THE METALLURGY OF CANADIAN COBALT ORES

II. LOSS OF SILVER IN CHLORIDIZING SPEISS

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The Canadian Copper Company of Copper Cliff, Ontario, was one of the pioneers in the successful smelting of Cobalt ore from the Northern Ontario mines. As early as 1905, they had purchased a few cars of high grade ore and were doing experimental work to determine the best methods of recovering the metals cobalt, nickel, silver and arsenic.

By direct smelting 80% to 85% of the silver was easily obtained in the form of crude silver buttons, but the remaining 15% to 20% was held up in the speiss along with the cobalt and nickel.

The average assay of the metal contained in 12 lots of speiss, shown in the first part of Table No. 3, is:—

Silver 1581 oz. per ton; Arsenic 26.29%; Cobalt 18.76%; Nickel 7.82%; Iron 20.15%

This analysis shows the complex nature of the material and indicates the difficulty of the metallurgical problems to be encountered in separating the various metals. At first this speiss was sold to lead smelters, where it was smelted along with lead ore. Thus the silver was recovered while the other metals were lost in the slag.

The writer of this article was in charge of the experimental work at the cobalt plant at Copper Cliff when it was decided to make a thorough investigation of chloridizing, leaching out, precipitating and refining the silver to be found in the speiss.

As the whole proposition would be impracticable if the loss of silver was large in the roasting, the first thing to do was to determine the loss of silver during the roasting process.

This thesis deals with the experiments which were conducted to determine this loss.

Roasting was first done on a small scale, using the muffle furnaces which were in the laboratory for the fire assay work. Two sets of roasts were made, mixing the speiss with 15% salt in the first and with 20% salt in the second. The weight of the speiss was the same in each case, i.e., 4000 grams ground to pass 40 mesh. Each charge was roasted for 10 hours at dull red heat and rubbed often enough to prevent lumps from forming. The results of these experiments are shown in Table No. 1. The silver content, before and after roasting, is figured just as if each

gram represented a pound. This makes the laboratory experiments easily compared with those conducted on a larger scale.

By increasing the salt from 15% to 20% the volatile loss was raised from 1.88% to 3.27%, or almost doubled.

As no provision was made for collecting the dust and fumes given off from the small muffle furnaces the writer determined to run two 5 ton lots in our Edwards furnaces, which were equipped with flue dust and fume condensing chambers. 15% of salt was used and with the addition of the silver contained in the flue dust the loss was only 1.18% or very reasonable. (See Table No. 2).

Arrangements were now made with the Orford Copper Company to purchase the speiss as chloro-speiss, for a run of three months. It was determined to keep a complete record of the material charged and discharged from the roaster and at the end make a careful clean-up of flue dust, crude arsenic, etc., and credit their silver content to the experiment. The volume of material was so large in this case that the possibility of error was reduced to the minimum. Complete figures covering this three-months test are shown in Table No. 3. The speiss was milled to pass 40 mesh and 15% of salt was added as the speiss was charged to the ball mill. Twelve lots of green speiss were milled and roasted, having a total silver content of 377,255.81 oz. Nine shipments of chloro-speiss were made to the Orford Copper Company of Camden, N.J. Three lots of rejected chloro-speiss were returned to the process. All speiss which contained more than 40 oz. of silver insoluble in sodium hyposulphite was rejected. When the silver content of the flue dust and crude arsenic was added to the other roaster products there was a total credit of 376,140.97 oz. of silver, giving a loss of 1114.84 oz. or only

As a result of this final test the chloridizing of the speiss was shown to be a safe proposition and all the green speiss produced in the cobalt plant thereafter, was chloridized in the Edwards furnaces.

After more experimental work was done on leaching processes for the recovery of silver from chloro-speiss a hypoleaching plant was built and put into successful operation thus making it possible to recover all the silver from the ore at the cobalt plant.

TABLE I.
Series A, Speiss Roasted in Muffle Furnaces with 15% Salt. (Weight in Grains).

No.	Weight of Speiss	Weight of Salt	Total Weight	Wt. After Roast			Silver After R.		Content After R.	Oz Silve Lost	er Per Cent Sil. Lost
1	4000	600	4600	5082	482	903.5	709.0	1807	1801	6	
2	4000	600	4600	5288	688	1221.6	897.0	2443	2373	70	
3	4000	600	4600	5140	540	1221.6	927.0	2443	2382	61	
4	4000	600	4600	5300	700	1221.6	908.0	2443	2407	36	
								9136		173	1.88%
				Series I	Speiss,	Roasted w	ith 20%	Salt.			
1	4000	800	4800	5289	489	1486.9	1100.0	2974	2909	65	
2	4000	800	4800	5241	441	1060.0	776.0	2120	2034	86	
3	4000	800	4800	5026	226	1060.0	812.0	2120	2041	79	
4	4000	890	4800	5290	490	1060.0	773.0	2120	2045	75	
								9334		305	3.27%