TECHNOLOGIES FOR MANAGING OF STEELMAKING DUST

Patrycja OSTROWSKA-POPIELSKA, Agata SOREK

Institute for Ferrous Metallurgy, st. Karola Miarki 12-14, 44-100 Gliwice; e-mail: ppopielska@imz.pl, asorek@imz.pl

Abstract

Abstracts Metallurgical processes creates many wastes, which are a serious hazard for environment. One of them is dust that comes from basic oxygen furnace (BOF)and electric arc furnace (EAFD). It is extremely because it includes a big quantity of heavy metals. Unfortunately despite of its toxicity in overwhelming partite is stored on piles and heaps. It causes serious changes in environment. Knowing its negative influence to environment and potential abilities to develop, it is justified to take tries to make modern methods of regaining and developing dust elements. The methods of regaining metals from BOF and EAFD we can differentiate for two groups: - pirometallurgical: based on fire processing wastes of metals and -hydrometallurgical: processes materials with chemical methods from water solutions of their salt. Presented work shows review of the most important and the most frequently applied methods of regaining metals from dust being made during production of steel in basic oxygen furnace and electric arc furnace.

Keywords:
Dust, managing, BOF, EAFD

1. INTRODUCTION

Industrial activity, in addition to advantage causes also looses, that can show up in the air pollution of gasses and dusts. Almost all technological process in mill are accompanied by pollution of gasses and dusts. Dusts and gasses in the atmosphere are very harmful to people and environment. The plants are particularly vulnerable to pollution. Dusts on the leaves of plants are the causes of disturbalance in the smooth functioning of their breathing apparatus and assimilation. This makes plant life shorter and in extreme causes death of them. Air pollution like dust and aerosols increases use of all machines and mechanism.

The use of modern technology gas cleaning and recycling wastes disposed like dust reduced emissions of toxic compounds into environment, that reduce the exploitation of natural resources. Purification of exhaust gasses will allow recovery of valuable components of feed processed, that reduce cost of production.

2. STEELMAKING DUST

Iron and steel industry are the one of the major “producers” of the pollution of dusts and gasses emitted into atmosphere. This is effect of many processes that consume large quantities of raw materials and energy. By altering raw materials and transport them to different units they become a source of pollutants.

Steelmaking dust is waste of both smelting process (electric arc furnace, basic oxygen furnace) and the casting of steel. Steelmaking dust from artificial sources are released into the environment, as a result of economic activity (steelmaking process).

2.1 CHARACTERISTIC EAFD

Dust contained in exhaust gasses can be divided into two groups:

- Dust from processed raw materials entrained mechanically. That dust is characterized by relative thick particles. The size of them is from several to tens of microns. Fig.1 shows the chemical composition of coarse dust [1]
Dust resulting from the partial evaporation and condensation of some components of the charge. That dust is characterized by small particles of size. Fig 2 shows the chemical compositions the fine dust [1]

Fig. 1 Chemical composition dust coarse-grained  
Fig. 2 Chemical composition dust fine-grained

The following factors effects amount of dust produced in steelmaking process:
- particle size of processed raw materials
- composition chemical and mineralogical of processed raw materials,
- temperature in the metal aggregate

EAFD prevails Fe$_2$O$_3$ and FeO. The dust entrained in the flue gas and collected in extraction units, can be recycled for recovery of iron. The rest goes to the cement plants as a feedstock for clinker process or is stored [2]

Dust emissions in each periods of smelting in electric arc furnace varies within wide limits, for national furnace it's:

- initial melting period $\rightarrow 0.08-3.1$ g/cm$^3$
- final melting period $\rightarrow 0.04-5.3$ g/cm$^3$
- refining ore period $\rightarrow 0.07+5.5$ g/m$^3$
- refining oxygen period $\rightarrow 0.85+7$ g/m$^3$
- finishing $\rightarrow 0.06+3.7$ g/m$^3$

Exhaust gasses dusts from electric arc furnace are result of partial evaporation and then condensation of some of components batch processed in these device. The source of dust are holes and klin like: ring around the electrode, the drain, leaks on ceiling and batch closing windows. Significant dust emissions occur during; melting, refining, loading, discharge [3]

Wastes from the Polish electric arc furnace are almond 100% utilized. The high dust content in gasses makes for purification. Dust pollutions are being stopped in the modern extraction units. By modernization of production process there is reduction of greenhouse gasses.

