RECOVERY OF ZINC FROM ZINC ASH

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The ever increasing need of zinc as a coating material on steels has compelled the galvanizers to have a relook on the economic and effective use of this material. The annual world wide consumption of zinc for hot dip galvanizing is around 600000t. The effective utilisation of zinc in different galvanizing plant throughout the world averages 78% but in our plant it comes to 58% only. The world average of zinc loss as zinc ash is 3% in hot dip galvanizing while at Tata Steel zinc loss is about 14 - 16% (shown in Fig.1). Of late, increased attention is being paid the world over for the recovery of scarce material from industrial waste. Particularly in India, it has drawn a great deal of importance as the country at present is not self sufficient in the production of zinc and has to import a substantial amount every year.

Zinc as generated at Tube Division of Tata Steel is fairly a large quantity which is sold out to chemical manufacturers and others at relatively low price. It this ash is treated in one way or other to recover some of its zinc for reuse in the galvanizing bath, quite a good amount of money can be saved. Therefore, a detail study was carried out to recover zinc from zinc ash economically.

Essentially, zinc ash is mixture of metallic zinc, zinc oxide, chlorine compounds and acid insoluble impurities (Fig.2). Zinc ash is formed as the molten zinc on the top of the galvanizing bath gets oxidised by the atmosphere. This process continues with the removal of the zinc oxide layer from the bath, whereby a new metallic zinc surface is exposed to the atmosphere. When ash is removed from the zinc bath, it also takes along some pure zinc with it from the bath. Composition of zinc ash has been found to be in the following range:

Zinc	- 60 - 85%	Chlorides	- 2 - 12%
Lead	- 0.3 - 2.5%	Aluminium	- 0 - 0.3%
Iron	- 0.2 - 1.5%		

A comprehensive literature survey was undertaken to review the established methods for recovery of zinc from ash and finally to select a process based on extensive laboratory experimentation, which would be best suited to our infrastructure - facilities available and the final application required at Tata Steel.

Experimental Details

A number of trials we have conducted to recover zinc from zinc ash generated at Tube Division. Melting experiments were carried out with as received zinc ash, as well as the zinc ash after grinding in a ball mill for different times and with combined flux also. When all the parameters like grinding time, size fraction and controlled temperature melting were established, 1 tonne ingot of zinc from zinc ash was produced in laboratory and sent to Tube Division for galvanizing of tubes. The summary is given in Table-1. The effect of grinding time, size fraction and combined flux on zinc recovery are listed in Table-2, 3 & 4 respectively.

Refinement of zinc produced from zinc ash was done by holding the zinc in a kettle at 425-430°C for 24 hours. After this the molten zinc was decanted. The chemical analysis are shown below:

	Before refinement	After refinement
Zinc %	98.5	99
Fe %	0.27	.02-.025
Pb %	Balance	Balance

Discussion of Results

Extensive laboratory experimentation after taking account of different process parameters like grinding, melting, size fraction, effect of flux etc. has shown that 85 - 88% zinc can be recovered from +3mm size fraction and 40 - 42% from -3mm +65 mesh size fraction. Below -65 mesh, there is no possibility of recovery of zinc on commercial basis.

Recommendation

Best on above studies, a flow sheet has been prepared which gives details of different process parameters. The process chart as well as a tentative lay out should help in developing the infrastructure facility for commercial recovery of zinc from zinc ash (as shown in Table-5). The following may be noted:

1	Capacity	:	660 tpa of zinc ash
		:	300 tpa of pure zinc
		:	80 tpa of zinc (-65 mesh)
		:	280 tpa of slag
2	Order of Magnitude capital cost	:	Rs.2.00 crore

Information about some existing plants are also shown in Table-6.

Conclusion

This zinc recovery project, though small, will definitely contribute towards reducing the foreign exchange out go. However, the technology will be totally indigenous and most of the equipment will be procured from Indian manufacturers.

