Integrated System for the Decontamination of Out of Service Vehicles*

Sistem integrat pentru depoluarea vehiculelor scoase din funcţiune

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Abstract. *It is proposed to achieve an integrated storage and processing of ELVs and treat decontaminated material from them. The system involves removing parts from vehicles for recycling or reuse and recovery of fluids especially polluting a disabled vehicle can contain (cooling liquid, breaking fluid, gasoline, diesel, motor oil, oil gearbox and differential). The theme aims to improve the quality of life with the rules and regulations and the EEC on operational safety, protection of health and life, environmental protection built ambient and industrial recovery It shows the component in percent of various materials in a car, that can be recycled.*

Key words: End of life vehicles (ELVs), recycling, life quality

Rezumat. *Se propune realizarea unui sistem integrat mediului prin neutralizarea, stocarea şi procesarea vehiculelor scoase din uz, precum şi tratarea materialelor rezultate din depoluarea acestora. Sistemul presupune extragerea de piese de la autovehicule în vederea reciclării sau refolosirii acestora şi recuperarea fluidelor poluante pe care un autovehicul scos din uz le poate conţine (lichid de răcire, lichid de frînă, combustibil, ulei de motor, ulei de cutie de viteze şi diferenţial, etc.). Tema urmareşte imbunătăţirea calităţii vieţii locuitorilor, cu respectarea normelor naţionale şi ale CEE, privind siguranţa în funcţionare, protecţia sănătătii şi a vieţii, protecţia mediului construit şi ambient.*

Cuvinte cheie: Vehicule scoase din uz (VSU), reciclare, calitatea vieţii

1. Introduction

To depollute used vehicles consist in extraction of polluted and pollutant fluids that an obsolete motor vehicle may contain (coolant, brake fluid, gasoline, diesel fuel, motor oil, gear oil and differential, etc.) from the vehicle body before it is dismantled. This process is conducted on a well-defined and reserved area for this sole purpose, using equipment designed and built especially for extracting fluids from ELVs, storing them for recycling, respecting the protection and safety standards for workers, as well as those of environmental protection. The integrated system is intended to meet European Parliament and Council Directive 2000/53/EC of regulating

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this area in the EU [1]. The Directive set targets for the recovery of ELVs to horizon 2006 - 2015: 2006 - 80% reuses and recycling; 2015 - 85% reuses and recycling.

Material nature has evolved a lot in the development of automobile construction. If we consider a 15 year old vehicle that weighs on average 1000 kg, we see that it is made mainly of steel (710 kg) - which is relatively easily quantifiable - and other materials according to the following table:

Table 1

The main material composition of vehicle components

Components	Quantity [% from total weight]
Steel	71,0
Rubber	9,0
Plastic	6,0
Glass	3,0
Aluminium	2,2
Lead	1,0
Copper and brass	0,6
Zinc	0,5
Other non ferous metals	1,1
Others	5,6

Average weight of a vehicle is currently of 800 kg, because of the use of more and more plastic materials (about 4,000 kinds of synthetic materials).

To know composition of wrecks vehicles are used the following strategies:

• Upstream indirect strategy (identify components used by manufacturers of vehicles);

• Downstream indirect strategy (analysis of residues from grinding vehicles and parts recovered).

The first identification strategy is not applicable yet because manufacturers do not always know the composition of the various parts, often made by specialized companies or do not reveal the composition because of competition reasons. However, this situation tends to change as a result of the agreement signed between the French and German environmental minister, which provides that all vehicles become 100% recyclable. This constraint motivated the vehicle manufacturers to seek solutions, in Germany, for example, plastics manufacturers and car manufacturers have launched a project on the marking, dismantling and recycling of plastic parts, which facilitate automatic identification and selection of different materials used.

Several companies have built factories for dismantle vehicles, to modify the design of new models and emphasized the following:

• Establish automatic procedures for the selection of materials and especially plastics;

• The possibility of recovery of various materials;

• Use of an accurate identification of the components;

• Standardization of materials;

• Develop projects to facilitate dismantling;

• Improving opportunities for energy recovery from waste incineration (in an incineration plant in the cement industry or in a foundry).

The second strategy for the identification, even if it is not very accurate, is currently used. The term ‘‘residue’, resulting from the operation of grinding of a car - defines a set of components from the grinding of a car in a shredder. Other terms, such as sterile waste, shredder residue, fluff, define the same type of waste. Ideally, removal is practiced by a recovery or a shredder operator and shall include the following steps:

• Removing the battery and acid recovery;
• Drain the engine oil;
• Recovery of brake fluid (special oils);
• Remove the tire in order to exploit them;
• Removing modules and parts that are apparently in good condition; they are recovered, refurbished and reintroduced onto the market;
• Removing catalysts; these contains rare metals, platinum and rhodium are recovered more than 90% and 80% by specialized companies;
• Removing non metal parties - chairs, synthetic part of the dashboard, etc.

