SOME ASPECTS OF TUBES GALVANISING AND PRACTICE AT 'TUBES DIVISION' OF 'TATA STEEL'

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Introduction :

Hot dip galvanising as a process by which iron & steel can be treated to prevent corrosion. Like other products, hot dip galvanising is most widely used for producing zinc coatings on tubes as this method ensures rapid application of zinc coatings on highly efficient production lines abroad and semi automatic line in India. In India the sector of galvanising tubes is important from the point of view of the tonnage of tubes galvanised and zinc consumed. Although the basic principles of galvanising have remain unchanged for long years, yet continuous research on various aspects of galvanising has enabled this industry to be technically controlled.

At Tata Steel the average galvanising production is around 50,000 mt of tubes per annum.

The Process in General :

For hot dip galvanising, like other products, it is essential that tubes are first degreased, which is normally accomplished by treating the tubes chemically in aqueous solution of alkali, predominantly sodium hydroxide, or a proprietary chemical, as the case may be. Degreasing s not necessary in case of tubes manufactured through hot rolling process and tubes can be pickled directly.

Afterwards, the tubes are rinsed and pickled. Use of both sulfuric acid or hydrochloric acid is common, and its choice depends upon various factors like availability, cost and disposal of waste acid. To prevent excessive pickling, acid inhibitors are added. For effective degreasing & pickling, such installation are often equipped with mechanism for rocking the tubes.

Pickled tubes are then rinsed in water and treated for fluxing in a separate bath using a flux solution. The most common fluxing agents are zinc and ammonium chlorides. Again this treatment depends upon the galvanisers choice for a particular procedures to adopt i.e. 'Wet' galvanising or 'Dry' galvanising. Today, the most common and widely used procedure is 'dry' galvanising of tubes. In the dry process the fluxed tubes are allowed to dry in preheating oven followed by hot dip galvanising

bath, where the tubes are dipped in molten zinc for a given period and then removed from the molten zinc through an air die which has multiple holes to wipe out extra zinc from the outer surface. The tubes are withdrawn from molten zinc through a set of magnet rolls and are then transported to steam blowing station for inside blowing. After steam blowing tubes are quenched in a water tank or a tank with passivation solution. The fig.1 and 2 show the flow diagram for galvanising in general and for the procedure being followed at Tata Steel respectively.

Factors Influencing the Galvanising of Tubes :

Zinc Coating Weights :

First of all, it is important to note the requirement of coating weight w.r.t. different specifications.

The minimum thickness of zinc coating has been prescribed in different specifications :

IS	Average of 400 gms/m^2
DIN 2444	400 gms/m^2 in the inside of tube
ASTM A53	550 gms/m^2
BS 1387	4 dips in copper sulphate solution.

The thickness of the zinc coating in tubes depends on the following :

a) Composition of the steel
b) Surface roughness
c) Immersion time
d) Temperature of zinc bath
e) Composition of the zinc bath
f) Angle of withdrawal
g) Rate of withdrawal
h) Time lag between withdrawal and blowing
i) Wiping efficiency.

Optimum Conditions :

It is necessary to arrive at optimum conditions through series of experiments, so as to have control over the above factors on which the coating thickness depends. This will lead to better results and is necessary so far economy in galvanising is concerned.

Saving on Zinc :

In hot dip galvanising, there is only one form of zinc consumption that is desirable i.e. the production of zinc coating in accordance with a standard or according to the customer's requirement. All other reactions and process that occur during hot dip galvanising result in undesirable consumption of zinc. The various factors that are responsible for this, could be :

* Exceeding the minimum required thickness
* Long immersion time
* Non observance of process control activities
* Excessive temperature of zinc melt or bath
* Faults in removing dross
* Unsuitable bath material
* High formation of ash
* Carry over of contaminants
* Faults in ash removal
* Drag out losses
* Unfavourable design of heating system, main equipments etc.

Process Control and Quality Assurance Activities :

In order to keep the galvanising process under control and to meet the customer's expectation, it is of utmost importance to keep the important parameters under control so that the process as a whole is economically viable and the product adheres to the specifications and is of consistent quality. Some steps involved in exercising process control :

1. Know your equipment well and its limitations
2. Steel composition
3. End use of the product
4. Infrastructures and raw materials used
5. Outline the important parameters and set the limits.

