ECONOMIC ASSESSMENT OF SECONDARY MATERIALS GENERATED IN METALLURGICAL COMPANIES

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Abstract

More than half of the material outputs throughout the production of iron and steel passes into outputs in the form of off-gas and solid waste, respectively. In the past, waste deposited in landfills, but new technologies, especially new ways of producing iron allows for greater share increase reuse and recycling of metallurgical waste. Utilization of metallurgical wastes in a closed production cycle, it means: the contribution of economic balance, reduce the need for dump, improving hygiene.

Keywords: Waste, recycling, economic balance

1. INTRODUCTION

Growth of worldwide production of iron and steel in previous years has led to the increased influence of metallurgy on the environment both in the area of greenhouse gasses and in the area of recycling waste products.

World production of steel has been increasing significantly since the year 2000 and it exceeded 1000 tons for the first time in the year 2004. World production of steel was increased to more than 1200 mil. tons in the year 2006. This increase was reasoned by the fact that steel production in China was increased from 127 mil. tons to 421 mil. tons in the year 2006.

From the very beginning the metallurgy as a branch of industry ranks among great factors being harmful to the environment. Air pollution and generation of a great amount of wastes are number ones in the hierarchy of impacts on environment components.

2. WASTE MANAGEMENT

The environment is a very important factor that determines the life of organisms on earth. To avoind further degradation of the environment, all companies are forced to act according to the sustainable development concept.

One of the methods, which allow for action in accordance with the sustainable development concept, is the process of recycling. It allows for the re-use of waste and production of new materials. What is more it allows to reduce exploitation of natural resources of the earth [1]. An important element of waste management is also optimalization of the use of materials to decrease amounts of waste arising in the production process.

Generally the waste management means the collection, transport, recovery and disposal of waste, including the supervision of such operations and the disposal sites.

The various methods of waste management create the waste management hierarchy (**Fig. 1**). This hierarchy included in the art. 4 of the Directive of the European Parliament and of the Council on waste and repealing certain directives [1,2], should apply as a priority order in law and policy relating to both the prevention of bio-waste and its management.

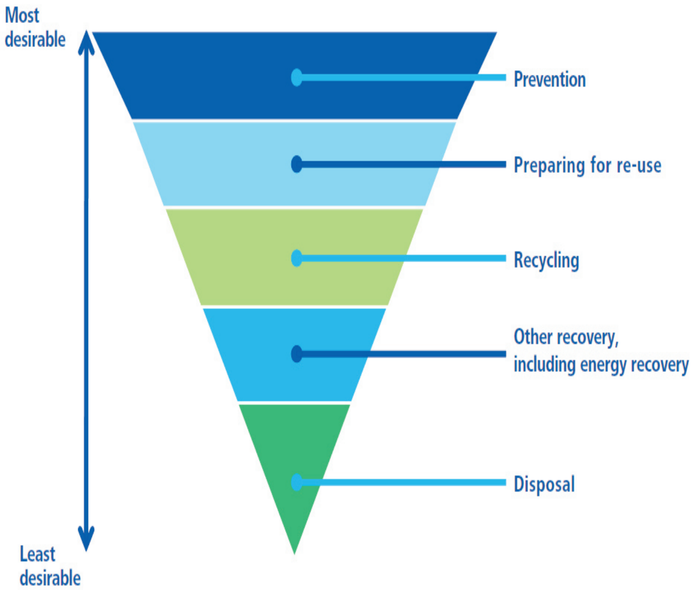

Fig. 1 Waste management hierarchy [2]

3. STATE OF AFFAIRS WITHIN EC

As follows from **Fig. 2** Europe is poor in ores in comparison with other parts, there is only 2 % of world resources of metal ores falling on our continent [2]. Therefore use of possibilities of metal production by recycling secondary raw materials and wastes is a topical present theme because it saves first of all primary resources; to obtain metals from wastes requires 5-10 % of fuels and energy in comparison with energy demands on exploitation, treatment and metallurgical processing raw materials; and waste treatment has minor impact on environment by gas exhalations, dust and sewage water.

