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MODELLING OF DISASSEMBLY PROCESSES FOR THE SMALL ELECTRIC APPLIANCES

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Abstract: *The entire world goes one way, way to environmentalism. Designing products in order to minimise their impact on the environment is becoming increasingly important. Each of products should be made for disassembly after its lifetime. Process of disassembly is composed of a few steps: preparing for disassembly, self-disassembly and final inspection. Final inspection is important step because make a decision about next using disassembled components: use original condition, recycling or waste conditioning.*
This paper not only presents this technique but also illustrates its use with a case study.

Key words: *modelling, disassembly, and disassembly process.*

1. INTRODUCTION

Nowadays on the market, there is a lot of small electric appliances and their number is still rising. At this increased productivity, soon the world will be flooded with electric waste. Therefore, a development of new products is impossible without caring about environmental consequences which product brings.

Environmental deterioration is a very actual question and still discussed regarding efficiency production resources of products, which do not load on a large scale the environment. The best way is the production of products with condition on component use after end of life.

In principle, every electric or electronic product consists of combination of the few basic units like circuit boards, cables, electric conductors and wires, synthetics containing inhibiter of burning, mercury switches, liquid crystal displays (LCD), accumulators, batteries, condensers, etc. Some of these components are possible to be recovered, that meaning recycling them in a new production process.

2. ENVIRONMENTAL PARAMETERS ASESSMENT OF PRODUCTS

The goal of environmental parameters assessment of products from view of producing and disassembly production modelling brings positive contributions for environment. Products are rated in three terms (Fig. 1):

- in projection and production,
- in use or in consumption,
- in inadequacy and in physical end of life.

In present trend it is necessary in general to deal with the third aspect of the product assessment – assessment of product in end of life. It must be remembered to design a new production for preventing the overloading of electric waste (Fig. 2).

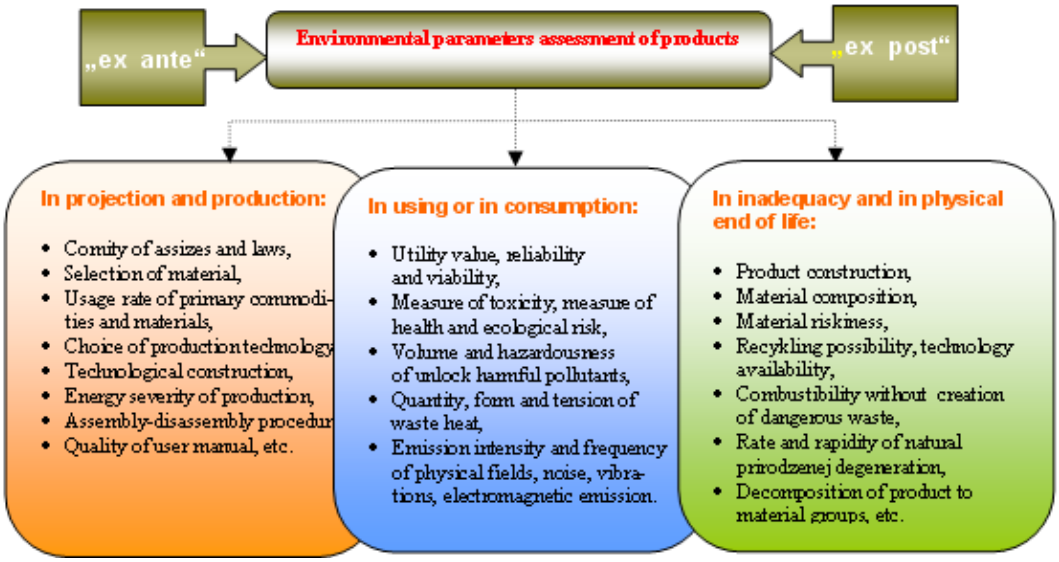

Fig. 1. Environmental parameters assessment of production.

