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CALCULATIONS OF LOAD CONTENTS IN THE ROTARY KILN PROCESS AT THE FERRONIKEL PLANT

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ABSTRACT

In this paper, we will calculate the load content in the process of rotary kilns, the thermal quantity of the content of calcine components in rotary kilns during the frying process, electricity consumption - melting of calcine on electric furnace I, for ton calcine of ferronickel in Drenas.

The nickel ore is frying in a rotary kiln where a partial reduction of iron-nickel is achieved.

Fuels used as an energy source in the process of rotary kilns:

- Kosovo lignite,
- Coal from Indonesia,
- Coal from Russia,
- Coal from Montenegro
- Fuel oil and pet-coke

During the industrial research at the Ferronikeli Plant in Drenas, we have ascertained that the maximum calcine temperature at the outlet of the rotary kilns is 700 ° C, during the analysis of the work.

Insufficient processing of iron-nickel ore for rotary kilns causes major problems in not reaching the temperatures inside the kilns, where the high humidity of iron-nickel ore causes great difficulties in the process of frying in rotary kilns.

Because of not achieving high temperatures in rotary kilns, the preparation of the calcine for electric furnace does not reach the proper preparation.

The amount of calcine during 2016 that entered the electric furnace was 291919.64 tons, the amount of energy consumed for melting calcine in electric furnace, reached 553.42kWh / t calcine, while the amount of electricity consumed was 57.92 MWh /t Ni.

Keys words: Calcine rotary kiln, plant, lignite etc.

2) Technical and Technological Sciences

INTRODUCTION

At the Ferronickel Plant in Drenas, the load of rotary kilns, in addition to ores from Kosovo, also consists of a large number of imported ores.

Starting from:

- Fe-Ni ores from Indonesia
- Fe-Ni ores from the Philippines
- Fe-Ni ores from Macedonia
- Fe-Ni ores from Turkey
- Fe-Ni ores from Guatemala
- Ores from Fe-Ni from Albania
- Ni concentrate from Taiwan.

All Fe-Ni ores that make up the load of the rotary kilns at the Ferronickel Plant in Drenas as locative and imported are laterite-oxide sources.

Characteristic of most imported ores is the high percentage of moisture as very important factors in the process of rotary kilns and the percentage of Ni as important factors in the process of nickel metal formation and interest of the process of production of Fe- alloy Ni.

It is characterized by high Ni content where the annual average ranges from 2-3% Ni while the percentage of moisture is up to 40% in the composition of ores.

The high moisture content is a very big problem of the realization of the frying process in rotary kilns-the production of frying has in many difficulties during the process, as Fe-Ni ore does not drying before entering the rotary kilns and the ore of iron-nickel in the kiln process zones fails to transform the shapes as predicted in the three rotary kiln process zones.

A special feature is the composition of iron-nickel ores of Albania as they have a low percentage of moisture (11%) and a high composition of iron oxides. The composition of iron oxides has a reducing effect on the composition of the rotary kiln.

METHODOLOGY

For the analysis of the load content calculations of the rotary kilns we used mathematical calculations based on industrial and laboratory data. For the calculation of the heat load of the rotary kilns we are based on the composition of the calcine from the rotary kiln, as the main source of information, and the daily amount of calcine spent.

During the industrial research we have ascertained that the maximum temperature of the calcine at the outlet of the rotary kilns during 2016 was 700 °C, and the heat content of the calcine during the calculations will be realized at this temperature.

The heat content of nickel is calculated:

Chemical analysis of the calcine shows the content of Ni = 1.05%, from which in the form of metal in rotary kilns has passed the amount of 0.08% Ni.

If the residue expressed in the form of oxide we will express with the equation:

$$NiO = \frac{P.Ni_{fergese} - Sasia\ e\ Ni\ në\ formë\ metali\ \times M_{NiO}}{M_{Ni}}$$

$$NiO = \frac{0.97\ x\ 74.7}{58.7} = 1.234\ \%$$

$P.Ni_{fergese}$- represents the amount Ni in calcine

For the ton we have 0.8kg Ni_{met} and 12,34 kg

Or if we express it in moles:

$$Ni = \frac{0.8}{58.7} = 0.013mol$$

$$NiO = \frac{1,234}{74.7} = 0.016mol$$

At a temperature of 700°C Ni_{met} corresponds to the amount of heat 20900 kJ / mol, while for Ni oxide (NiO) corresponds to the amount of heat 36784 kJ / mol from which we obtain:

The amount of heat it contains:

$$Ni_{met} = 0.013\ x\ 20900 = 271.7\ kJ$$

While the amount of heat it contains:

$$NiO = 0.016\ x\ 36784 = 588.5kJ$$

The amount of heat of Co:

The content of Co in the baked matter (frying) is 0.04% and when expressed in oxide form is:

$$CoO = \frac{P.Co_f.x\ M_{CoO}}{M_{Co}} = \frac{0.04x74.93}{58.93} = \frac{2.99}{58.93} = 0.050\%$$

So a ton calcine contains 0.5 kg of CoO or we express it in the form of moles:

$$CoO = \frac{0.5}{74.9} = 0.0067mol$$

At a temperature of 700 °C CoO contains 36366 kJ /mol, then the amount of heat per CoO is:

The amount of heat it contains:

$$CoO = 0.0067\ x\ 36366 = 243.65kJ$$

The amount of heat than Fe.

