ISSN 2277 – 5528
Impact Factor- 3.145

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

INVESTIGATION OF HOT DIP GALVANIZING & EPOXY POWDER COATING OF CABLE TRAY SYSTEM

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ABSTRACT

JabelAli Extension, Dubai placed Cable Tray Support System with Siemens, Germany. These cable trays are to be coated as per DIN EN ISO 12944-1 with 80 micron hot dip galvanizing. Further the same is to be coated with 60 micron epoxy powder primer and 60 micron epoxy powder by electrostatic precipitation method. After coating is completed, investigation (through field inspection and laboratory testing) is carried out to find whether coating is done as per specification. For this purpose, the coated samples were investigated by microscope, Fourier transform infrared spectroscope. It would be interesting to mention that coating with only epoxy polyester powder is found.

Keywords: *Hot dip galvanizing, Electrostatic precipitation, Microscope, Fourier transform infrared spectroscope, Epoxy polyester.*

I. INTRODUCTION

Siemens, Germany received order for Cable Tray Support System from Jabel Ali Extension Dubai. These cable trays care made from steel. To mitigate corrosion, cable trays are to be coated with hot dip galvanizing further to be coated with epoxy powder by electrostatic precipitation method. The above system was chosen in steed of corrosion resistant organic coating like solvent free epoxy as powder epoxy will give better bonding and thickness will be uniform. The composite system of hot dip galvanizing and epoxy powder is better than solvent free coating as hot dip galvanizing will act as second line of defense in case powder coated epoxy fails, hot dip galvanizing will act as an anode.

Siemens, Germany handed over the project to Siemens, India who in turn awarded the contract to Company A. Company A has only hot dip galvanizing plant, they decided to carry out rest (i.e., 60 micron epoxy primer and 60 micron epoxy) from Company B which is 70 km from Company A and who has a blasting unit and a powder coating unit. The entire process of sweep blasting and epoxy powder coating process (after hot dip galvanizing) was accorded by Company A, Company B & Siemens India.

Sweep Blasting & Epoxy powder Coating Process

Material Unload to Company B – plant I (for sweep blasting)
↓
Material Sweep Blasting
↓
Priming must be done within 4 hours of Sweep Blasting
↓
Material unload at Company B plant II (for powder Coating)
↓
Material Clean by dry Air – visual inspection
↓
Measure DFT for galvanizing [86 micron avg.]& Surface profile
↓
Clean by solvent, so that the surface is free from oil, grease & dirt – visual inspection
↓
Check dew point temperature (surface temperature of cable trays to be more than 3°C above dew point temperature)
↓
Load the material on conveyor – visual inspection [For Priming coat – 60 micron]

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↓

Pass the material through the paint booth and apply the primer coat using electrostatic gun

↓

Pass the material through the oven [metal temp. 180 degree for 20 minutes]

↓

Unload from conveyor at Touch up section – visual inspection

↓

Check whether the primer coat is fully cured or not & also check the required thickness of epoxy primer in DFT minimum 60 micron ± 20%

↓

Load the material on conveyor – visual inspection [For Final coat – 60 micron]

↓

Pass the material through the paint booth and apply the final coat using electrostatic gun

↓

Pass the material through the oven [metal temp. 180 degree for 20 minutes]

↓

Unload from conveyor at Touch up section – visual inspection

↓

Check whether the final coat is fully cured or not

↓

DFT & CROSS HATCH test [ASTM A 653 – Cross Hatch test]. Total DFT of Epoxy Primer & Epoxy Powder minimum 120 micron

↓

Check for paint / coating failure if any by visual inspection

↓

Ok material move from touch up section to Dispatch section after visual inspection.

Salt spray test for final 720 hours for sample given by Company A.

Powder Coating of epoxy was done by spraying the powder using an electrostatic gun or corona gun. The gun imparts a positive electric charge to the powder which is then sprayed towards the object by mechanical spraying and then accelerated towards the work piece by powerful electrostatic charge. The cure process called cross linking by curing at 200°C for 10 minutes in a convection cure oven. However, for practical purpose, convection cure oven is kept at 180° C and cross linking took place for 20 minutes.

Inspection: After coating was completed we were asked to inspect whether everything was in order. At blasting plant of Company B, no blasting works were in progress. No compressor, oil and water separator could not be inspected as we were told that those were sent for maintenance.

The blasting grit is mineral fine grid (dark grey color). It was stored under a roof which was partly not closed. Certificate of grit manufacturer could not be provided.

