

Theses

For

Paul Lukács' dissertation about the

*„Recycling of End-of-Life Vehicles and Mobile Machines
– Conception, Realisation and Practical Questions”*

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Targets

During the setting of the targets of the scientific activity the basis point was the inco-ordination of the Hungarian ELV-treatment-system. While in some West-European countries the ELV-problem has already been solved since 15 years, today in Hungary the further life of an ELV after its de-registration cannot be followed.

Because of the complexity of the topic the setting of project-backgrounds had run on more parallel lines, the selection of interfering subjects has guaranteed the accurate overview of the candidate into the technical, economical and scientific backgrounds of the whole procedure.

The most important target was, how could the Hungarian ELV-treatment-system be established according to the best European praxis and how the Hungarian law can be harmonised according to the existing European regulations.

During the candidates scientific activity the European Union has adopted the Directive about the ELV's – 2000/53/EC – and its harmonisation was started by the Hungarian Government. The candidate who started his activity at first as secretary, than as president of the Recycling Working Group of the Association of Hungarian Automobile Industry (AHAI) could „closely” follow the preparation work of the law-harmonisation and could take part very actively in the social- and economic discussions between the Government and the economic operators.

The second target was the analysis of that construction materials and manufacturing technologies used at the manufacturing of vehicles which have a basic importance on the recycleability of the ELV's. Target was the examination of application trend of used construction materials with special regard on the evaluation of iron- and steel-materials against the upsurgence of light-metals and plastics. To help this work the candidate spent 4-months in Aachen in Germany in frame of a scholarship of the DAAD-program. Here he took part in a work of the Department of Bodywork of IKA (Institut für Kraftfahrwesen in Aachen) and could get acquainted the best specialists in the German ELV-system like the economist Mr. Frank Wallau and the head of the Arge-Altauto Dr. Martin Schenk. Also for this purpose the subjects were chosen at the BUTE like the „Material science” hold by Dr. Gábor Búza and the „Construction materials in vehicles” hold by Dr. Antal Lovas. The scientific results of this work was summarised by the candidate in his university book „New materials and technologies in the automotive industry I. - Új anyagok és technológiák az autógyártásban I.” which was published by the publisher Maróti-Godai.

The third target was the investigation of using the dismantled parts for equivalent purpose. To achieve this the candidate has visited more domestic and foreign companies which have a big experience in the reparation- and recovery technologies. One of these centres has worked in frame of Volánbusz Trust and here buses were recovered in two parallel process lines. In one line the engines was dismantled, recovered and reassembled, in the second one the bodyworks. It is typical for the Hungarian circumstances that this (by the Germans admired) centre had been closed, their employees were discarded.

The fourth target was the research of the recycling-possibilities of the material-fractions originated from the dismantling of ELV's. In frame of this work the candidate visited noted Hungarian- and foreign waste utilisation companies and he has contacted the Association of Hungarian Waste-Recyclers with which he still works together in common projects.

The fifth target was the analysis of change in the traditional product-design according to the new challenges created by the growing need for part- and material-recycling in the ELV's. For this purpose the candidate studied for three semesters the subject „Mechanical engineering” hold by Prof. János Márialigeti.

Actual stand of technology

Today the topic of vehicle-recycling has a very rich bibliographical background. The ten most important and by the candidate owned publications consist of the following articles, books and reports:

