ECONOMIC AND TECHNOLOGICAL ASPECTS OF THE USE OF SECONDARY METAL-BEARING RAW MATERIALS FOR METALLURGICAL PRODUCTION

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Abstract

In the context of economic changes is to highlight the demand for new, alternative ways of recycling materials. Also currently rising raw material prices and demand for cheaper raw materials that could suitably replace the existing one. One area of current interest is waste management. Especially in our region is the issue of recycling and reuse of waste materials economically very relevant with regard to the industrial character of the region, a high proportion of old environmental burdens and very promising economic prospects treatment of certain wastes. It is necessary to focus on the complexity of processing different types of waste. Usually, the first sets limits for the energy, and the material page. Followed by adjustment of the input when the waste separation process categorizes the part of recyclable and non-recyclable portion, which can be processed biological and thermal treatment. Environmentally it can handle only a fraction of the waste. Therefore, efforts orient mainly on modern trends using plasma technology to treat waste or unusable, including municipal waste.

Keywords: recycling, metallurgical waste, electronic waste, economic recovery

1. INTRODUCTION

Recycling of steel scrap from discarded automobiles and electronic appliances contain copper wires, tin galvanized plate and other materials. Copper and tin in steel are detrimental to various steel properties and these are “tram” elements in relation to recycling steels. In order to remove such tramp elements before remelting, steel scrap is per-treated in the solid phase. Alloying copper and tin, however, cannot be removed by means of such pre-treatment. Therefore, copper and tin have to be removed in liquid phase.

Recyclable copper and tin in molten iron can be removed by evaporation with high vacuum treatment below 10Pa. However, difficulty has been encountered in their removal by evaporation under a commonly used reduced pressure of several hundred Pa, because their removal rates are not adequate under such conditions. The main limitation on copper and tin removal have been shown to be caused by a mass transfer step in the gas phase under pressures above 1 kPa, however the removal rate phenomena is very complicated. Therefore, under the commonly used reduced pressure, increase in the interfacial area should be effective in accelerating their removal rates.

Process of plasma heating is widely used for re-heating of an iron melt in tundishes and ladles. Thermal plasma is impinged directly at melt surface, and therefore the surface temperature is driven higher than bulk. Furthermore plasma heating is also thought to be suitable to use in reduced conditions and effective in accelerating the recycling of copper and tin.

Low-temperature plasma heating was adopted as the local heating method and combined with weak oxidizing powder blowing method under a commonly used reduced pressure for recycling of copper and tin from molten iron. [1,2]

2. ELECTRONIC WASTE

Descriptions waste - electronic waste - that fast technology obsolescence places great demands on the continuous innovation of electric equipment even if the existing one still works. Therefore a considerable amount of electric waste is cumulated. This waste can be partially used for renovation and repeated use for users having lower demands, partially it can be recycled for secondary raw materials. Nevertheless not small amount of this waste still ends at waste disposals. This kind of waste contains among others heavy metals, toxic substances dangerous for the environment but also precious metals that could be recycled using new processing methods.

In compliance with strategy of the Association for Waste Disposal it is necessary to support use of wastes aiming to limitation of waste amount determined for elimination and save natural sources, mainly through repeated use, recycling, composting and use of energy from wastes. Personal computers, incl. all their parts, CPU, monitor, keyboard and mouse rank among the group “equipment of information technologies and telecommunications systems”. At present personal computers that fully or partially work are scrapped because they do not suit to their users because of their parameters. Functional parts such as for example hard discs of these personal computers can be used further on as for example reserve source or they can serve to less demanding users. If it is not so, waste of electric and electronic devices originates. We can gain precious kinds of materials just from this type of electronic waste, mainly metals such as iron, copper, aluminium and other ones that can be used and recycled by common methods.

All over the Europe volume of originating electric and electronic waste is increasing. Each consumer produces on average 16 kg of waste per year, which means 6 mil. tons per year all over the Europe. It means a huge wasting of resources as well as a serious threat to the environment. Electric appliances and electronic equipment contain highly toxic heavy metals and organic contaminants. Many European countries have taken measures forbidding electronic waste disposals. Nevertheless in some European countries introduced practice in electronic waste disposal continues. Personal computers, incl. all their parts are one of the components of electronic waste. [3,4]

2.1 Electronic Waste as a Resource of Secondary Raw Materials

Electronic waste is one of the waste kinds with the most quickly increasing volume. Its amount is growing by 3-5 % annually all over the world. With rapid development of information technologies already functional electronic equipment that is not convenient any more is scrapped.