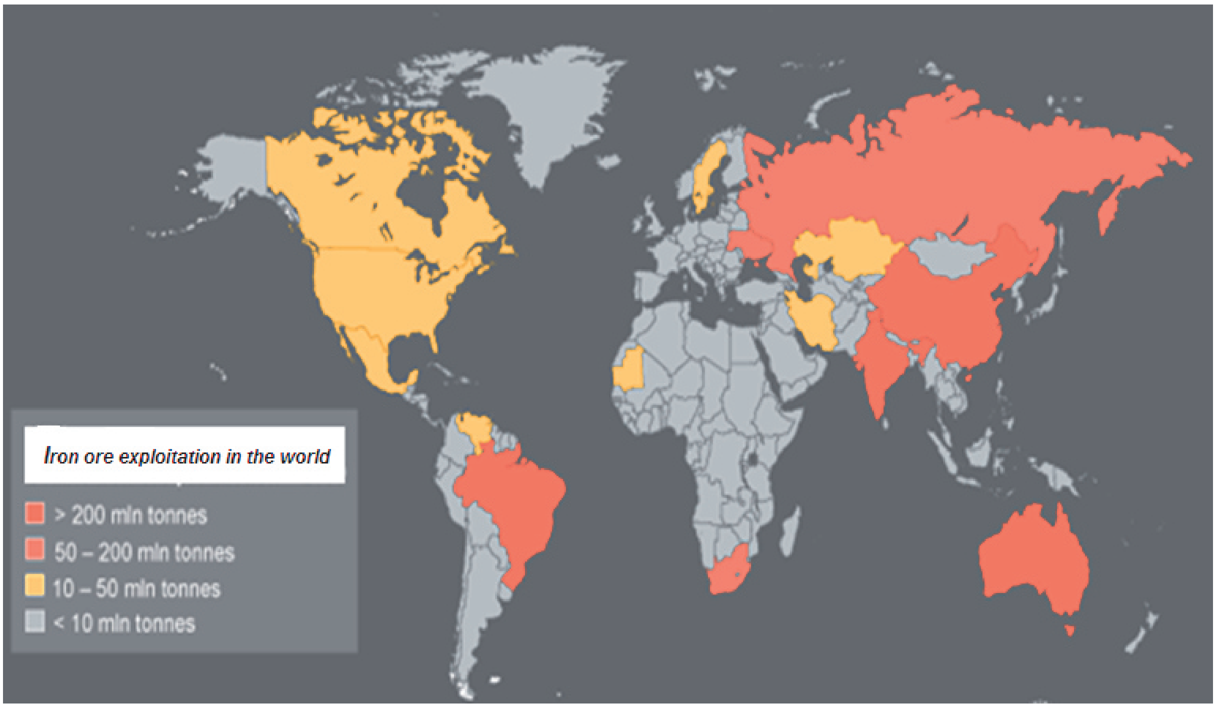

Fig. 2 Iron ore exploitation in the world [2]

Generally a substance or subject which has stopped being a waste or has never become a waste is considered to be a secondary raw material.

According to statistic data 530 mil. tons of scrap iron and steel is used on average worldwide. At total production of iron and steel amounting to 1 412 mil. tons it represents only 38 % share of secondary raw materials on steel production in comparison with Europe where this share reaches the value of 54.5 %. Industry of secondary raw materials uses 700 -800 mil. tons of secondary raw materials a year.

4. METALLIC METALLURGICAL WASTES

Currently there are worldwide developed a number of processes for treatment of metallurgical wastes. Nevertheless so far there were not found unambiguously beneficial technologies for treatment of these wastes. Solution of these problems is concentrated on the area:

- Direct reduction which is used for example in Japanese model for treatment of wastes with higher iron content,
- Melt reductions are preferred in Europe which is proved by successfully developed technologies, first of all PRIMUS, THERMOSELECT and also ZERO WASTE processes (**Fig. 3**) [3, 4].