- [bech, 93] Bechmann, A. – *Abfallwirtschaftliche und –technische Untersuchungen zur Verwertung kunststoffhaltiger Abfälle am Beispiel von Shredderleichtmüll* – genehmigte Dissertation, RWTH Aachen, 1993.
- [ditt, 96] Dittmann, R. – Wallau, F. – Wallentowitz, H. – *Altautorecycling – Beiträge zur Optimierung von Stoffkreisläufen* – In RWTH-Themen 1996.
- [härđ, 94] Härdtle, G. – *Altautoverwertung: Grundlagen – Technik – Wirtschaftlichkeit – Entwicklungen – Beihilfe zu Müll und Abfall*, Berlin 1994.
- [kehl, 91] Dirk Kehler Dr. – *Trockenlegung von Altautomobilen – Neue Konzepte für die Autoverwertung* – VDI Bericht 934. Düsseldorf S.39-62. 1991.
- [kre, 97] Hans-Peter Kremer – Axel Kopp Dr. – *TÜV-Ratgeber, Altauto-Verwertung – Gesetzliche Anforderungen an Annahmestellen, Verwertungsbetriebe und Anlagen zur weiteren Verwertung (Shredderanlagen) auf der Grundlage der Altauto-Verordnung (AltautoV) vom 04.07.1997*.
- [ned, 95] Auto-Recycling Nederland B.V. – *Recycling von Pkws in den Niederlanden – Ein einzigartiges Konzept schon jetzt Realität* – Amsterdam 1995.
- [püch, 94] Püchert, H. – *Autorecycling: Demontage und Verwertung, wirtschaftliche Aspekte, Logistik und Organisation*. – Bonn, 1994.
- [sche, 98] Schenk Martin Dr. – *Altautomobilrecycling* – 1998. XXIV, 387 Seiten, 43 Abb., 22 Tab. Gabler Edition Wissenschaft, ISBN 3-8244-6826-3
- [wall, 97] Wallau Frank – *Die aktuelle Situation der Altautoverwerter in der Kreislaufwirtschaft. Eine empirische Untersuchung* – Abfallwirtschaftsjournal - 9 (1997) 11, S.42-45.
- [wall, 97] Wallau Frank – *Die aktuelle Situation der Shredderbetriebe in der Kreislaufwirtschaft – Eine empirische Untersuchung unter besonderer Berücksichtigung der Altautoentsorgung* – Abfallwirtschaftsjournal - 9 (1997) 9, S.46-50.

As it can be seen these materials originate mostly from German-speaking areas. This is based on the very developed German ELV-treatment-system and on the high level of research activity in this field. No other European country has researched this topic with the same intensity and no other country has as many experts as Germany has.

Further help for the candidate was that he as president of the Recycling Working Group of AHAI could (can) take part on the ACEA's – Association of European Automotive Industry – WG-RG- (Working Group Recycling) meetings in Brussels and he receives frequently the memoranda about the daily work of WG-RG ACEA from the head of WG-RG Dr. Hans-Martin Lent-Philipps. These periodical reviews, country-reports, studies belonging to the implementation possibilities of the EU-Directive had an elemental importance during the work-out of the dissertation.

Essential tool was the regular investigation of IDIS-catalogue – International Dismantling System –, in which 22 automotive-manufacturers have summarised their dismantling information about their own manufactured personal cars in the last 15 years. In this catalogue the most important issues are the location of fuels, plastic-, rubber- (also with their identification-codes for a needed separation) and glass parts and the listed tools to be used for the different dismantling procedures.

During the evaluation of the Hungarian vehicle-fleet the database of the Central Statistical Office (KSH) was the essential source, from which all the necessary data could be gained, i.e. the data about the content of the fleet, average age, areal distribution etc. For the evaluation of future tendencies the candidate has used the tool in the Microsoft Excel® program for fitting regression curve.

Applied methods

During the work-out of the dissertation the candidate has consequently followed the tasks defined in the target field.

He has regularly published his research results, in the last seven years he wrote over 20 articles – many of them was published in noted trade journals e.g. in „Abfallwirtschaftsjournal“- . He held more than 25 conference lectures and took part in working-out of seven scientific report in the ELV topic. After finishing the foundational study on the possible law-harmonisation of European ELV-Directive – 53/2000/EC – in Hungary in the year of 2002, he received the leading of a new project of Ministry of Environment of Hungary as a project leader. In this project a domestic system for the collection and treatment of Hungarian ELV's will be worked out.

During the execution of appointed tasks the candidate has co-operated with his professors and tried to find such practical challenges in all different subjects, where the worked-out material could be built into the educational activity of the given department. Such activity was for example the translation from German to Hungarian of VDI 2243 directive which describes all the necessary steps for the design-for-recycling constructions. After finishing this work the candidate has published the common results with his director of studies, Prof. János Márialigeti together in the trade journal „Gép” and in the frame of a common conference lecture.

Naturally there were also co-operation with other departments too, for instance together with the Department of Vehicle Manufacturing and Repairing a common project was carried out with the name „New and environment friendly design-, manufacturing-, repairing- and recycling methods for the public vehicle-constructions” in frame of a Ministry of Education application.

