POSSIBILITIES OF ECONOMIC UTILIZATION OF BRIQUETTED METALLURGICAL WASTE

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Abstract

Recycling of metals from secondary sources is a growing industry. Metals are a renewable resource. Most metals are used in industry in a fairly massive elemental form, which greatly facilitates recycling. In the field of metallurgy Czech Republic belongs to typical processing countries without their own resources of raw materials. The use of metallurgical and other metal containing waste is therefore of significant economic importance. The overall concept of metallurgical production affects not only the economic aspects of production, but also quantity, properties and possibilities of recycling of the waste generated within the metallurgical company. Briquetting processes become at the iron- and steelmaking, an increasingly important factor also in the central European conditions.

Keywords: metallurgical waste, recycling, economic utilization, briquetting processes

1. INTRODUCTION

Together with the development and more intensive metallurgical production a great amount of waste products originates and therefore it is necessary to look for other possibilities of their use. EC legislation of waste management puts emphasis on restriction of waste origination and on exploitation of originated wastes and their elimination only by the methods which do not threaten human health and living environment [1-3].

Ministry of Industry and Trade has implemented the Policy of secondary raw materials into prepared law on wastes. Secondary resources would step by step replace primary raw materials where it is technically possible and economically effective, and contribute in this way to a decrease of material and energy demandingness of the production. Higher fees are to motivate companies to limit dumping places which will be much more expensive during next years. Prepared law on wastes takes into account that fees per each ton of waste taken out to the dumping place will be higher. According to the plan of the Ministry of Environment companies will be motivated in this way to recycle or incinerate waste in a greater deal [4].

2. WASTE MANAGEMENT

The energy exploitation of all kinds waste is preferred by Act 185/2001 Sb. about Waste. Energy exploitation of all the produced waste is highly important for these reasons [5]:

- The waste is a good alternative source of raw materials
- In comparison with other European countries, the Czech Republic does not energetically exploit the waste sufficiently

Obviously, the waste material rich in iron is suitable for energy exploitation.

Production of iron and steel is accompanied by generation of a great amount of wastes and above all it is important that wastes would become secondary raw materials. From the total amount of waste originating during production of one ton of steel 15 - 20 kg falls on direct landfilling of dangerous waste. [6]

Charge for landfill consists of two components. The basic component of the charge payable for waste storage, the storage of hazardous waste is also true risk component [5]. The rate of the basic and risk charge for depositing waste are mentioned in the following **Table 1** and **2**.

Table 1 The rate of the basic charge for depositing waste [5]

The rate of the basic charge for depositing waste in CZK·t^{-1}				
Waste category	2002-2004	2005-2006	2007-2008	2009 and next years
Dangerous	1 100	1 200	1 400	1 700
Municipal and other	200	300	400	500

Table 2 The rate risk charge for storage of hazardous waste [5]

Rate risk charge for storage of hazardous waste in CZK·t^{-1}				
Waste category	2002-2004	2005-2006	2007-2008	2009 and next years
Dangerous	2 000	2 500	3 300	4 500

According to the proposal of the Ministry in 2014 will increase the price per ton from 500 to 1 200 CZK in 2 025 and will gradually increase to 2 900 CZK.

3. POSSIBILITIES OF ECONOMICALLY EFFECTIVE PROCESSING OF METALLURGICAL WASTE CONTAINING HEAVY METALS

The decrease in production cost and increase in production quality arises from new attitudes establishment to identification of blast furnace quality such as quality of coke and iron ores. New methods of process and chemical engineering enable stabilization and gradual optimization of reductive and heat processes. [7]

In metallurgical companies more and more sophisticated separating devices are introduced and this leads to the great increase of captured flying ashes (dusts). Dusts are caught in gas treatment plants and sludge originates by spraying it. Basic principal of present industrial production is so called net production which means a contribution in better exploitation of sources when industrial pollution of environment is restricted in economically more effective way. [8, 9]

An example of such method of net production is the exploitation of sludge and dusts in the scope of metallurgical technological cycle. Sludge contains a high portion of water and a high portion of FeO and Fe_2O_3 components but moreover it contains also Zn. A significant producer of dusts and sludge is also blast furnace production of iron. An example of average chemical composition of dust and sludge from blast furnace technology shows presented in **Table 3**.

