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Determination of the Theoretical Quantity of Air during the Concentration Oxidising of Copper Ores Containing Iron

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Abstract: Concentration in metallurgy is the oxidation process that may have several purposes, but the main goal is to remove the entire concentration quantity S (sulphur), or a part thereof from ore. Depending on the conditions and technical parameters in the furnace for concentration process, a portion of the sulphur can be converted to sulphate or not oxidized and be present in concentration. If the ore is present FeS_2 often what happens during concentration decomposed into FeS and FeS_2. Concentration process usually requires excess air for reactions that decomposes during concentration so that any part of the ore to be in contact with air O_2.For this work at all times, the furnace for concentration should be done ore blending. The quantity of air that inflates and his preheating represents one of the most important factors of the concentration process of copper ore in furnaces for concentration.

Keywords: *ore, copper, concentration, oxidation, furnace,*

Introduction

In terms of concentration technological process is the process of preparation of ores and concentrates prior to metallurgical processing, for smelting. The essence of the process lies in the thermal processing load in the atmosphere in order to make them without being smelting to change the composition. The process is based on the reactions that take place between solid and gaseous phase of heterogeneous process and without the appearance of the liquid phase. Process is very important in metallurgy of Copper and has a positive impact on the effects of further phases of the process of processing (smelting) and made it more suitable as regard technological as well as economic.

Types of Concentration are:

- Concentration oxidizing
- Concentration Calcined
- Reducing Concentration
- Concentration sulphurising
- Concentration chlorine

Concentration is the most used type in pyrometallurgy of Copper.

Theoretical basis process

Concentration in metallurgy is the process of oxidation the processing to which removing the entire quantity of Sulphur or part of most of his from ore by converting sulphide metal oxide which in the next stage (smelting) exceed the easy and rapid slag. The rate of desulphurization, furnace capacity for concentration and other indicators of the concentration process depend on:

- Composition of mineralogical,
- Particle size
- Process temperature
- Amount of air that inflates in the furnace
- Residence time of material in the furnace
- Intensity of mixing the material

In the composition of copper ores and concentrates of copper minerals in addition, are also the other non the accompanying minerals such as iron, lead, cadmium, zinc, arsenic, antimony, silver, gold *etc*. Quantity the accompanying minerals in raw material are different for different types of raw

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materials, so that such a significant impact on the choice of process conditions for technological development, especially the temperature and the degree of desulphurization.

The initial temperature or lower the temperature of the concentration process depends on the temperature of the separation of sulphur present in the raw material. Concentration the maximum temperature depends on the smelting temperature of sulphur present in the raw material so care should be taken to be realized concentration temperature lower than the smelting temperature of sulphur present.

Table 1. Temperature separation some sulphurs metals

Sulphur	$CuFeS_2$	Cu_2S	FeS_2	ZnS	Sb_2S_3	CdS	MoS_2
Temperature ^oC	380	435	360	755	325	735	480

Tabela2. The smelting temperature of sulphurs some metals clean aggregate

Sulphur	FeS	Cu_2S	PbS	ZnS	As_2S	MnS	CoS	Ni_3S_2
Temperature ^oC	1171	1135	1120	1670	818	1530	1140	787

Concentration start up process determines that the sulphurs burner temperature dependent upon the physical properties of tires mainly from specific heat, heat conductivity, sulphurs density,particle size. Concentration process speed depends on many factors of which are of great importance:

- The dimensions of the particles of the material to be concentration
- Physico-chemical properties of sulphur
- Temperature
- Quantity air for of burning process
- The rate of desulphurization
- The presence of catalyst etc.

The normal development process of concentration suitable speed and equally in the whole mass of material to concentration can be achieved by mixing his intestine so that every part of the material to come in contact with oxygen in the air. For this reason the excess air used. Concentrating oxidant copper ores and concentrates usually accomplished with temperatures from 825-850 °C depending on the preparation of the components with the lowest smelting temperature at which the material concentration.