Probably the research of constructional materials and new technologies has delivered the most valuable result, namely the research-materials were summarized in a form of a university book with the name „New materials and technologies in the automotive industry I. - Új anyagok és technológiák az autógyártásban I.” In this book the candidate summarised the new materials and solutions in the field of steel- and cast-iron materials in 164 sides in the year of 1998. Publisher company was the Maróti-Godai publisher. Beside the iron-based materials the book also handles – in shorter content – all the other construction materials too, and as a forerunner of this dissertation there is an own chapter for vehicle-recycling.

Beside these the candidate could meet in accordance with his scholarship in Germany, with his taking-part on conferences and his membership in AHAI with all the important personalities of the international vehicle-recycling, e.g. with Dr. Martin Schenk, Dr. Dirk Kehler, Frank Wallau, Dr. Alex Kopp, Dr. Hans-Martin Lent-Philippis, etc. From this contacts the candidate could get essential technical assistance.

In the year 1999 the Department of Automobiles of TUB has organised a conference in the topic of vehicle recycling, on which illustrious Hungarian- and foreign experts could present the actual situation in this field. In this occasion the candidate was the secretary of the organisation board.

After finishing of the pre-harmonisation work in accordance with the EU-Directive 53/2000/EC in 2002, there will be shortly started the new project for a built-up of Hungarian ELV-collection- and treatment system. In this project the candidate will lead the organisation work as a project-leader.

Scientific results

This dissertation shows the results of the author's research activity in the field of vehicle recycling in which he could work between 1994-98 as a Ph.D. student of the Department of Automobiles of BUTE, between 1999-2001 as a secretary, than since 2001 as a president of Working Group Recycling of the Association of Hungarian Automotive Industry for a framing of the new Hungarian ELV utilisation system.

The dissertation embraces the whole procedure of vehicle-recycling according to its effect on the automotive industry, on the protection of the environment, on the overhaul- and repair-industry as well as on the change of design of new vehicles. The dissertation has been separated into the following main parts:

- „Process of the modern vehicle-recycling”, which shows the domestic- and international legal backgrounds of the activity indicating the insufficiencies of the today's Hungarian-system. Additional it has shown the in the procedure very important operation of dismantling- and shredder facilities with its detailed processes.
- The chapter „Reuse of dismantled vehicle-parts for the equivalent function” presents the technologies according to the qualification, reparation and renewing of vehicle-parts originating from vehicle-engines, and shows the future repair technologies for the new steel materials having extended strength, but lower possibility on the reparability. At the same time it also emphasized the use of such a modern technologies like the application of super-thin plastic-coatings in the mechanical engineering.
- Chapter with the name „Recycling of construction-materials from vehicles” presents the recycling-possibilities of construction-materials proceed by the dismantling of ELV's. A separate part handles with the today's “biggest problem”, namely the shredder-residues, which contains mixed plastic-, rubber- and glass fractions.
- “Recycling-aspects in the modern product-design” gives a guide about the effects of recycling-aspects on the modern product-design, beginning with the aspects of material-choosing, through the construction and choosing of connecting elements, over the reparability of parts including the separation possibilities of dividual material fractions.

In this place the candidate summarizes his scientific results.

The theses are concentrating essentially on the solution possibilities of today's difficulties in Hungarian vehicle recycling system.

Thesis num. 1.

„The law harmonisation of European Directive 53/2000/EC about the recycling of ELV's cannot be accomplished in Hungary without the creation of “*conception about the collection and treatment of wreck cars*” which will embrace the whole utilisation procedure. Before the publication of a Ministerial Order by the Minister of Environment an *Executive Decree* relating to the economic backgrounds of wreck car recycling has to be created.