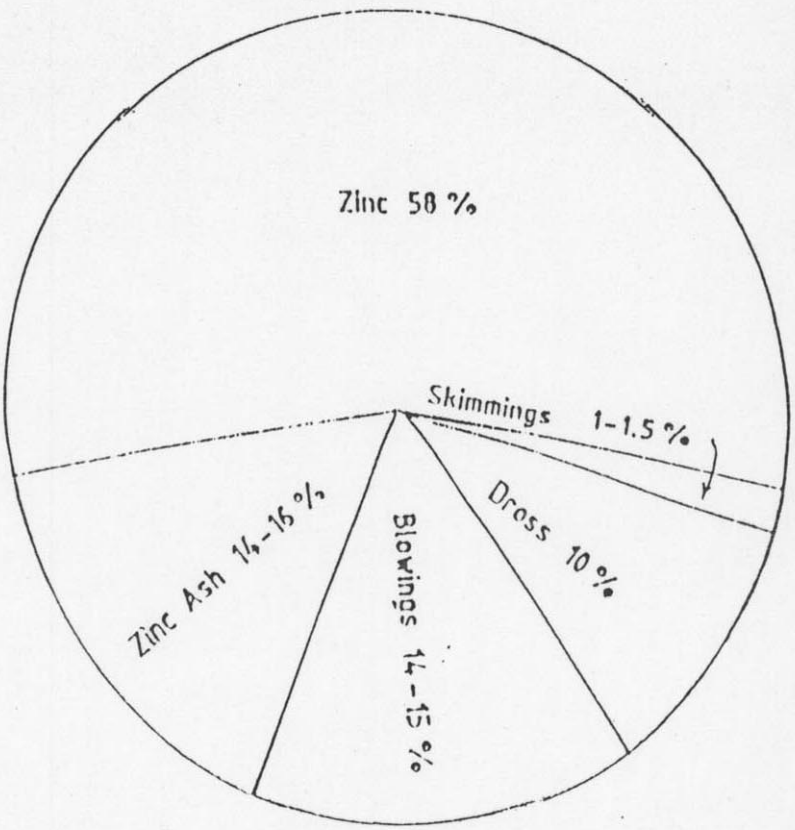

FIG. 1: ZINC BALANCE DURING GALVANIZING.

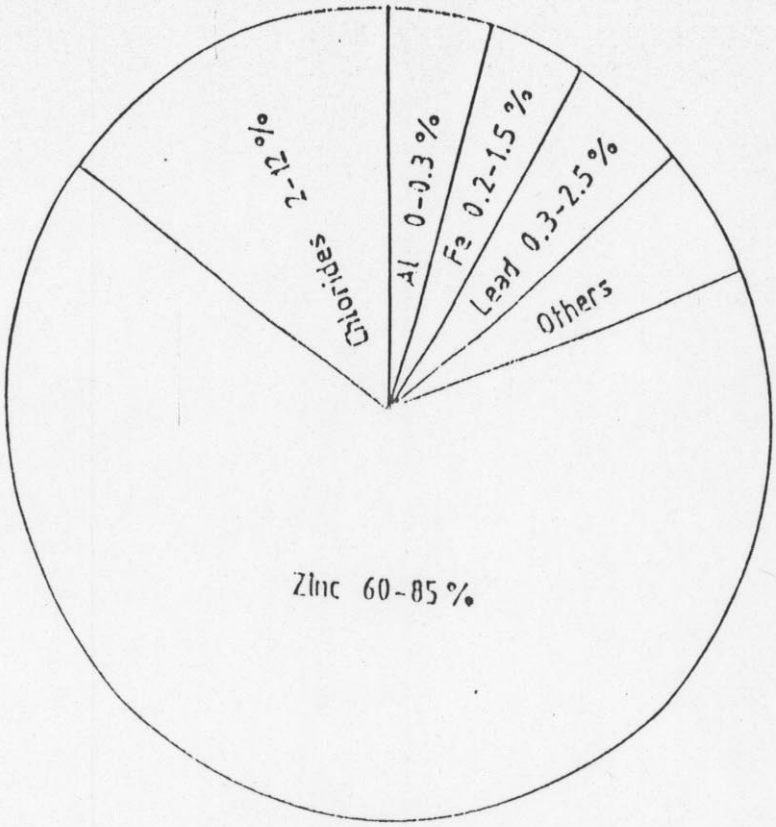

FIG. 2: ANALYSIS OF ZINC ASH.

