P-ISSN 0126-3188
E-ISSN 2443-3926

METALURGI

VOLUME 38 No 3 2023

SCIENTIFIC JOURNAL ACCREDITATION NO.3/E/KPT/2019

The Effect of AlTi5B1 and ALTAB Ti80 with a Combination of AlSr15 and Mg Additions on Strength and Ductility of A356 Aluminum Alloys

Residual Stress Measurement of Used Mining Dump Truck Frame for Remanufacturing Purposes

The Effect of pH and Sodium Silicate Dosage on the Separation of Magnesium and Lithium from Artificial Brine Water Using Chemical Precipitation Techniques

Kinetic of Dissolution of Nickel Limonite Calcine by Sulfuric Acid Solution

Comparative Studies Simulation Software for Bone Plate Compression

National Research and Innovation Agency

Publisher :
National Research and Innovation Agency (BRIN)
B.J. Habibie Sains and Technology Area, Banten, Indonesia 15314

E-mail: metalurgi@brin.go.id

Science and technology journal, regularly published every year; one volume consists of 3 editions

METALURGI

VOLUME 38 NUMBER 3 2023

P-ISSN 0126-3188
E-ISSN 2443-3926

ACCREDITATION : SK No. 3/E/KPT/2019

Preface.....xxii
Abstract.....xxiv

The Effect of AlTi5B1 and ALTAB Ti80 with a Combination of AlSr15 and Mg Additions on Strength and Ductility of A356 Aluminum Alloys

Afghany Mostavan, et. al.....83-94

Residual Stress Measurement of Used Mining Dump Truck Frame for Remanufacturing Purposes

David Ferdiyanto, et. al.....95-100

The Effect of pH and Sodium Silicate Dosage on The Separation of Magnesium and Lithium from Artificial Brine Water Using Chemical Precipitation Techniques

Latifa Hanum Lalasari, et. al.....101-108

Kinetics of Dissolution of Nickel Limonite Calcine by Sulfuric Acid Solution

Iwan Setiawan, et. al.....109-116

Comparative Studies Simulation Software for Bone Plate Compression

Dita Mayasari, et. al.....117-124

Index

PREFACE

The author gives thanks to Allah for bestowing His blessing and direction, allowing the **Metalurgi Journal Volume 38, Edition 3**, **2023** to be successfully published.

The first article results from Afghany Mostavan and colleagues research activities on *The Effect of AlTi5B1 and ALTAB Ti80 with a Combination of AlSr15 and Mg Additions on Strength and Ductility of A356 Aluminum Alloys*. David Ferdiyanto and colleagues presented the second article, *Residual Stress Measurement of Used Mining Dump Truck Frame for Remanufacturing Purposes*. Latifa Hanum Lalasari and colleagues presented *The Effect of pH and Sodium Silicate Dosage on the Separation of Magnesium and Lithium from Artificial Brine Water Using Chemical Precipitation Techniques* in the following article. For the fourth article, Iwan Setiawan and colleagues discussed *Kinetics of Dissolution of Nickel Limonite Calcine by Sulfuric Acid Solution*. The fifth article by Dita Mayasari and her colleagues, discussed *Comparative Studies Simulation Software for Bone Plate Compression*.

The publication of this volume in Metalurgi Journal will benefit the advancement of research in Indonesia.

EDITORIAL

METALURGI

ISSN 0126 – 3188 Vol. 38 No. 3, 2023

Keywords sourced from articles. This abstract is reproduced without permission or fee.

UDC (OXDCF) 669.715

Afghany Mostavan[a], Asep Ridwan[b], Arif Basuki[b], Husaini Ardy[b] ([a]Doctoral Program of Materials Science and Engineering, [a,b] Department of Materials Science and Engineering, Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung)

Metalurgi, Vol. 38 No. 3, 2023

The Effect of AlTi5B1 and ALTAB Ti80 with a Combination of AlSr15 and Mg Additions on Strength and Ductility of A356 Aluminum Alloys