Every year 200,000 tons of new electric appliances are sold in the Czech Republic and at the same time 140,000 tons of electric waste originates. Majority of this waste continues to end at the waste disposals 8 mil. tons of electric appliances are scrapped in the EC.

At present there is a number of companies in the Czech Republic dealing with collection, transportation, sorting and then even processing of electric and electronic waste. [5,6]

3. ALUMINUM CAN

Another type of waste that from an economic perspective is conveniently recyclable is aluminum waste. Aluminum is a metal with a very high technical importance. It occurs naturally in many minerals and is the third come common (after oxygen and silicon) element of the earth's crust **Table 1**.

Table 1 Occurrence of element on earth [9]

	Occurrence in %	
	Total earth	Earth crust
Other	<1	<1
Aluminum	1.1	8.0
Ca	1.1	2.4
Na	<1	2.1
K	<1	2.3
S	1.9	<1
Ni	2.4	<1
Mg	13.0	4.0
Si	15.0	28.0
O	30.0	46.0

Aluminum is produced from bauxite, a clay-like ore that is rich in aluminum compounds. The aluminum is only found as a compound called alumina, which is a hard material consisting of aluminum combined with oxygen. This alumina has to be stripped of its oxygen in order to free the aluminum. The alumina is dissolved in a molten salt at a reduction plant and a powerful electric current is run though the liquid to separate the aluminum from the oxygen [7,8].

The main characteristics of aluminum in comparison to a copper and steel are presented in **Table 2**.

Table 2 Characteristics of aluminum in comparison to a copper and steel [9]

Qualities	Unit	Aluminum	Copper	Steel
		Al 99.5		St 60-2
Tensile strength R_m	N/mm^2	360	500	650
Tensile strength $R_{0,2}$	N/mm^2	320	430	520
Spec. Gravity	g/cm^3	2.7	8.92	7.85
Conductivity	$m/\Omega mm^2$	35	56	
E-module	N/mm^2	$0.7*10^5$	$1.2*10^5$	$1.2*10^5$
Melting point	°C	658	1083	1539

From a technological point of view, aluminum is very useful as a deoxidising agent and as an alloying element. The high affinity for oxygen makes that this is the element effectively binding oxygen dissolved in the liquid steel. By using aluminum, during solidification of the steel there is no phenomenon of blowhole creation in the material structure.

The costs of acquiring secondary aluminum (recycled from aluminum scrap) account for about 5% of the costs of production of primary aluminum. Thus, from an economic point of view, it is desirable material for steel making [14,15]. The deoxidising agent in the form of aluminum used in steelworks in Poland, according to standard PN-71/H-82162, should have proper chemical composition **Table 3**.

Table 3 The standard chemical composition of aluminum for steel deoxidation [9]

Grade		Al+MG [%]	Mg max. [%]	Total impurities (Cu, Zn, Si, Pb, Sn etc.) [%]	Note
Sign	Feature				
Al 97	A 4	97.0	0.10	3.0	For higher quality steel deoxidation is allowed to use aluminium EN AB-AL 99.90 according to PN-EN 576:1998
Al 92	A 5	91.0	3.0	9.0	
Al 86	A 6	86.0	4.0	14.0	

An aluminum can is a leader among “recyclable beverage containers”. In the world almost 70% of aluminum cans are recovered. In **Fig. 1** the percentage of the recycled aluminum cans in selected countries is presented.

