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METHOD OF REMOVING NICKEL AND COBALT IMPURITIES FROM ZINC ELECTROLYTE SOLUTIONS

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1

This invention relates to the removal of impurities present in zinc electrolyte solutions prior to the recovery of zinc therefrom by the electrolytic method, and it is directed particularly to the removal of cobalt and nickel from such solutions.

It is well known that impurities in the electrolyte cause great difficulty during the operation of plating by electrical methods, in some cases due to the impurity itself plating and so causing the deposit to be impure and of less value, and in other cases due to the impurity bringing about a lowered efficiency in the plating process. Consequently great pains are taken and much expense is incurred in removing the harmful impurities so far as possible.

It has for many years been known that purification of an electrolyte may be effected by the displacement of one metal from the solution by another higher in the electromotive series and that such a displacement may be aided by the presence of a metal low in the electromotive series. Thus it is common, after iron and other metals have been precipitated by treating an electrolyte with zinc oxide or roasted zinc ore or lime while air is blown through the solution, to treat it with zinc dust and to increase the purifying action of the zinc dust by coating it with finely divided copper. This copper is commonly formed by precipitating it from the solution to be purified by the zinc dust.

On the basis of the above generalization as to removal of one metal in solution by another metal higher in the electromotive series, and this removal being aided by the presence of a metal low in the electromotive series, one would expect that all of the impurities could be removed without serious difficulties. Experiments have shown, however, that certain elements such as cobalt and nickel, which should, from the position assigned to them in the electromotive series, easily be removed, are exceedingly difficult to precipitate, the difficulty becoming more pronounced as the quantity of the impurities present in the electrolyte becomes less. Thus, it has not been possible to remove more than a few milligrams per litre, say from about 15 down to about 10 milligrams per litre, of such impurities as cobalt and nickel, and much work has been done to determine methods of removing these and other impurities which are similarly difficult to precipitate.

It has been proposed to use arsenic with zinc dust and copper but we have found that zinc dust, copper and arsenic additions alone are of

2

little, if any, value in removing impurities such as cobalt and nickel and this is illustrated by the following experiment which was carried out with a sample of tankhouse electrolyte (electrolyte ready for electrolysis in the hydrometallurgical process for winning zinc) having the following analysis:

Zinc	grams per litre, about	120
Copper	milligrams per litre	0.4
Cadmium	do	0.3
Cobalt	do	16.0
Arsenic	do	0.04
Antimony	do	0.024

Zinc dust and copper were then added to this electrolyte, using the normal small amounts, namely, 5 grams per litre of zinc dust and 1.4 grams per litre of copper as copper sulphate. Then purification tests were run on samples of this electrolyte with additions of arsenic (as arsenious oxide dissolved in sodium hydroxide and water, and neutralized to methyl orange with sulphuric acid) as set forth below, the samples being agitated for one hour at 45° C. The analyses of the filtrates from these tests were as follows:

Test	Extra Additions	Analysis of treated solution in milligrams per litre				
		Cu	Cd	Co	As	Sb
A	50 mg./l. Arsenic	0.5	0.2	11.0	.5	0.022
B	100 mg./l. Arsenic	0.6	0.2	12.0	1.5	0.026
C	200 mg./l. Arsenic	0.7	0.2	12.6	8.0	0.024
D	300 mg./l. Arsenic	4.5	0.3	12.9	20.0	0.028

We have discovered that surprisingly good results are obtained in the removal of impurities and particularly cobalt if small amounts of both thallium and arsenic in the form of soluble compounds are present in addition to the normal small amounts of zinc dust and a soluble copper compound. The amount of thallium to be added varies according to the concentration of impurities in the particular electrolyte to be purified, and precise directions as to the addition required for a given degree of purification may, therefore, not be stated. However, tests made on samples of tankhouse electrolyte show that remarkably good results are obtained with as little as ten milligrams per litre of thallium and that about twenty-five milligrams per litre is usually sufficient to reduce cobalt and nickel present as impurities to vary small amounts.

Thus, for example, 25 milligrams per litre of

thallium (thallium metal dissolved in sulphuric acid brought to dryness, dissolved again in water and neutralized to methyl orange with sodium hydroxide) with 175 milligrams per litre of arsenic added to the sample of tankhouse electrolyte of the analysis set forth above made cobalt not detectable. The additions of zinc dust and copper and the treatment were as described in connection with tests A to D and the analysis of the filtrate in milligrams per litre was as follows:

Cu	Cd	Co	As	Sb
0.9	0.3	0.0	0.3	0.022

Similarly, 25 milligrams per litre of thallium, as thallium sulphate, with 175 milligrams per litre of arsenic in sulphuric acid solution made nickel not detectable in a sample of tankhouse electrolyte of the following analysis:

Zinc	grams per litre	135
Cadmium	milligrams per litre	0.4
Antimony	do	0.02
Copper	do	0.5
Arsenic	do	0.02
Cobalt	do	23.6
Nickel	do	18.8

The additions of zinc dust and copper were as set forth above and, after agitation for one hour at 40° C., the analysis of the filtrate was:

Nickel		Not detectable
Cobalt	milligrams per litre	1.2

The considerable effect of the thallium addition is apparent on comparing the above analysis with the following result of a corresponding test carried out on the same electrolyte without any addition of thallium. The analysis was:

	Milligrams per litre
Nickel	13.6
Cobalt	18.0

Other tests carried out showed that bismuth, gold, iron, cadmium, mercury, chromium, molybdenum, phosphorus, gallium, tungsten, sulphur, tellurium, germanium, selenium, nickel, palladium and platinum are, amongst others, of no value along with zinc dust, copper and arsenic; indeed certain of these metals, as for example platinum, are very detrimental, since not only is cobalt not removed, but the solution is left high in copper and arsenic.

What we claim as our invention is:

1. A method of removing impurities from zinc electrolyte solutions, comprising contacting the electrolyte with small amounts of zinc dust, in the presence of small amounts of soluble copper, arsenic and thallium compounds.

2. A method of removing impurities from zinc electrolyte solutions, comprising contacting the electrolyte with small amounts of zinc dust in the presence of small amounts of soluble copper and arsenic compounds and from about 10 to about 25 milligrams per litre of thallium in the form of a soluble compound.

3. A method of removing impurities from zinc electrolyte solutions, comprising adding to the electrolyte small amounts of zinc dust, copper sulphate, a soluble arsenic compound, and thallium sulphate.

4. A method of removing impurities from zinc electrolyte solutions, comprising adding to the electrolyte small amounts of zinc dust, copper sulphate, a soluble arsenic compound, and from about 10 to about 25 milligrams per litre of thallium sulphate.

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