Iron in fryers comes in three forms:

- Iron metal, Fe_{metal}= 0.13%
- Iron oxide, FeO=11.39%
- Magnetit, Fe_3O_4 = 14.10%

Fe_{met}=$\frac{1.3}{56}$ = 0.03mol

$$FeO = \frac{113.9}{72} = 1.58mol$$

$$Fe_3O_4 = \frac{141}{232} = 0.61mol$$

Metallic iron (Fe_{met}) at 700°C contains 22154 kJ/mol

Iron oxide, FeO ne 700°C cantains 36720 kJ /mol and Fe_3O_4 contains 142120 kJ /mol, the amounts of heat are:

The amount of heat $Fe_{met} = 0.03\ x\ 22154 = 664.62\ kJ$

The amount of heat $FeO = 1.58\ x\ 36720 = 58017.6\ kJ$

The amount of heat $Fe_3O_4 = 0.61\ x\ 142120 = 86693.2\ kJ$

The amount of heat of $C_{fix.}$ In a ton calcine have 1.2kg C in the mol:

$$C = \frac{1.2}{12} = 0.1\ mol$$

At 700 °C carbon contains 10868 kJ / mol

The amount of heat $C_{fix} = 0.1\ x\ 10868 = 1086.8\ kJ$

The amount of heat of calcine losses.

Chemical analysis of calcine has shown the amount of calcine losses of 3.03% which for one ton of calcine is:

Losses of calcine $\frac{30.2}{44} = 0.68\ mol$

At 700 °C the calcine losses contain 31768 kJ /mol, from which we have:

Heat quantity of calcine losses = 0.68 x 31768 = 21792.8kJ

The amount of heat that SiO_2. The content of SiO_2 in calcine is 46.72%, one ton of calcine contains 467.2kg SiO_2 or we express it in moles:

$$SiO_2 = \frac{467.2}{60.08} = 7.8mol$$

At 700 °C SiO_2 contains 44308 kJ / mol, from which we have:

The amount of heat $SiO_2 = 7.8x\ 44308 = 345610.2\ kJ$

The amount of heat Ca. Ca in calcine is found in two forms: If CaO =53.867 t/24h and if $CaCO_3$=288.55 t/24h, that in percentage:

$$\%CaO = \frac{53.8967\ x\ 100}{1633.0} = 3.30\%$$

$$\%CaCO_3 = \frac{288.55\ x\ 100}{1633.0} = 17.66\%$$

For a calcine tone it is 0.33 kg CaO and 176.6 kg $CaCO_3$ or expressed in mol:

$$CaO = \frac{33}{56.08} = 0.588\ mol$$

$$CaCO_3 = \frac{176.6}{100} = 0.047mol$$

The amount of heat of CaO at 700°C is 32604kJ/mol, while for $CaCO_3$ it is 64790 kJ/mol, from which we have:

The amount of heat $CaO = 0.588\ x\ 32604 = 19171.15kJ$

The amount of heat $CaCO_3 = 1.765\ x\ 64790 = 114354.35kJ$

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The amount of heat $magnesium$ (Mg)- Magnesium in calcine is found in two forms as: MgO=27.1125t/24h and $MgCO_3$ of 56.71t/24h which in percentage is:

$$\%MgO = \frac{27.1125\ x\ 100}{1663.0} = 1.62\ \%$$

$$MgCO_3 = \frac{56.71x\ 100}{1633.0} = 3.471\%$$

For a calcine tone it is 16.6 kg MgO and 34.71 $MgCO_3$ if we express it in moles we will have:

$$\text{MgO}=\frac{16.6}{40.3} = 0.412\ mol$$

$$MgCO_3 = \frac{34.71}{84.3} = 0.412\ mol$$

At a temperature of 700℃ MgO and $MgCO_3$ contain 31768kJ / mol

We calculate the amount of heat: $MgO = \ 0.412\ x\ 31768 = 13056.6kJ$

$$MgCO_3 = 0.412\ x\ 31768 = 13056.6kJ$$

DISCUSSION OF RESULTS

The heat of the calcine at the temperature of 700 °C is 694440 kJ/t calcine.

Since 1 kWh = 3600 kJ then the heat of calcine 651728 kJ/t calcine is equivalent to the electricity consumed of 192.9kWh/t calcine.

According to the calculations of the amount of heat we notice that at a temperature of 700°C we have electricity savings in the electric furnace affecting 192.2kWh /t calcine.

From the calculations of the quantities of heat of the calcine compositions we conclude that during 2016 we spent quantities of heat of 42712 kJ / t calcine less in relation to the amount of heat of the calcine at a temperature of

700 °C. This change in heat quantities comes as a result that during 2016 two rotary kilns have prepared the calcine for only one electric furnace and it has not been worked for six months of 2016.

Recommendations

- Apply drying for Fe-Ni minerals.
- The amount planned to be equal to the realized amount (ores and fuels).

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