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## **APPROACH TO COLLECTING AND RECYCLING OF THE PORTABLE BATTERIES AND ACCUMULATORS IN SLOVAKIA**

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### ***Abstract:***

*The contribution deals with collection and recycling of portable battery and accumulators. The present state in Slovakia isn't suitable. The paper mentions possibilities of its solution by example from neighbouring region. This state is unfavourable as from look position of the state to European legislative and its strike (directive EU2006/66/ES) and producers and importers, who are responsible for performance of engagements.*

### ***Keywords:***

*collection, recycling, portable batteries and accumulators.*

## **INTRODUCTION**

The current state in the area of collecting and recycling batteries in Slovakia is not suitable. This situation is caused mainly by charging the battery manufacturers, while no indices and anticipations for systemic collection of used batteries from distribution spots, in terms of the waste act, are not being fulfilled. The same situation is also in the case of recycling, storage and disposal of these used batteries. This condition is unfavourable not only from the state's point of view and its attitude towards the EU legislation and its fulfilling (the new directive EU2006/66/ES), but also for manufacturers or importers, who are directly responsible for putting the directive in practice. Therefore it is vital to search for the means of making the process of collecting more effective and find the solutions to this problem.

## **EUROPE LEGISLATIVE**

Considering the European legislative (directives 2006/66/ES), all the member states must reach a certain level of backwards collecting, processing and recycling of portable batteries. According to the directive, the level of collecting and subsequent recycling of used portable batteries and accumulators in the EU member states should reach the target of 25 % by 2012. This share should be at least 45 % by 2016. At the same time, the new directive forbids selling of batteries and accumulators which contain more than 0,0005 % of mercury and portable batteries which contain more than 0,002 % of cadmium. The forbiddance doesn't include the portable batteries used in emergency and alarm systems, medical appliances and wireless electronic appliances.

The target level of 45 % of collecting is currently being reached only in Belgium and Switzerland, however very close to this number are the collective organizations in Austria, Germany and Netherland. Czech Republic is currently on the level of almost 17 %. Seeing that the situation in Slovakia is not satisfactory, it is necessary to create as good conditions as possible for successful fulfillment of mentioned goals of waste management in this particular area – used portable batteries and accumulators.

The directive assumes that financing of the costs of collecting, recycling and processing of all batteries must be secured by the manufacturers and importers of batteries in the Slovak Republic (SR). The separated collecting and recycling of industrial and automobile accumulators can be financed from the very good revenues gained by selling the obtained metals. Different situation is in the case of portable batteries, where the costs of collecting and processing significantly exceed the returns from recycling. The directive sets the compulsory recycling of all collected batteries and accumulators, which subsequently have to be materially capitalized.

## **COLLECTING AND RECYCLING OF USED BATTERIES IN SLOVAKIA**

Each year are imported to Slovakia about 550 tones of portable batteries and accumulators. This represents an enormous burden for environment, especially when amount that big isn't suitably processed. Issue of this kind of waste is very current topic from several points of view: environmental, economic, law and technical (technological).

Collecting itself is a significantly complicated phase of the whole manipulation process with used portable batteries and accumulators. This particular phase still isn't completely solved, even in the countries which organize the collecting of used batteries for more than 10 years. The consequence of relatively low share of collected used batteries is the fact that many portable batteries finally end in an ordinary municipal waste. Possible material potential is being destroyed on dumping places and in incinerator plants. This material potential could be used to reach savings in drawing from primary natural resources etc. It is therefore necessary to collect and recycle as much used portable batteries and accumulators as possible. It is generally estimated, that maximal possible extent of recycling is approximately 80-85 %, because it is not possible to identify the differential percentage of collected used portable batteries and accumulators, concerning their chemical composition. In countries where collecting of portable batteries is organized via collecting spots together with electro-waste, the level of collected amount is considered to be low, approximately 30 % from the total presence in the particular country. Only the returned batteries can be collected and only those collected ones could be then sorted and recycled. The essential of this system is complexity beginning at the collecting stage and ending in the industrial usage of gained materials from used portable batteries and accumulators. Manipulating with used portable batteries and accumulators is a serious problem for every single state which won't be able to fulfill the conditions of the new European legislative, as well as for manufacturers and importers who are fully responsible for fulfillment of this legislative.

