Trans.Indian Inst. Met
Vol.43,No.4, Aug 1990, pp 218-220

RECOVERY OF Cu-Ni ALLOY FROM Ni-RICH ANODE SLAG

S.Kar
Indian Statistical Institute , Calcutta

B.C.Ray and P.S.Basak
Deptartment of Metallurgical Engineering.,Indian Institute of Technology, Khargpur.

1 INTRODUCTION

The resources of Cu and Ni in the world are in danger at being exhausted within the next few years. On the other hand, these two metals are being consumed at a very high rate, as newer fields of their application are developing.

Anode slag produced by H.C.L., Ghatsila, during purification of blister copper in anode furnace contains considerable amount of nickel. Presently, the anode slag is being recycled to either matte smelting or converter. The amount of nickel in the anode slag or 'red Jam' may be as high as 6% when Mayurbhanj ore is used. The present situation demands the development of an efficient process to recover nickel in the form of Cu-Ni alloy.

Therefore, investigation has been carried out to develop a suitable process involving the chemical reduction of the 'Red Jam' in the presence of fluxes, to produce Cu-Ni alloy. The effect of amount and composition of fluxes and also the amount of charcoal on the metallic yield has been studied.

2 EXPERIMENTAL

The nickel in the blister copper (~ 0.5%) is eliminated by fire refining in the anode furnace. The chemical composition of the anode slag is given in Table 1. It was experimentally found that the freezing range of anode slag is 1200°C to 1240°C.The experimental procedure consisted of crushing the anode slag which was mixed with activated charcoal and fluxes. Then the charge (300 gm for each melt) was taken in a clay graphite crucible and heated in a furnace to 1350°C for 1 hour. The melt was then poured in preheated (350° C) metal mold to cast an ingot. The percentage of copper and nickel of the slag was analysed.

Table 1 - Chemical Composition of the Anode Slag (wt.%)

Cu	Ni	Fe	S	O
75.300	6.000	0.006	0.006	1

3 RESULTS AND DISCUSSION

3.1 Optimization of CaO and SiO_2

Fig. 1 shows the variation of the metal loss through the slag with CaO/SiO_2 at constant level of charcoal (10%). The lowest amount of the metal loss through the slag was obtained at $CaOSiO_2$ at around 1.2 which is very close to the eutectic mixture of α - $CaO.SiO_2$ and $3CaO.2SiO_2$ as found from CaO-SiO_2 binary phase diagram. Although the liquidus temperature of this eutectic is 1470°C, it may be lowered in the presence of Cu and Ni oxide which ensures the low viscosity of the slag. The amount of fluxes was varied with the fixed basicity. The highest metallic yield (I.E. wt. of the metal recovered x 100/wt. of the metal in the 'Red Jam') was obtained when 8.8%

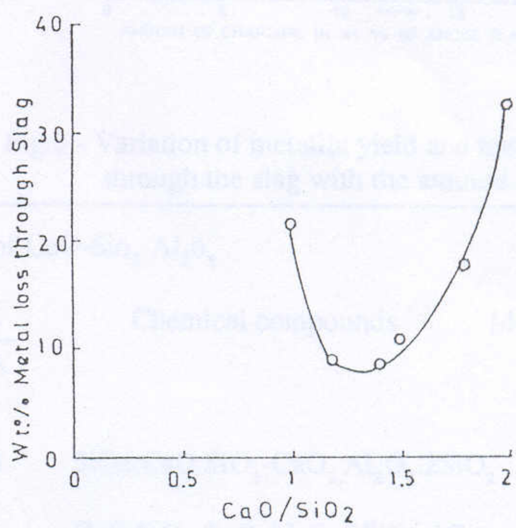

Fig.1 - Variation of metal loss through slag with CaO/SiO_2 (amount of charcoal is 10% of Anode slag).

fluxes were used (Fig 2).

3.2 Optimization of Reductant

It is evident from Fig. 3 that the optimum metallic yield and the metal loss through the slag is found at around 10%. The reduction of both the oxides of Cu and Ni is thermodynamically feasible[1] to near completion with the presence of charcoal at 1350°C. It is interesting to note that nearly 6% characoal would be required for complete deoxidation of Cu and Ni from the anode slag when only CO_2 is produced. Hence, the amount of charcoal in this case can be reduced with the help of stirring or reducing gas injection[2,3].

3.3 Addition of Al_2O_3

Al_2O_3 was added to the charge in some definite proportions in order to form the eutectics given in Table2[4].

