ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

IMPLEMENTATION OF IPPC DIRECTIVE FOR BATCH GALVANIZING

Irina SMICAL, Vasile HOTEA, Gabriel BĂDESCU

North University of Baia Mare, Science and Materials Engineering Department
e-mail irinadan2003@yahoo.com

Keywords: IPPC Directive, batch galvanizing, corrosion protection, galvanized steel, zinc coating

Abstract: Unless otherwise stated, references to “the Directive” in this document means the Council Directive 96/61/EC on integrated pollution prevention and control. This document forms part of a series presenting the results of an exchange of information between EU Member States and industries concerned on best available techniques (BAT), associated monitoring, and developments in them. Hot dip galvanizing is a corrosion protection process in which iron and steel fabrications are protected from corrosion by coating them with zinc. The paper deals with Integrated Prevention and Pollution Control (IPPC) Directive and its application in batch galvanizing. The following major activities are discussed from the point of view of specific pollution of environment: emissions to air (HCl from pickling, and dust and gaseous compounds from the kettle); spent process solutions (degreasing solutions, pickling baths and flux baths), oily wastes (e.g. from cleaning of degreasing baths) and zinc containing residues (filter dust, zinc ash, hard zinc).

1. INTRODUCERE

Unless otherwise stated, references to “the Directive” in this document means the Council Directive 96/61/EC on integrated pollution prevention and control. This document forms part of a series presenting the results of an exchange of information between EU Member States and industries concerned on best available techniques (BAT), associated monitoring, and developments in them. It is published by the European Commission pursuant to Article 16(2) of the Directive, and must therefore be taken into account in accordance with Annex IV of the Directive when determining “best available techniques”.

The term “best available techniques” is defined in Article 2(11) of the Directive as “the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.” Article 2(11) goes on to clarify further this definition as follows [1]:

- “techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;
- “available” techniques are those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;
- “best” means most effective in achieving a high general level of protection of the environment as a whole.

Furthermore, Annex IV of the Directive contains a list of “considerations to be taken into account generally or in specific cases when determining best available techniques bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention”.

These considerations include the information published by the Commission pursuant to Article 16(2).

2. GENERAL INFORMATION ON BATCH GALVANIZING

General galvanizing is a service industry, offering the application of zinc coating corrosion protection to steel fabricators or the users of fabricated steel products. The sector operates with short lead times and short order books to give enhanced service to customers. Distribution issues are important, and so plants are located close to market concentrations.
Consequently, the industry consists of a relatively large number of plants, servicing regional markets in order to minimize distribution costs and increase economic efficiency.

Only a few 'niche' operators are prepared to transport certain classes of fabrication for longer distances in order to exploit their special expertise or plant capability. Opportunities for these specialist operators are limited. About 600 galvanizing plants with more than 30000 employees are distributed throughout the EU, as shown in Table 1 [2].

Table 1 Distribution of galvanizing plants in the EU

Member State	Number of plants in 1997	Steel Galvanized [t/y]
Austria	17	132916
Belgium	22	263268
Denmark	17	122500
Finland	19	73360
France	69	690105
Germany	185	1428610
Greece	4	n.a.
Italy	74	810716
Luxembourg	1	n.a.
Netherlands	21	242717
Portugal	9	42368
Spain	35	314509
Sweden	34	120000
United Kingdom (+ Ireland)	88	738928
Total:	595	**4979997**

The zinc consumption of the EU galvanizing industry (excluding Greece and Luxembourg) in 1997 was 381188 t. The main galvanizing countries are Germany with of 27.5 % of the production, Italy with 15.6 %, UK/Ireland with 14.2 % and France with 13.3 % [5].

In recent years the markets for galvanized steel have grown more rapidly than previously. The share of total market accounted for by various market sectors is shown in Table 2.

Table 2 Market segmentation for Galvanized Steel

Market	Tonnage [t]	Percentage [%]
Construction	2022886	39.0
Infrastructure and highways	832634	16.1
Power transmission	531042	10.2

Agriculture	524586	10.1
Transport	308786	6.0
Fasteners	254056	4.9
Other	712264	13.7
Total	5186254	100.0

Industry turnover is estimated at EUR 1800 million per year. The capacities of the most economic operating units are related to the size of the steel fabrications to be treated and to the demand in the accessible market. Most companies in the sector are small or medium sized enterprises financed by private capital. Integration into the zinc production or steel fabrication industry is very unlikely. About half of the European capacity is in the hands of businesses that own one or two plants. Larger companies, owing up to 20 plants, have emerged in some Member States.

