

SELECTED PROBLEMS IN CAR RECYCLING

Kazimierz Lejda

Technical University of Rzeszow, Poland

INTRODUCTION

Rapid increase in the number of transportation means in all branches of economy results in arising quite new problems, which were neglected or underestimated previously. This concerns liquidation of used-up automotive vehicles, the number of which increases at a very high rate. While the problem remains still underestimated in Poland, it becomes a priority issue in highly developed countries.

Repeated use of materials coming from used-up cars presents today quite a new approach to the problem. This is caused by both economical and ecological reasons. On the one hand, the resources of some natural raw materials decrease rapidly, which compels manufacturers to look for substitution materials or to manage existing resources more economically. On the other hand, there is increasing pressure of the public opinion on the issues related to environmental protection, and “environmental friendliness” becomes still an important criterion of product assessment.

RECYCLING AUTOMOBILES – CHARACTERISTICS OF THE PROBLEM

Recycling is a term adopted from English, which in relatively short time has become a widely used international concept. Formerly prevailing trends in car development were aimed at manufacturing of a failure-free car, with stress laid on the economy of maintenance, safety, and comfort of use. At present, pro-ecological solutions have begun to dominate in development trends, where economy of the use of materials and energy represents a very important indicator.

Even at a present level of development of material and raw-material recovery technology, it is generally accepted that the goal defined as recovery of virtually all materials can be actually achieved, if only economical and ecological reasons are not against it. Pilot projects implemented in recent years by the

world's largest automotive concerns, related to the establishment of the most effective technologies and equipment for recycling of used-up cars, have answered the question how to manage the increasing invasion of cars withdrawn from use or damaged in crashes. The scale of the problem is characterized by the number of 12,5 million of automotive vehicles which every year reach the end of their operation period in highly motorized countries of Europe [3, 5].

To co-ordinate actions and rationalize organization of recycling in Europe, a common representation of national institutions dealing with car recycling named EGARA (European Group of Automotive Recycling Associations) has been established. The creators of a complex concept of total recycling take into account the fact that there will be a several-year-long transition period in which vehicles not adapted for recycling will be continually withdrawn from use, as transportation means is very durable goods. New cars produced within the period of project realization have to be fully adapted for recycling.

Recycling is no longer a problem of car companies alone. Most of manufacturers collaborate with different companies, which co-operate in the scope of recovery and management of materials, including oil refineries, tire and battery manufacturers, and even cement mills and building construction companies. Total recovery of materials, without any hazard to the environment, has become a common target for all.

STRUCTURE OF CAR RECYCLING

Different sorts of processed materials and different forms of recycling require different technologies of used material recovery, various organizational systems of purchase, management, and utilization. In general, recycling can be divided into three categories:

- material recycling,
- chemical recycling,
- energetic recycling.

Material recycling consists in processing of used-up car parts in order to recover materials for manufacturing of new elements and/or compounds. The process of material recycling consists in melting scrap metal, pulverization of plastic material elements etc. The priorities in material recycling are:

- recovery of the same compounds,
- manufacturing of new compounds,
- re-construction of new car parts,
- manufacturing of other commercial products.

Metal recycling process represents a closed, fully payable cycle. For example, steel, which in the recycling process has not achieved the same quality parameters as before, is used for manufacturing of less important car parts or elements used in building construction. A good example of economical aspect of

recycling is the fact that from 1 ton of catalytic converters, one obtains about 1.5 kg of platinum and about 0.3 kg of rhodium. The recovery of lead from batteries is equally profitable. Proper metallurgical processes allow for the recovery of 100% of steel and almost 90% of non-ferrous metals [4].

Thermoplastic materials, e.g. polypropylene, polyethylene, polyurethane materials etc. are those especially well-adapted for recycling. There are attempts towards unification of plastics used in car construction in order to simplify the process of recycling as much as possible [1]. Owing to these efforts, the Mercedes company recovers about 90% of used plastic materials. From the recovered materials they produce multi-layered bumpers, sound-dumping screens, air ducts, electric cross-cable tubes, hub cover caps, chassis protection shields etc.

Chemical recycling consists in thermal and chemical processing of elements made of plastics into elementary compounds such as gases or oils to be used as chemical components or as fuels. Another form of chemical recycling is processing of used-up motor oils and other dispensable fluids. For example, brake fluid is processed into household cleaning chemicals. Because of ecological reasons, special attention is paid to chemical recycling of electrolytes. However, relevant technologies are very complicated and expensive.

Energetic recycling consists in combustion of all flammable materials into ashes and use of the produced energy for water heating, steam and electricity generation, etc. This is the way of utilizing the used-up car materials, which cannot be recovered by means of material and chemical recycling.