It was observed that the eutectic e1 was very viscous at 1350°C and efficient pouring of liquid metal was not feasible. The viscosity of e1 is greater than 75 poises at 1400°C.

The formation of e_2 and e_3 showed a marked decrease of the metal loss through the slag as given in the Table 3. The metallic yield of the charge with CaO-3.17%; SiO_2-3.5% and Al_2O_3- 1.67% was 96.5% in comparison with 85.7% obtained from the other combination of fluxes. This may be attributed to the increased amount of Al_2O_3 in the eutectic e3 which increases the melting point of the slag and consequently raises its surface tension.

4 CONCLUSIONS

4.1 The metallic yield is 92.5% with CaO-4.8%, SiO_2 -4% and 10% charcoal.

4.2 Addition of Al_2O_3 appears to improve the metallic yield to 96.5%.

ACKNOWLEGEMENT

The authors are very much thankful to Prof. P.P.Das, Department of Metallurgy, B.E.College, Howrah and Dr.S.K.Biswas, H.C.L., Ghatsila, for their valuable suggestions and co-operation.

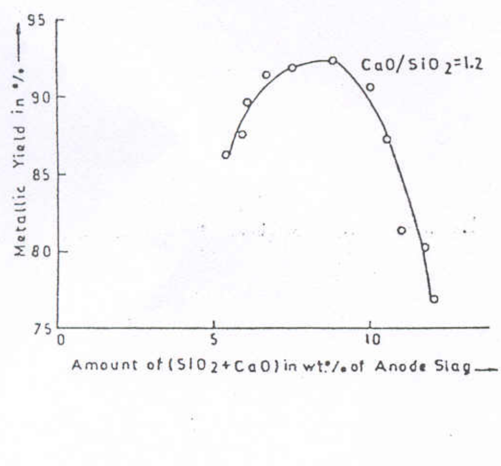

Fig.2 - Plot of metallic yield with the amount of fluxes.

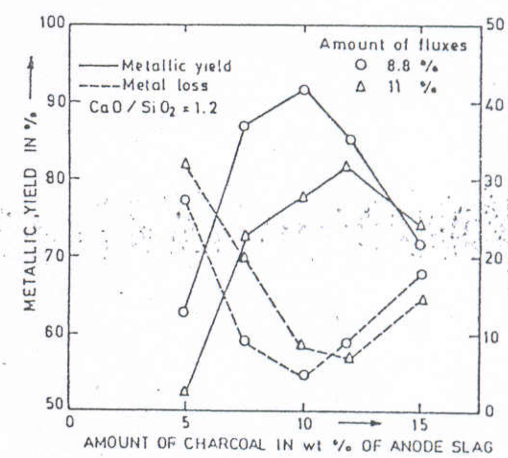

Fig.3 - Variation of metallic yield and metal loss through the slag with the amount of charcoal.

Table 2- Eutectics of CaO-SiO_2-Al_2O_3

Designation of eutectics	Fluxes CaO (%)	SiO_2 (%)	Al_2O_3 (%)	Chemical compounds	Melting points
e_1	23.5	62.0	14.75	SiOz.CaO.SiO_2-CaO_2.Al_2O_3.2SiO_2	1165°C
e_2	38.0	42.0	20.0	CaO.SiO_2-CaO.Al_2O_3.2SiO_2-2Cao Al_2O_3.SiO_2	1265°C
e_3	47.8	41.2	11.0	CaO.SiO_2-2CaO.SiO_2-2CaO.Al_2O_3.	1310°C

Table 3 - Variation of slag composition with fluxes

Fluxes Weight % of anode slag			Eutectic	Slag Analysis	
CaO	SiO_2	Al_2O_3		Cu(%)	Ni(%)
4.8	4	1.2	e_2	4.17	2.2
3.17	3.5	1.67	e_3	1.92	0.47

REFERENCES

1 Themelis N.J. & Yannopoulos J.C., *Trans. Met. Soc., AIME*, **236**, (1966), 414.

2 Nanda C.R. & Geiger G.H., *Met. Trans.* **2**(A), (1977), 1101.

3 Romaipu-Morguel G.J., Olvera F., AguireS. & Sanchez *Metals*, **40, 9** (1988), 38.

4 Volsky A. & Sergivsleaya E., *Theory of Metallurgical Pr* Mir Publisher, Moscow, 1978.