Even so, the assets of these groups are widely distributed in order to service regional markets and the opportunity for concentration of productive capacity is limited [3]. In recent years the cost of entry has risen, reflecting greater capital intensity arising from use of improved technology and increased environmental control. This has discouraged the entry of poor quality, short life operators. On the other hand, the sector is highly competitive as to price and quality of service. In general, the sector enjoys reasonable economic success but it is occasionally subject to price pressures because of over-capacities in some markets and variations in the price of zinc.

3. BATCH GALVANIZING

Hot dip galvanizing is a corrosion protection process in which iron and steel fabrications are protected from corrosion by coating them with zinc. Prevalent in batch hot dip galvanizing is job galvanizing - also referred to as general galvanizing - in which a great variety of input materials are treated for different customers. The size, amount and nature of the inputs can differ significantly. Galvanizing of pipes or tubes which is carried out in semi or fully automatic special galvanizing plants is usually not covered by the term job galvanizing.

The items to be coated in batch galvanizing plants are steel fabrications, such as nails, screws and other very small items; lattice grates, construction parts, structural components, light poles and many more. In some cases tubes are also galvanized in conventional batch coating plants.

Galvanized steel is used in construction, transport, agriculture, power transmission and everywhere that good corrosion protection and long life are essential.

The sector operates with short lead times and short order books to give enhanced service to customers. Distribution issues are important, and so plants are located close to market concentrations. Consequently, the industry consists of a relatively large number of plants (about 600 all over Europe), servicing regional markets in order to minimize distribution costs and increase economic efficiency. Only a few ‘niche’ operators are prepared to transport certain classes of fabrication for longer distances in order to exploit their special expertise or plant capability. Opportunities for these specialist operators are limited.

In 1997 the tonnage of galvanized steel was about 5 million. The largest share was produced by Germany with 1.4 million tones and 185 galvanizing plants (in 1997). Second largest producer was Italy with 0.8 million tones (74 plants), followed by UK and Ireland with 0.7 million tones (88 plants) and France 0.7 million tones (69 plants).

The batch hot-dip galvanizing process, also known as general galvanizing, produces a zinc coating on iron and steel products by immersion of the material in a bath

of liquid zinc. Batch galvanizing usually comprises the following process steps: degreasing, pickling, fluxing, galvanizing (melt metal coating), finishing.

Batch galvanizing usually comprises the following process steps:

- Degreasing
- Pickling
- Fluxing
- Galvanizing (melt metal coating)
- Finishing

There are two different fluxing methods, dry and wet (Figure 1).

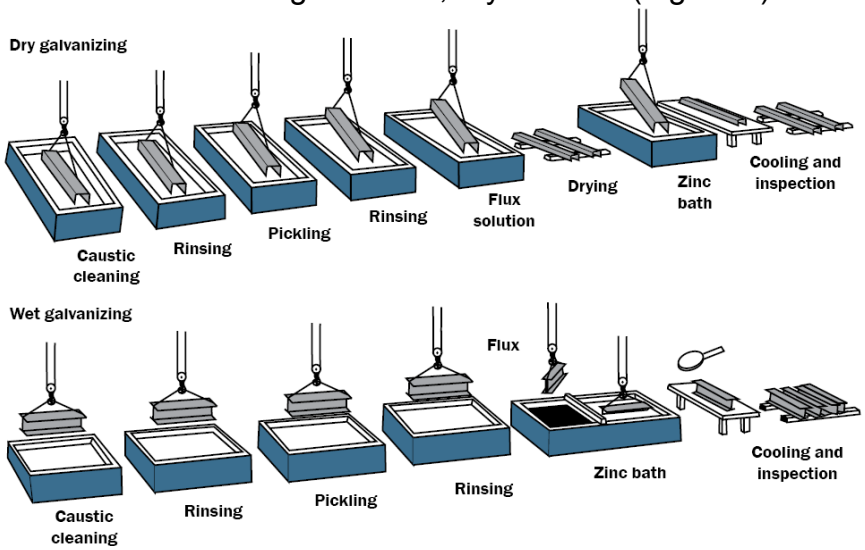

Figure 1 Batch Hot-Dip Galvanizing Processes.

A galvanizing plant, essentially, consists of a series of treatment or process baths. The steel is moved between tanks and dipped into the baths by overhead cranes.