In practice, removing not always run because of the high cost of labor, which greatly influences the composition of residues from grinding. Residues from milling are about 25% by weight of an ELVs.

2. The thesis

Using an integrated processing and remediation ELVs provides great flexibility in terms of functional adaptation in the recycling of vehicles and their components. Direct identification strategy has a drawback ELVs waste: materials that are not used to manufacture vehicles are in their mill residues, this due to the fact that shredder operators feed these plants and other types of waste, such as used appliances and other waste from the collection of bulky waste.

The following data shows the average composition by weight of materials for new vehicles (1995) and the average composition ELV ground in 1995, that the vehicles were manufactured in the 80s. It is noted the decrease in the amount of ferrous of from 70% to 64% due to the use of non-ferrous metals, in particular aluminum, and plastic materials, which currently account for 13% of the total weight of the vehicle. Regarding the composition of grinding residue after extraction of ferrous metals, it is presented in the following table:

Table 2

Composition of grinding residues - light and heavy

Light waste	**%**	**Heavy waste**	**%**
Foams	4-5	Foams	<1
Plastic / rubber	5-6	rubber	60
Plastic coating / textile	5-15	Plastic	10
Fibrous materials	2-4	Metals	5
Non-ferrous metals	2-3	Wood	2
Cardboard	2-3	Glass	2
Wood	Aprox.1	Fine fraction	20
Glass / Paper	Aprox.1		
Fine fraction (<10mm)	40-60		

Light fraction of grinding residue may contain traces of PCBs and heavy metals - for which a reduction must be made by adopted regulations.

In 1995 were reviewed in 15 countries U.E. about 15 million vehicles in circulation. Each year, 5% - 6% of the fleet is eliminated as a result of accidents or aging.

Currently, the vehicles are crushed in shredder plants, and the resulting metal is recovered in steel plants (electric oven). As a result of the grinding process, significant quantities of waste are generated, which are removed mainly by controlled containment.

One of the obstacles to recovery grinding residue is that ELV is not decontaminated prior to milling. Thus the presence of waste oil, of containing PCB capacitors, of liquid and particles of various heavy metals reduce the potential for recovery of such wastes.

Adoption of European ELVs Directive introduces the concept of producer of new vehicles responsibility, witch must arrange their disposal at end of life, and the goals to be reached by 2015, on the recovery and disposal of ELVs - 85% material recovery, 10% energy recovery and 5% final disposal.

ELVs management includes prevention, collection, recovery and disposal. Regarding prevention, producers will have to reduce the presence of unrecoverable materials in vehicle on the market, so as to achieve the recovery and disposal objectives. Manufacturers are thus responsible for:

• Easy and clear identification of items recovered, unrecoverable or dangerous;

• Defining the procedure for removal of these items;

• Inform all operators involved in the management ofELV on stripping operations - depollution.

Based on the economic analysis of environmental considerations and the experience of Swiss companies operating in the area, a center of remediation - scrapping ELV should have a capacity of at least 10,000 ELVs / year. ELVs are collected and dismantled to recover parts second - hand, then they must depolluted (extracting liquids and hazardous substances), and the metal parts are oriented to metallurgy. Oils, which represent the largest amount of recovered liquids are decontaminated and for recovery (fuel). Heavy non-contaminated fraction resulting from grinding is recovered in the cement industry. The destination of light residues resulting from the grinding that are contaminated with heavy metals is controlled storage of hazardous waste and heavy fraction less contaminated is stored in non-hazardous waste landfill.

To improve recovery of ELVs, manufacturers will have to build vehicles with those materials that have a higher recovery potential and integrate into existing vehicle design becoming an amount greater than parts made from recycled materials. The removal should be limited to non-hazardous waste and final (for which there is no recovery method).

Alternatives for ELVs management:

- Development of selective removal;

• Improved separation technologies (hydrocyclonage, flotation) for light debris resulting from crushing to their recovery;

• Recovery of residues from grinding in the cement industry;

• Harnessing the pyrolysis residues from grinding.

European Directive requires the creation of a financial system for the operations of collecting and managing ELVs, so as to ensure free disposal of the last holder of ELVs.

Highlights are ELVs treatment [2]:

• Pollution

• Dismantling

• Crumbling

• Treatment of shredded products

The following figure schematicallv these phases.