Confirmation:

The *conception of wreck-car treatment* defines for all economic- and control participants of procedure (last owner, places for receiving of wreck cars, dismantlers, shredding facilities and control authorities) their rights and obligations beginning with the de-registration of the vehicle inclusive with the *total recycling* of parts and construction materials proceeding with the dismantling and processing of wreck cars and bodyworks. The existence of the conception and its consequent execution guarantees the verifiability of procedure, the economic calculability for the economic operators and also warrants for the authorities the completion of the enforced country-report which has to be presented for the EU in every three years about the realisation of targets laid down in 53/2000/EC Directive. With the help of *Executive Decree* it will also be possible to define the tasks of the individual ministries. This helps to avoid the todays practice, where the different ministries do their jobs parallel, without any synthesis. The most important target of the *Executive Decree* is to compose an *economic model* for the whole procedure. This can also solve the problem of vehicles *without* any existing manufacturers or importeurs, of vehicles which was delivered to the country in frame of *privat import*, and of the vehicles which because of their *obsolesion* has to be de-registered after Hungary's joining to the EU.

Thesis num. 2.

„In the Hungarian ELV-treatment system - which is to be established – the own *rights* and *obligations* of the *individual economic operators* has to be also accurately defined. According to this the task of the *last owner* is to deliver its wreck-car to the *disposal places* (to dismantlers or to the collecting point) which has to be authorized by the Hungarian authorities and he gets a CoD (Certificate of Disposal) for it. The *system of disposal places* has to ensure the covering of the whole country and to ensure the stocking of dismantlers with wreck cars. The *dismantlers* has to execute the dismantling procedure according to the existing environmental instructions and to the economic point of view. The *shredding facilities* perform the separation of construction materials originating from bodyworks into individual fractions after their processing in shredders. The *process-controlling authorities* – Environment- and Transport Supervisals, Customer Protective Office, self-governments etc. – control the conformance of legal ordinances.

Confirmation:

Last owner has to deliver his wreck car to the treatment companies (disposal places) which are authorized by the environment- and transport authorities, and in case of specialised dismantler, by the manufacturer. This obligation can be enforced when the last owner can only de-registrate his car with the submission of *CoD (Certificate of Disposal)* which he can get only from the authorized disposal places. Up to the de-registration his obligation for the paying of tax- and insurance will exist. The circumstances of the disposal has to be defined by the market conditions – it means, it has to be calculated from the remaining value of car – taking into consideration the already existing-, resp. the after 1. January 2007 into force coming cost free take-back obligation of the product-responsible (manufacturers, importeurs).

The *system of disposal places* has only to ensure the whole covering of the country – it means the last owner should not deliver his wreck more than 50 km from his inhabitation -, and the safe storage of wrecks until its further-delivering into the dismantling places. No pre-dismantling activities must be executed on the disposal places!

The *dismantlers* has to complete the removal of fluids, in accordance with it they drain (detach, remove), adequately store, than deliver the fluids, batteries and catalytic converters to authorized treatment companies.

To reach the *operable system under market conditions* it is needed to accomplish the pre-demolition of wrecks, to be able to resell the still useable parts (engines, gears, etc.). To achieve the *recycling quotas* it some additional removal and individual separation of plastic-, rubber- and glass parts is also needed. The aggregates has to be handled individual, the plastic-parts has to be separated according to their manufacturing codes for identification, glass wastes has to be collected in separated coloured- and white fractions, and before processing of bodywork the wheels, the catalytic converters, the non-iron metals and the cables has to be removed from it.

To ensure the *close of material-circles* the above listed separated material fractions has to be delivered to the aggregate-processing facilities, to the plastic-, glass-, rubber-industry, to the iron- and light-metal works and to the building industry.

In accordance with the *lowering of delivery costs* the bodyworks has to be pre-treated, its tool can be the pressing or balling.

The so pre-treated bodyworks can be delivered to the shredder-facilities or when the pre-demolition was carried out in sufficient degree to remove the most of pollutants, direct to the ironworks.

The *procedure-controlling authorities* must control the proper collection, store, emplacement and treatment of dangerous substances with special regard on the fluids (used oils, braking fluids, cooling-fluids, etc.), on the batteries, on the catalytic converters, on some problematical plastic parts and on the pyrotechnical elements of air-bags and safety belts.