In electric arc furnace 12-16 kg/steel. An important feature of steelmaking dust is high iron content more than 60% of the mass Fe. Fig 3 shows the chemical composition from national and foreign electric arc furnace. The Fig. 3 shows that dust from electric arc furnace is characterized by high content of zinc, of more than 20% mass. The dust are suitable for processing in non ferrous metals smelt [4]
2.2 CHARACTERISTIC BOFD

The dust from BOF gas can be divided into coarse and fine dust. Treatment of dry gas furnace made coarse dust as a sludge in the wet treatment. The dust after appropriate preparation is:

- recycled in the process of converter,
- directed to the process of sintering ore

The fine dust contains higher amount of lead and zinc can be not refitted and is stored in landfills.

![Chemical composition sludge from national and foreign electric arc furnace](image1)

The chemical composition dust from national and foreign basic oxygen converter shows Fig. 5

Fig. 6 shows designed dust from converter gas purification to dry in the UE and Fig. 7 shows the designed dust from wet cleaning converter gas in UE.
Fig. 5 Chemical composition sludge from national and foreign converter steel

The dust are suitable for processing in non ferrous metals smelt.

Converter dust contain less zinc only to 7%

Steelmaking dust are characterized by significant dispersion:

- 77-85% fraction below 5 um
- 0,1-10% fraction above 50um

In converter steelwork is used wet dedusting, while in electric arc furnace steelwork dry. The converter steelwork generated 8-12 kg/mg steel [6]

Fig. 6 Designed dust from converter gas purification to dry in the UE[7]

Fig. 7 Designed dust from wet clearing converter gas in EU [7]
3. **USE SLUDGE AND DUST STEELMAKING**

Dust and sludge from steelmaking converter should be selective used depending on zinc content. Part of them with low can be used in sintering production after averaged with dust blast furnace. The methods provides thickening a mixture of sludge’s dewatering fragmentation drying dust in a special mixers. That prepared mixture can be consume as part of sinter mix. (Fig.8)

![Diagram in the plant raw material of iron-bearing sludges.](image)

**Fig. 8** Diagram in the plant raw material of iron-bearing sludges.

Dust are used in many manufacturing technologies outside the metallurgical (Fig.9) [8]

![Diagram of use of steelmaking dust](image)

**Fig. 9** The use of steelmaking dust in manufacturing outside the metallurgical

Depending on metal concentration in dust, and current demand in metallurgy the best known and most commonly used methods for recovery zinc from steelmaking dust are:

- piometallurgical- based on fire processing wastes of metals,
- hydrometallurgical- process materials with chemical methods from water solutions on their salt.

The most commonly used piometallurgical methods are: Proces Wealza, process Elkem, process ZTT Ferrolime, process MetWool, process Ttronics, process Enviroplast, process All Met, process Plasmadust, process Imnetco, process IBDR-ZIPP, process Sirosmelt.
The most commonly used hydrometallurgical methods are: proces S.E.R.H, proces Zincex, proces Ezinex, proces Cashman, proces Rezeda, proces Terra Gaia. The recovery of zinc are detailed described in journal Hutnik- news mill write by P. Ostrowska, K. Mierzwa, no 7/2007, Recovery zinc from metallurgical wastes [9]

LITERATURE

[2] www. mos.gov.pl,
[3] OSTROWSKA P.: Emisja zanieczyszczeń gazowych w konwertorach tlenowych oraz sposoby ograniczania oddziaływania na środowisko naturalne, Krakowska Konferencja Młodych Uczonych, s. 133-138, Kraków, 2008 r,