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PLASTIC RAW MATERIALS FROM END-OF-LIFE VEHICLES

The paper presents the possibility of recovery and recycling of end-of-life vehicles from 1.1.2015. Based on the analysis of the construction of various types of vehicles, the quantity of raw materials was estimated. It was found that the trends in the construction of the cars can be identified. Moreover the dependence of the quantity and types of raw materials used by particular producers is observed.

With a rapid growth in the number of produced technical equipment, reuse of materials becomes a necessity. This is particularly important in the case of mass-produced machines – cars. Nationwide in Poland in the coming years, one million vehicles per year will have to be recycled. Implementation of a recycling system is a project related to motor vehicles whose technical conditions warrant their permanent withdrawal from service, i.e. dismantling, economic exploitation of parts which can be used, management and processing of raw materials procured and removal of waste in a manner consistent with environmental protection requirements. Nevertheless, acquisition of raw materials or retrieval of energy resources in the combustion process of used articles is still a side effect.

Sales of new vehicles as well as import of used ones have led to saturation of vehicles market in Poland (Fig. 1). The statistics are not encouraging – Polish vehicle market consists mostly of used cars (Fig. 2). Its characteristic feature is wide diversity of brands and types of vehicles as well as their long life cycle. Using data collected in the ARES system [11], it can be concluded that the average age of a recycled vehicle amounts to 17 years, being 3–5 years longer than the average age in the EU.

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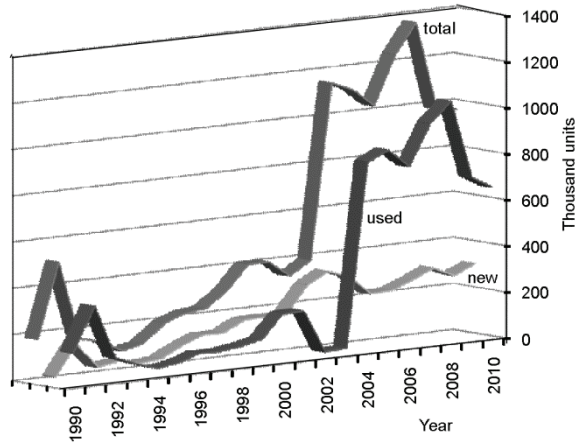


Fig. 1. Number of vehicles in Poland 1990–2010

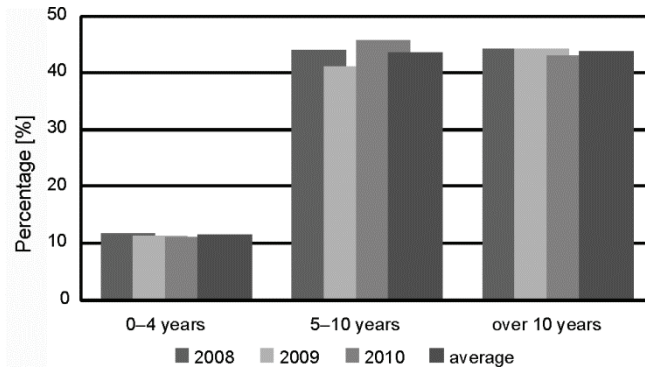


Fig. 2. Vehicle market in 2008–2010

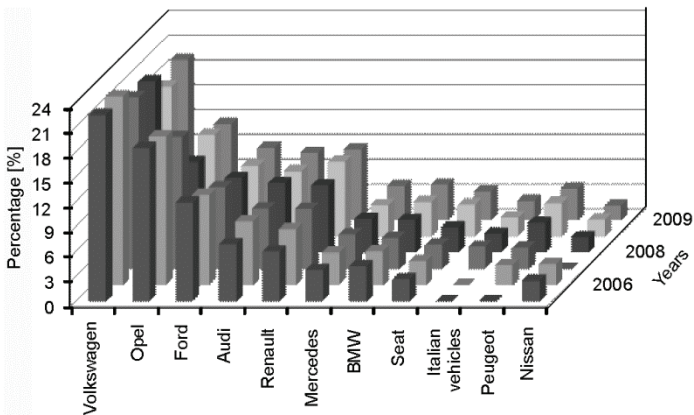


Fig. 3. Imports of used vehicles to Poland 2005–2010

After analysis of the automotive market in Poland during the last 5 years, the following conclusions can be drawn: in the new vehicle segment, the leading brand is Skoda, before Toyota, Opel and Ford with the 11% market share. The segment of used vehicles imported to Poland is dominated by Ford and Opel (Fig. 3).

Based on the analysis of the construction of various types of vehicles of particular producers, the quantity of raw materials was estimated and it was found that some trends in the construction can be identified as well as the dependence of the quantity and types of raw materials used by particular producers.