The *authorities* have to work-out their strategies to the procedure, they should purchase the needed tools for the control and they have to ensure the possibility of sanctions in case of any abuses. Very important is the settlement of a unified data management system for a registration and de-registration of vehicles. The today's originality-checking system has to be worked-over. The money coming in from incidental penalties has to be used for research and development in the topic of vehicle-recycling. According to the ELV conception the authorities have to assort the list of the materials used in the automotive-manufacturing and in form of a technical guide they have to propose their best recycling possibilities which can be used later as a directive too. The authorities also have to define in case of a product (material)-group the technologies which are not or only under special circumstances are allowed for the processing of that fraction.

Thesis num. 3.

„The *product-responsibles* – manufacturers or importeurs – have to establish the basis of a *country-covering take-back system*. The *manufacturers* have to reach the *retirement* (and substitution) of 4 material groups laid down in the Annex II. of EU Directive, namely the *substitution* of cadmium, hexavalent chrome, mercury and lead. The manufacturers obligation is to ensure the up-to-date *dismantling informations* for the dismantlers.

Confirmation:

The last owner's "disposal obligation" is represented by the entering of obligation of tax- and insurance paying, but this can lead to the unserviceability of system in case of lack of country-covering take-back system. It is not acceptable to expect from the last owner that he should travel more hundreds of kilometers with his ELV to deliver to the first authorised take-back point. The acceptable maximum distance for delivering is 50 km under Hungarian circumstances. This value is in the preliminary ministerial ordinance and the same was proposed by the product-responsibles.

The substitution of materials listed in the Annex II. in the EU Directive is not a simple task, nevertheless according to their dangerousness is legitimated and necessary. In this field the manufacturers has formed international group where they try to find the new solutions based on the cost-effectiveness.

To ensure the dismantling information the solution is the extending of today's IDIS Plant – International Dismantling Information System – project activity. In this project 22 manufacturers has collected in categorised form their product's dismantling informations retroactively to the last 15-20 years. The up-to-date function of the system is guaranteed by the update versions in every half year.

Thesis num. 4.

„The financial basis for a waste-processing support has to be established. The scope of operation of utilisation fee has to be extended on all problematical materials in vehicles. To ensure the proper use of collected fees the product responsibles has to establish a non-profit organisation which can achieve the enforcement of product-responsibility, can collect the utilisation fees paid by the product responsibles and finance the utilisation procedure in a controlled way. In case of *vehicles without any existing manufacturers- and importeurs* the governmental support is necessary. A further analysis has to show how this planned non-profit organisation can handle these vehicles. In case of *privat import* the product responsibility has to belong to the *importing person*, he has to organise the future disposal of wreck car.

Confirmation:

Today in Hungary the market of "light-fractions" (plastic-, elastomer- and glass) is stagnating, the primer commodities are cheaper than the seconder materials. In the same time there is a prejudice against the use of secondary materials too. The best tool to negotiate the prejudices would be the establishment of a financial support system for a growing application of seconder materials.

This system should be mentioned in the National Development Plan (Nemzeti Fejlesztési Terv).

The conception of a non-profit organisation is allowed by the Waste Economy Act. For this purpose it was laid down that the state is the most expensive waste recycler, the state wants to give a possibility for the product responsibles to solve the problem under market conditions. This non-profit organisation is able – after adequate economic analysis – to solve the problem of vehicles without any existing manufacturers or importeurs, and for vehicles from privat import.

Thesis num. 5.

„With traditional utilisation methods – processing of bodyworks without any pre-demolition and fuel-removal – in shredder facilities – the *today's reached 75% recycling quota can not be raised any more*. To reach the recycling quotas laid down in the 53/2000/EC Directive the *preliminary removal of fuels* ("taking to dry the bodywork") and the *preliminary demolition* of parts which covers also the main *plastic-, rubber- and glass elements* too is necessary.”

Confirmation:

Vehicles manufactured in the last 20 years contain about 70-75% of metals with decreasing tendency. These metallic materials can be separated with the traditional shredding procedure with a very good efficiency. The metal materials are mostly represented beside the engine-area in the bodywork, which is for instance in Hungary not right, in case of the Trabants. The post shredding technologies need the pre-removal of fuels, because the dangerous substances could defeat the economic effective utilisation of separated fraction (they would need an extra cleaning). The prescribed utilisation quotas can only be achieved with the removal of fuels, with pre-demolition of bigger plastic-, rubber- and glass parts and with their individual recycling.

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