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Variants of Recycling Management Strategies

Ishkina E.G.
Institute of industrial technology and engineering
Industrial University of Tyumen
Tyumen, Russia
ishkinaeg@tyuiu.ru

***Abstract*—The implementation of the last stage of the life cycle of a motor vehicle involves its recycling. The realization of this stage for motor vehicles that are not suitable for operation depends on the availability and management of recycling facilities. The purpose of the research is to consider strategies for the management of motor vehicle recycling, taking into account environmental safety and resource saving. The factors affecting the formation of needs in enterprises for the recycling of motor vehicles are described. Two strategies for the management of the recycling of motor vehicles are proposed and their comparative analysis is carried out. The approaches are defined for the determination of annual optimal number of motor vehicles to be disposed, at which it is economically feasible to organize recycling production in the region. With a smaller number of motor vehicles, it is more expedient to receive cars for recycling at car services or enterprises for receiving scrap metal, and then to adjust the logistics of enterprises for the processing of automotive components.**

Keywords—life cycle of a motor vehicle; recycling of motor vehicles; vehicle recycling strategies; recycling of automotive components

I. INTRODUCTION

The purpose of the car is the transfer of passengers and goods, however, considering the life cycle of a car, the following periods may be determined: design, production, assemblage, stor-age, operation and recycling. The last stage of the life cycle of motor vehicles is recycling. Motor vehicles that have been decommissioned for various reasons are subject to recycling. Motor vehicles that are not in use are waste products that pose a threat to the environment because they contain toxic substances [1, 2].

Usually under the recycling of motor vehicles the following aspects are understood:

- Secondary use of units and in their present condition or after the restoration of their performance;

- Recycling (car recycling) of materials - recycling and return to the production of materials;

- Energy generation, by burning of part of car wastes.

The majority of consumers are only interested in the operation of a motor vehicle, and recycling issues most often arise when they are faced with control and supervisory bodies.

One of the attempts to introduce responsibility for a motor vehicle that has served its time is the State Recycling Program, which encourages consumers to implement the phase of utiliza-tion.

The state program for the utilization of motor vehicles started in Russia in 2010, and since 2016. This program covers not just the passenger car type, but also includes trucks and buses. Discount for a purchase of a new car, when disposing of an old car get not only individuals but also legal entities.

II. RESEARCH PURPOSE

When a motor vehicle reached the end of its service life or cannot be exploited, a utiliza-tion stage begins in its life cycle. The incentive to implement the full life cycle of a car exists. How-ever, it is not always realized. Every year in Russia, a large number of cars require recycling, and the problem of recycling of used vehicles arises.

The Commission of the European Union for environmental protection recommends re-turning motor vehicles that are over aged to automobile plant for disassembly and recycling, which is fully correspond to the existing State recycling program.

However, recycling process in Russia has not changed; the following waste is currently being disposed of: tires, batteries, used engine oil, car body, light bulbs.

In this regard it turns out that a consumer cannot simply junk a car for recycling. There are two options: first, bring a car according to the program for recycling with the condition of ac-quiring a new one, or to bring it to scrap yard before preparing it for recycling by removing a bat-tery, light bulbs, car tires and draining engine oil. The utilization of a complete car is not organized enough.

The standard procedure for auto recycling of old cars in Europe is to collect cars and is-sue a recycling certificate to the last car owner. The purpose of the research is to consider strategies for the management of car utilization, taking into account environmental safety and resource con-servation.

III. METHODS AND MATERIALS

The issue of the utilization of motor vehicles unsuitable for further operation is extreme-ly relevant for Russian cities, especially large ones. The fleet of used vehicles is growing rapidly, due to the dynamic development of the automotive industry and the increase in financial well-being of population. However, the average age of vehicles that are used in Russia is higher in comparison with European countries.

However, despite the obviousness of the existing problem, there are very few enterprises for utilization of vehicles and often they are concentrated close to megacities (Moscow, St. Petersburg) and are practically absent beyond the Ural region.

Previously, N.V. Aldoshin proposed three strategies for the collection and transportation of recycled equipment. The following strategies were determined: “A” - the collection and transpor-tation of the completed equipment that was out of service; “B” - the collection and transportation of disassembled equipment, retired from service; “C” - the collection and transportation of large and complex equipment, subject to partial pre-dismantling. These strategies were used in agricultural ma-chinery and for its components [3, 4].