Salt Spray is generally carried out for underground structure/pipeline. For cable system appropriate test should have been accelerated weathering (QUV) as it simulates damaging effects of long term outdoor exposure of materials and coatings.

Further discrepancies found as epoxy powder primer and epoxy powder are from different manufacturers. It was further found that instead of epoxy powder, polyester epoxy powder was used.

Epoxy Powder and Polyester epoxy have different functional group. Epoxy is governed by the formula.

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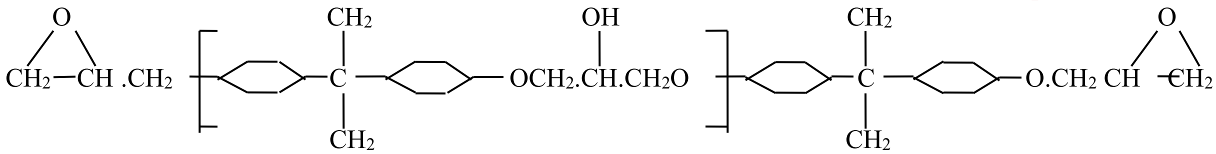
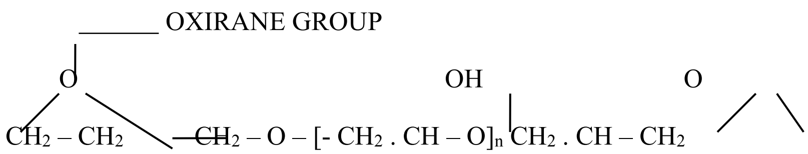


Whereas Polyester Epoxy has formula as follows.



Further investigation by Tooke Gauge revealed that

a) Though total DFT is above 200 micron, coating itself without galvanizing is found to be 80-100 micron which is lower than minimum of 120 micron. It is shown in fig 1 and fig 2
b) Inspection of the cut through the coating does not show two different layers. This test has been carried out three times with the same result.

We also found that galvanizing process is state of the art, even the final step is the passivation in dischromating bath (2-3 %). Quality is good and as per specifications.

It was suggested to send the sample to laboratory in order to find out whether epoxy powder is applied in two layers.

Result from Elca Lab, India under microscope report is given in fig 3. Report also states "It seems after galvanizing, two coats of paints (primer and finished) are of same colour code and hence it is difficult to identify. Had it been different colour code for these two coats of paints, then it would have been easy to differentiate. "

Report from Institut Fur Korrosionsschutz Dresden Gmbh, Germany:

German Laboratory investigated in the following manner. The sample is shown in fig 4.

- Preparation of metallographic cross sections of powder coating for detailed illustration of the coating system using the inverse light microscope.
- Identification of the resin binder of the powder coating by FTIR spectroscopy by ATR technology.
  Results of the cross section of hot dip galvanizing, powder coated component through microscope are shown in fig 5 and 6.

The layer thickness of hot dip galvanized coating on the bracket is 162- 175 micron and the thickness of single layer powder coating is 185-200 micron.

Investigation through FTIR spectroscopy has been carried out to determine the base binder of the powder coating. The vibrational bands, observed at 3330 and 2923 cm^{-1} are attributed to the O-H and aliphatic C-H stretching vibration. Bands, appeared at 1718, 1507, 1450 and 1416 cm-1, originate from stretching vibration of acidic C=O bond, COO^-(acidic salt), CH_2 bending vibration and H-C bending vibration corresponding to CH-CO. Bands, found at 1243, 1086 and 1014 cm^{-1}, are ascribed to OC-O-H dimer, present in epoxy polyester. In this investigation it was found that the powder based on epoxy polyester mixed powder as shown in fig 7 and fig 8.

II. CONCLUSION

After thorough investigation it was found that

a) Hot dip galvanizing is good and according to specification.
b) Epoxy powder coating though claimed by Company A / Company B in two layers
   (I) Epoxy Powder Primer

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(II) Epoxy Polyester Powder and they are of same colour of light grey

Whereas investigation by German laboratory found out that it is one coat of Epoxy Polyester by carrying out FTIR spectroscopy. Epoxy Powder and Polyester Epoxy are of different functional group, the test result would have shown different spectrum in fig 7 and 8. But those are similar and confirm to epoxy polyester powder only. Hence claim by Company A and Company B is not correct and there is only one layer of epoxy polyester.

