DESIGN OF AUTOMATED DISASSEMBLY DEVICES

Angela JAVOROVÁ, František PECHÁČEK, Radovan ZVOLENSKÝ

Slovak University of Technology in Bratislava, Faculty of Material Science and Technology
Institute of Production Systems and Applied Mechanics – SLOVAKIA

ABSTRACT

Environment is in present day constantly menaced by huge technological progress. This progress also has some consequences. For example on of them is that there is huge number of products with various shapes, dimensions, kinds or product ranges. The problematic questions are, what we will do after finishing of its life cycle, or what we will do with damaged or rusty product? In these days people are also talking about huge economic lucrative possibilities, which gives to us disassembly or recycle process of rusty or used product. To the end of life management strategies belongs reusing, reutilization and recycling. Before these end of life strategies we have to disassemble the product.

KEYWORDS:

disassembly, maintenance, automation

1. DISASSEMBLY AND ITS STATUS IN PRODUCT LIFE CYCLE

There are several definitions of disassembly. All these definitions can be divided in to two groups. First group of definitions are looking on disassembly as on reverse process of assembly. Second one group defined disassembly as phase, which is standing on end of product life cycle. There is also another one look on the disassembly. This look is created in recycle problematic, and is talking about disassembly as about friendly environment technology.

Very important element in disassembly problematic is product life cycle. The disassembly process is nearly connected with the product life cycle. We can say that product life cycle is created by several parts, or sections. The sections of product life cycle are: (Fig. 1)

- The creation section
- The maintenance section
- The end of life section

Each of these sections is nearly connected with disassembly operations. Creations sections are usually made by manufacturing and assembly operations. But also in this phase of product life cycle we can find disassembly aspects.

For example is very important to design the product consider to its future disassembly which can be realized during maintenance, renovation or in end of life. Expect of these reasons there are also other ones which are implemented disassembly to the product life cycle. The reasons of disassembly implementation are: (Fig. 2)

- Design with reference to the disassembly
- The maintenance
- The innovation
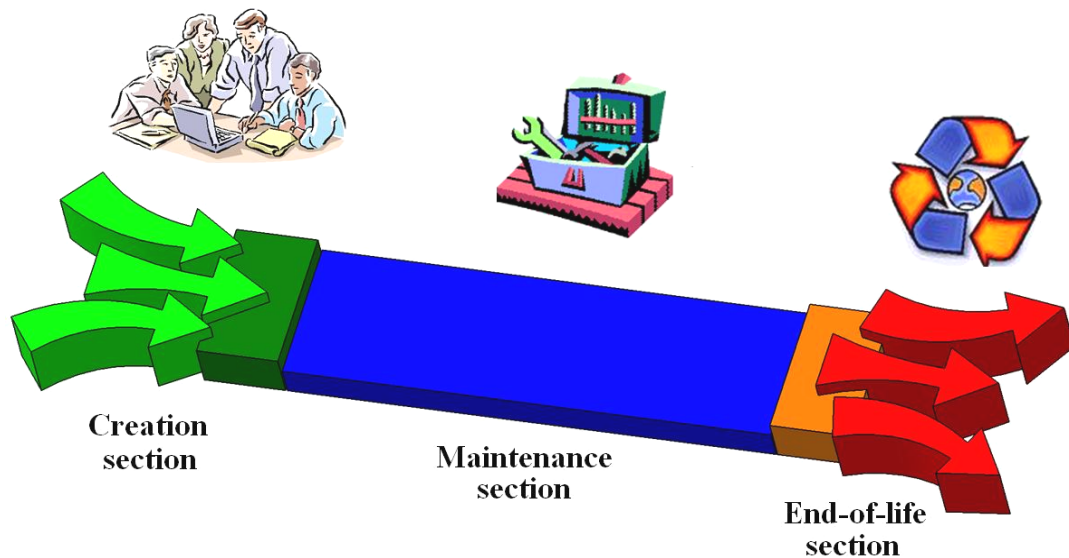- The end-of-life
- The recycling
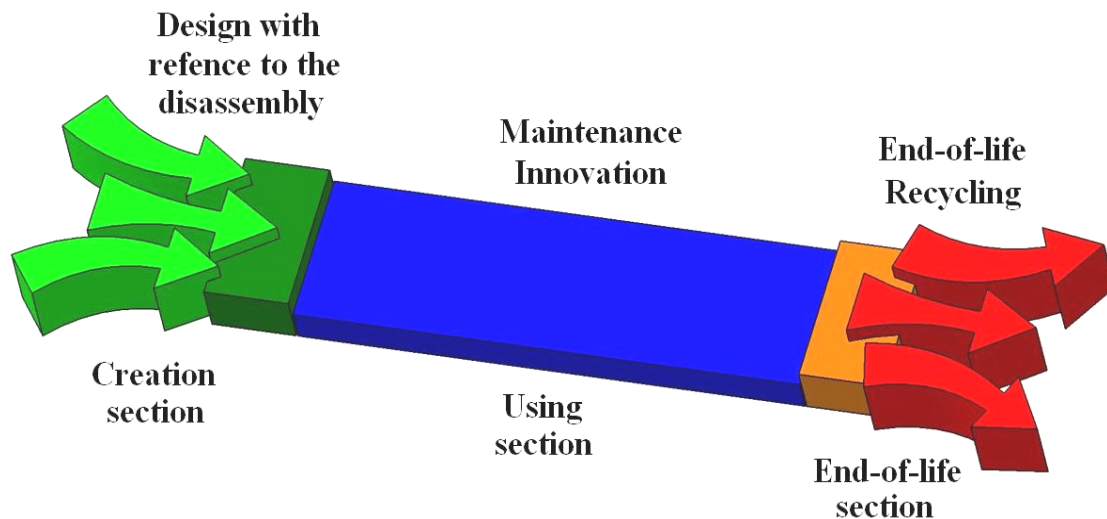
Fig. 1 Product life cycle