If the ore is present FeS_2 also what often happens during concentration FeS_2 decomposition:

$$FeS_2 \rightarrow FeS+S$$

Most of FeS to gaining the oxidized Fe_2O_3 and finally the reaction can be expressed:

$$2FeS_2+11/2O_2 \rightarrow Fe2O_3+4SO_2$$

The process of oxidation of copper sulphide decomposed by the reaction:

$$Cu_2S+2O_2 \rightarrow 2CuO+SO_2$$

chalcopyrite decomposed by the reaction

$$4CuFeS_2 \rightarrow 2Cu_2S+4FeS+2S$$

As well as other sulphurs behaviour of particular significance if present on raw materials such as lead sulphide (PbS), zinc sulphide (ZnS), the antimony sulphide (Sb_2S_3), silver (Ag_2S, etc.).Spherical minerals that are part of the first subjects that are copper, limestone (CaO), quartz (SiO_2), aluminium oxide (Al_2O_3) etc. During concentration remain the Indissoluble of that during smelting move in slag. In modern metallurgy of copper, for the concentration process is ever more used for concentration aggregates in limbo and we add values.

Results and Discussion

Three copper ore with differs concentration using oil as fuel for burning and that 5% of the amount of ore. The gases burning gases concentration join and leave through the flue. Sulphur passes into the furnace of SO_2. Oil for burning contains 85% C and 15% H_2.The chemical reactions that take place during the concentration process ores are:

$$Cu_2S+2O_2 \rightarrow 2CuO+SO_2 \quad (1)$$

$$2FeS_2+11/2O_2 \rightarrow Fe_2O_3+4SO_2 \quad (2)$$

$$C+O_2 \rightarrow CO_2 \quad (3)$$

$$H_2+1/2O_2 \rightarrow H_2O \quad (4)$$

Table3. The composition of the three Cu ores

Ore 1	Ore 2	Ore 3
Cu_2S=20%	Cu_2S=22%	Cu_2S=20%
FeS_2=38%	FeS_2=38%	FeS_2=40%
SiO_2=32%	SiO_2=30%	SiO_2=30%
H_2O=10%	H_2O=10%	H_2O=10%

Calculations made for 1t of ore.
Calculations for first ore;

- Quantity of O_2 for oxidation reaction of Cu_2S by 1:

$Cu_2S:2SO_2=200:X_1$
$X_1=200x2O_2/Cu_2S=56m^2o_2$ $L_{X1}=56/0.21=266.7$

- quantity O_2 for oxidation of FeS_2 by reacting 2:

$2FeS_2$: $11/2O_2=380:X_2$
$X_2=380x55xO_2/FeS_2=195m^2o_2$ $Lx_2=195/0.21=928.7m^3$

- quantity O_2 for oxidation of C fuel by reacting 3:

$C:O_2=50x0.85:X_3$
$X_3=50x0.85xO_2/C=79.33\ m^3o_2$ $Lx_3=79.33/0.21=377.8m^3$

- quantity O2 for H_2 by reacting 4:

$H_2:0.5O_2=50x0.15:X_4$
$X_4=50x0.15x0.5xO_2/H_2=42\ m^3o_2$ $Lx_4=42/0.21=200m^3$
$\Sigma O2=X_1+X_2+X_3+X_4=56+195+79.33+42+372.33\ m^3$

- theoretical quantity of air for the first ore:

$L^1_t = \Sigma O_2/0.21=372.33/0.21=1773\ (m^3)$
$L^1_t = 1773\ (m^3\ air)$

- Calculations for the second ore:
- quantity O_2 for oxidation of Cu_2S

$Cu_2S:2O_2=220:Y_1$
$Y_1=220x2O_2/Cu_2S=61.6\ (m^3O_{2)}Lt_1=61.6/0.21=293.4(m^3\ air)$

- quantity O_2 for oxidation of $FeS_{2;}$

$2FeS_2:11/2O_2=380:Y_2$
$Y_2=380x55xO_2/2FeS=195\ (m^3o_2)$ $Lt_2=195/0.21=928.6\ (m^3\ air)$

- quantity O_2 for C fuel is the same as for first ore:

$Y_3=X_3=79.33\ (m^3O_2)$
Quantity $O_2$for H_2 of the fuel is equal to the first ore:
$Y_4=X_4=42\ (m^3O_2)$
$\Sigma O2=Y_1+Y_2+Y_3+Y_4=61.6+195+79.3+42=377.9\ (m^3O_2)$

- The theoretical quantity of air for the second ore:

$L2t = \Sigma O2/0.21=377.9/0.21=1799\ (m^3air)$

- Calculations for the third ore:

Quantity $O_2$for Cu_2S
$Cu_2S:2O_2=200:Z_1$
$Z_1=200x2O_2/Cu_{2S}=56\ (m^3O_2)$ $Lt=56/0.21=266.7\ (m^3air)$