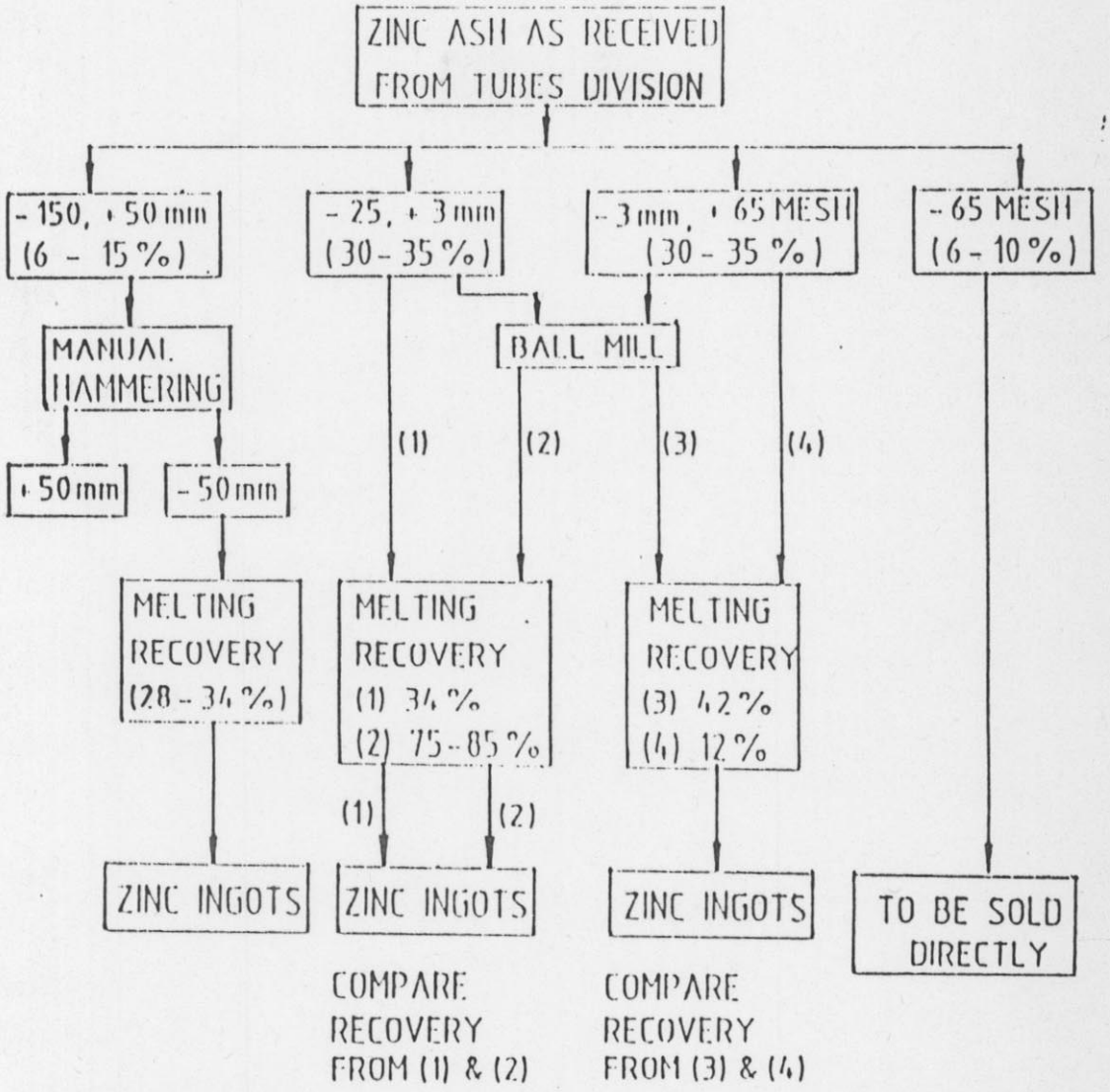

FIG. 3: PROCESS FLOW SHEET FOR ZINC ASH MELTING TRIAL FOR DIFFERENT SIZE FRACTIONS

TABLE - 1 : SUMMARY OF THE 1 TONNE BATCH TRIAL OF ZINC INGOT

	Weight kg	Remarks
Total amount of Zinc ash (-3mm, and + 3 mm) taken,	4701.31	
-3 mm Zinc ash screened out before feeding in ball mill	1866.31	
+3 mm Zinc ash as feed for Ball Mill	2835.0	
+3 mm Zinc ash concentrate as discharge from Ball Mill	1552.31	54.76 %
+3 mm Zinc ash concentrate used for melting	1259.0	
Weight of zinc Ingot produced	1011.60	80.35 % Recovery
Ammonium Chloride flux consumed for producing 1T Zinc Ingot	70	7.00 % of zinc ingot

TABLE - 2 : EFFECT OF GRINDING TIME ON ZINC RECOVERY

Grinding Time, minutes	-65 mesh fraction retained,%	Over all zinc recovery, %
0	11.0	23.7
15	28.8	43.8
30	27.6	45.3
60	30.0	44.65
90	33.4	41.4
120	45.0	30.0