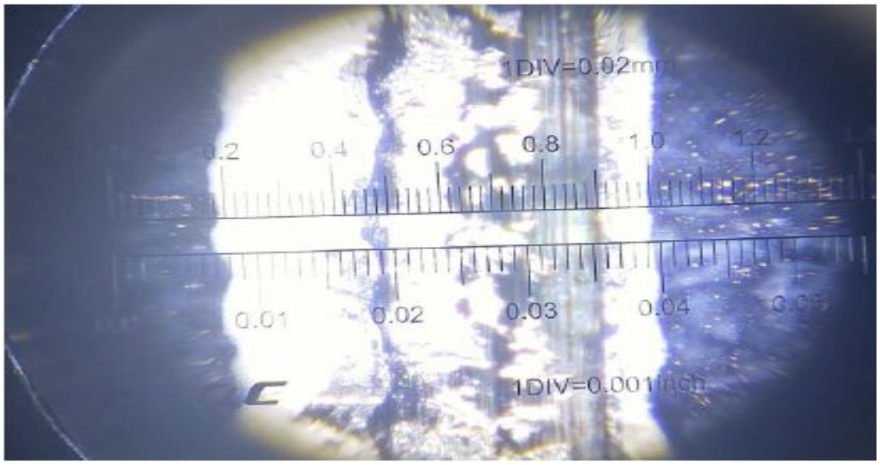

Fig. 1

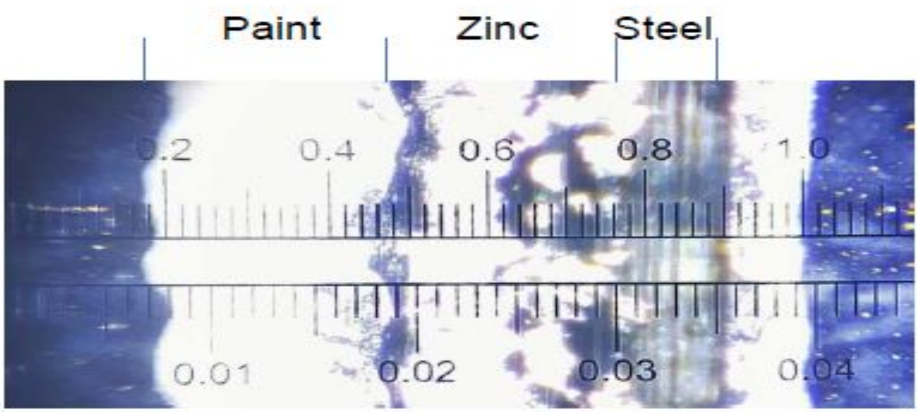

Fig 2

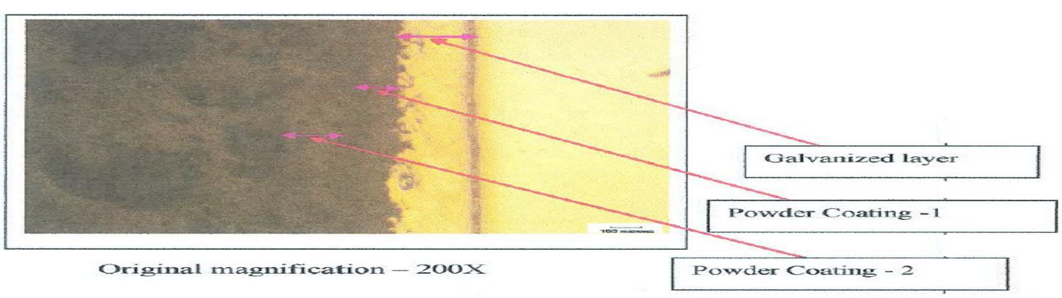

Fig. 3

