INFLUENCE OF MODIFIERS AND HEAT TREATMENT ON THE FATIGUE LIFE AND MECHANICAL PROPERTIES OF RECYCLED CAST ALUMINIUM ALLOYS

MICHAEL KAMAU NJUGUNA

MASTER OF SCIENCE

(MECHANICAL ENGINEERING)

JOMO KENYATTA UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY

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ABSTRACT

Recycling aluminium provides metal at only 5% of the energy invested in producing primary aluminium from ore. Further, recycling aluminium alloys provides an alternative source of raw material to ores, in addition to ensuring that aluminium scrap is put to good use. Across the world, there is a renewed drive to explore new uses for recycled aluminium alloy products. To widen the scope of application for recycled aluminium alloy products, it is necessary to understand the whole range of properties that is possible to achieve, particularly when property influencing processes such as modification and heat treatment are used.

An investigation was carried out to determine the effects of modification and heat treatment on recycled cast aluminium alloys. The effects of these two processes on the fatigue life and mechanical properties of sand cast secondary foundry aluminium alloys were investigated. Selected scrap components mainly composing of pistons, cylinder heads, gearbox housings and oils sumps were used. Unmodified and sodium (Na) modified samples were subjected to the T6 and T4 heat treatment while others were tested in the 'as cast' condition.

To investigate the influence of varying the heat treatment parameters on the mechanical properties, different sample sets were subjected to different solution treatment and ageing times. Constant amplitude, fully reversed fatigue tests under a stress ratio of R = -1 were carried out using a rotating bending machine at room temperature.

Increasing the sodium content to 0.025% was found to improve the tensile properties of the secondary alloys obtained. However, increasing the modifier content to 0.020%Na led to a reduction in the fatigue life properties of the recycled aluminium alloy, thus modification reduced the fatigue life.

Heat treatment to the T6 condition increased the ultimate tensile strength and the hardness of the secondary alloy when compared with the T4 temper condition.

Increasing the ageing time was also found to increase strength properties of the secondary aluminium alloys. Quality index charts for the aged recycled aluminium alloys were also developed. Compared with the ’as cast’ samples, T6 heat treated samples had fatigue lives that were over 50% higher. T4 heat treated samples had fatigue lives close to those of the T6 condition.

The results indicate that the secondary aluminium alloys used in this study had chemical compositions that were very close to some existing primary commercial alloys especially AC 2A, LM22, LM16, LM4, 332 and 319. However, the fatigue life and mechanical properties were much lower.