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Recycling Aluminium Waste Into Gardening Tools

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Abstract: This study aims to evaluate the various methods for limiting aluminium chip disposal that can be used to reach zero waste generation. The study also considered if there would be a bigger difference between modern products made of some of the other materials, such steel, and those made of recycled aluminium. The goal of the study is to determine how to lessen the amount of CNC aluminium trash that is dumped in the junkyard in order to minimise material pollution from mechanical shops, factories, and companies. Another goal of the project is to examine the process for turning scrap CNC aluminium into recyclable goods that can benefit consumers more.

Keywords: Aluminium, Waste Management, Recycling Metal, Sand Casting

1. Introduction

It is impossible to exaggerate the significance of a thorough revival of vital resources for conducting research that is suitable for industrial application. This chapter's objective was to review pertinent information on the use of recycled aluminium chips in gardening equipment and supplies. The majority of the information came from scholarly journals and highly influential publications. The section opened with a summary of the characteristics, uses, and forms of aluminium and its alloys. After that, a summary of aluminium recycling strategies was given before going into further detail on the solid-state recycling method. Subheadings such as management of waste alloys, recycling idea and technique, and metal composite materials were also considered. The feature that will be highlighted in this study is the ability to analyse mechanical properties of aluminium chips reinforced by alumina. As a result, experiments or study into the process are also examined and evaluated to make sure the right procedures are used in order to prevent producing failed findings that will undermine the aim and goal of the research. The majority of the information in this chapter came from books and journals.

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The results of this study will benefit society because CNC machining and metal resources like aluminium are essential in numerous industries including engineering and building. The environment will be protected and maintained thanks to the decrease in aluminium chip waste produced during the engineering process. The results of this study will also be helpful to people who want to learn more about the recycling of used aluminium chips to make new things, especially gardening tools. This study will help the researcher identify important areas in the management of metal waste that many researchers have been working to analyse in order to produce the least amount of metal waste feasible throughout the process.

Aluminium is a metal that is easy to work with, conducts electricity well, and resists corrosion. Because of this combination, aluminium can now compete in a variety of applications. Aluminium and its alloys are increasingly frequently used in contemporary production due to their superior mechanical properties. Al-alloys are widely employed in a variety of industries, including packaging, construction, energy, and medicine. The production technique of choice for processing aluminium is CNC machining. Table 1 shows there are several different permit kinds that can be used in CNC.

Table 1: Type of aluminium

Type of Aluminium	Mechanical specifications
Aluminum 6061-T6	● Ultimate tensile strength: 310 MPa ● Elongation at break: 17% ● Modulus of elasticity: 68.9 GPa ● Hardness: 60 HRB
Aluminum 7075-T6	● Ultimate tensile strength: 434 – 580 MPa ● Elongation at break: 10-15% ● Modulus of elasticity: 69 – 76 GPa ● Hardness: 79-86 HRB ● Maximum service temperature: 100 °C
Aluminum 2024-T4	● Ultimate tensile strength: 200 – 540 MPa ● Elongation at break: 14 – 20% ● Modulus of elasticity: 71 – 73.1 GPa ● Hardness: 70 – 120 HB ● Maximum service temperature: 200 °C
Aluminum MIC 6	● Ultimate tensile strength: 166 MPa ● Elongation at break: 3% ● Modulus of elasticity: 71 GPa ● Hardness: 65 HB ● Maximum service temperature: 427 °C
Aluminum 6082	● Ultimate tensile strength: 140 – 340 MPa ● Elongation at break: 6.3 – 18% ● Modulus of elasticity: 69 – 71 GPa ● Hardness: 35-56 HRB ● Maximum service temperature: 130 – 150 °C

The study concentrated on aluminium 6061, also known as aluminium alloy AA6061, whose demand has gradually increased in recent years for use in aerospace, aircraft, and vehicle applications

due to its high strength-to-weight ratio, ductility, corrosion resistance, and fracture resistance in harsh environments.

In the form of chips, machining processes generate a substantial amount of waste (typically 3-5 percent of the casting weight) [1]. While secondary fabrication and the manufacture of aluminium from scrap need only around 13.6 GJ per tonne of energy, the traditional method of making aluminium from ores uses about 113 GJ per tonne of aluminium. On the other hand, recycling aluminium can help save up to 88 percent of the energy needed to extract aluminium from ores [2]. On the other hand, due to changes in properties, recycled aluminium alloy chips are not frequently used in other applications, such as the automotive industry. The properties of recycled aluminium can be significantly enhanced by the application of reinforced materials. Recently, it was revealed that reinforcements might be utilised to increase yield while simultaneously achieving the desired attributes, such as tensile strength.

2. Materials and Methods

This section's goal is to explain and describe how the study was carried out in accordance with the study methodology. The flow chart in Figure 1 below, which depicts the general flow of this study method, serves as the starting point for the investigation.