TABLE -3: MELTING EXPERIMENTS WITH -3mm, + 65 mesh SIZE FRACTION

Sl.No.	Wt. of charge, kg	Wt. of Zn Ingot, kg	Recovery, %
1	12	5.10	42.5
2	12.40	5.0	40.32
3	12	5.10	42.5

TABLE - 4 : COMPARISION OF RECOVERY OF ZINC FROM ASH WITH COMBINED FLUX (NH_4Cl + $ZnCl_2$) AND NH_4Cl FLUX

Sl.No.	Size fraction	Flux used	Percentage recovery	Improvement in yield by using combined flux.
1.	+3 mm	NH_4Cl + $ZnCl_2$	77.50	2.5 %
2.	+3 mm	NH_4Cl	75.00	
3.	+3 mm	NH_4Cl + $ZnCl_2$	76.67	1.67 %
4.	+3 mm	NH_4Cl	75.00	
5.	-3 mm, +65 mesh	NH_4Cl + $ZnCl_2$	42.5 %	2.18 %
6.	-3 mm, +65 mm	NH_4Cl	40.32%	

TABLE - 5 MATERIAL FLOW FOR THE PROPOSED ZINC RECOVERY PLANT

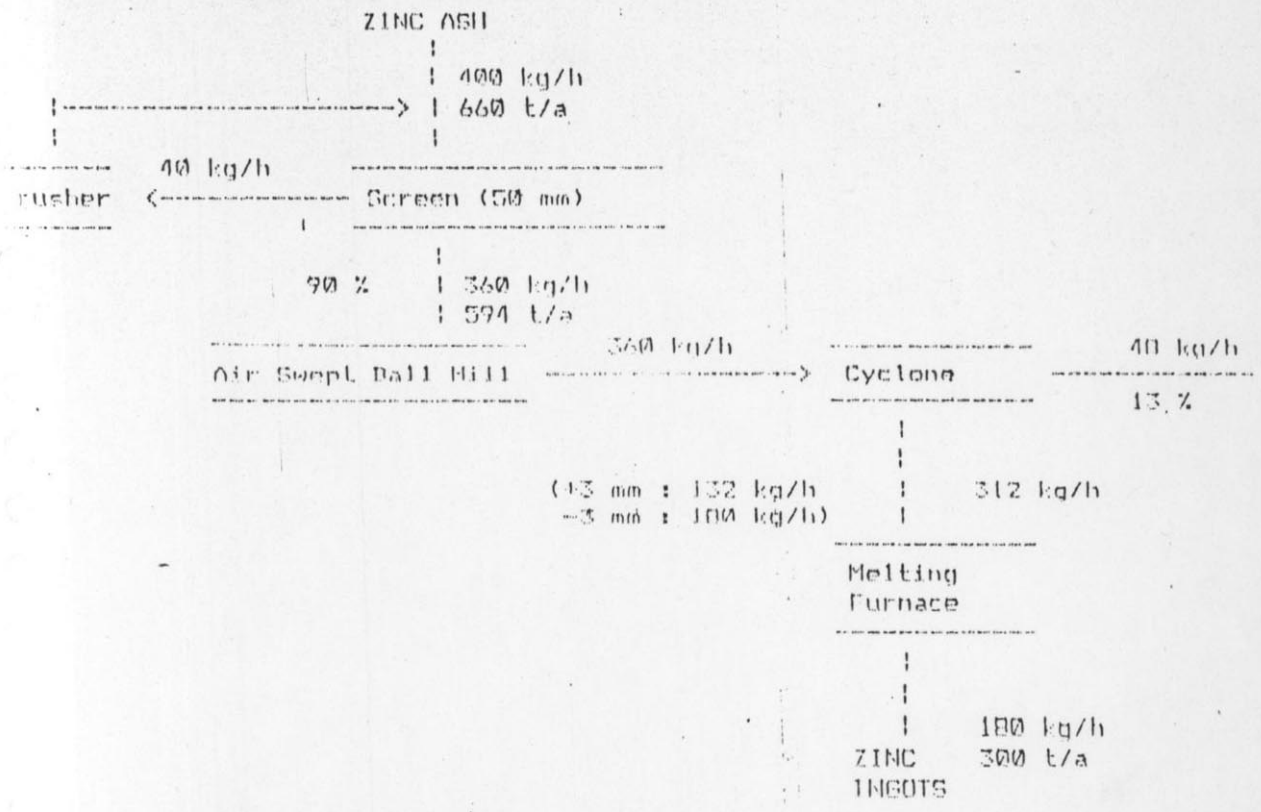

TABLE - 5 (CONTD)