The act of Ministry of environment No 223/2001 Slovak Republic about wastes is an implantation of the requirements set in the directive of European parliament and Council 2006/66/ES about batteries and accumulators and about waste batteries and accumulators.

## 1. Current situation in Slovakia

The current situation is mostly about charging the manufacturers. However, indices and assumptions for systemic collecting of used portable batteries are not being consistently fulfilled, especially in the case of collecting spots defined by law. We are talking mainly about distribution places defined by the mentioned law. These are the places where the new portable batteries and accumulators are being sold. Recycling, storage and material valuation or disposal are also defined and lacking practical effect. The sole recipient of the fees is currently the Recycling Fund of the Slovak Republic (RF), which:

- returns the fees for the collected and recycled batteries backwards or
- may grant the donations for projects concerning collecting and recycling, however there is no legal claim for these donations.

Based on the information from the European parliament, as well as considering the development in this area, the SAB SK (Slovak association for batteries) association was established in May 2006. Founders were the 7 most important manufacturers or importers of batteries in Slovak Republic. The goal of SAB SK is to represent the interests of manufacturers, importers and distributors of batteries at the legislative organs or other different institutions of the state administration, as well as to monitor the development in national and international legislation in this area. In cooperation with an international organization EPBA (European Portable Battery Association), the association aims to work out the strategic plans for reaching the maximum effect in facilitating backwards-collecting of the used batteries and their disposal or recycling in collaboration with authorized processor.

## TRENDS AND DEVELOPMENT OF CONSUMPTION

As mentioned earlier, the waste market with used portable batteries and accumulators in SR currently represents amount of 550 tons per calendar year. This number is crucial for setting the right collecting, processing and recycling capacities. Its size determines the possibility of creation as well as consequent usage of such capacities in SR or moving the collected and sorted used portable batteries and accumulators to recycling facility abroad, with preference of the EU countries. The size of this waste market is currently being made of average consumption of portable batteries per SR citizen in amount of 4,8 batteries per year. Just for contrast and comparison of situation within EU we would like to mention, that the above indicator in the EU founding countries is in the range of 10-12 batteries per citizen per year.

Aforesaid consumption consists of the two main categories, which are:

1. Primary batteries, mostly divided into:
  - zinc - chloride batteries
  - alkaline batteries
  - lithium batteries, these however still represent only minimal share in the segment of primary batteries
2. Secondary batteries (accumulators).

Unit as well as weight proportion between the shares of primary and secondary batteries speak clearly about the dominance of primary batteries, in the rate 97 % to 3 %. Based on this reality, the trend of development and consumption of the primary portable batteries in the recent years is a vital parameter for us. This parameter would identify potential running out of the development of consumption in the western European countries.