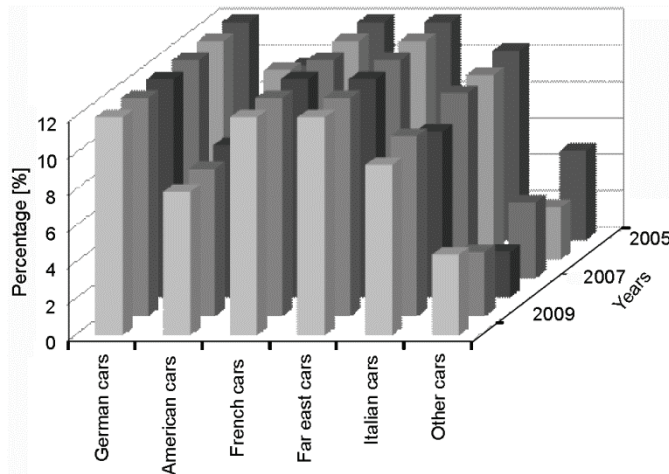


Fig. 4. Market share of new vehicles according to groups of producers

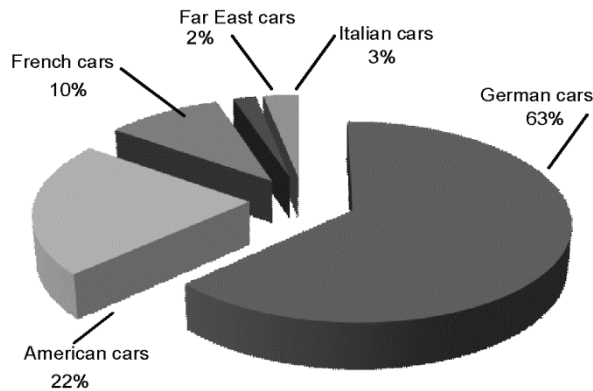


Fig. 5. Average market share of used vehicles according to groups of producers

Appropriate brand vehicles were classified into groups of producers:

- German cars produced by German car manufacturers, i.e. Volkswagen, Mercedes, BMW, Audi, Seat, Skoda,

- American cars produced by US car manufacturers – GM and Ford, i.e. Opel, Chevrolet, Pontiac, Ford, Saab, Volvo,
- French cars produced by such companies as Renault, Peugeot, Citroen,
- Far East cars produced by Japanese and Korean car companies, i.e. Toyota, Honda, Suzuki, Mazda, Mitsubishi, Nissan, Subaru, Kia, Lexus, Infiniti, Hyundai,
- Italian cars produced by companies such as Fiat, Lancia, Alfa Romeo.

Figures 4 and 5 show the percent of vehicle market share in Poland of particular group of car manufacturers between 2005 and 2010: new vehicles and used vehicles. Based on the assessment of the situation on the car sales market forecasts are made of cars out of use.

The raw material potential of a vehicle consists mostly of [3] average depending on the brand and type of vehicles, year of production (values were given according to tendencies of use): steel, iron, cast amounting to 69.1–66%, non-ferrous metals 5.5–6.9%, plastics and composites, degradable structures 8–11%, rubber and elastomers 4.6–5.5%, laminated and ordinary glass: 3.5–2.7%, operating fluids: 5.3–5.5%, other 2.9–3.5%.

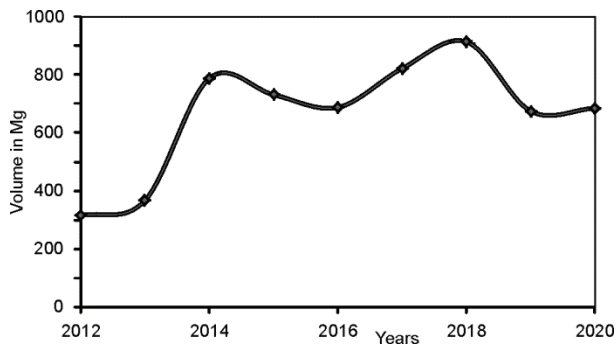


Fig. 6. Forecast of acquisition of steel, iron, cast in the years 2012–2020

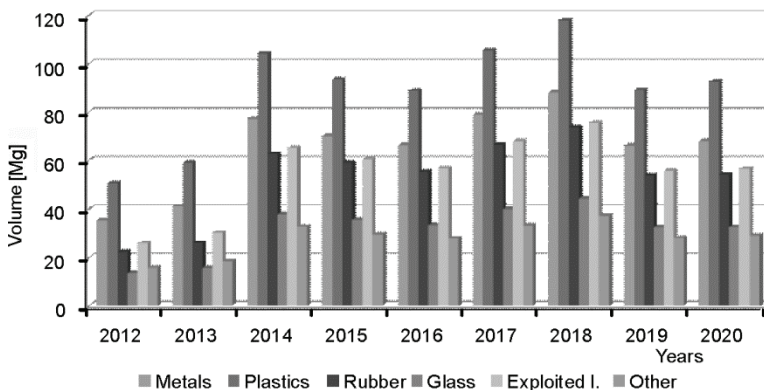


Fig. 7. Forecast of procured materials from motor vehicles to 3.5 tons in the period 2012–2020

