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Sustainability in Galvanizing from In-house Applied Waste Management of General Hot Dip Galvanizing Ashes and Skimmings and Continuous Galvanizing Line Top Drosses.

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Introduction.

All galvanizing and metal coating companies know the daily market price for zinc.

They also maintain detailed records of operational costs, plant productivity and plant profitability… but until recently there has been a limited awareness of the hidden, but significant extra values available from process ashes/skimmings and top drosses and of the potential offered to enhance business profitability.

Previous options to increase ashes/skimmings' and top dross values have been limited both in choice and in the size of returns.

Improved collection procedures and general housekeeping have given small improvements. LME percentages paid by traders for GHDG ashes/skimmings and CGL top dross have until recently been modest but are now starting to improve.

However, indications are that GHDG ashes/skimmings and CGL top dross values can be enhanced by as much as 20 LME zinc price percentage points by in-house processing for zinc recovery.

Collecting the Ashes/Skimmings

Recovering Process Zinc

Re-use of Recovered Zinc

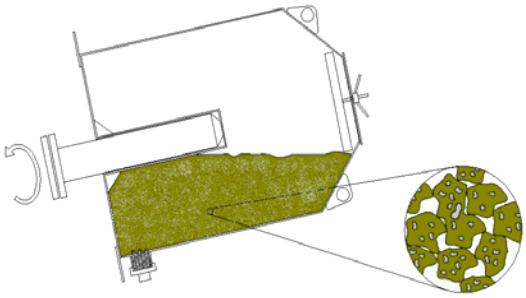
There is also a range of other elements of value associated with the in-house recovery process in addition to the value of the recovered metal. For example there is no LME premium payable on the recovered zinc as it is already the property of the galvanizer while metal recovery and re-use within 24 hours contribute worthwhile cash flow benefits to the overall business.

This paper will discuss in-house processing of General Hot Dip Galvanizing Ashes and Skimmings and Continuous Galvanizng Line Top Drosses and will highlight the elements of value available to the galvanizer to improve profitability.

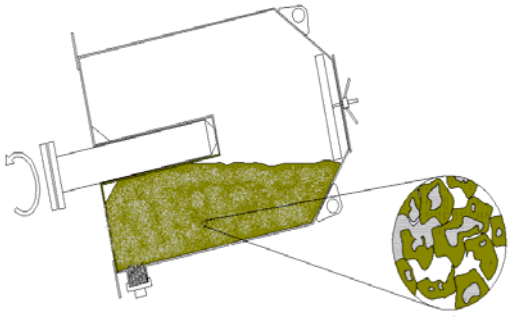
1 In-house Recovery.

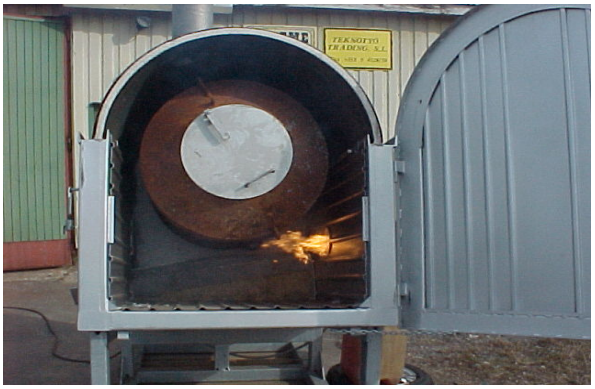
In-house recovery can be carried out by using a thermo-mechanical device to separate free metal present in GHDG ashes/skimmings and CGL top drosses generated as part of the galvanizing process.

a) The intimate mixture of particulate zinc, zinc oxides and other zinc chemicals is first collected in a process barrel.

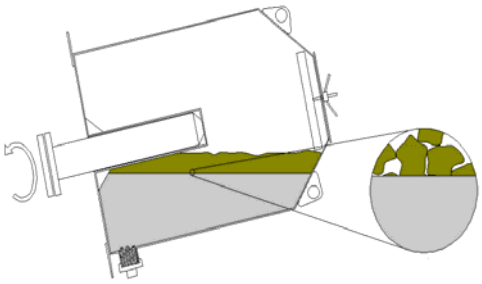


b) Placing the loaded barrel into a heating chamber and slowly rotating it while applying indirect heat from the outside of the barrel allows the particulate zinc to melt and agglomerate with maximum protection from excessive oxidation.





c) Continuous barrel rotation with applied heat over a set time period results in the collection of liquid metal covered with a protective blanket containing zinc oxides. After a set processing time the liquid metal can be collected in a mould leaving the protective oxide blanket material inside the barrel.



2. Elements of Value

The Global Galvanizing Industry has identified and developed a growing list of elements of value following an increased use of in-house metal recovery..

2.1 Positive Value Elements

a) Recovered Zinc Metal

b) Recovered Residues

c) No LME Zinc Metal Premium

d) Positive Cash Flow Contributions

The picture on the left shows ashes/skimmings which had been collected over a three month period.