The main environmental issues for batch galvanizing are emissions to air (HCl from pickling, and dust and gaseous compounds from the kettle); spent process solutions (degreasing solutions, pickling baths and flux baths), oily wastes (e.g. from cleaning of degreasing baths) and zinc containing residues (filter dust, zinc ash, hard zinc).

For detailed emission and consumption data, refer to Chapter .3 where the available data are presented with qualifying information.

The key findings regarding BAT for individual process steps and different environmental issues of batch galvanizing are summarized in Table 1. All emission figures are expressed as daily mean values. Emissions to air are based on standard conditions of 273 K, 101.3 kPa and dry gas. Discharges to water are indicated as daily mean value of a flow-rate-related 24-hour composite sample or a flow-rate-related composite sample over the actual operating time (for plants not operated in three shifts).

There was consensus in the TWG on the best available techniques and associated emission/consumption levels presented in the table 1 [4].

Table 1 Key findings regarding BAT and associated emission/consumption levels for batch galvanizing

Best Available Techniques	**BAT-associated emission and consumption**
Degreasing	
• Installation of a degreasing step, unless items are totally	

grease free. • . Optimum bath operation to enhance efficiency, e.g. by agitation. • . Cleaning degreasing solutions to extend lifespan (by skimming, centrifuge, etc.) and recirculation, reutilization of oily sludge or • Biological degreasing' with in situ cleaning (grease and oil removal from degreaser solution) by bacteria.	
Pickling + stripping	
• . Separate pickling and stripping unless a downstream process for the recovery of values from “mixed” liquors is installed on site or is available through a specialist external contractor • Reuse of spent stripping liquor (external or internal e.g. to recover fluxing agent). In case of combined pickling and stripping: • Recovery of values from “mixed” liquors, e.g. use for flux production, recovery of acid for re-use in	
HCl pickling	
• Close monitoring of baths parameters: temperature and concentration • Operating within the limits given in Part D/Chapter D.6.1 ‘Open Pickling Bath Operation’. • . If heated or higher concentrated HCl-baths are used: installation of extraction unit and treatment of extracted air (e.g. by scrubbing). • Special attention to actual pickling effect of bath and use of pickling inhibitors to avoid over-pickling. • Recovery of free acid fraction from spent pickle liquor or • external regeneration of pickling liquor.Zn removal from acid. • Use of spent pickle liquor for flux production. • Not using spent pickle liquor for neutralization • . Not using spent pickling liquor for emulsion splitting	HCl 2 – 30 mg/Nm³
Fluxing	
• . Control of bath parameters and the optimized amount of flux used are also important to reduce emission further down the process line. • . For flux baths: internal and external flux bath regeneration.	
Best Available Techniques	**BAT-associated emission and consumption**
Hot dipping	
• Capture of emissions from dipping by enclosure of the pot or by lip extraction and dust abatement by fabric filters or wet	

scrubbers. • Internal or external reuse of dust, e.g. for flux production. The recovery system should ensure that dioxins, which may occasionally be present at low concentration due to upset conditions in the plant, do not build up as the dusts are recycled.	Dust < 5 mg/Nm³

CONCLUSIONS

The paper deals with Integrated Prevention and Pollution Control (IPPC) Directive and its application in batch galvanizing. The following major activities are discussed from the point of view of specific pollution of environment: emissions to air (HCl from pickling, and dust and gaseous compounds from the kettle); spent process solutions (degreasing solutions, pickling baths and flux baths), oily wastes (e.g. from cleaning of degreasing baths) and zinc containing residues (filter dust, zinc ash, hard zinc).

Hot dip galvanizing is a corrosion protection process in which iron and steel fabrications are protected from corrosion by coating them with zinc. Prevalent in batch hot dip galvanizing is job galvanizing - also referred to as general galvanizing - in which a great variety of input materials are treated for different customers.

REFERENCES

[1] EC (1996). “Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control", Official Journal of the European Communities (OJ), L257
[2] CETS (2002) "Reference document on best available techniques for the surface treatment of plastic and metals using electrolytic or chemical process", CETS
[3] Eurofer (2003). "Draft Reference document on best available techniques in the continuous electrolytic coating of steel", Eurofer
[4] http://www.anpm.ro/Files/bref/BREF/BREF_Ferrous_Metals_Processing_Industry_RO.pdf
[5] EGGA, General Assembly 98, Gothenburg, Sweden