An important issue is the recovery of energy from plastic materials. For example, production of 1 kg of polypropylene requires the use of about 2 kg of oil, while the combustion of 2 kg of polypropylene produces the energy equivalent to 0,8 kg of oil. Toyota Company uses flammable waste car materials which mixed with fine coal are used for the production of electric energy. This way, about 2% of electric power used in the process of car manufacturing come from energy recycling. Ash, in turn, is used as a filler in the products made of polypropylene [5].

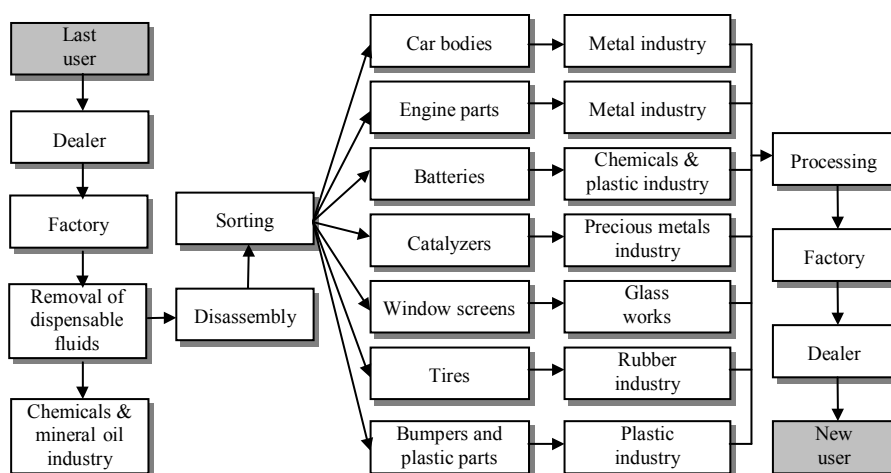


Fig. 1. General diagram of car recycling [5].

The most important item in energetic recycling of car elements is used-up car tires. Compared to coal, tires contain more energy and energy-producing chemical elements. Moreover, the combustion of rubber is more favorable from ecological point of view because of a lower concentration of emitted carbon dioxide.

Depending on the level of the motorization development of individual countries, the processes of recovery and utilization of recycling products differ significantly. The general scheme of car recycling, realized with minor modifications in the USA and in European Union, is presented in Fig. 1.

RECYCLING AND TRENDS IN CAR CONSTRUCTION

In European Union, the USA and Japan, the recycling of vehicles has been carried out and developed for many years. There is a well-organized system of collecting used-up cars by licensed workshops. The leading role in the organization of recycling is statutory entrusted to car manufacturers working in the cooperation with recycling plants. The statement “who pollutes that pays” is generally applied. As the recycling requires a significant investment, there is a general tendency to burden the cost on manufacturers of cars, components, fuels, motor oils, plastic car elements, tires etc.

In the European Union, a legal basis for recycling consists of directives of the European Union Council related to the procedures applicable to used-up transportation means [2, 5]. These directives oblige car manufacturers to implement, starting from the year 2006, such car designs, which allow the repeated use of at least 85% of car materials. Only the remaining 15% are allowed to be stored and utilized. Moreover, it is assumed that starting from the year 2016, 95% of the car mass will be recycled. The realization of the recommended trend in car recycling is graphically presented in Fig. 2.

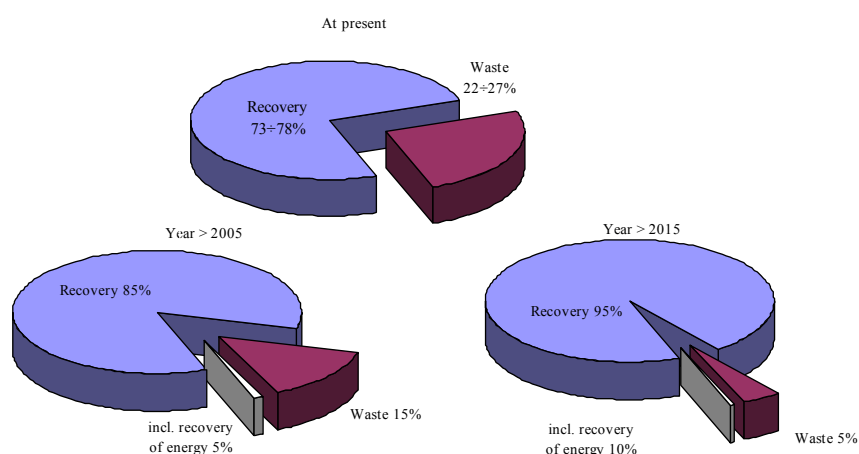


Fig. 2. Management of used-up vehicles according to EU Council Directive

The recommendations of the EU Council related to car recycling state that the recycling process has to be taken into account as early as at the stage of car design, according to what has been mentioned above. Each newly designed vehicle has to be re-thought from the point of view of the recovery of virtually all parts of the construction. An important element of the common policy is the tendency towards the implementation of the same regulations concerning car manufacturing and recycling by all transportation and environmental protection ministries in all member countries of the European Union. All elements of the project, i.e. normative, organizational, legislative, and technological ones, would allow for the creation of a complex environmental protection and natural resources conservation system.