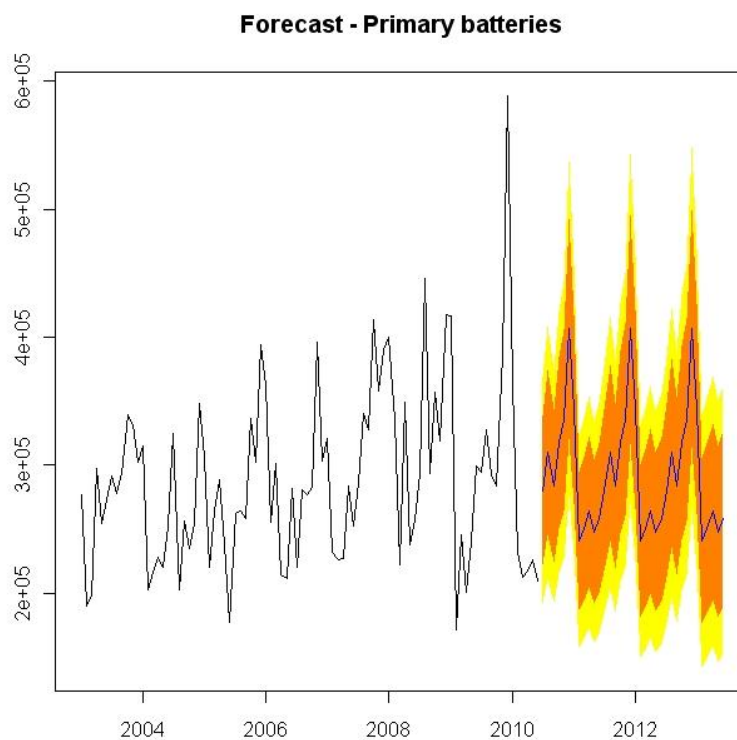
For this research, the sale results of a distribution company, which operates in the whole Slovak Republic, were used. This company represents approximately 15 % of the whole market with portable batteries and accumulators in SR, which makes our data exceptionally predicative. This predicative ability is supported by stable market shares of the distributed brands in SR, documented by the AC NIELSEN company, which in the long term monitors the mentioned segment.

For setting the trend of consumption, the sale data from years 2003 – 2010 have been used. As a base data we used the sale results from the year 2003, to which we compared sale results in the following years through the coefficient of growth.

We have to identify the type and model of time series and forecasts to determine a period of 36 months with using the open source R software package (package “forecast”). The output from this software is the type of exponential model in the form of ETS (Error, Trend, and Seasonal).

The analysis of output from the R package indicates that the most advantageous model is model without trend with additive seasonal component and multiplicative errors (MNA model).

The Figure 1 shows a graphical representation of empirical values together with the forecast values and the 80% and 90% confidence intervals.



*Figure 1: Trend and forecast of consumption of the primary batteries in SR*

Primary batteries are, as a whole, characterized by various size types of these batteries. As the carrying types in this category the following size types could be considered: AAA, AA, C, D, 9V. From the creation of the consumption trend point of view, it is interesting to look at the mentioned tendency through the type marking. This trend is, for comparability, compared also to the base year 2003 through the coefficient of growth or decline in particular following year. This is graphically shown in the Figure 2.