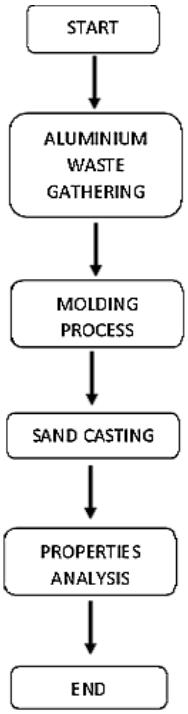

Figure 1: Flow chart

2.1 Aluminium waste gathering

Sand casting is used as part of the procedure to make the new aluminium spade product. At least 5 kg of scrap aluminium is required to build multiple aluminium spades, which can then be used for testing or laboratory studies in the future. In order to make the aluminium molten in the furnace, aluminium trash and chips were gathered. In particular, the FKMP lab for machining, casting, and tuning collected aluminium from all over the campus.

2.2 Molding

The first step in sand casting is the placement of the mould pattern in the sand. The size and shape of the casting are directly influenced by the mould. Therefore, in order to produce shovels and spades in the required sizes and shapes, manufacturers must create new moulds.

2.3 Sand Casting

The shovel and spade were created using the manufacturing process of sand casting and scrap aluminium chips. These are the fundamental sand-casting steps that will be utilised to create gardening tools made of aluminium:

- Place mold pattern in sand
- Set up the gating system
- Remove the mold pattern
- Pour molten metal into mold cavity
- Wait for molten metal to cool
- Break open mold to remove aluminium casting.

2.4 Properties analysis.

The relationship between a material's deformation or response to an applied force or load can be seen in the mechanical characteristics of that material. Strength, hardness, ductility, and stiffness are significant mechanical qualities. Physical traits that a substance demonstrates in response to applied forces are known as mechanical characteristics. The elastic modulus, tensile strength, elongation, hardness, and fatigue limit are a few examples of mechanical qualities. In order to find the properties, some lab test or experiment must be carried out to identify the properties of the product.

3. Results and Discussion

This study test is utilised to assess spade corrosion for aluminium. Because corrosion rates affect how long metal constructions last, it is crucial to understand how quickly metal corrodes. This feature determines the metals used for particular applications and environments. The degree of corrosion affects how much upkeep is required for structures.

The corrosion test was conducted to see how long the aluminium spade could withstand potential flaws that could arise in real-world use. The aluminium spades were placed in a bucket of water and remained there every day until a corrosion spot appeared as part of the experiment. The experiment was conducted over the course of two months. Table 2 shows the results of corrosion that can be spotted during the experiment.

Table 2: Corrosion rate

Element of spade	Time taken for corrosion spotted
Waste aluminium	59 days
Pure Aluminium	61 days

Figure 2 shows the corrosion graph for both wasted and pure aluminium. Because both types of aluminium still have the same composition, their corrosion is a little bit different. Wasted aluminium’s composition is unaffected by the external substance it contains, hence its physical characteristics are identical to those of pure aluminium. For aluminium to take on the qualities of another material, it must reach the point of melting. The experiment has led to the conclusion that scrap aluminium will continue to possess pure aluminium’s mechanical qualities

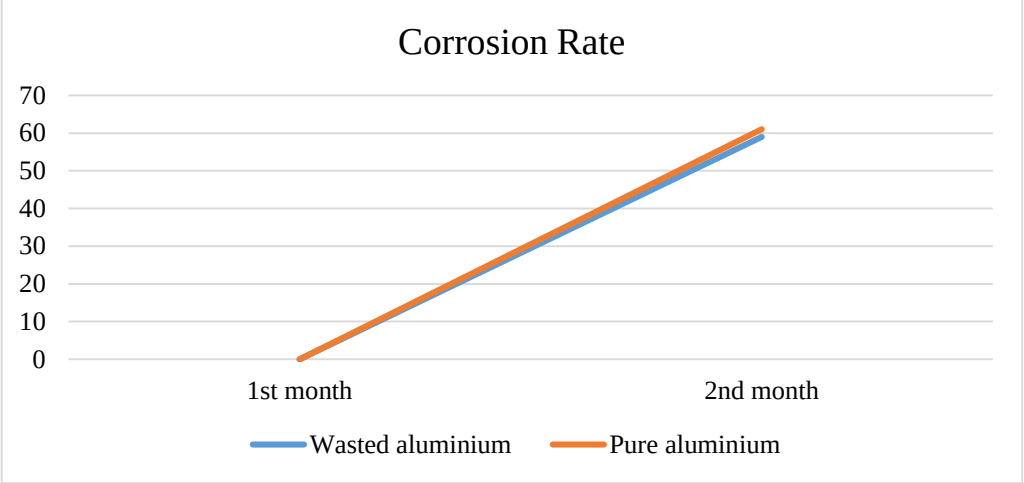

Figure 2: Corrosion graph

4. Conclusion

In this study, the comparison between spades that used pure aluminium and wasted aluminium have been explained in detail. Thus, it concludes that the objectives of this study have been successfully achieved encompassing several findings that have been successfully clearly identified. It is clear that there are not many differences between two elements that were tested before. The results in both tests have slightly difference or gap because of similar composition and properties.

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