There were 50 tonnes of ashes/skimmings.
The Zinc price was US$3000/tonne
The Trader Value was US$63000 (42% LME for Zinc)
Recovered value @ 75% zinc content was US$110250.
Immediate increase in value US$ 47250

e) Improved Material Logistics

1 General Hot Dip Galvanizing.

In 2006

The European GHDG ash/skimmings generation was	52000 tonnes
New Zinc returned from these ashes/skimmings	21000 tonnes
Total material shipped	73000 tonnes
Residues generated by in-house processing	17500 tonnes

This represents a decrease of 55500 tonnes of material shipped or 76%

2 Continuous Galvanizing Top Dross (500 tonne Quantities)

a) Trader

Dross Transport from site.	500 tonnes
Equivalent New Metal Transport to site	340 tonnes
Total Material Movement	840 tonnes

b) In-House Recovery

Residue Transport from site	75 tonnes
Total Material Movement	75 tonnes

Reduction in Material Movement/500 tonnes of Dross 765 tonnes (90%)

f). Reduced Global Energy Demand.

Energy to Create Virgin Zinc from Ore	32000MJ/Tonne
Energy to Recover 1 tonne of Zinc	1600MJ/Tonne
Energy decrease.	30400MJ/tonne (95%)

g) Hard Currency

Some traders will pay for the ashes/skimmings and top dross in local currency.

New zinc has to be paid for in US$

Recovered zinc does involve hard currency charges.

2.2 Negative Value Elements

a) Cost of In-House Processing

Fuel for 3 Hour Firing	30 litres of oil or 30m^3 of gas
Drum Cost	100 uses
Labour	1 operative hour/firing
Total Cost	US $100/firing

Assume 800kg of product processed/firing
COST/KG OF PRODUCT PROCESSED US $0.125

3. The Process.

Recovery processes and procedures for General Hot Dip Galvanizing ashes/skimmings and Continuous Galvanizing Line top drosses are basically similar.

3,1. The ashes/skimmings or the top dross are collected in a process barrel…….

Collecting GHDH ashes/skimmings Process Barrel CGL Top Dross

A small amount of release agent is added to the CGL process barrel. This enhances the volume of recovered zinc and improves the handling characteristics of the residues left in the process barrel.

3,2. The process barrel is placed in the heating chamber ....

…….and the unit tilted to its operating position

3.3 The burner is switched on and the zinc recovery process started……

Processing time depends upon the zinc content of the furnace burden.

The nominal capacity of the unit shown is 750kg. Process time for GHDG ashes and skimmings is about three hours while the total time for CGL is about five hours.

Similar process times apply to the larger 1500kg capacity unit.

3.4. After the appropriate processing time the zinc is tapped and collected in an ingot mould..

Collection from a 750kg unit

Collection from a 1500 kg unit

3.5. ……and returned to the kettle or the zinc pot for immediate re-use.

4. Recovered Metal (Volumes)

The volume of Zinc recovered depends on the galvanizing process.

4.1 General Hot Dip Galvanizing

a) Mixed Product and Fabrications.

Metal yield varies between 55% and 75% and averages about 65%.

b) Spin/Tube/Pipe Galvanizing

Metal yield varies between 65% and 75% and averages about 70%.

Customer	A	B	C*
Recovery rate (%)	60	68	70
Material processed (tonnes)	25	95	660
Zinc recovered (Tonnes)	15	65	465

* Tube/pipe galvanizer

4.2 Continuous Galvanizing Top Dross

a) GI Coated Strip.

Theoretically about 90% of CGL top dross is available for recovery.

Improved recovery techniques operated over the last two years are giving an average yield of about 85%.

5. Recovered Metal (Quality).

5.1 General Hot Dip Galvanizing.

Recovered Zinc quality has been questioned on past occasions, particularly with respect to iron content and its influence on the suitability of recovered Zinc for the galvanizing process.

It is acknowledged that a slightly elevated iron content in recovered zinc will generate a small amount of extra floating dross compared to the use of pure, virgin feedstock. The incidence of this happening will increase with the percentage of reclaimed zinc added to the kettle.

The maximum recommended addition of reclaim to a kettle at any one time is 15%, a value very rarely achieved.

When reclaimed zinc is blended to this recommended maximum, quality concerns generally prove to be minimal. Bottom dross build-up is negligible and does not contribute to a need for an increased frequency of removal.

Operational Data.

The following data has been collected from high a productivity kettle operating with reclaimed zinc as an additive as part of its normal operating procedure for more than three years..

Operational kettle samples were taken at the same time as the ashes/skimmings were collected.

		Kettle Zn	Kettle Fe	Reclaim Zn	Reclaim Fe
Range %		98.97 to 99.04	0.021 to 0.022	98.05 to 98.91	0.11 to 0.28
Average %		99.02	0.021	98.56	0.2

5.2 Continuous Galvanizing Line Top Dross

Recovered zinc from Continuous Galvanizing Line Top Dross has been investigated fully for its suitability for re-introduction to the zinc pot of the process.