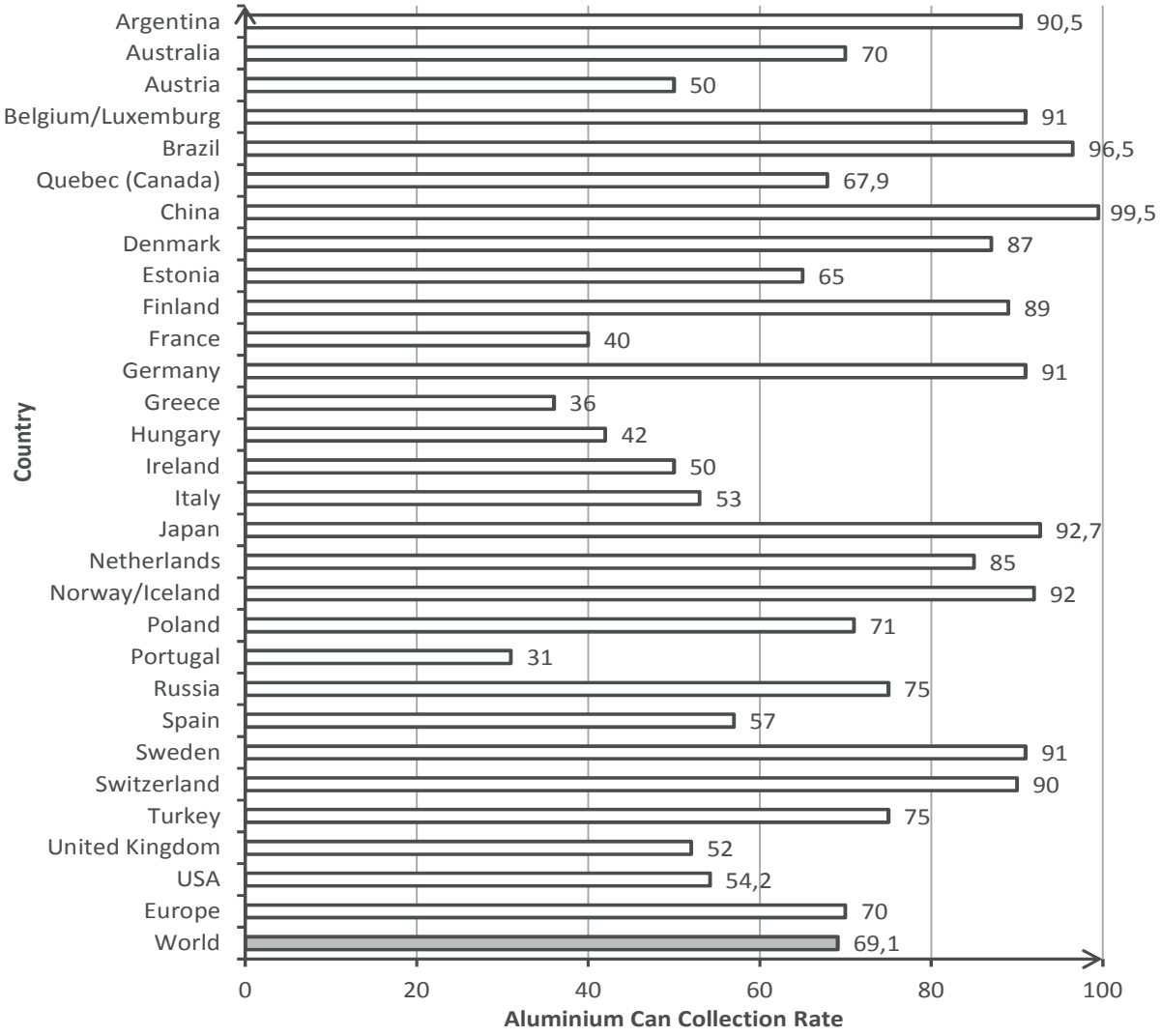

Fig. 1 Global Aluminum Beverage Can Collection Rate [9]

In the world and in Europe almost 70% of the aluminum cans are recovered. Poland was ranked on the average position between countries shown in **Fig. 1**. This means that Poland does not differ much from the average recovery rate in other countries. The largest recovery was recorded in China and Brazil. However, the lowest recovery between countries mentioned in **Fig. 1**, was found in Portugal, far below the global average.

CONCLUSION

Recycling of the aluminum beverage cans has the biggest impact on the aluminum recovery. Canned beverages are especially popular among young people, and their average consumption is more than 220 billion per year. Average global aluminum beverage can collection rate is over 70%, and Poland, despite of the lack of the "closed loop" for processing used cans into new ones, keeps the global average.

By recycling aluminum cans it is possible to reduce the amount of produced aluminum waste, which increases also amount of the available material resources. Economic benefits are connected also with saving of energy or materials in comparison to the production of the aluminum from ore. This means lower costs of production. Especially that aluminum is the most cost-effective material to recycle. All these activities lead also to the reduction of negative effects on the environment.

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