An attempt has been made to briefly outline the process control and quality assurance activities at Tubes Division of Tata Steel as under :

ITEM	PARAMETERS	FREQUENCY	REMARKS
Steel chemistry	Checked for every heat at Main Works	Check analysis on audit basis & customer requirement	Test certificate is received.
Zinc spelter	Electrolytic 99.95% high grade zinc is used. Sample analysis is done on audit basis. It is made sure that it confirms to the specification I/S-209. Every consignment is received along with the test certificate from the supplier.	Once in three months if test certificate is supplied.	Test certificate is received
Ammonium Chloride	Technical grade of NH_4Cl is used.	Audit check to technical delivery condition	T.C. is received.
Zinc Chloride	Commercial grade	--------do--------	T.C. is received.
Triple salt (Galva flux)	Manufactured under the instructions of NML scientists.	Certified by NML Scientists with each lot	T.C. is received.
Pretreatment			
ADA Tank	Check Concentration, level of solution & time of dipping.	Daily or as per the requirement.	
Pickling	Concentration of sulfuric acid-5-15% Temp. 50-65°C Twadle - 60 max. Discard between 55-60°C Twadle.	Twice a shift	

ITEM	PARAMETERS	FREQUENCY	REMARKS
Rinsing	Double rinsing (cold)	Every lot	
Fluxing	Check temp., Twadle, Iron content, ACN	Once per shift or as per the requirement	
Drainage	On inclined trussel	Every lot	
Pre-heating	Oven temp.	Every shift	
Galvanising	Bath temp. & flue temp., RPM of dipping screw, air die pressure, steam blowing pressure, duration burners & zinc of steam blowing, flame characters of flat flame burners & zinc coating weight Appearance - Lucas (Al. addition)	Every shift	
Passivation (Galvasave)	Concentration	Daily	
Bath violations	Bath & Flue temp.	Every shift	
Bath chemistry	Pb, Al, Fe, Zn	Twice a month	
Byproduct analysis	Total Zinc	Once in two months	
Galvanising defects remedies	See annexure-I	Every shift or as the case may be	

Galvanising Defects :

The main galvanising defects on tubes are :

a) Black spot

b) Rough surface

c) Lumpy surface

d) Peel off

The enclosed Annexure (1) highlights the causes and remedial measures to bring down the rejections on this account :

Conclusions :

Small improvements in galvanizing bring favourable results from both quality and cost point of view. Optimising the various parameters in controlling the process are necessary to bring about the favourable results.

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Rolled Tubes

⇓

Degreasing

⇓

Rinsing

⇓

Pickling

⇓

Rinsing

⇓

Fluxing

⇓

Preheating

⇓

Galvanising

⇓

Quenching in water/
passivation solution

Flow Diagram of
General Procedure for Tube Galvanising

(Fig.-1)

Hot Rolled Tubes
of F.M. Origin

Welded Tubes from
HFIW Mill

⇓

Degreasing

⇓

⇓

Pickling H_2SO_4
Temp.60-65°C

⇓

First Rinse
(Cold Water)

⇓

Second Rinse
(Cold Water)

⇓

Fluxing
($NH_4Cl + ZnCl_2$)
or (Triple salt)
Temp. ≈ 65°C

⇓

Pre-heating

⇓

Galvanising
Temp.450 ±5°C

⇓

Quenching in water

⇓

Passivation treatment

Flow Diagram of the Procedure followed
at Tubes Division, Tata Steel

(Fig.-2)

Defect Type	Causes	Remedy : Action to be Taken
1. Black spot (B.S.) on Tube surface	i) Due to pickling : a) Improper pickling	Check remaining fluxed tubes on the Feeder's table. If scales are observed then remove the lift and send for re-pickling.
	b) Oil in pickling tank	Skim off the oil.
	ii) Pre-heat temp. high (check pre-heat furnace temp. if it exceed 200°C. Black spot will be observed at random in such cases)	1. Regulate steam supply. 2. Add little water if flux twaddle permits
	iii) Pre-heat temp. high (check pre-heat furnace temp. if it exceed 200°C. Black spot will be observed at random in such cases)	Regulate gas in pre-heat burners.
	iv) Light coloured ash (the colour of zinc ash should be dark brown, if it is light brown)	1. Add NH_4Cl to the bath
2. Rough surface	1. Bath temp. low (if bath temp. is below 440°C.	1. Stop bah and raise the temperature.
	2. Chocked air	1. Check air die and if any hole is chocked, clean it. 3. Check air die and if any hole is chocked, clean it.
3. Lumpy Bore	1. Steam pressure low (check the tube bore, it should be clean)	1. Check steam pressure, if low, stop production and inform Services Dept.
4. Peel-off	1. Excess dipping time	1. Check, if tubes are remaining in the bath for more than 2 minutes, adjust the settings.