1 with 76 While P6M1 has 1605 nodule mm2 P9M1 and P8M1 has 1274 and 1141 nodul mm2 respectively While the biggest nodule diameter is P6M1 with 10 20 m the next is P8M1 with 9 71 m and then P9M1 with 9 09 m Ferrite and carbide is found in the matrix The severity level of carbide from the highest to the lowest is P9M1 P8M1 and P6M1 From mechanical aspects the highest ultimate tensile strength is obtained by P6M1 with 367 MPa then followed by P9M1 with 329 MPa and P8M1 with 146 MPa Where as for the elongation P6M1 is 2 P9M1 is 1 1 and P8M1 is 1 The mechanical properties obtained don rsquo t fulfill the standard.</i>