It is now being used increasingly as an addition to construction and general product zinc pots.

Operational Data

The results shown from a project recovery programme give a good indication of the chemistry of the recovered zinc. As with GHDG, it can be blended with confidence to about 15% of the total pot volume.

Reference	Recovery %	Fe%	Al%
1	82	0.026	0.16
2	86	0.007	0.19
3	88	0.0064	0.23
4	84	0.01	0.16

6. Recovered Residues.

Chemically bonded zinc residues remaining in the process barrel after the free zinc has been removed are rated as a valuable feedstock for further processing. This is especially true for residues processed to a give a free flowing granular characteristic.

Produced in this form and collected in appropriate packaging, it is not unusual for the material to be valued at up to 20% of the LME price for Zinc.

As referred to , an additive needs to be included with the top dross collected from CGL operations.to enhance zinc volume recovery and to particularly leave a residue in the barrel with free flowing characteristics.

The pictures below illustrate the character of GHDG ashes/skimmings residue. A similar product is obtained when the additive needed for CGL dross residues is included in the recovery process but without the additive, the resultant residue needs further processing to maximise zinc yield and ease residue recovery.

GHDG residue and CGL residue with additive

CGL dross residue without a process additive

7. Do the Pluses and Minuses Offer an Opportunity to Save Money and Enhance Sustainability?

The answer to this question is dependent on the quantity of free zinc available for recovery and the value placed on the ashes/skimmings by the traders/recyclers.

In general the answer is “yes” with the returns for Continuous Galvanizing Lines being particularly attractive.

7.1 General Hot Dip Galvanizing

In 2006 the European GHDG Industry produced about 52,000 tonnes of ashes/skimmings

Trader pricing @ 45% of LME (US$2000) valued these ashes/skimmings at US $47 million

At average Zinc Recovery Rates of 65% for GHDG and 75% for spin/tube galvanizing, in-house recovery valued the ashes/skimmings at US $78 million

The difference of US $31million shared between 640 European Plants yields an average increased value of US $48,000/plant/year or US$ 240,000 over a five year write down period for a process unit.

7.2 Continuous Galvanizing Line Top Dross

The global CGL Industry produces about 500000 tonnes of top dross/year.

A Trader price of 70% Zinc LME @ US$2000 values this dross at US$700 million

An In-House Zinc Recovery Rate of 85% values the dross at US$850 million

The difference of US$150 million shared between 340 World lines yields an average increased value of about US$440000/line or US$2.2 million over a five year write down period for the process unit.

8. The Future

Developments are continuously being introduced to increase options available to the galvanizer for in-house processing and metal recovery from process wastes.

These include;

8.1 Alloying on site.

Controlled quantities of master metals or alloys can be added to the waste being processed to produce ingots for return to the kettle and to allow simple, easy and uniform dispersion of the minor elements involved. These include Aluminium and Lead. Small additions of Nickel containing kettle feedstock can also be added.

Alloys removed as ashes/skimmings and top dross from kettles and process pots are recovered as the original alloy. This has been illustrated previously in this paper with CGL alloys containing aluminium while Magnesium containing drosses have already been processed with similar results.

8.2 Recovered Metal Quality Improvements by Filtration.

Programmes are currently underway to examine the possibility of modifying recovered metal chemistry by filtration. This applies particularly to the iron content of the recovered metal.

Technologies and procedures being developed successfully for Continuous Galvanizing drosses look set to be transferred to the general Hot Dip Galvanizing industry sector.

8.3 Bottom Dross Processing.

Results from the filtration work mentioned above and progress with continuous galvanizing line (CGL) drosses indicate that potential for recovery of metal from bottom drosses is increasing. Ongoing programmes of work are planned to be reported upon in the near future but commercial considerations may make it difficult to justify current procedures economically.

Bottom dross processing is considered a long term project at present.

8.4 New Equipment, Designs and Capabilities.

A continuous programme of work to upgrade equipment performance and productivity is ongoing and is exhibiting highly positive results.

The Primary Zinc Industry with high volumes of ashes and drosses is moving to the use of larger machines while the Continuous Galvanizing Industry is also starting to follow the same trend.

A unit recently introduced to process 1500kg of ashes/skimmings or top dross per firing is now commercially available and is proving particularly attractive to the operators of Continuous Galvanizing Lines.

A 1500kg/firing processing unit

Three 1500kg.firing units in operation

9. Summary

In-house recovery of technically acceptable process metals and alloys from ashes and skimmings generated during General Hot Dip Galvanizing and from top drosses generated on Continuous Galvanizing Lines has been proven to be a feasible alternative to traditional methods of disposal.

As environmental issues continue to demand increasing creativity and original thought from Global Industry with respect to the creation and disposal of waste, galvanizers around the world now have a remarkable opportunity to conform to any new legislation and at the same time improve their basic business performance and profitability.