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Recycling aluminum chips derived from mechanical sawing by powder metallurgy techniques

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Statement of the Problem: A vast amount of resources are used in mining and refining virgin metals. This process poses environmental risks, due to the potential release of harmful substances into the soil, air, and water. Aside from this, metals are non-renewable resources, meaning that there is finite amount of them in the earth. Sawing is the most common technique used to break down metals before manufacturing processes, and it produces a considerable amount of wasted aluminum in form of chips. These chips are small and semicontinuous, so they are not suitable for recycling by melting.

Methodology & Theoretical Orientation: The aim of this paper is to study the recyclability by powder metallurgy techniques of aluminum chips left over from sawing processes, studying the influence of the milling time on the properties both of the aluminum powder and the sintered materials. The milling was performed in a hermetic ball mill, using zirconia cylindrical ball media and a rotational speed of 55 rpm. The ball media to material ratio was 10:1. The cold compaction process was performed applying 800 MPa of pressure. The cylindrical samples were sintered in a reaction chamber of steel, using argon as the inert gas, at a temperature of 620 ^{0}C for 1 hour.

Findings: With lower milling times, powder is composed of flattened large-sized particles. With higher milling times the morphology of the flattened particles becomes irregular. This influences the properties of the sintered samples: the higher the milling time of the chips, the higher the density and hardness. Conclusion & Significance: it is possible to obtain samples that exhibit almost 90% of the density and hardness of the original aluminum subjected to sawing. Therefore, aluminum chips from the sawing process are suitable for recycling by powder metallurgy techniques.