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Fig. 4

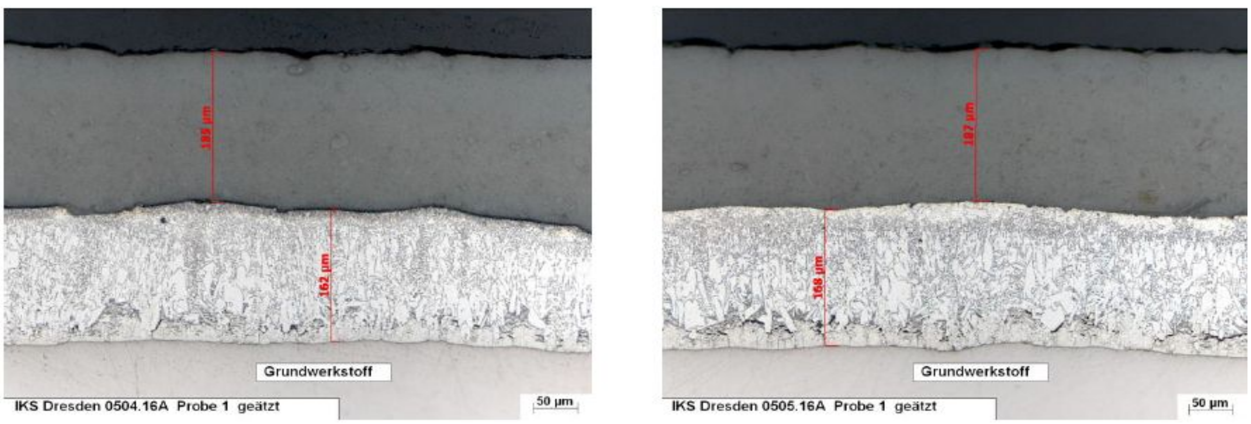


Fig. 5

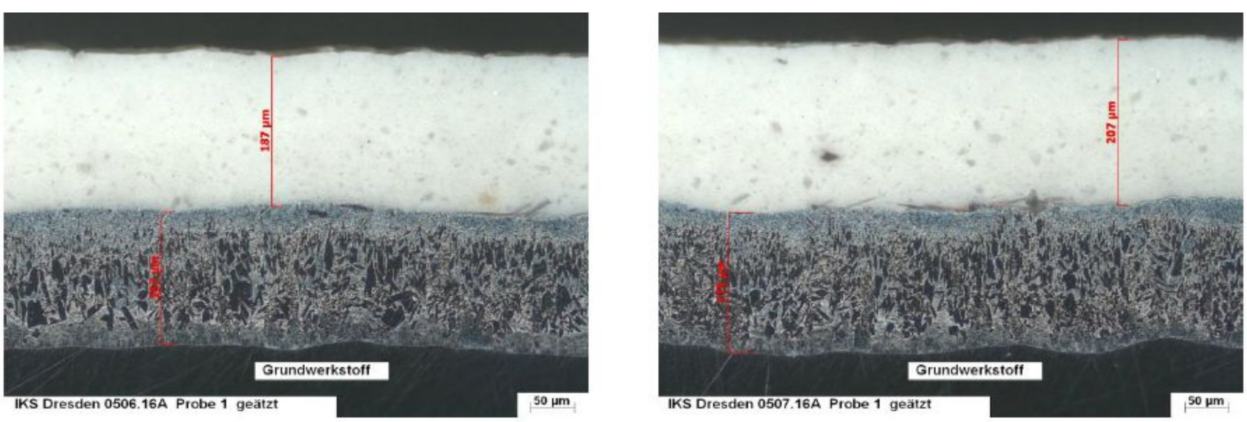
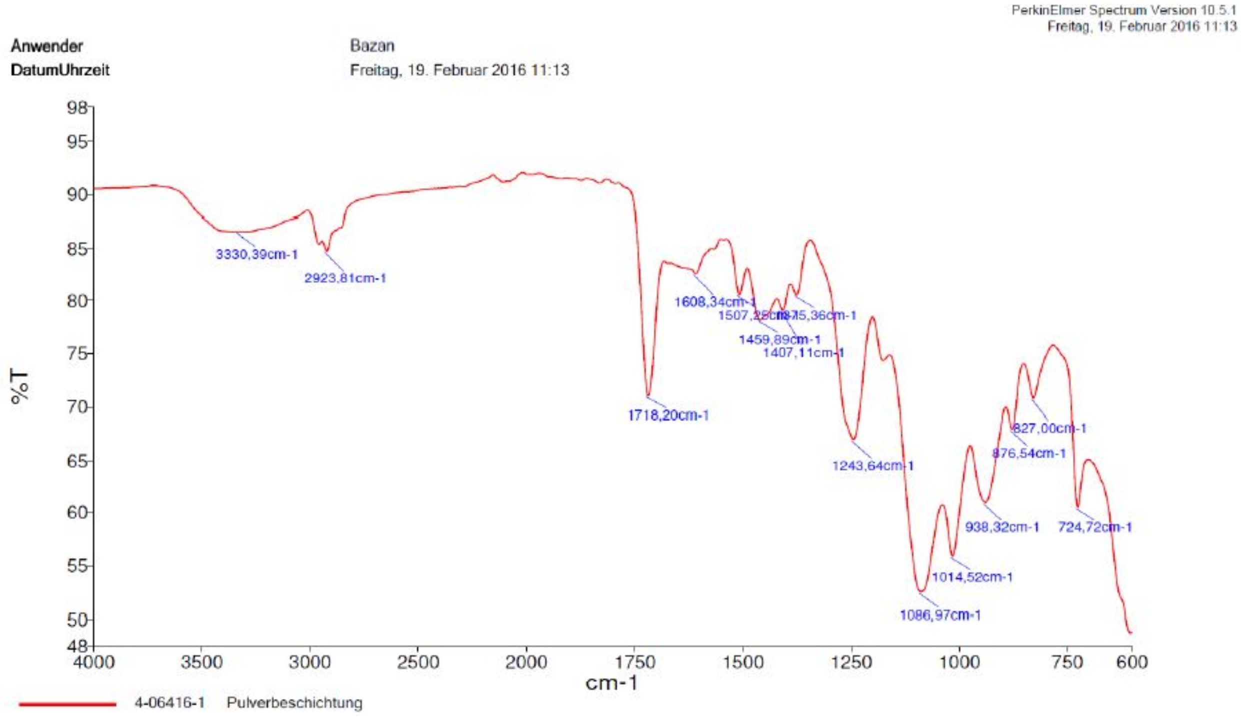


