Effect of Heat Treatment on the Hardness of Magnesium Alloy AZ91D and The Effect of Microballoon Density and Strain Rate on the Properties of Syntactic Foam Composites

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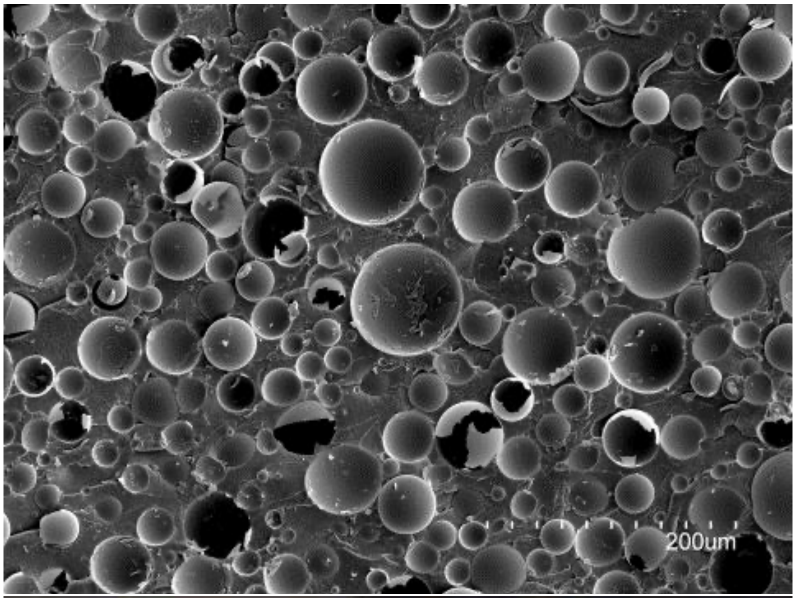
Research

Title: 1. Effect of Heat Treatment on the Hardness of Magnesium Alloy AZ91D and 2. The Effect of Microballoon Density and Strain Rate on the Properties of Syntactic Foam Composites

The current research is aimed at analyzing the effects of heat treatment on a recently developed Magnesium Aluminum Zinc alloy, AZ91D. Composite materials like AZ91D are important to study because they can outperform commonly used materials in certain scenarios based on specific characteristics such as strength, strength to weight ratio, density. The main purpose of Jason's research was to determine the Vickers Hardness value for the AZ91D when exposed to heat treatment procedures such as solution treatment (T4) and solution treatment + ageing process (T6). Moreover, he focused on comparing this data to commonly used materials in the industrial world, specifically aluminum and steel. Finally, he also analyzed the hardness progression of AZ91D through the heat treatment process.

Charisse studied syntactic foams, which are mechanical mixtures of microballoons in a matrix material. Microballoons are tiny hollow glass structures that when combined in a matrix allow the new composite material to be both sturdy and lightweight. One notable use of syntactic foams is by the US Navy in the restructuring of a human operated underwater vehicle, Alvin. The foams aid in buoyancy effect on Alvin, thereby allowing the Navy to create a vehicle that can operate smoothly even when carrying all of Alvin's necessary equipment. Charisse's research looked at how change in the wall thickness of the microballoons (and thus the density) and the rate at which the foams were stressed influenced properties of the foams. Two syntactic foams with different densities: SF220 and SF460 were studied at different strain rates from 0.001 to 0.1 s-1. The stress was observed to increase with the strain rate for 460 type and the modulus values showed an increase with the strain rates for both the 220 and 460 types.



Syntactic foam with microballons and a material testing apparatus

Lesson Plan

Title: Test and Compare Material Properties

Most classroom environments engage students in overly structured and guided problem solving. The real world does not always have these luxuries. Thus, it is imperative that students experience independent problem-solving, make claims, and use data to defend their claims. Moreover, the classroom assignments students face are often abstract or irrelevant to their lives. The proposed activity will help remedy the above two issues. First, it will require students to collect real data of their own and compare some of their data to existing and accepted data for accuracy. Second, it will allow students to function in an environment with minimal teacher interaction. The teacher in this scenario is a facilitator and an observer, helping ensure students' safety in the lab and instructing them on equipment use. Lastly, the proposed activity will give students an opportunity to choose a prompt they want, make a claim, and then defend

their claim with data they collected themselves. Exposing students to activities like this will help them experience collaborative work, independent and divergent thinking, and real-world problem-solving.
Students will gather specific information on the density, hardness (using a pre-built macrohardness tester), and cost to weight ratio for an array of materials (aluminum, wood, plastic, etc.) and then using this information defend a material choice for three different build scenarios.

An example of a Vickers hardness tester for common materials used to examine the microstructure of a material and test the hardness of the material. The lesson plans goal is to simplify this process and make it feasible for students to produce similar, more conceptual results for hardness values for several materials.