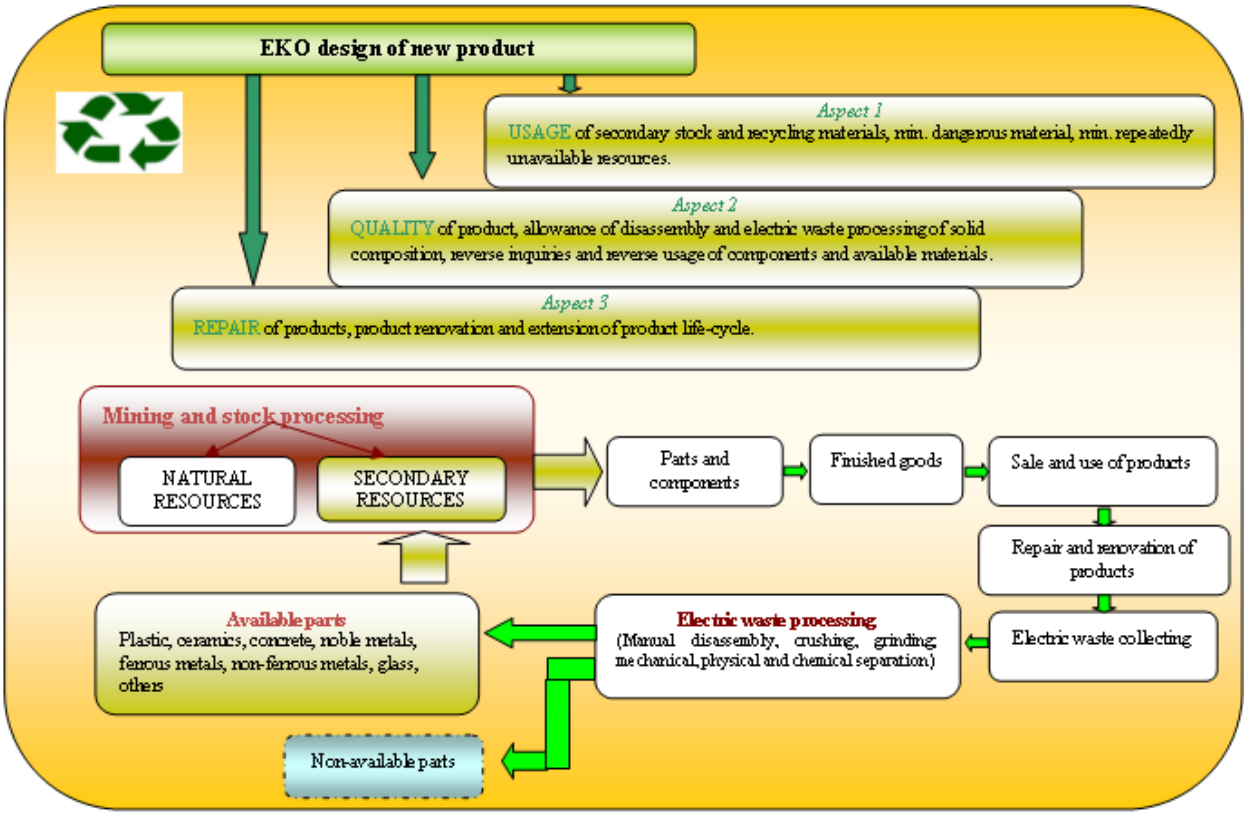

Fig. 2. EKO design of new product.The general question for producer is: why to care about disassembling of disabled products? The argument for disassembly can be the small part of reusable product.

In disassembly process is product in bulk input of the crushing process – disassembly. Naturally, if that is addition of the disassembly process and following material recycling such that it is possible to return effectively bulk of material contents. In this case will be preferred crushing process. It's a deal above all for products with high material homogeneity rate (example: plastic wrappers, toys, etc.), or products with high concentration of rare materials.

However, there are a few other equally important reasons why to realise product disassembly:

- use of components with high value of repeatedly,
- processing and safe disposal with dangerous content (batteries, petrol tanks, mercury),
- processing parts with high thermic value for others firing (tyres, rubber),
- decomposition of parts and components for the sake of prevention for unwarranted re-sale.

3. TECHNOLOGICAL PROCEDURE OF ELECTRIC WASTE INQUIRIES AND MODIFICATION

At first, it is necessary to assure inquiries of electric waste from customers. There must be a provision of electric waste transport with public containers or salvage of electric waste straight in a store and services.

The simplified technological flow diagram inquiries and modification of electric waste is given in Fig. 3. It starts from product collection followed by product testing in order to sort reusable and non-reusable electric waste separately. Non-reusable electric waste is disassembled and electric waste fractions are sorted into reusable and non-reusable parts. Non-reusable electric waste parts undergo size reduction, separation and recovery of different materials, while the remaining electric waste fractions are disposed.

The base of electric waste processing is material flow. Every disassembly consists of operations, by which is electric waste unmounted to concrete force groups and these are splited up to the next dismountable subgroups and undismountable subgroups. Undismountable subgroups are not possible to process and they came to be waste given to liquidation. After complete disassembly all the groups and subgroups, dangerous remains are transported to dump or they are burnt. Description of processing on every group and subgroup level is given with entry requirements, individual operations and output from processing level.

Electric waste recycling (Fig. 4) forms resources for recovery wide raw materials assortment, which are convenient for further usage. Outputs are depending up applied technology in different quality. All the time it´s act about mixture of ferrous metals, plastics, concentrate of copper, aluminium, etc. It depends on market resources, to which final output is needed to lead technological advance. Impact on environment is also important, because by inexpert recycling it may get out dangerous substances to environment.

