



# Design Optimization of Aluminium Recycling Process and Life Cycle Assessment Tool for Sustainable Metal Management

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## DESCRIPTION

The demand for aluminium products is continually increasing. Aluminium is the world's second most widely used metal, and aluminium cans are the most recycled consumer product and is widely used in a variety of industries, including air, land, and sea transportation, food and medicine, packaging, building, electronics, and electrical power transmission.

Aluminium is a great recyclability material, combined with its high scrap value and cheap energy requirements for recycling, makes it highly desirable to all [1]. The global demand for aluminium is expected to increase to about 70 million tons by 2020, up from around 37 million tonnes now.

### Recycling of aluminium

The percentage of recycled metal used in the global production of aluminium goods has climbed from 17% in 1960 to 34% currently, and is predicted to reach nearly 40% by 2020 [2]. Global recycling rates are high, with over 60% of used beverage cans being collected and about 90% of metal used for transportation and building uses recovered because the atomic structure of aluminium is not altered after melting, it does not degrade during recycling. Aluminium recycling is both cost-effective and environmentally friendly, as recovered aluminium uses only 5% of the energy required to produce primary aluminium and can have similar qualities. In fact, it can be recycled indefinitely without losing its material qualities. Multiple recycling introduces an increasing number of alloying elements into the metal cycle [3]. This effect is useful in the manufacture of casting alloys, which require certain components in order to get the necessary alloy characteristics. Used aluminium goods are collected and recycled in the industry.

Over the years, the United States and European countries have successfully created robust independent collecting systems for aluminium packaging. The consumption of precious energy resources is reduced by recycling, which minimizes the requirement for raw materials. Aircraft, automobiles, bicycles,

boats, computers, cookware, gutters, siding, wire, and cans are all created from recycled aluminium.

### Process of recycling

The most recycled consumer product on the planet is aluminium cans. Each year, the aluminium industry pays out more than US\$800 million for empty aluminium cans because old beverage cans that are recycled are largely utilized to create beverage cans, recycling aluminium cans is a closed-loop operation. Cans that have been recycled are used to make new cans or other valuable aluminium items such as engine blocks, building facades, and bicycles. In Europe, recycled aluminium accounts for nearly half of all semi-fabricated aluminium is utilized in the creation of new beverage cans and other aluminium packaging items. The following are the primary steps in recycling of aluminium cans:

- Aluminium cans are collected at recycling centers, community drop-off sites, and curbside pickup locations, among other places;
- Scrap processing facilities compress the material into thick briquettes or bales, which are then delivered to aluminium businesses for melting;
- The inner and exterior dyes of condensed cans are shredded, crushed, and removed. The potato chip-sized pieces are placed into melting furnaces, where recycled pieces are mixed with new aluminium;
- Molten aluminium is transformed into ingots, which are then fed into rolling mills, where the thickness is reduced to around 1/100 of an inch.

After that, the metal is coiled and transported to can makers and cans are shipped to beverage firms to be filled. In as little as 60 days, the new cans, loaded with beverages, are returned to store shelves and then the recycling process starts all over again.

### Aluminium packaging

Every intended recycling and processing route is compatible with aluminium packaging. When it comes to material recycling,

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aluminium packaging must be segregated from other packing materials [4]. Eddy current separators are being used in an increasing number of sorting facilities, providing a thorough method of separating the aluminium fraction.

Apart from aluminium packaging, such as beverage cartons, multi-material packaging systems can include plastics, tinplate, beverage cartons, and paper packaging. Repulping, mechanical separation, and pyrolysis are some of the methods used to recover aluminium from complicated packaging systems [5].

Evaporation removes the non-metallic components from the aluminium during pyrolysis. The thermal plasma technique, which separates the three components as aluminium, plastic, and paper into different fractions, is a newer technology.

### Aluminium from municipal waste

Aluminium exposed to fires at landfills can cause noxious fumes and mosquito breeding, posing a major environmental threat. Apart from huge energy savings, recycled aluminium can be used in practically all applications, preserving raw resources

and reducing hazardous emissions. Aluminium nodules can be recovered well from the bottom ashes of municipal solid waste incinerators. Municipal solid waste is burnt wholly or partially in several European nations.

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