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The study of chlorination of nickel oxide by chlorine and calcium chloride in the presence of active additives

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Résumé / Abstract

Chlorination of nickel oxide by chlorine and calcium chloride in the presence of C, BaS and S were studied, both experimentally and theoretically. Chlorination of nickel oxide by chlorine was carried out in the temperature range 573-873 K and by calcium chloride in the temperature range 1023-1223 K. The results obtained of the chlorination of nickel oxide by chlorine showed that C has the strongest and S the weakest effect on the process. Addition of BaS has a favorable effect on the chlorination of nickel oxide by calcium chloride during segregation roasting, while addition of S has no major influence.

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The study of chlorination of nickel oxide by chlorine and calcium chloride in the presence of active additives

Abstract:

The previous investigations in the field of the metal compounds chlorination of the refractory nickel minerals: garnierite and nontronite, by the chlorine, Cl_2, HCl, NaCl or $CaCl_2$, were determined directions, confirming the perspective of the mentioned process for the treatment of the low grade and complex minerals-laterites. The existing combined methods for enriching of the oxide-silicate nickel ores are these through which by heating the ore with coke and $CaCl_2$ at high temperature reduced metal from nickel silicate or nickel ferrite is formed on the present coke, or on the silicates which are the component parts of the ore.

INTRODUCTION

For the metallurgical calculation Ni in the oxide - silicate minerals may be shown by means of the general formulas.

The iron in these Ni - bearing minerals and ores is appeared as ferrite $Fe_2O_3.nH_2O$ and as a complex mineral $(Fe ,Al)_2(Si_4O_{10})(OH)_2.nH_2O$.

The oxide-laterite ores are with low nickel content. Nickel and iron are as Ni-Fe-limonite $(Fe ,Ni)O(OH).nH_2O$ or in the talc form.

The following chemical reactions have explained the scheme and complex segregation high temperature process:

$$CaCl_2 + H_2O = CaO + 2HCl$$
$$CaCl_2 + H_2O + SiO_2 = CaO.SiO_2 + 2HCl$$
$$CaCl_2 + H_2O + Fe_2O_3 = CaO.Fe_2O_3 + 2HCl$$
$$NiO + 2HCl = NiCl_2 + H_2O$$
$$NiSiO_3 + 2HCl = NiCl_2 + H_2O + SiO_2$$
$$Ni_2SiO_4 + 4HCl = 2NiCl_2 + 2H_2O + SiO_2$$
$$NiFe_2O_4 + 6HCl = NiCl_2 + 3H_2O + 2FeCl_2$$

The following chemical reactions have explained the scheme and complex segregation high temperature process with additives of BaS or FeS:

$2NiO.SiO_2 + 6HCl + BaS\ (FeS) = 2NiCl_2 + BaCl_2\ (FeCl_2) + 2SiO_2 + 2H_2O + H_2S$
$NiFe_2O_4 + 8HCl + BaS\ (FeS) = NiCl_2 + BaCl_2\ (FeCl_2) + 2FeCl_2 + 3H_2O + H_2S + ½\ O_2$

The following chemical reactions have explained the scheme of high temperature process of reduction and segregation (metal obtaining) on coke or other inclusion:

$NiCl_2 + H_2 = Ni + 2HCl$
$NiCl_2 + H_2O + C = Ni + 2HCl + CO$
$NiCl_2 + H_2O + CO = Ni + 2HCl + CO_2$
$NiCl_2 + Fe = Ni + FeCl_2$

The following above mentioned chemical reactions have explained the scheme of high temperature process of reduction and segregation (metal obtaining) on coke or other inclusion. The thermodynamic and kinetic of these reactions are well known, showing appropriate results which prove the thermodynamic possibility of isobaric values (ΔZ^o_{298}), together with kinetic values of reaction velocity, kinetic equation which have showed the rate of above mentioned reactions.

Conclusion

The existing combined methods for enriching of the oxide-silicate nickel ores are these through which by heating the ore with coke and $CaCl_2$ at high temperature reduced metal from nickel silicate or nickel ferrite is formed on the present coke, or on the silicates which are the component parts of the ore. The thermodynamic and kinetic of these reactions are well known, showing appropriate results which prove the thermodynamic possibility of isobaric values (ΔZ^o_{298}), together with kinetic values of reaction velocity, kinetic equation which have showed the rate of above mentioned reactions.

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