The current study aims to analyze microstructural changes affecting the A356 aluminum alloy, a hypoeutectic Al-Si-Mg alloy. This aluminum alloy is well-known for its strength, resistance to corrosion, lightweight, and heat treatability. The main objective of this research is to improve the strength and ductility of A356 alloys by using a synergistic strategy that includes AlTi5B1 and ALTAB Ti80 for microstructural alteration in combination with AlSr15 and Mg. The experimental results show that including all constituents in the as-cast condition enhances the ultimate tensile strength and elongation. Furthermore, in the heat-treated state, the addition of ALTAB Ti80 effectively maintains tensile strength (σ_{uts}=233.7 MPa), yield strength (σ_y=180.3 MPa), and elongation (e=5.8%). Additionally, when combined with Mg, the tensile strength and yield strength exhibit further improvement (σ_{uts}=253 MPa and σ_y=215.7 MPa); however, elongation is significantly reduced (e=2.7%).

Keywords: A356 alloy, microstructure modification, mechanical properties

METALURGI

ISSN 0126 – 3188 Vol. 38 No. 3, 2023

Keywords sourced from articles. This abstract is reproduced without permission or fee.

UDC (OXDCF) 621.785

David Ferdiyanto[a], Nofrijon Sofyan[a,b], Akhmad Herman Yuwono[a,b], Donanta Dhaneswara[a,b] ([a]Department of Metallurgical and Materials Engineering, [b]Advanced Materials Research Center, Faculty of Engineering, University of Indonesia)

Metalurgi, Vol. 38 No. 3, 2023

Residual Stress Measurement of Used Mining Dump Truck Frame for Remanufacturing Purposes

Remanufacturing the main frame of a mining dump truck can save cost, energy, and materials in heavy equipment industries. It also can reduce CO_2 emissions for environmental preservation to achieve sustainability. However, since the mainframe received a dynamic load during operation, it presumably leaves accumulated residual stresses in the frame. The residual stress, particularly tensile residual stress, stands out as a primary contributing factor to the initiation of cracks, which may ultimately result in failures. In this paper, the residual stress of the used mining dump truck main frame was identified by modeling simulation using FEA (finite element analysis) and actual measurement using a portable x-ray residual stress analyzer with the cos α method. The results showed that the weld area subjected to dynamic loads exhibited the highest tensile residual stress, reaching approximately +772 MPa. This specific region emerges as a critical area demanding attention during the remanufacturing process. The application of PWHT (post-weld heat treatment) at 400 °C for 1 hour effectively reduced residual stress on the weld joint, predominantly tensile residual stress, by more than 80%.

Keywords: Residual stress, cos α method, mining dump truck, remanufacturing, stress relief

METALURGI

ISSN 0126 – 3188 Vol. 38 No. 3, 2023

Keywords sourced from articles. This abstract is reproduced without permission or fee.

UDC (OXDCF) 546.673

Latifa Hanum Lalasari[a], Eko Sulistiyono[a], Sri Harjanto[b], Januar Irawan[a], Florentinus Firdiyono[a], Tri Arini[a], Lia Andriyah[a], Ariyo Suharyanto[a], Nadia Chrisayu Natasha[a], and Fariza Eka Yunita[a] ([a]Research Center for Metallurgy, National Research and Innovation Agency, [b]Department of Metallurgical and Materials Engineering, Faculty of Engineering, University of Indonesia)

Metalurgi, Vol. 38 No. 3, 2023

The Effect of pH and Sodium Silicate Dosage on the Separation of Magnesium and Lithium from Artificial Brine Water Using Chemical Precipitation Techniques

This study aims to report the findings of an investigation into the separation of lithium and magnesium ions in the artificial brine water. The artificial brine water contains concentrations of magnesium, calcium, and lithium cations that closely resemble the concentrations seen in natural brine water sourced from Gunung Panjang using magnesium chloride, calcium chloride, and lithium chloride p.a. The objective of this experiment was to investigate the impact of pH and the addition of sodium silicate on the separation of magnesium and calcium ions from lithium ions in artificial brine water. The best outcomes were achieved when the pH of the brine water was set at 10, and sodium silicate was added in a stoichiometric ratio of 219%. These parameters led to a lithium content of 90.06%, magnesium removal of 70.32%, and a Mg/Li ratio of 6.29, indicating a substantial presence of magnesium ions precipitated as solids with pyroxene ($MgSiO_3$) phase. This research also succeeded in increasing the lithium content by 94.28% and reducing the Mg/Li ratio to 4.96 after the precipitated solids were subjected to a water-leaching process.