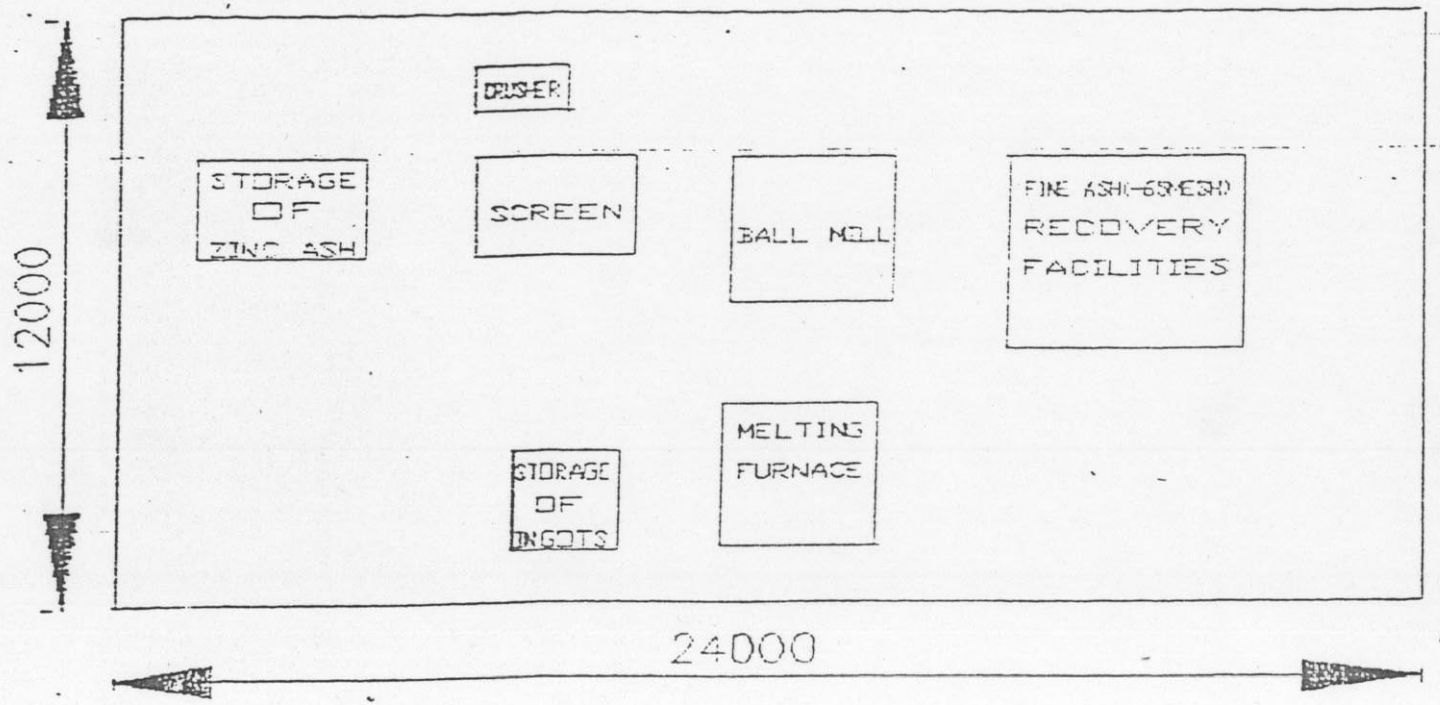

TABLE- 6 ZINC RECOVERY PLANTS IN INDIA

	Location	Capacity	Raw Mat'l	Capital Cost (Rs Cr)
1. ABC Electricals and Industries	Backward Area of Maharashtra	5,000	Zinc Ash	2.00
2. Alcobex Metals	Udaipur, Rajasthan	3,000	Zinc Ash	5.00
3. Ganesh Narayan and And Sons	Union Territory of Daman	6,000	Zinc Ash,	2.50
4. Gujrat Steel Tubes	Kali, Dt.Mohsana Gujrat	5,000		5.00
5. Modi Zinc	Tarapur, Bombay	2,100		2.10
6. Om Metals And Minerals	Pithampur, Indore	2,100		2.50
7. Prakash Tubes	Sankhol, Dt.Rohtak Haryana	6,000		2.20
8. Priyadarshini Metals And Alloy	Paithan, Aurangabad Maharashtra	2,100	Dross Dust	2.20
9. Rajendra Mechanical Industries	Pen Dt.Raigad Maharashtra	5,000		2.00