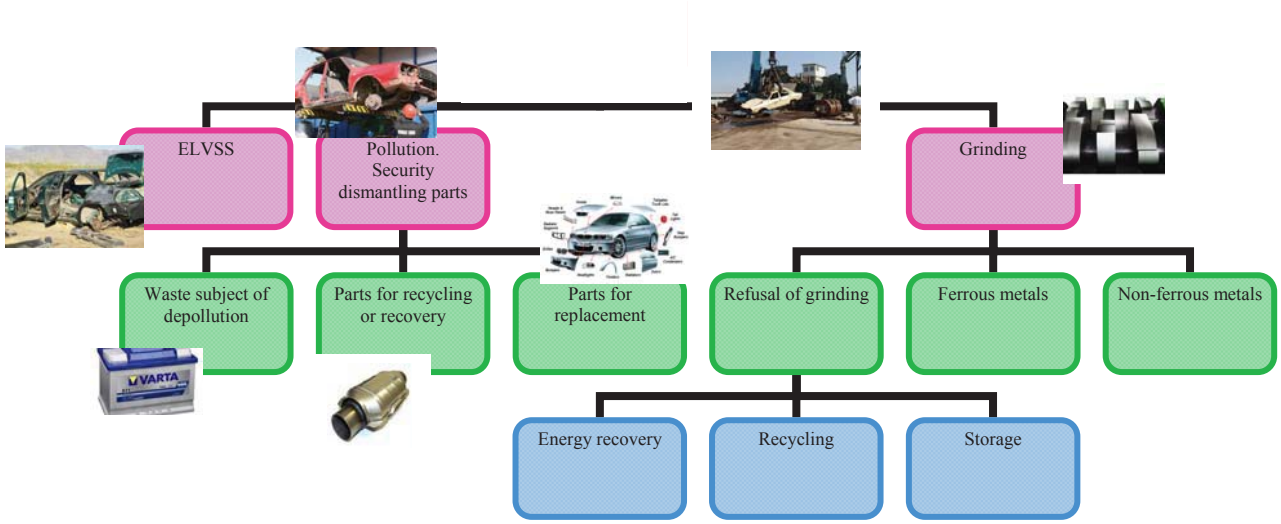
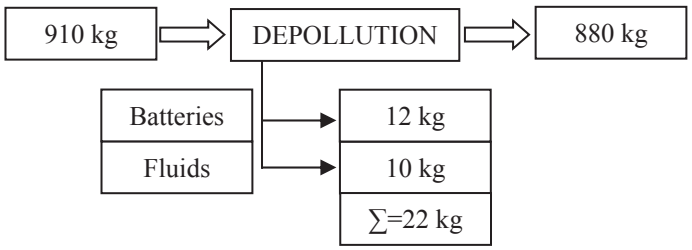


Fig.1 ELV treatment phases

By **depollution** (removal of fluids and batteries battery from ELVs), according to [2], we get a rate of reuse - recycle of about 1, 9%, and by re-capitalization, a rate of approx. 2.45%.

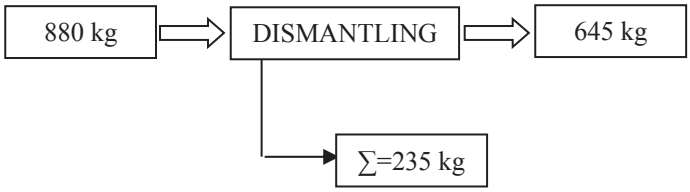
Fig.2 shows the quantities of ELVs extracted by depollution.



Reuse		Recycling		Energy recovery	
Metals	Non-metals	Metals	Non-metals	Metals	Non-metals
0	0	7,5	5,1	0	0
0	0	0	4,7	0	5,0
0	0	7,5	9,8	0	5,0

Fig. 2 Remediation contribution to the rates of reuse, recycling and recovery of ELVs

Removing shows the contribution to the reuse rates, recycling and recovery of ELVs as shown in Figure 3. Rates of reuse - recycle and reuse - recovery are both around 27%.