In the framework of the presented research a different approach is proposed. An important point in the management of car recycling is the rationale for the creation of enterprises of various types: specialized or universal. Depending on the need for recycling, it is necessary to de-termine the type of facility for car recycling.

The process of management the utilization of motor vehicles may be considered in sev-eral ways. The management of vehicle recycling in full or in components is considered in several research works [5–7]. Taking into account the selected option, it is possible to consider the following choice - recycling at specialized or universal processing plants. In case of the choice of a specialized enterprise, it is possible to organize an auto-recycling process.

There are approaches to the management of the utilization of vehicles on the basis of the concentration of recycling enterprises to the places of high concentration of vehicles, i.e. close to major cities.

This approach takes place. However taking into account the geographical features of our country and the uneven resettlement of car owners, as well as the large difference in income, signifi-cantly affecting the average age of vehicles in use, it is possible to consider a different approach to the management of car recycling.

It is possible to propose a design of a car as one of the options for the management of car recycling in the context of low concentration of cars [8–10]. That is, to consider for recycling not specialized (narrow-focused) enterprises, but universal ones.

With this approach, it is enough to organize only a line for disassembling a vehicle and to transport scrap metal to an ordinary metal processing plant. Autoplastic processing is carried out in the same way. Tires, batteries, technical fluids should be sent for recycling to relevant processing plants existing almost in every major city.

This approach will reduce the cost of the management of car recycling in cities with a low concentration of vehicles in operation.

Many researchers [3, 8, 9] offer a solution to this problem through the determination of the rational location and creation of enterprises for utilization and recycling of motor vehicles. A well-known fact is that, for the most part, with all the proposed options, this trend is developing rather slowly, in some regions of the country there are no such enterprises at all [10–12]. The main interest is shown by the government, and only commercial enterprises can realize it.

Thus, as long as this activity is performed by the government (collection of the utilization fee), and the utilization production is commercialized, it is possible to concentrate on a different approach.

IV. Results and Discussion

1) Conceptually, the author offers the option of using existing production facilities, in order to consider the utilization of motor vehicles not as a separate production, but as processes which is gradually implemented [13].

2) That is, not to organize a separate special production, but to optimize logistics between existing enterprises and partially supplement universal enterprises (scrap yards, car service) with some non-specific operations.

3) At the moment there is a developed infrastructure for the collection of scrap metal. En-terprises (scrap yards) of collecting scrap metal are most often equipped with presses, which allows, after pressing, sending the resulting product to a metallurgical plant, where materials are separated and metal is smelted.

4) In order to implement this strategy, it is possible to organize the reception of scrap metal at enterprises for partial preparation of a vehicle: discharging technical liquids, removing tires, seats, and batteries. In terms of labor and equipment costs, this is not a large operation.

5) In the considered scheme, the following enterprises present a logistics channel: a receiving point (scrap yard, car service center), a battery factory, rubber processing enterprises, enterprises for the processing of petroleum products, enterprises for the recycling of household waste.

6) The proposed strategy will reduce the cost of car recycling, make it more accessible to car owners and partially solve the environmental issues of vehicle operation, and will improve the resource conservation of the country to some extent.

7) In order to determine the option (strategy) of the management of utilization, it is neces-sary to determine the number of vehicles to be disposed of per year, at which it would be more ex-pedient to create a specialized recycling company. In order to establish the regularity of the for-mation of the need for vehicle recycling enterprises, it is necessary to establish the factors influenc-ing this need.

8) The research will be limited by the following boundaries: the number of vehicles operat-ed in relation to the region and the existing infrastructure in the region.

9) The number of vehicles to be disposed of is one of the significant factors in the for-mation of the need for car recycling enterprises. The need is formed mainly on the basis

of two components: cars which have reached the end of its service life, have lost their operational and con-sumer properties and malfunctioning cars which have lost their consumer properties as a result of an accident and which are not subject to recovery due to the lack of technical capabilities or economic expediency. The number of vehicles to be recycled depends entirely on the total number of vehicles in use in a given region (Fig. 1).