- Quantity O_2forFeS_2

$2FeS_2:11/2O_2=400:Z_2$
$Z_2=400x5.5xO_2/2FeS_2=205.3(m^3O_2)$ $Lt=205.3/0.21=977.9\ (m^3air)$

- Quantity of O_2 for fuel:

$Z_{3=}Y_3=X_3=79.33(m^3O_2)$

- Quantity of O_2 for H_2 of fuel:

$Z_4=Y_4=X_4=42\ (m^3O_2)$
$\Sigma O_2=Z_{1+}\ Z_{2+}\ Z3_+\ Z_4=56+205.3+79.3+42=382.6m^3O_2)$
$L^3_{t\ =}\ \Sigma O_2/0.21=382.6/0.21=1821.9\ (m^3air)$

Table 4.the results of the theoretical quantity of air for the oxidation of the ores components

Ore 1	Lt (m^3)	Ore 2	Lt (m^3)	Ore 3	Lt (m^3)
Cu_2S=20%	266.7	**Cu_2S=22%**	293.4	**Cu_2S=20%**	266.7
FeS_2=38%	928.7	**FeS_2=38%**	928.7	**FeS_2=40%**	977.8
fuel	577.6		577.6		577.6
∑	1773		1800		1822

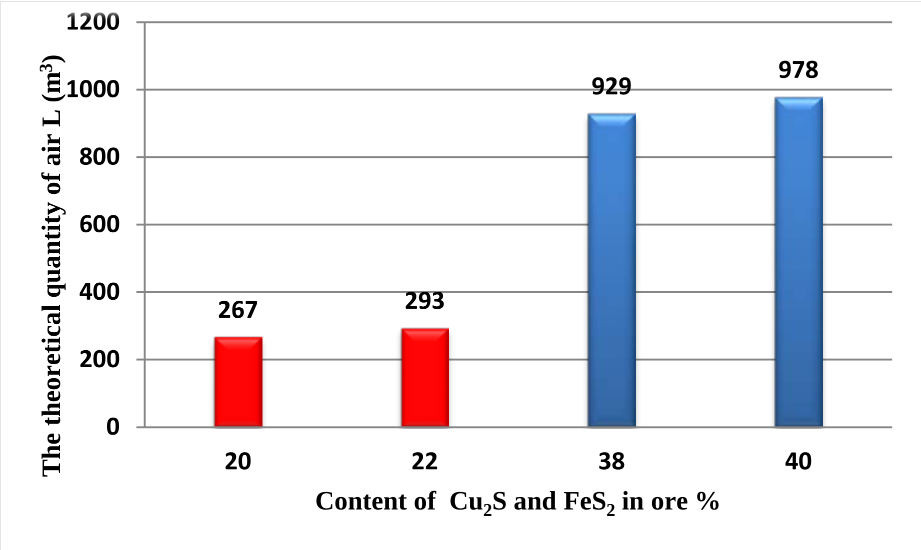

Figure1. Diagram of the theoretical quantity of air for certain quantities of Cu_2S and FeS_2 in ore

From the results obtained proved that the biggest quantity spent for air oxidation of FeS_2, then for the burning of raw material (oil) with certain composition and finally for the oxidation of Cu_2S.With the increase of the content of the ore and it Cu_2S for 2%, the theoretical quantity of air that inflates for concentration of 1t of ore must be greater for $27m^3$ / t of ore. With the increase of the content of the ore and that FeS2 for 2%, the theoretical quantity that inflates air for concentration of 1t of ore must be higher $49m^3$ / t of ore.

Conclusion

For better development of the process of concentration in the furnace for concentration and for the shortest time possible with this process, one of the most important factors is to determine the quantity of air for inflated. The quantity of air for inflated up the rate of desulphurization during the concentration process and the further smelting prosperity that we furnace for smelting concentration. For concentration copper ore, the biggest quantity spent on air oxidation of FeS_2, burning raw materials and oxidation of Cu_2S (what is defined in this paper for copper ores with certain composition).

Accurate determination of the capacity of the fan for blowing the air certain quantity of the decrease in spending and increases the rate of exploitation of copper in the whole process. Practical quantity of air for inflated up of the theoretical quantity determined by analytical calculations and is higher than the theoretical quantity required which is defined by a coefficient of surplus air.

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