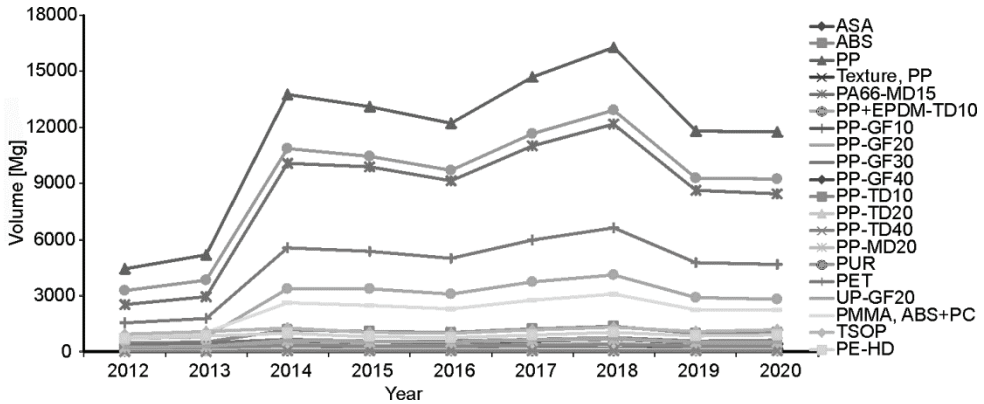


Fig. 8. Forecast of obtaining of polymer structures withdrawn from use

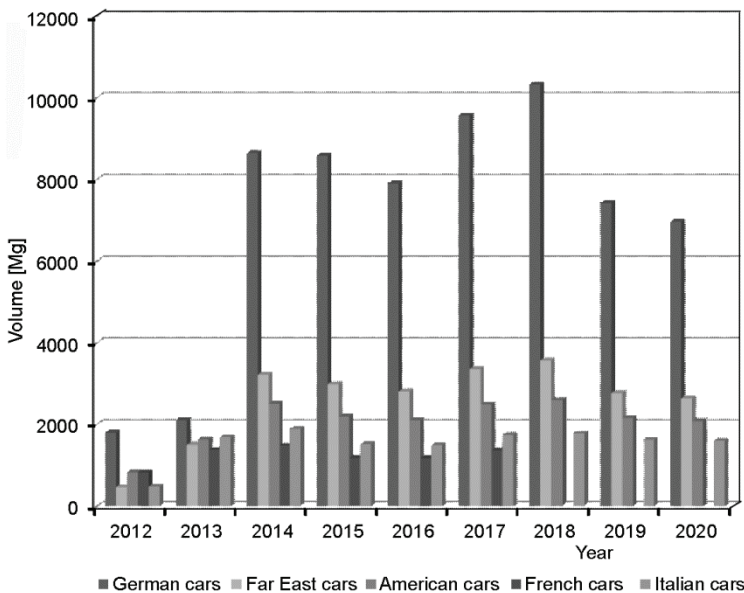


Fig. 9. Estimated weight of lead derived from the ELV by producer groups

In estimating the minimum content of raw materials it was assumed, in accordance with the vehicle recycling law, that vehicles delivered to the disassembly station should be complete containing at least 90% of the vehicles own weight. In particular, car windows and car fluids can be missing in vehicles retained from car accidents or worn out, not in use for long periods of time before transfer for dismantling [1, 2, 6]. The above analysis indicates that in the upcoming years 600 000–1 200 000 cars will have to be dismantled in Poland annually (Fig. 1). It has to be assumed that weight of materials shown in Figs. 6–9 will be acquired.

Estimates made for this analysis allow one to evaluate the real number of ELVs in the period 2012–2020. This gives the basis to develop the strategy of processing the capacity of raw materials obtained from vehicles withdrawn from use. The need to acquire and process large quantities of raw materials with high potential for product has been shown. It was found that Poland has sufficient production capacity of mills: steel, non-ferrous metals, glass, oil refineries, radiator and brake liquids production plants, batteries and in many cases the production capacity exceeds the potential for obtaining used raw materials. Deficiencies occur in the recycling process of plastics. This is a result of the need to implement expensive technologies as well as high costs of recycling in many cases exceeding the cost of producing the same product from natural materials.

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