J. Int. Environmental Application & Science, Vol. 12(1): 59-62 (2017)

Optimization of the Process the Mixture of Copper ores for Melting the Analytical Method

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Received February 12, 2016; Accepted March 13, 2017

Abstract: he basic aim of the process of smelting in furnaces with flame is smelting full of material and reaching effects optimal technical or economical to process with minimum consumption of fuel, maximum speed and pass as full of copper in the main product of the merger in Matte. In oven with flame, except concentration concentrate can be processed and also other material that contents copper or other precious metals that are characterized by the fine granulomeric structure as: Rich copper ore; Rich ores of precious metals; Furnace dust in copper metallurgy; The converter slag; Restoration materials with flame furnace; Surpluses and by-products of different branches of the metallurgy. One of the most important factors to good work the operation of the furnace development of chemical reactions that enable the creation of products composed of certain (mattes and slag) is the process of calculating (determining) the amount of ore that must be mixed and which are available amalgamation. Determination as accurate enabled by knowledge on the theoretical foundations of the process of melting the ore different copper chemical reactions that must take place during melting, accurate calculations and work much better furnace for melting with all assistive devices.

Keywords*: ore, copper, melting, optimization.*

Introduction

As raw material for the smelting process are used ores and concentrates of copper containing various copper. Ores that do not contain sufficient quantities of sulphur for the formation of mattes *m* *(m =* Cu_2S *+ FeS2)* added additional quantities of sulphur. Conversely ore with content high sulphur subject concentrating Prior (desulphurization) with the aim of reducing the content of it. It should be noted that the benefit of mattes with high content of copper is not appropriate since the content of copper slag is raised with increasing its content in Matte. In practice, as appropriate is Matte containing copper 40-45% Cu. It is important to note that the choice of processing of ores copper based accounts metallurgical, as well as in economic, especially if processed ore rich in pyrite with concentrating of which acquire through gases that can be used to produce acid sulphuric acid.

Melting processes and products in furnace

The mixture of ore and smelter (limestone) enters the furnace that heats rapid 1100-1300^oC temperatures, namely up to the temperature of melting chemical reactions and the formation of mattes and slag. Matte of liquid or Cu_2S-FeS system formed as a product of the reaction between the sulphur to copper than iron. The content of copper in Matte depends on the amount of sulphur and forms Cu_2S, while FeS oxidized forms. It follows that, as far as this sulphur FeS so more will be formed, and with this reduced the amount of copper in Matte. From the whole amount of oxidized sulphur in an amount of gases and this amount is in the range 13-30%. The entire amount of the iron part passes in the form of FeS matte, passes the slag in the form of FeO. Under suitable conditions for the development of processes in the oven, the losses of copper slag are less than 0.5% of the amount of slag and that the mixture (compound) as the most accurate ores that are available, rational use of fuel and control of technological parameters of the process can also be reduced. Melting chemical reactions consist of diffraction sulphur reactions and in the formation of slag reactions, of which the most important are:

$$2CuFeS_2 \rightarrow Cu_2S+2FeS+S$$
$$2Fe_2O_3 \rightarrow 2Fe_3O_4+0.5O_2$$

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$2Fe_3O_4+3SiO_2=3[(FeO)_2xSiO_2]+O_2$
$3Fe_3O_4+FeS+ 5SiO_2=5[(FeO)_2xSiO_2]+SO_2$
$CaO (MgO)+SiO_2 \rightarrow CaO (MgO)xSiO_2$

If the ores are present zinc sulphide and some other metal sulphide, passing through the slag in the form associated with silicate oxide:

$2ZnS+2FeOxSiO_2=2ZnOxSiO_2+2FeS$

If the individual pieces of reactive furnace area come to the formation of oxide Cu_2O, due to greater affinity of sulphur to copper line formation Cu_2S:

$Cu_2O+FeS=Cu_2S+FeO$

In this case can come to the creation of elementary copper:

$4Cu +Cu_2S + = + SO_2+ 2CuO$

In the presence of elemental copper FeS passes Cu_2S:

$2Cu + FeS = Cu_2S + Fe$

Basic iron oxides reacts with his highest being converted into oxide with lower valence and slag passes. Desulphurization with the merger in the oven is 20-25%, which means that 75-80% of the amount of sulphur that enters the furnace passes in Matte.

Data for the ore, smelters and fuel that are available in the courtyard of ore

We present ore yard are three types of ores (X_1, X_2, X_3) and smelter (limestone) X_4 with composition as in the Table 1.Using coal as fuel powder is that 15% of the whole amount of cargo. To establish the specific amount of ash after combustion of coal dust with gases allegedly removed through stack (chimney).