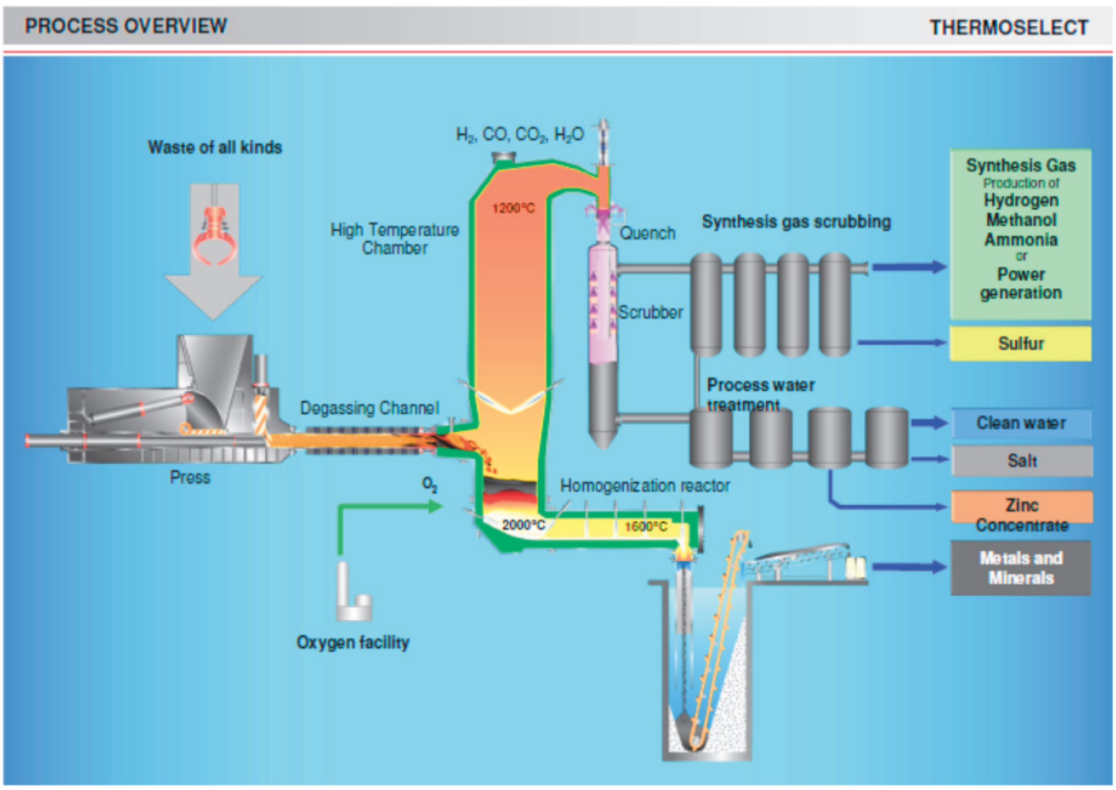

Fig. 3 Process THERMOSELECT [3]

Recently metallurgy has been introducing more and more sophisticated separating devices and it results in great increase of captured flying ashes (dusts). Dusts are caught at gas treatment plants and sludge originates by spraying it.

Metallic metallurgical wastes can be divided according to the content of slag-making components into three groups:

- wastes with a very low share of slag-making components, for example scales and metal chips from machining shops,

- wastes with a medium content of slag-making components, such as dusts and sludge from oxygen converters. These wastes contain a considerable share of volatile components and heavy metals,
- wastes with a high share of slag residues, such as slag from converter steel production.

Blast-furnace slag

Slag amount accompanying production of pig iron has been reduced in recent years. In 1950s 800-1200 kg of slag originated during production of 1 ton of iron. Now-a-days the share in Poland ranges in between 300-400 kg of slag per ton of pig iron.

Blast-furnace slag is considered to be the most important blast furnace waste. Now-a-days the entire occurrence of blast-furnace slag is processed; it means that it does not concern production waste. As a result of increase of abundance of blast-furnace charge in recent years slag specific occurrence has decreased from 600 kg.t^{-1} to approx. 430 kg.t^{-1} of slag per ton of produced pig iron. Slag from blast furnace process during desulphurization has rather high iron content. As per granulation type the slag is divided into several different categories for next processing [5].

Slag treatment in sintering process is one of the possibilities how to recycle it. A high sulphur share producing SO_2 during sintering is disadvantageous. This gas causes typical acid rains which is harmful to the environment. The total emission limit for sintering process is 2000 t of SO_2 per year. It is 10 % of total number of emissions during sintering process with a waste or fuel containing a high share of sulphur.

SO_2 in sintering process is eliminated by processing blast-furnace slag into briquettes. Experimental results gained from a blast furnace operation confirm that it is possible to process blast-furnace slag and influence the environment or technological procedure in this way. Advantages of recycling blast-furnace slag in metallurgical aggregate were verified and other technologies are expected to be developed in the nearest future.

Steel slag

Amount of steel slag is lower than during pig iron production and it is approx. 10 % with regard to the amount of produced steel. As far as reduction of silicon content during pig iron production is concerned, this share is constantly lower. Steel slag differs from blast-furnace slag in acidity and much higher phosphor content as well as a higher share of iron oxides and metal iron. Historically steel slag was used as a fertilizer, especially that one with higher phosphor content.

Scale

Scale is produced from surface oxidation of ingots, bars at high temperatures. Scale is made up from iron oxides and a small amount of impurities and therefore it is a precious metallic material. It can be used directly or it is processed in a blast furnace after a suitable treatment. Presence of more than 1 % of oil results in difficulties with its use.

Scrap iron

Scrap iron can originate from steel works and then it is in-house scrap. Composition of this scrap iron is similar to the composition of steel produced in steel works and it enables its recycling. On the contrary foreign iron scrap has another origin and composition. Presence of some chemical elements (zinc, lead, copper, tin) contained in it can cause technological problems [8,9].

Dusts and sludge resulting from gas cleaning

Items belonging to the dust category resulting from gas cleaning are as follows:

- dust from cleaning of burned gases from sintering,
- dust from wet cleaning of sludge and dry cleaning of blast furnace gas,

- dust and sludge from cleaning of waste gases from steel aggregates

Dust from sintering plants and blast furnaces is poor in iron, its content ranges from 30 to 50 %. On the contrary burned gas dust from BOF dust removal often contains more than 60 % of Fe. Dusts and sludge are used especially during ore sintering or sintering by other methods [10, 11].

5. CONCLUSION

Already since long ago waste management is one of the most important factors connected with the protection of the environment. Currently about 60 % of waste undergoes to various ways of use. Share of exploited materials depends on type of waste and economic branch in which they were produced.

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