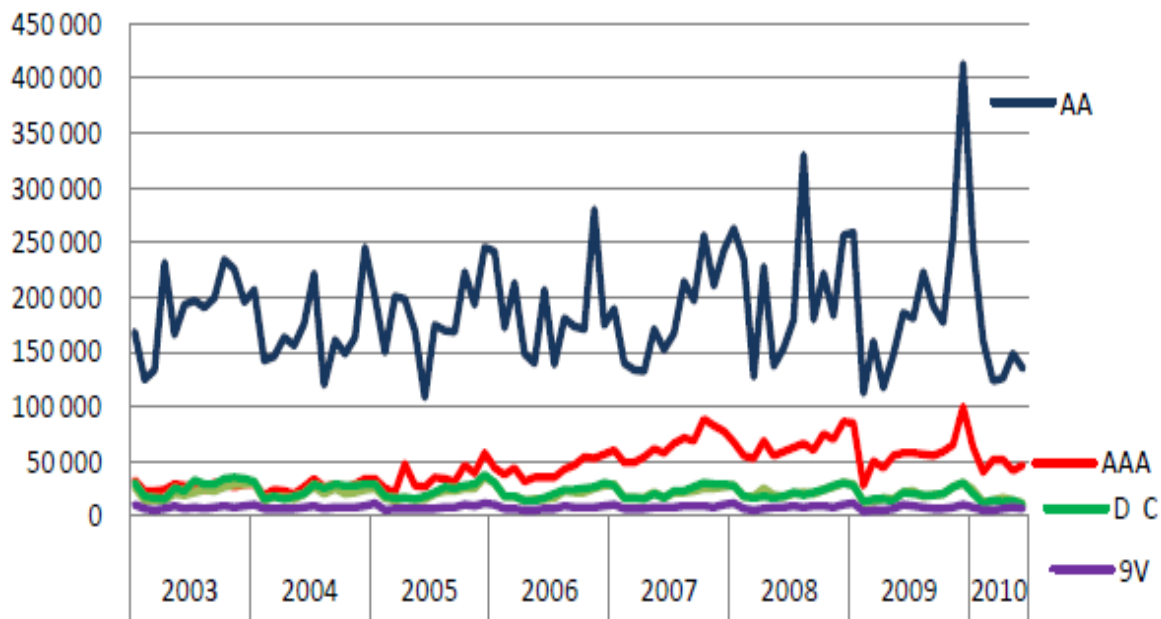


Figure 2: Trend of consumption of the primary batteries in SR based on the particular types

As we can see from the Figure 2, the growth of overall consumption of the primary batteries was effected mainly by the growth of the AAA type, which is commonly used in modern appliances and which in fact represents the smallest portable primary unit from the mentioned basic group. Growth in the monitored term was more than double. Concerning the initial starting position of the AAA type in 2003 is, however, the impact on the overall trend of consumption of the primary batteries smaller than expected. The trend of consumption is negatively effected by the declines in consumption of the so called big batteries (types C and D), which are caused by the miniaturization of the electronic appliances and subsequent demand for minimization of the portable source of energy (represented by primary battery) as well. The trend-stable graph with slight trend growth is in the case of batteries with the type marking AA and 9V, which did not record a significant deviation in the whole length of the monitored term.

## METHODOLOGY OF OPTIMISATION

Waste market for used portable batteries and accumulators is quite complicated, because it is composed of a large number of small portable batteries, of which the dominant part comes from household garbage and a minor part of other consumer places. Optimal guidance must respect effective practice and procedure to determine the appropriate system for the collection, treatment, recovery and recycling of portable batteries and accumulators according to current legislation. Principles, from which were based on developing and creation of methodology, are following:

- build of the optimal independent systems - the design solution must be enforced locally or by other interests, which impair the competitive environment,
- build up a flexible system - the system must be designed so that it can respond flexibly and not to make a major collapse,



- obtain continuity - at the creation of a new system must be bind in an optimal way on present system and its individual elements and to modernize and to intensify them in order to become an effective part of the newly existing system.
- minimize risks - by draft of progressive establishment in the selected time horizon to minimize the risk of potential missteps,
- real applicable outputs - designed system will have a number of outcomes which must be applicable in the market environment and from these reasons should not be endangered its functioning.

Methodology of collection optimization of used transferable batteries and accumulators can be seen in Figure 3.