Table 1.The composition of ores available to smelters

Ore 1 (X_1)		**Ore 2 (X_2)**		**Ore 3 (X_3)**		**Smelters (X_4)**	
Cu_2S	13%	**$CuFeS_2$**	29%	**Fe_2O_3**	78%	**Fe_2O_3**	2%
FeS	9%	**FeS_2**	19%	**SiO_2**	13%	**SiO_2**	2%
Fe_2O_3	31%	**SiO_2**	52%	**Al_2O_3**	4%	**Mg_CO_3**	21%
SiO_2	35%			**$CaCO_3$**	5%	**$CaCO_3$**	75%
Al_2O_3	12%						

Analytical Calculations

From practical experience losses of copper slag to be minimal, the amount of copper in Matte must be within the limits: 40-45% Cu, and for the calculation is taken Cu^m = 43% Cu, while the slag viscosity that enables leakage best from oven and minimum amount of copper slag, with the following composition: Z = 40% SiO_2CaO + 15% + 45% FeO, while the scale of the sulphur removal of gases: 20%.

Ore X_1 does not have enough sulphur to obtain the requested Matte. X_2 that satisfies ore which contains a considerable amount of copper which is linked to X_1 copper ore. This is determined by After the ratio of slag quantity of iron ore X_3 and X_4 amount of smelter.

$\% Cu_2S^m = \% Cu \times Cu_2S/2Cu= 42 \times 160/2 \times 64 = 53.75 \%$
$\%FeS=100-53.75=46.25$
$\%Fe^m_{FeS}=46.25 \times Fe/FeS= 29.43 \%$
$\% S_{FeS}= 46.25-29.43=16.82 \%$
$\% S_{Cu_2S}=53.75-43=10.75 \%$
$\% S^m=16.82+10.75=27.57 \%$

For 100kgofore (X_1) has:

$Cu^x = 100x0.13x2Cu/Cu_2S = 10.4kg\ Cu$
43 kg Cu: 27.57 kg S = 10.4:y
y=6.73 (kg S)
$S^{X1}=100(0.13xS/Cu_2S+0.09xS/FeS)x(1-0.2)=4.7kg\ S$

Amount of sulphur (S) from ore X_2should be:

$S^{X2}=6.72-4.7=2.02kgS$

For 1kg of ore X_2:

$S^{X2}_{1kg} = 1x(0.29x2S/CuFeS_2+0.19x2S/FeS_2)x0.8=0.16kgS/kgS/kgX_2$

$Cu/1kgX_2=0.29xCu/CuFeS_2=0.29x64/184=0.1kgCu/kgX_2$
43kgCu:27.57kgS=0.1:y
y=0.1x27.57/43=0.064kgS
$S^{X2\rightarrow X1}$=0.16-0,064=0.096kgS/kgB
$1kgX_2$:0.096kgS=X_2:2.02kgS
X_2=1x202/0.096=21.04kg
X_2=21.04(kg) 100kgX_1+21.04kgX_2
SiO_2^{X1+X2}=35+21.04x0.52=45.94kgSiO_2
Fe^{X1}=9xFe/FeS+31x2Fe/Fe_2O_3=27.42kg Fe
Fe^{X2}=21.4(0.29xFe/$CuFeS_2$+0.19xFe/FeS_2)=3.77kgFe
∑Fe=27.42+3.77=31.19kgFe
Cu^{X1+X2}=10.4+21.04x0.1=12.5kgCu
Fe^m=12.5x29.43/43=8.56kgFe
Fe^z=Fe^{X1+X2}-Fe^m=27.42-+3.77-8.56=22.6kgFe
FeO=22.63xFeO/Fe=29.09kgFeO^{X1+X2}
SiO_2^{X1+X2}=35+21.04x0.52=45.97kg SiO_2^{X1+X2}
40kgSiO_2:45kgFeO=45.97kgSiO_2^{X1+X2}: y
y=51.7kgFeO^z
FeO^{X3}=51.7-29.09=22.61kgFeO^Z
Ores X_3 contain 78% Fe_2O_3 and decomposed by reaction:
$Fe2O_3\rightarrow 2FeO+1/2O_2$
$1kgX_3xFeO/kgX_3=0.78x2FeO/Fe_2O_3=0.702kg\ X_3$
Ore X_3 contain SiO_2, that amount of FeO for SiO_2ownmelting is:
40kg SiO_2:45kgFeO=0.13kg : y
y=45x0.13/40=0.146kgFeO/0.13kg SiO_2
$FeO^{X3\rightarrow(X1+X2)}$=0.702-0.146=0.556kgFeO/kgX_3
1kgX_3:0.556kgFeO=X_3:22.61
X_3=40.66kg; X_1=100 kg; X_2=21.04 kg; X_3=40.66 kg
$SiO_2^{X1+X2+X3}$=35+0.52x21.04+40.66x0.13=51.22kgSiO_2
40kgSiO_2:15kgCaO=51.22kgSiO_2:y
y=15x51.22/40=19.2kgCaO
CaO^{X4}=19.2-1.1=18.1kgCaO
CaO+MgO/kgX_4=1.1x0.75xCaO/$CaCO_3$+0.21xMgO/$MgCO_3$xCaO/MgO=0.58kg
Calculate amount of CaO for SiO_2 of own melting X_4:
40:15:0,02:y
y=15x0,02/40=0,075kgCaO
Amount of $CaO^{X4\rightarrow(X1+X2+X3)}$=0.58-0,075=0.505kgCaO/kgX_4
1kgX_4:0.505kgCaO=X_4:18.1 kg
X_4=18.1/0.505=35.84kg
X_4=35.84kg

