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# Aluminum Gearbox of Vehicle Engine Recycling

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**Abstract:** The usage of natural mines and materials is rapidly increasing in parallel to population growth and industrial developments. It is very important for future generations that the materials used are transported to landfills and protected from mineral resources by preventing them from being thrown into the environment. Separation of materials produced from different metals as much as possible, production of new materials, protection of mineral resources, and reduction of environmental pollution is also very important in economic terms. In addition to legal sanctions for the recycling of metals and other resources, voluntary organizations are making efforts in this regard. For the ones with high production and cost value at the beginning of recycled materials, more successful results are obtained. In the aluminium recycling plant, the collection and disassembly of the vehicle engines and vehicle transmissions are used in the domestic and abroad, and the dismantling of the aluminium alloys prepared according to the specifications requested by the customers. It is considered during this project stage that the vehicle engines and vehicle transmissions from domestic and foreign countries will not need to be recycled, and the vehicle engines and vehicle transmissions will be sold directly if they can be used directly in the vehicles after the necessary repairs.
**Keywords:** Scrap metal, Aluminium, Engine, Gearbox, Recycling,

## INTRODUCTION

Vehicles and automobile usage is increasing day by day in a continuous manner in Turkey and as well as in other world countries. In 2020, for the Turkey, each 1,000 people expecting rate of car ownership amount will be rise to more than as 200 identified through research [1-3]. Increased number of vehicles is increasing environmental problem, in addition to the traffic problem, seen in the provinces with high population density, disadvantages such as increasing the number of End-of-Life Vehicles (ELVs) and consequently increasing the human-induced environmental damages have been observed. The main purpose of the relevant in Turkey regulations for reuse, recycle and increased recovery rates for ELV aimed to be harmful waste arising from at least [4-7]. It aimed to keeping mandatory of reuse and recycling targets in Turkey in the years 2020s [8-10].

Scrape aluminium recycling has highly advantages for primary row aluminium production for its lower production cost and also less energy consumption for all. It can play extremely more and more important role play into the all overall aluminium supply chain. This share of the production of secondary aluminium material has been constantly growing for worldwide, and recently increased to over 40% in western Europe [11]. Scrap aluminium wastes that have been used in various places for different purposes and ELV wastes from abroad or domestically were provided and ELV motor-gearboxes have been used for new production [12,13]. The vehicles, whose clearing and dismantling processes are completed, are usually pressed and sent to the shredder to be crushed.

### Aluminium Wastes

Aluminium wastes to be used within the scope of our project will be supplied by domestic and international provide transport. Vehicle engines and transmissions from abroad will be provided, especially in Germany and France. At the same time throughout our country: wastes such as aluminium plates, pipes, profiles, scrap metals, aluminium beverage cans, scrap copper, scrap brass, scrap zinc, scrap lead, which may pose a threat to environmental health and reduce raw material usage, will be collected and passed through the necessary steps. In the world where raw material decreases with increasing population, aluminium recovery means 40% less energy than aluminium is manufactured

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from source [14-16]. Hazardous waste sources by types and Non-hazardous waste sources are classified in Table 1 and 2.

**Table 1.** Hazardous waste sources by type [14-16].

| Fields of Activity | Activities / Processes | Hazardous Wastes Generated |
|---|---|---|
| During production | The process of passing chips through the centrifuge | Waste oil |
| During production | Absorbent, fatty workers' clothes to get fat | Absorbents, filter materials, cleaning cloths, protective clothing contaminated with dangerous substances |
| During production | Supply of oils | Contaminated packaging |
| Dining hall | Cooking | Vegetable waste oil |
| Medical waste | Medical intervention | Wastes whose collection and disposal are subject to special treatment in order to prevent infection |
| Administrative building | Correspondence and administrative procedures | Paper, Cardboard and Plastic packaging |
| Administrative building | Electronic transactions | Used battery |
| Administrative building | Electronic transactions | Fluorescent Lamps |

**Table 2.** Non-hazardous waste sources

| Fields of Activity | Activities / Processes | Non-Hazardous Wastes Generated |
|---|---|---|
| Dining hall | Waste caused by the personal eating and drinking needs of the staff | Biodegradable kitchen and canteen waste |

**Automobiles Metal Recovery**

Recovery means investment in the future and the economy. Reducing recycling resources is the basis of life in the long-term, which is not used to life's convenience and economically. It is necessary to constantly renew itself in the consumption of the consumed substance, equipment, and a ring. The rapidly increasing population and the shortage of raw materials that cause this will hopefully lead to further lives with recycling and recovery. Recycling should also be seen as a tool to create new job opportunities and new social environments [17-19].

Increasing for rough production increasing the recycling aluminium metal unit loss, therefore those decreasing the metal recycling rate of automotive scrape aluminium component. A fluctuating has always reached pertaining into the maximum of aluminium metal amount that may be recovered from those metal waste stream [20]. As everyone knows, Japan has the potential to generate the most waste in the world with its population of over 127 million. However, Japan has stepped into a new change with the importance it places on industrialization and energy. The Japanese Toyota company goes to the sorting plants and buys usable scrap from the tests. These are ferrous, non-ferrous, plastic, PVC, *etc*. It shows the reuse of every waste for every substance that will work to the world. These collected pieces are first taken to the separation process and then processed for reuse. Now Toyota Company uses recycling materials in 85% of its designed vehicles and uses less energy and raw materials [20,21].

## MATERIAL AND METHOD

In this study, as research material, ELV waste potential and ELV motor-transmissions used from different locations for different purposes has been used. The parts of the ELVs whose disintegration and dismantling processes are completed are then usually pressed and sent to disintegrate. It is aimed to make the scraps formed after processing plants, namely shredding, purification and dismantling, ready for recycling or disposal by methods such as cutting, shredding, grinding.