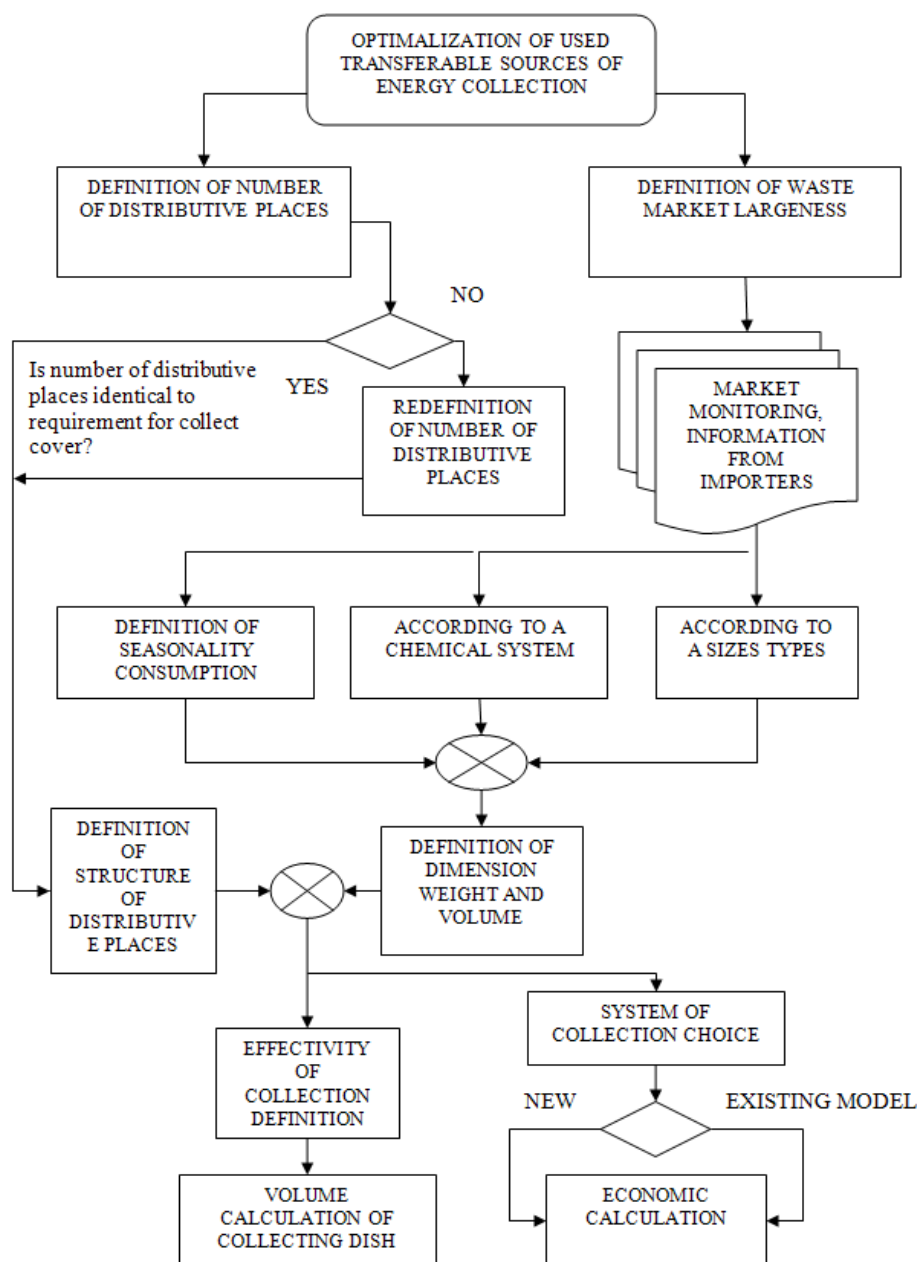


Figure 3: Methodology of optimisation collection of used portable batteries and accumulators

## DISCUSSION

Potential risk for the environment, resulting from the great amount of used primary batteries represents a challenge for manufacturers, distributors, final consumers of batteries and most of all for those subjects, which are directly involved in collecting, processing and recycling of the used portable batteries and accumulators. Only the returned batteries can be collected, and only collected batteries can be then sorted and recycled. Evaluating of the primary and secondary portable batteries in Slovak Republic still lags behind the advanced European countries. The basis of an effective system is complexity, since the collecting till the final industrial usage of gained materials from used portable batteries and accumulators. Significantly high effectiveness is a matter of great interest of manufacturers and importers of the portable batteries in SR, because its cost greatly influences the process of price-making of the new portable batteries. Having that in mind, the most effective system will be successfully built by using their distribution capabilities, within the system of selling-collecting.

## CONCLUSION

Considering the trend of consumption development of the portable primary batteries and accumulators in SR, it is not possible to anticipate significantly rapid growth of the waste market in this area. On the contrary, it is possible to expect balanced, slightly increasing unit consumption, which is the input assumption for the consequent solution and optimalization of the collecting, processing and recycling capacities (concerning the measure of technical and logistic facilitating). It will be necessary to minutely evaluate the particular trends which influence the unit consumption, because the increase of the unit consumption of the smallest types and decrease of consumption of the biggest types could eventually cause dimensional decrease of size of the waste market of the particular category in weight units.

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