Table 3 Average chemical composition of the dust and sludge from blast furnace technology (% mas.) [10]

	Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	Mn	P_2O_5	Na_2O	K_2O	Zn	S	C	Pb
Dust	46.86	9.20	5.00	6.32	0.93	0.90	0.24	0.06	2.81	3.93	2.14	0	2.88	1.07
Sludge	14.60	4.53	4.25	6.33	1.13	1.59	0.16	0.08	0.15	0.24	13.64	2.06	36.45	1.69

Fig. 1 shows the use of dust and sludge from the treatment of blast furnace gas. Analysis of chemical composition of dust and sludge confirms that it is rich ferriferous material and therefore it can be used as a material for blast furnace production. Flue-dust is processed in sintering or put to individual pieces by other methods, for example by briquetting. [11]

The Technology of Materials department at Volgograd State Technical University (VolgGTU) is conducting research to develop a new briquetted charge material with prescribed properties by using wastes from metallurgical operations. The briquetting of finely dispersed materials is the most universal method of recycling valuable metallurgical waste products that cannot be used directly in the steelmaking process. These finely

divided wastes are unsuited for direct use in steel production due to their low gas permeability, which prevents them from being included in sintering-machine charges without preliminary treatment. [12] In the Czech Republic it is Progres Ekotech, s.r.o company dealing with briquetting of ferriferous wastes in industrial scale. [13]

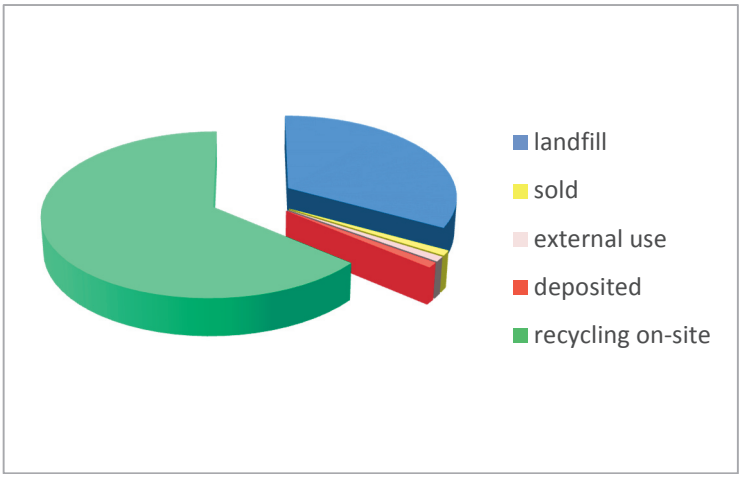

Fig. 1 The use of dust and sludge from the treatment of blast furnace gas

4. TESTING OF REDUCIBILITY OF FERRIFEROUS BRIQUETTES

The Progres Ekotech, s.r.o company has developed production procedure of addition briquettes for batch mixture for metallurgical aggregates. Briquette consists mainly of materials arisen during metallurgical processes as by-products and/or from metallurgical wastes, sludge and dust. Due to briquetting and following exploitation of these briquettes in the metallurgical process their ferriferous portions are subsequently effectively used.

Chemical composition of addition briquettes is given in practice by the requirement of the customer who delivers material for briquetting purposes. Nevertheless it has to be respected technological procedure of briquette production covered by the patent and it means that a certain portion of bonding agent and/or metallurgical coke is added. Chemically neutral substance is used as a bonding agent for metallurgical industry. Kind and particular method of use as well as briquette production are governed by patent protection [14], as well as briquettes developed VolgGTU. A charge material that has been developed at VolgGTU is made with the use of a special binder which prevents the briquetted part of the charge from fracturing during the initial stage of the heat. The binder has properties that are well-suited for maximizing the reduction of iron from oxides and carbonizing the melt. [15, 16]

Photos (see **Fig. 2a)** and **2b)**) taken from advertising materials of ProgresEkotech, s.r.o company represent practical outputs from serial production delivered to customers. New briquetting technology enables nearly complete recycling of difficult metallurgical wastes containing indispensable portion of ferrous elements. [13]

During testing of reducibility [17] of ferriferous briquettes from LVVVS Centre ENET it was evaluated briquette produced by ProgresEkotech company, s.r.o from ferriferous wastes by ISO 4695 reducibility test. The most important test result is so called reducibility index dR/dt representing reduction velocity in % per minute. During first tests of ferriferous briquettes index of 1.27 was reached and it confirmed a good reducibility of tested briquettes. [18]

Fig. 2 Practical output of the serial production ProgresEkotech company, s.r.o: 2 a) Briquette from metallurgic metalline dust 2 b) Briquette from blast furnace sludge [13]

CONCLUSION

Prepared increase of fees on dumping of wastes at dumping places will increase a demand on suitable technology processing metallurgical wastes into form suitable for next use in the scope of the company.

Optimum possibility seems to be processing of waste products near to the particular producer, preferably using existing technological equipment together with replacement of the part of input raw materials. Application of new ways of briquetting appears to be a suitable form of putting dust and tiny wastes into individual pieces and it was also proved by first tests of briquette reducibility.

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