Keywords: Separation, magnesium ion, lithium-ion, sodium silicate, artificial Brine water

METALURGI

ISSN 0126 – 3188 Vol. 38 No. 3, 2023

Keywords sourced from articles. This abstract is reproduced without permission or fee.

UDC (OXDCF) 546.423

Iwan Setiawan[a], Annisa Nabilah[b], Soesaptri Oediyani[b], Rudi Subagja[a], Januar Irawan[a], Arief Budi Sampoerno[c], Fariza Eka Yunita[a], Ariyo Suharyanto[a], Adi Noer Syahid[a] ([a]Research Center for Metallurgy, National Research and Innovation Agency, [b]Department of Metallurgy, Sultan Ageng Tirtayasa University, [c]PT. Arbuno Tujuh Tiga)

Metalurgi, Vol. 38 No. 3, 2023

Kinetics of Dissolution of Nickel Limonite Calcine by Sulfuric Acid Solution

Currently, more than 60% of nickel processing is carried out using nickel sulfide as a raw material. Nonetheless, due to the depletion reserves of nickel sulphide, nickel laterite has drawn a lot of interest to be processed as raw material. Nickel laterite in Indonesia is generally found in low grades, with a nickel concentration of <1.15%. One method of treating nickel limonite is leaching in a sulfuric acid solution. This study aims to determine the reaction rate in the leaching process of calcine nickel limonite and the effect of sulfuric acid concentration and leaching temperature on the percent nickel extraction. In this research, the limonite ore from Pomalaa, Southeast Sulawesi, Indonesia, which has undergone a reduction process, was used as raw material. This research was conducted by leaching method on nickel limonite calcine using sulfuric acid reagent with 0.2, 0.5, and 1 M concentration variation, temperature variations of 60, 70, and 90 °C, stirring speed 500 rpm, and %S/L (w/w) 10%. In this leaching research, the activation energy obtained at a sulfuric acid concentration of 0.2, 0.5, and 1M are 13,7379; 19,7582; 20,3161 kJ/mol, respectively. The leaching process of nickel limonite calcine was controlled by diffusion. The optimum nickel extraction percentage in this study was 97.45%, obtained at a concentration of 1M sulfuric acid, temperature of 70 °C, and leaching time of 240 minutes.

Keywords: Nickel limonite, calcine, leaching, kinetics, sulfuric acid

METALURGI

ISSN 0126 – 3188 Vol. 38 No. 3, 2023

Keywords sourced from articles. This abstract is reproduced without permission or fee.

UDC (OXDCF) 616.71

Dita Mayasari[a], Sirojuddin Muhammad[b], Joko Triwardono[c], Daniel Panghihutan Malau[c], Muhammad Satrio Utomo[d], Talitha Asmaria[c] ([a]Department of Biomedical Engineering, University of Dian Nuswantoro, [b]Airlangga University Campus C Mulyorejo, [c]Research Center for Metallurgy, National Research and Innovation Agency, [d]Department of Biomedical Engineering, Universtiy of Melbourne)

Metalurgi, Vol. 38 No. 3, 2023

Comparative Studies Simulation Software for Bone Plate Compression

Medical applications occasionally require PSI (patient-specific implant) designs to match the implant bone's geometry. To verify and predict failures of the design as well as a treatment before the manufacturing process, FEA (finite element analysis) is employed to simulate when given a specific number of loads. Plenty of studies have done the FEA using a couple of types of software; however, to the best of our knowledge, there needs to be literature to compare those several FEA results with a comparable experiment. This study further analyzes material stress, particularly to compute the VMS (Von Misses stress) of the Ti6Al4V bone plate. Furthermore, this study proposes to examine and deliver a comprehensive understanding using the four most used software of COMSOL, Ansys, Abaqus, and Autodesk Inventor. The results of those four simulations are then compared with the stress test through the Hardness Vickers test. This study will contribute significantly as a novel comparison between VMS and hardness test as a stress prediction in an implant material.

Keywords: Finite element analysis, titanium alloy, bone implant, stress analysis