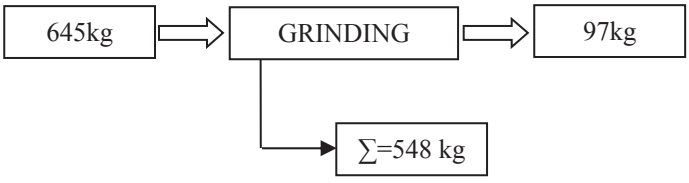
Reuse		Recycling		Energy recovery	
Metals	Non-metals	Metals	Metals	Non-metals	Metals
158	18	52	7	0	3

Fig.3 Removal contribution to the rates of reuse, recycling and recovery of ELVs

According to data provided by the manufacturers, removed parts for reuse containing metal 90% by weight, the remaining 10% consisting of non metallic materials (plastic, rubber, etc...). In addition to removing the metal parts (consisting mainly of non-ferrous metals), removal contribute to recycling (tires, parts and bumpers polypropylene). Weight of main parts extracted for reuse is:

- Motor, for a total mass of disassembled for reuse engines representing 5% by weight;
- Gearbox (1.31% by weight of ELV);
- Front and rear doors (1.30% by weight of ELV);
- Rims (1.11%);
- Tires (0.9%)
- Train (front or rear, 0.86%);
- Fenders (0.78%);
- Gimbals (0.66%).

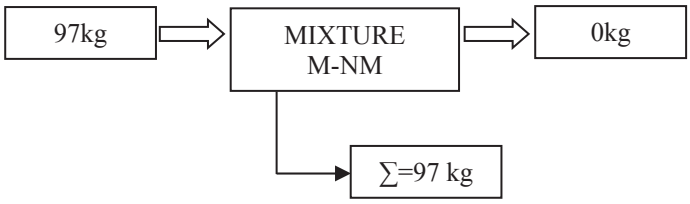
Grinding is the technological operation by which the ELVs, free of re-usable and recyclable materials is fed into a special device, which converts the rest of the vehicle in small particles (50-100 mm). Rates of reuse - recycle and reuse - recovery are both around 50%.



Recycling		Energy recovery		Elimination	
Metals	Non-metals	Metals	Metals	Non-metals	Metals
445	0	0	0	0	102

Fig.4 Grinding contribution to the rates of reuse, recycling and recovery of ELVs

The treating of the grinding product refers to a mixture of metallic and non-metallic components, which leaves the grinding device and can not be separated. Rates of reuse - recycle and reuse - recovery are 2% and 4% respectively.



Recycling		Energy recovery		Elimination	
Metals	Non-metals	Metals	Metals	Non-metals	Metals
20	0	0	15	0	62

Fig.5 Residues contribution to the rates of reuse, recycling and recovery of ELVs

Summary of results

Reuse and recovery rate: 81.86%

Reuse and recycling rate: 79.31%

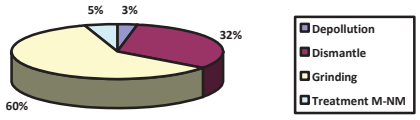


Fig.6

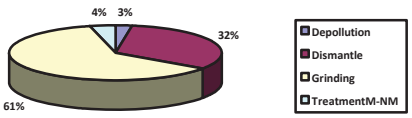


Fig.7

ELVs management includes prevention, collection, recovery and disposal. Regarding prevention, producers will have to reduce the presence of non-recoverable materials in vehicle on the market, so as to achieve the recovery and disposal objectives. Manufacturers are thus responsible for:

- Easy and clear identification of items recovered, non-recoverable or dangerous;
- Defining the procedure for removal of these items;
- Inform all operators involved in the management of ELVs on stripping operations - pollution.

Fig. 8 is a schematic diagram of a stand (equipment) for the depollution of ELVs. The equipment can be mounted both above ground and underground, in the latter case, access is ensured by descent of steps carved.

The stand will have on one side with scaffolding with an access ladder and a work platform to access to the top of the vehicle.

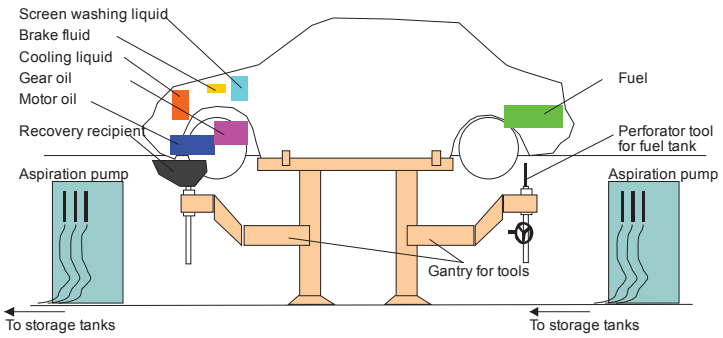


Fig.8

3. Conclusions

Integrated system wants to come to meet the Directive 2000/53/EC of the European Parliament and of the Council concerning the regulations for this domain in the EU. Using an integrated processing and remediation of ELVs, provides great flexibility in terms of functional adaptation in the recycling process of vehicles and their components. Adoption of complex equipment for depollution, disassembly, shown in Figure 8 contribute to achieving remarkable results in the treatment ELVs in Romania

4. References

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