Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 181 (2017) 357 – 362

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Conference Interdisciplinarity in Engineering, INTER-ENG 2016

An Assessment of the Metallic Iron Content from Metallurgical Wastes - Essential Factor for Sustainable Development in the Steelmaking Industry

Dana-Adriana Iluţiu-Varvara[a,]*, Carmen Maria Mârza[a], Florin Vasile Domniţa[a], Ioana - Monica Sas - Boca[a], Marius Tintelecan[a]

[a]*Technical University of Cluj - Napoca, 28 Memorandumului Street, 400114, Cluj-Napoca, Romania*

Abstract

The paper presents an assessment of the metallic iron content from metallurgical wastes (slag dump) and from the dust (resulted from steelmaking in the electric arc furnaces). The determination of total and metallic iron in the metallurgical wastes samples was achieved by spectroscopic methods. The device used was a spectrometer based on X-ray fluorescence. The metallic iron content from the analyzed metallurgical wastes samples varies according to: the composition and the quality of the raw materials (old scrap and metallic wastes) used in the steelmaking process, the auxiliary materials used in the steelmaking process (oxidants (iron ore), ferroalloys (FeNi, FeCr, FeSi, FeMn, FeMo, FeTi, FeV, FeAl)) and the type of steel produced. The results show that the metallurgical wastes from slag dump are a significant source of metallic iron. The recovery of the metallic iron (by magnetic separation), followed by its use as a raw material to the steelmaking, leads to a sustainable development in the steelmaking industry.

Peer-review under responsibility of the organizing committee of INTER-ENG 2016

Keywords: metallic iron; metallurgical wastes; dust; steelmking; sustainable development.

1. Introduction

The steelmaking processes involve a combination of primary resources and metal scrap. Although the use of primary resources has always been the main production source, the recycling of scrap is gaining ground and has

* Corresponding author. Tel.: +40-745-267218.
E-mail address: dana.varvara@gmail.com, dana.adriana.varvara@insta.utcluj.ro

Peer-review under responsibility of the organizing committee of INTER-ENG 2016
doi:10.1016/j.proeng.2017.02.401

become the main source for the steelmaking in the electric arc furnaces. The general worldwide trend is characterized by a stronger use of recycling routes versus primary resources. In this context, the evaluation of metallic iron contents from metallurgical wastes, followed by its separation and reuse in the steel industry shows an important economic and environmental usefulness.

The concept of sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. In other words, sustainable development is the development that contributes at increasing life and environment quality [2,3,4,5]. The concept of sustainable development in the steel industry depends on economic, social and environmental indicators. The International Iron and Steel Institute [6,7] have suggested a number of sustainability indicators to measure environmental, economic and social performance for steel industry.

Sustainable development to the steelmaking in the electric arc furnaces, involves [8]:

- recovery the metallic iron contents from the wastes;
- recovery the valuable components from the wastes;
- conserving the natural resources such as iron ore, coal, dolomite, magnesite etc.;
- reducing the quantity of wastes landfilled;
- increasing the degree of recycling of dust and slag;
- reducing the quantity of hazardous wastes;
- reducing the emissions of carbon oxides;
- reducing the emissions of nitrogen oxides;
- reducing the emissions of sulphur oxides;
- reducing the other gaseous emissions such as volatile organic compounds (VOC).

The aim of this paper is the assessment of the metallic iron contents from metallurgical wastes (from the slag dump) and from the dust (from steelmaking in the electric arc furnaces) in order to improve the management of industrial wastes from steelmaking in the electric arc furnaces.

The objectives of the paper are:

- the assessment of the total iron contents from metallurgical wastes (from the slag dump);
- the assessment of the metallic iron contents from metallurgical wastes (from the slag dump);
- the assessment of the total iron contents from the dust (from steelmaking in the electric arc furnaces);
- the assessment of the metallic iron contents from the dust (from steelmaking in the electric arc furnaces);
- improving the metallurgical wastes management from slag dumps;
- improving the dust management from the electric arc furnaces.

2. Material and method

The characterized metallurgical wastes samples were taken from a slag dump (Alba County, Romania). The types of wastes stored at the slag dump include: metallurgical slag from steelmaking in the electric arc furnaces, refractory materials from the electric arc furnaces, acid and basic lining from the electric arc furnaces, foundry waste sands, casting cores and molds. The raw materials used in the steelmaking process are old scrap and metallic wastes. The auxiliary materials used in the steelmaking process are: oxidants (iron ore), fondants, fluidizing materials, ferroalloys (FeNi, FeCr, FeSi, FeMn, FeMo, FeTi, FeV, FeAl), fuels and alloying elements. The metallurgical waste samples were collected from 20 points close to the edge of the slag dump. The eight dust samples were taken from a temporary deposit of wastes. The dust samples are generated from the steelmaking in the electric arc furnaces. Metallurgical wastes samples are generated from the steelmaking of the following types of steel: carbon steels, alloyed steels and high alloyed steels.

The determination of total and metallic iron in the metallurgical wastes samples was achieved by spectroscopic methods. The device used was a NITON type spectrometer based on X-ray fluorescence. The metallic iron content from metallurgical wastes samples was determined in compliance with the methodology described in the reference [9,10].