Fig. 2 Reasons of disassembly implementation in to the product life cycle

Disassembly and disassembly processes have in product life cycle specialized status. This status has important place especially in product end-of-live. But there are several possibilities how can be product end-of-live realized. But, problem is that during the using of product, we are not able to know how we will end the product life cycle. If it is necessary to know, how we will end the product life cycle during his using phase, we can use strategies for product end of life ending. There is huge number of product end of life strategies, but there are some, which can be defined as most respected. To these most respected end of life strategies belongs:

- reusing of used product
- reconstruction of used product
- using of used product as spare parts
- recycle with disassembly
- recycle without disassembly
- storage of using product on dumps

Very important problematic is exactly need of specialized disassembly system. This kind of disassembly system will need disassembly machines and devices which will be able to work in automated sequences.

2. PROBLEMATIC OF AUTOMATED DISASSEMBLY DEVICES

Automated assembly of various product kinds became to be standard in many countries, especially in developed countries of Europe, USA or Japan. To reach economic targets it is necessary to create new effective automation resources such as manipulating devices, industrial robots, sensors systems and so on.

On the other hand, there is other situation in field of automated disassembly systems. There are many external factors which are influenced to the disassembly automation process. There are factors such as quality of disassembled product or identification of part which have to be disassembled. Usually there is huge product range which have to be disassembled and disassemble products can come to the automated disassembly system more or less damaged. That why for disassembling of any product is needed automated disassembly device which will be very sophisticated.

In principle, generally any product can be disassembled automatically. But for this kind of disassembly process can be realized only at specialized workplaces, which will be equipped with high sophisticated automated instruments such as industrial robots with robovision, or intelligent disassembly devices.

But application of these kind devices has some disadvantages such as:
- Price of one disassemble part will be huge
- Need of special educated employee, which will program these devices
- Need of advance preparation which will depend on disassemble product

Against these possibilities of disassembly process automation is evident, that the most effective is decentralized process of automated disassembly devices. That means, that such disassembly system will be created by number of smaller, less complicated automated disassembly devices, which will be build of simple automation instruments. As simple automation instruments can be indicated pneumatic, hydraulic, electric elements such as, valves, actuators, electric axis, relays, PLC modules and so on.

But, for creation of such decentralized, automated disassembly devices it is necessary to have methodology, which will describe and reflect all resources for creating such devices regarding to the subjects of disassembly process.

Creation of such methodology is aim of researches realized at the department of technological devices and systems. The department has strong partners in field of automation process realization. Department is cooperate with firms such as Festo, or SMC. Methodology of automated disassembly device design will be standing on skills and knowledges connected with product ranges of reflected cooperation.

With help of disassembly devices design methodology we would be able to create peripheral disassembly device, which will operate in automated manufacturing and assembly cell, situated in department laboratories. (Figure num. 5) The creation of such automated disassembly device will be verification of created disassembly devices design methodology.

3. CONCLUSION

The rapid development of new product has shortened product time-to-market and shelf-life, increasing the quantity of wasted used goods. In this context, all these factors must be considered during the design stage of a product. Disassembly aspects have to be taken into account in several steps of the product Life-Cycle, both in product design and during the process design for the disassembly of End-of-Life product. In End-of-life phase is very important to choose optimal and effective strategy. There are several most frequented strategies, but main part of them can be realized only with help of automated disassembly system. Generally every disassembly system can be automated, but this usually very complicated and sophisticated solution may not be able to bring some economical effect. That why it is more effective to decentralize this system with creating of smaller, simple disassembly devices. For creating such device it is necessary to have methodology which will solve all questions which can rise during the design of automated disassembly device.

REFERENCES / BIBLIOGRAPHY

[1]   POPPEOVÁ, V., ČUBOŇOVÁ, N., URÍČEK, J., KUMIČÁKOVÁ. Automatizácia strojárskej výroby. Žilinská univerzita v Žiline: EDIS, 2002. 230s . ISBN 80-8070-009-5

[2]   MARCINČIN, J.N.: Tendency in development of up–to-date CAD/CAM/CAE systems. Engineering, n.3, fascicle.11, 1999, pp.36-37

[3]   PETERKA, J., JANÁČ, A. CAD/CAM systémy. Bratislava: STU, 2002.

[4]   HRUŠKOVÁ, E.; MATÚŠOVÁ, M.: Modular clamping fixture modeling. In: Machine Design: On the Occasion of the 47th Anniversary of the Faculty of Technical Sciences. 1960-2007. 2007.