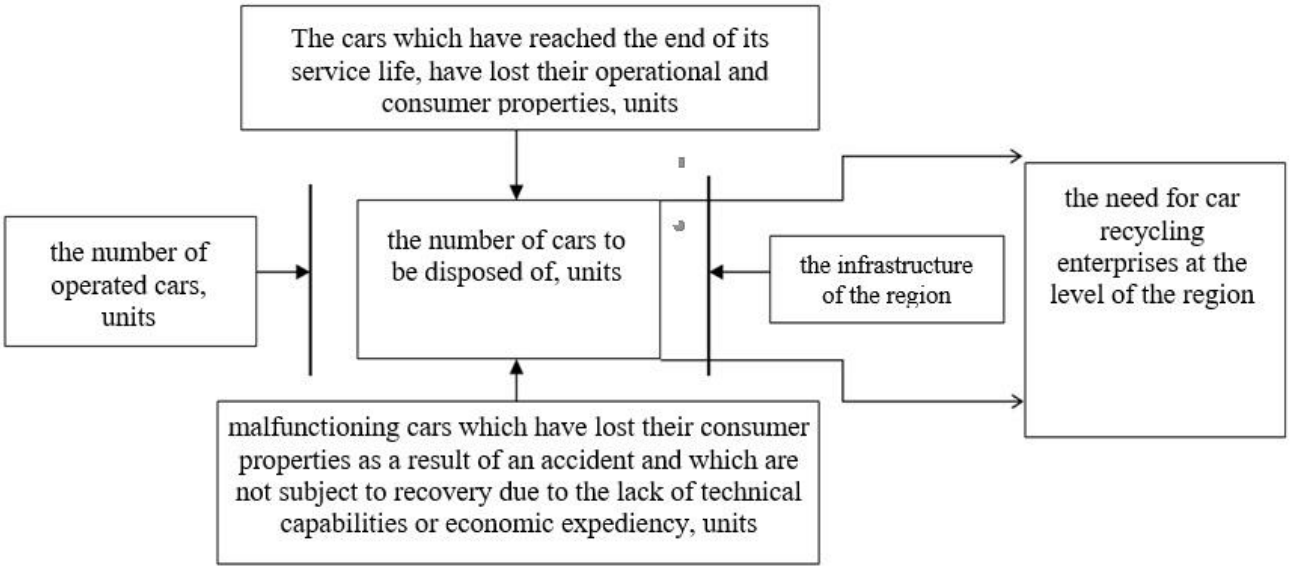

Fig. 1. Formation of the need for vehicle recycling facilities.

which can be recovered and components suitable for re-use are transferred to service centers.

The advantages of choosing one of the above mentioned strategies is determined by the factors that influence the formation of demand in enterprises for the recycling of vehicles, taking into account the practicability and economic efficiency.

Both options have their advantages and disadvantages. In order to determine the most effective, it is necessary to make appropriate economic calculations, however it is also possible to make superficial analysis of the advantages and disadvantages.

Let us compare the advantages and disadvantages of these two options (Table I) with the help of SWOT analysis.

TABLE I. SWOT-ANALYSIS OF STRATEGIES FOR CAR RECYCLING

	The 1st strategy (universal)	The 2nd strategy (specialized)
Advantages	- availability of recycling; - compactness of production; - small terms of implementation of processes; - the possibility of obtaining components suitable for further operation; - processing of small volumes of utilization.	- secondary materials receiving; - effective resource saving; - high level of environmental friendliness.
Disadvantages	- long chain of participants; - possible failures in organizational communications.	- high time expenditure on implementation; - increased recycling costs; - high sensitivity to the volume of recycled cars.

Despite the above mentioned advantages and disadvantages, the main arguments in the choice of options will be presented by financial result from the implementation of the strategy.

When choosing a strategy for the management of the recycling of vehicles, it is neces-sary to take into account the optimum cost of car recycling.

V. CONCLUSION

To conclude with it is necessary to note that there is an optimal number of cars to be uti-lized. When this point is reached it is advisable to make a decision (the choice of the second strate-gy) on the management of a specialized enterprise for car recycling. In the case of a smaller number of cars to be disposed of, it is more rational to implement the recycling process in stages: to collect and prepare a material for recycling at universal enterprises, and then to process a material in com-ponents at specialized companies. During the course of the research it was established that for the south of the Tyumen region the optimal number of cars corresponds to 20 thousand per year.

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