Discussion of Results
By quantifiable results obtained optimal three types of ores (X_1, X_2, X_3) and smelter (X_4).
X_1=100 kg; X_2=21.4 kg; X_3=40.66 kg; X_4 35.84 kg
Σ=197.9kg
For 1000 kg of the mixture (combination) that their participation ore is:
197.9: 100 = 1000:X1; X_1=505.3 kg (50.53%); X_2=108.2kg (10.82%); X_3=205.5kg (20.55%); X_4=181kg (18.1%)
Σ=1000kg (100%)
Data obtained can be presented in Figure 1. These are optimal amounts of the mixture (combination) of ore X_1, X_2, X_3 and smelters X_4 for 1000kg, expressed in percent.

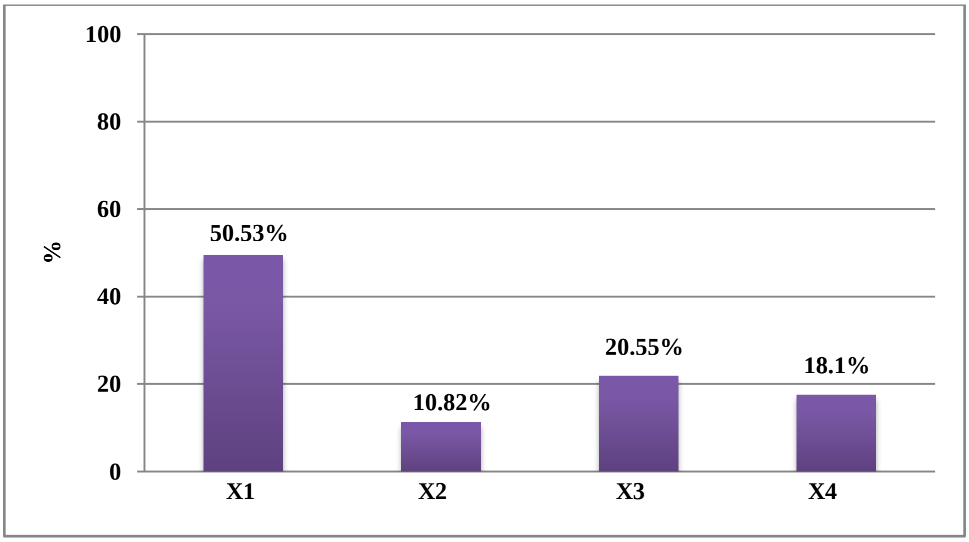

Figure.1.The amount of ore (X_1, X_2, X_3) and smelter (X_4) that must be mixed aboutmelting.

Conclusion

Accurate determination of the quantity and amount of ore smelter is one of the most important factors of good work progress of the furnace for melting copper ore, which provides:

- High degree of exploitation
- Work short time

Energy costs:

In industries and smelters mixture of ores that are available in the courtyard of the ore can be done in different ways and use different systems.

For this purpose, mainly used these systems:

- Banking system
- Storage system and the delivery of ores by means of bearings and
- Automated systems

References

Agolli F, (1985) Metalurgjia e metaleve me ngjyrë, UP Prishtinë.

Biswas AK, Davenport WG, (1994) Extractive Metallurgy of Copper, 3rd Edition, Elsevier Science Press, New York, NY.

HabashiF, (1984) Principles of extractive metallurgy, McGraw Hill, New York, Vol 3.

RosenkqvistT, (1994), Principles of extractive metallurgy, McGrawHill, New York.

Vračar R, Kamberović Z, Sinadinović.D, Savović V, Stopić S, Cerović K, (2000) Proračuni u metalurgiji obojenih metala, Bakar-Bor.

William G, Mark E, Biswas AK,(2002) Extractive Metallurgy of Copper, 4th Edition.

Zander M, (2011) Improving Copper Recovery from Production Slags by Advanced Stirring Methods; Copper, General Pyrometallurgy, Vessel Integrity, Process Gas Treatment, vol.1.