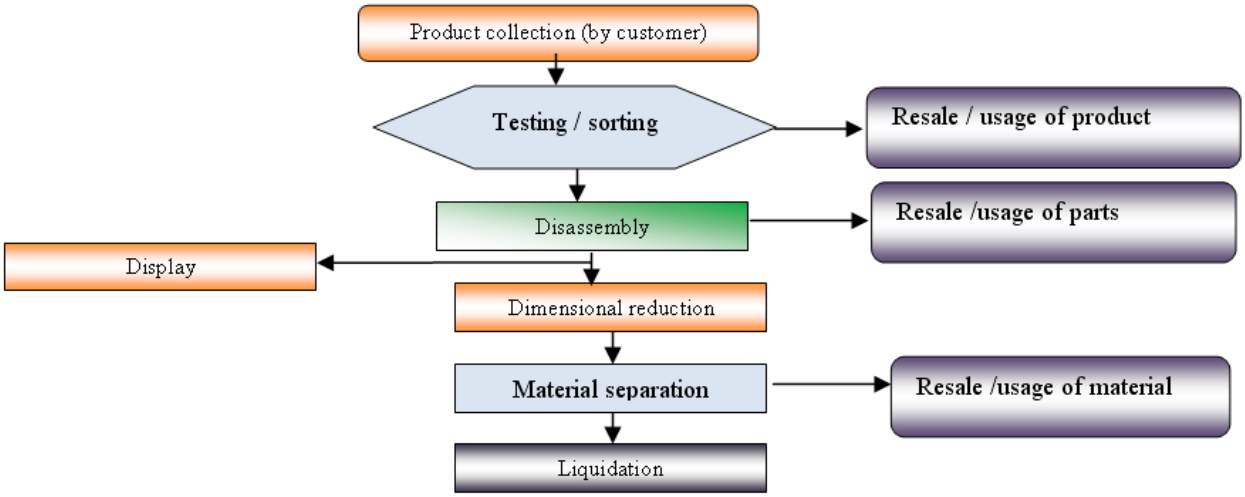

Fig. 3. Example of the technological flow diagram of small electric appliance.

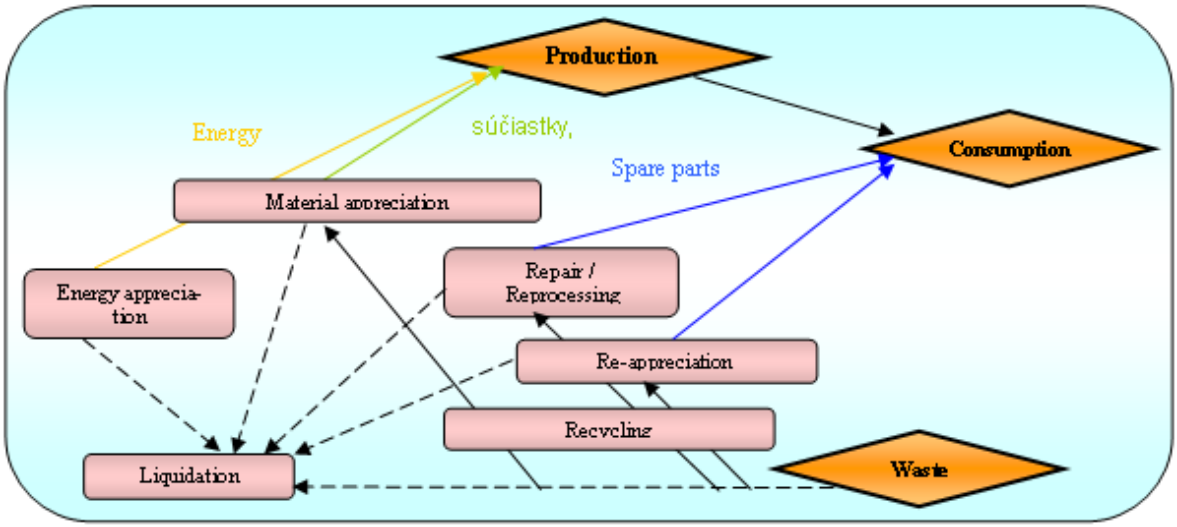

Fig. 4. Recycling of the small electric appliances.

4. MODELLING OF DISASSEMBLY PROCEDURE

Disassembly procedure appears from disassembly of concrete product (Fig. 5). Differents in disassembly procedures are under review and consequently it´s created best possible disassembly procedure, which make it possible product disassembly in minimum of possible time.

One of the calls in model creation of disassembly piece list is exact description process of product scanning. While is noted closing balance, variety problem of product decomposition to single parts complicates this exact description.