In new designs, manufacturers should aspire to decrease car mass by means of increasing the share of parts made of plastics and aluminum. The decrease of the car mass results in the reduction of fuel consumption. Nowadays, when the mileage traveled by cars still increases, the decrease of fuel consumption can reduce significantly the demand for gasoline and diesel oil. The reduction of fuel consumption results also in lower emission of carbon dioxide, which in turn influences the degree of environment pollution.

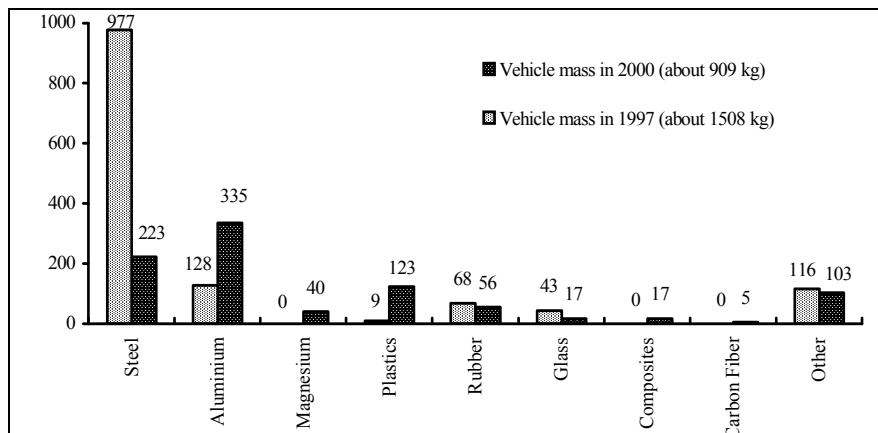


Fig. 3. Materials used in medium-class automobile constructions and their quantity in the years 1997 and 2000

The research conducted in the world's leading automotive concerns (Mercedes, Audi, Toyota) show that the reduction of car mass by 100 kg results in the reduction of fuel consumption by about 0,6 l/100km. The use of aluminum car body reduces the mass of an automobile by about 35% without a negative effect on comfort of using it and operational functionality of the car. Moreover, a "crash" type test has proved that the automobile with the elements made of aluminum is as safe as a conventional vehicle [5]. The fact most important from the point of view of recycling is that aluminum is a material suited in 100% for recycling and reuse. The share of aluminum, plastics, and various composite materials in new design solutions increases very fast. This trend is clearly visible when comparing materials used in medium-class car constructions in the years 1997 and 2000 (Fig. 3).

SUMMARY

Economy of any developed country requires efficient and well-operating transportation, which plays fundamental role in communication and transfer of goods. Recycling of motor vehicles is a costly process and not every automotive concern can afford to carry out all of its elements. Therefore, the intended effect can be achieved only by means of co-operation of final product manufacturers with suppliers of components and media.

Since protection of human environment become not only a temporary fashion but just a forced necessity, car manufacturers have to be sure that their products are suitable for recycling, and recovered materials suitable for reuse. Total recovery of materials became common target of all companies of car manufacturing sector.

The Council of the European Union proposes to introduce the so called "car transfer certificate" meaning that the last car owner will not be able to remove it out from register it without transferring the vehicle to the recycling point. In this case, proper document will be issued which presented in municipal transportation department will be the legal basis for crossing the item out from the register.

Application of unified legislative and organizational standards as well as technological procedures will surely allow in future for effective operation and measurable effect in the domain discussed herein. One should expect that in the nearest future, heaps of used-up and scrapped cars would disappear from our devastated landscape. If the consciousness of positive aspects of recycling were general, living in the world of man-automobile relations would be more comfortable, with our environment cleaner and friendlier. In case of recycling, imaginative car manufacturers already realize the motto: "The end is always a beginning of something new".

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SUMMARY

This paper deals with problems related to automotive vehicles recycling. Car recycling represents an ecological problem of primary importance occurring in liquidation of means of transportation. Arguments presented in this paper show that positive results can be achieved only if the recycling is carried out in a complex way and with use of up-to-date technologies.