Aluminium scrap wastes that have been used in various places for different purposes and ELV wastes from abroad or domestically of ELV motor-gearboxes have been used. The vehicles, whose clearing and dismantling processes are completed, are usually pressed and sent to the shredder to be crushed [18,19,22,23].

Metal scraps entering the facility with licensed vehicles are first passed through the scale and weighed and processed into the MOTAT system in our investigation. The weighed materials are taken into the system installed in the area of the facility. In order to prevent damage to the crushers, it is started with the separation of the parts of scrap that may damage the crusher. After pre-screening, scraps are taken to the crusher and shredding takes place.

**Process Work Flow Chart**

At the facility; scrap metal processing, hazardous and non-hazardous waste landfill site, life cycle vehicle engine transmission warehouse area, life cycle vehicle engine transmission, and then cutting, shearing and pressing activities will be carried out [11,24].

**Management phase**

Those who are in operation phase: Hazardous and non-hazardous waste recycling, Scrap aluminium processing, End-of-Life Vehicle engine and transmission processing, Tanker cleaning.

**Study Area**

12 sections to be found in the facility created by taking into consideration the relevant article of the Regulation is listed as; Business area; Raw material stock area, Product stock area, dining hall area, WC, Non-hazardous waste area, Hazardous waste area, Waste reception area, Office, Crusher, Radiation well. The total area of the facility is 935 $m^2$ and the areas of the sections in the facility are shown in Figure 1 and Table 3.

**ELV Motor-Gearboxes Parts Supply**

Scrap metals and vehicle engines are supplied by road with transportation works both domestically and abroad. Vehicle sourcing and transmissions are provided from other European countries, mainly France and Germany abroad country. Metal scraps will be supplied a large majority of the organized industrial zone where the plant is located and will be purchased from home country.

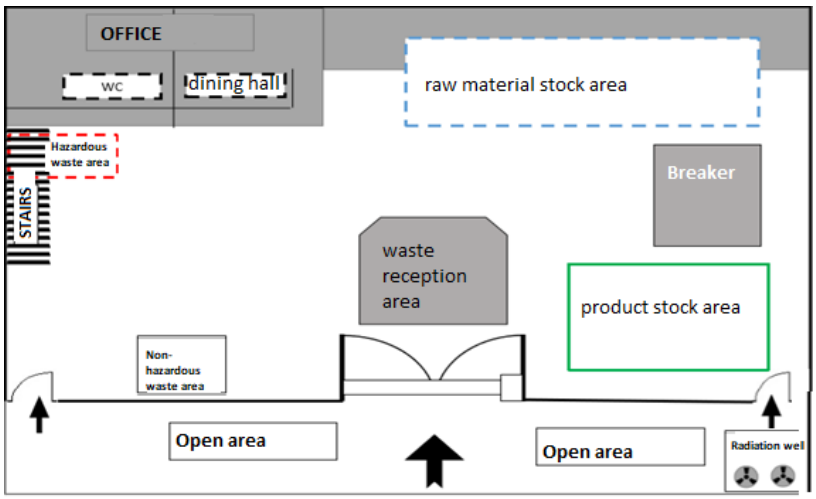


**Figure1.** Scrap metals and vehicle engines Status plan

**Table 3.** Scrap metals and vehicle engines Facility areas

| | |
|---|---|
| Raw material stock area | 67 $m^2$ |
| Product stock area | 45 $m^2$ |
| Crusher area | 26 $m^2$ |
| Waste acceptance area | 45 $m^2$ |
| Hazardous waste area | 15 $m^2$ |
| office | 85 $m^2$ |
| Hazardous waste area | 12 $m^2$ |
| radiation well | 12 $m^2$ |

**Scrap Recovery Facility**

Scrap metals arriving at the recycling plant in scrap metal processing activity, vehicle engine transmissions are primarily measured by radiation and pre-separation and detailed separation processes, then non-ferrous materials and iron the materials are individually crushed and cut and pressed and ready to be offered to the market. Energy is consumed for refining process. Scrap transformation of recycled aluminium requires approximately 5% of the energy system input needed primary to produce ingot from bauxite. Connected on the impurities into the waste scrap has, various air emissions might be produced, for example as toxic organic compounds and different size of dust particle.

Deburring and skimming have processed, often in the present recycling plant, to recovering the metals from waste. Salty slags have been recycled in special facility for recover the metal product and other yielts.

## RESULTS AND DISCUSSION

Generally aluminium alloys are used as cast alloy in cars, in the parts production such as motion system, engine and gear. Common use of aluminium after casting in the automobile is aluminium extrusion profiles. The extrusion method makes it possible to manufacture parts with complex structures. Aluminium extrusion profiles are used in frame parts, space cage, bumper and energy-absorbing crash boxes. Interior and exterior panels in vehicles are parts that provide significant lightening with aluminium plate applications and contribute greatly to vehicle weight reduction studies. In the production of parts with complex geometries by using sheet products, by pressing operations, the part can be manufactured by using less energy by taking advantage of the low yield strength of aluminium [25]. Preventing the formation of waste from vehicles for the protection of the environment and human health, waste to be disposed of by reuse, recycling and recycling of End-of-Life Vehicles and their parts is intended to reduce the amount. For this purpose, domestic and international metal scraps, vehicle engines and transmissions recovery social, economic, minimizing the membranes to the environment, decreasing raw material consumption, preventing unnecessary energy use a new line of work, greenhouse gas emissions reduction, as well as a study on behalf of the environment and humanity [26-31].

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