In addition to exact description of product components is needed forward to assess mode of usage component parts (Table 1). When are some disassembly groups or subgroups unavailable for recycling or renovation, it´s economical ineffective these groups or subgroups also disassemble. Simply they are disassembled only those disassembly groups whose components can be easier recycled and renovated.

After determination of simple component efficiency it is possible to model disassembly process in table bellow, part, simplified description, etc. how much screw we which consists of operation number, description of parts, period needed for operational time for concrete need to take off, as well as another acts needed for disassembly this parts etc. Dismantling of product is performed until there is no needed another decomposition. It can be influenced by unavailability of components or limited resources.

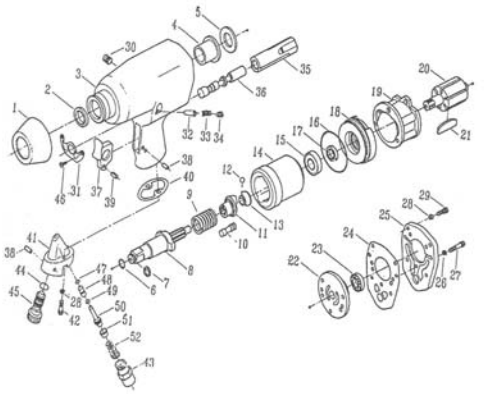

Fig. 5. Example of product components decomposition.

Table 1

Utilization methods of simple parts

No	Name	Utilization methods		
		Material recycling	Part renovation	Dismantling - waste
1.	1, 2, 24	X	/	/
2.	3	X	O	/
3.	4	O	/	/
4.	8	O	X	/
5.	9, 33	X	/	O
6.	10	O	/	X
7.	11	/	X	/
8.	12	X	O	/
9.	13	X	/	/
10.	14	O	/	X
11.	15	O	X	/
12.	18,22	X	/	O
13.	19	O	X	/
14.	20	O	X	/
15.	21	X	O	/
16.	25	X	O	O
17.	26	X	/	O
18.	27, 29	X	O	/
19.	30	X	/	O
20.	31	/	/	X
21.	32	X	O	/
22.	35	O	/	X
23.	36	O	X	/
24.	37	O	X	/
25.	41	X	/	/
26.	45	/	/	X
27.	48	X	O	/

Legend: X - napt, O - less napt, / - inapt

Simulated disassembly procedure can be clarified in production tree, which is created following dismounting procedure for existing sample. Production tree makes it possible to clarified asking steps to reach specified components of product.

5. CONCLUSIONS

It is possible to characterise disassembly process as total transaction of dismantle operation of simple parts from bigger parts, technical, so simply and economic effectively. Disassembly invades unity of product construction for proposed to obtain parts multiple-repeated, rare materials, etc. Parts can be destroyed, defected, rusted and from the point of view production recycling useless. Modeling of disassembly procedure consists of construction documentation of product, existing mechanical outfit and from normative for determining time norms for simple disassembly operations. Following structural disassembling bill of material we work out order of disassembling operations for product for each assembly group and for each subassembly group.

It is not possible to simply render inverse look like assembly. Features of this problematic are singular to assembly. Studies show that planning of disassembly process in order to assembly are presently new. In scientific literature there is taken much more attention, nowadays.

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REFERENCES

[1] Das, S.K.**,** Naik, S. (2002). *Process planning for product disassembly***,** International journal of production research, 40:66, Taylor & Francis, pp. 1335-1355.

[2] Mohite, S., Hong-Chao Zhang (2005). *Disassembly analysis, material composition analysis and environmental impact analysis for computer drives*, Electronics and the Environment, 2005, Proceedings of the 2005 IEEE International Symposium on Volume, Issue, 16-19 May, pp. 215 – 220.

[3] Source: Hai-Yong Kang, Julie M. Schoenung (2005), *Electronic waste recycling*, A review of U.S. infrastructure and technology options, Resources Conservation & Recycling 45, Elsevier, pp. 368-400.

[4] Šebo, Dušan - Trebuňa, P., (2007). *Logistika strojárskeho výrobného procesu.* In: Acta Mechanica Slovaca. roč. 11, č. 3, s. 107-114. ISSN 1335-2393.

[5] Turisová, R., Liberko, I., (2003). *Monitoring of the efficiency of the process*, Intercathedra. No 19, pp. 136-140. ISSN 1640-3622.

[6] Liberko, I., Trebuňa, P., et al. (2005). *Podnikové hospodárstvo*, Praktikum. 1. vyd.. Košice: TU, ISBN 80-8073-287-6.

[7] Šutaj-Eštok, A., Trebuňa, P., et al. (2006). *Všeobecná ekonomická teória,* 1. vyd. Košice: TU SjF, ISBN 80-8073-741-X.

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