Fig. 6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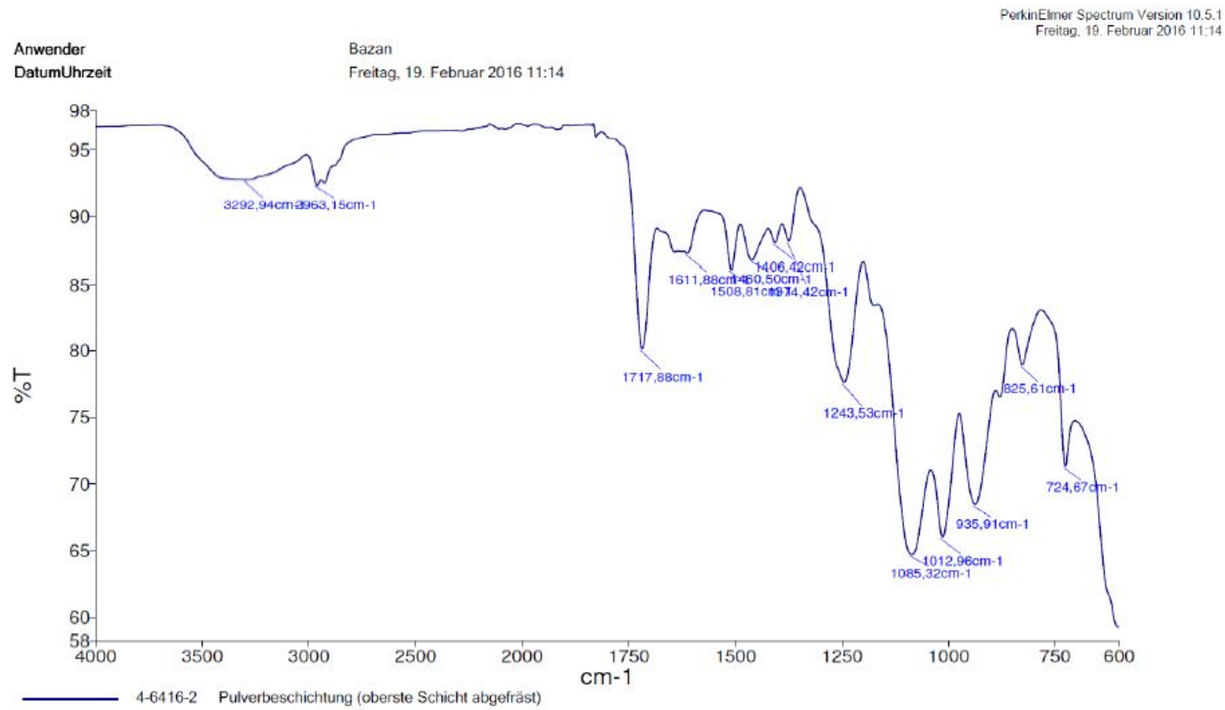
4-06416-1 Pulverbeschichtung

Fig. 7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1012,96cm-1
935,91cm-1
825,61cm-1
724,67cm-1
4-6416-2 Pulverbeschichtung (oberste Schicht abgefräst)

Fig. 8

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