Pengaruh kandungan cu terhadap respon pengerasan penuaan paduan al 9zn 4mg pada temperatur 130°C = Effect of cu content on the age hardening response of al 9zn 4mg alloy at 130°C

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Abstrak

Aluminium memiliki sifat yang ringan dan tahan korosi, sehingga banyak digunakan di bidang manufaktur. Penggunaan material aluminium sangat efektif untuk meningkatkan efisiensi turbin pembangkit tenaga listrik Organic Rankine Cycle (ORC). Aluminium seri 7xx (Al-Zn) merupakan pilihan yang diperhitungkan pada turbin ORC karena memiliki kekuatan yang tinggi dibanding seri lainnya. Untuk lebih meningkatkan kekuatan Al-Zn, ditambahkan unsur Mg dan Cu serta pemberian laku pengerasan penuaan.
Penelitian kali ini mempelajari pengaruh penambahan Cu sebesar 0, 1, 3 dan 5 wt.% pada paduan Al-9Zn-4Mg (wt.%). Paduan dibuat dengan proses investment casting pada cetakan berbentuk impeller turbin. Pada paduan dilakukan proses laku pelarutan pada temperatur 460°C selama 2 jam dan dilanjutkan proses penuaan pada temperatur 130°C. Karakterisasi meliputi pengujian kekerasan untuk mengamati respon pengerasan penuaan, pengamatan struktur mikro dan pengujian Differential Scanning Calorimetry (DSC). Struktur mikro diamati menggunakan mikroskop optik dan Scanning Electron Microscope (SEM) yang dilengkapi dengan Energy Dispersive Spectroscopy (EDS).
Hasil penelitian menunjukkan bahwa penambahan Cu ke dalam paduan Al-9Zn- 4Mg menurunkan kekerasan awal (2 jam) akibat segregasi kompeks Cu-V ke batas butir yang akan melunakkan dan memperlebar batas butir, Namun kandungan penambahan Cu meningkatkan kekerasan puncak, walau tidak terlalu signifikan akibat tingginya kandungan Zn dan Mg. Selama pengerasan penuaan terjadi reaksi eksotermik yaitu pembentukan GP zone, presipitat ’ (MgZn2) dan presipitat (MgZn2) serta reaksi endotermik dari dissolution GP zone dan presipitat . Sementara, fasa kedua yang ditemukan adalah MgZn2 dan Al7Cu2Fe di batas butir.
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Aluminium is a light-weight material and possesse high corrosion resistance, so that it is widely used in manufacturing industries. Aluminium alloy is a candidate to be used as turbine impeller in an Organic Rankine Cycle (ORC) power plant system. Al 7xx series (Al-Zn) has the highest strength compared to other aluminium series, therefore it is suitable for ORC turbine. To futher increase the strength of Al-Zn alloys, Mg and Cu are added as well as age hardening treatment.
This research studied Al-9Zn-4Mg alloys with Cu content of 0, 1, 3 and 5 wt.%. The alloys were produced through investment casting taking the shape of turbine impeller. The samples were solution treated at 460°C for 2 hours and then aged at 130°C. The characterization included hardness testing to observed response of age hardening, microstructural observation and Differential Scanning Calorimetry (DSC) testing. Microstructural observation was conducted by optical microscope and Scanning Electron Microscope (SEM) which was combined with Energy Dispersive Spectroscopy (EDS).
The results showed that addition of Cu initially decreased the hardness during early ageing (2 hours) due to segregation of Cu-V complexes toward the grain boundaries which then decrease the hardness and enlarge the grain boundaries. However, the peak hardness is increased by addition of Cu although not as significant

due to high concentration of Zn and Mg. exothermic reaction of formation of GP zone, ’ (MgZn2) and (MgZn2) was found during precipitation process while endothermic reaction were observed due to dissolution of GP zone and (MgZn2). Presence of MgZn2 and Al7Cu2Fe were also observed in grain boundaries.