CHAPTER - VI

PREPARATION OF PROTECTIVE COATING AND LABORATORY STUDIES ON TEST PANELS:

The waste water characteristics and its corrosive nature has been observed in the three different types agro based industry which were chosen for the present study. Analysis of waste characteristics, in the light of the various available and established datas, and the photographs from the industries clearly confirms the impact of factors like low pH, high temperature, high solids, high BOD/ COD, high fats and high iron cause material loss due to corrosion leading to system failure and economic loss.

Most of the commercially available good quality and suitable protective coatings are invariably cost prohibitive.(33) This may lead to short sighted approach for material protection under corrosive environment of waste water. It is an irony that sometimes the cost of protective lining is more expensive than the material to be lined !

In the light of the above, an attempt has been made to develop a paint suitable for the corrosive environment of the effluents, under which the pollution control system has to perform. The prime objective is "Technical suitability and economic viability" of the protective coating.

In the present study, an attempt has been made to develop an epoxy based epoxy silicone paint which can control the corrosion related damage of materials.(18)

The primer [25 PVC] and top coat [18 PVC] are prepared by using dispersing pigments such as titanium oxide, chromium oxide, mica and silica into the epoxy silicone resin dissolved in a 1:1:1 mixture of xylene, MIBK, cellosolve. The ingredients are mixed using an atritor for 30 minutes [to get Hegman value of 8].

The primer was applied by brush on the mild steel test panels [size 2 x 3 inches] to get a thickness of 55 microns per coat. After allowing the primer to dry for one day, the top coat was applied to get a thickness of 45 microns. The painted panels are allowed to cure under ambient conditions for 7 days prior to testing. The coating thickness [average of 4 locations on the test specimen] was measured using POSITEST meter and the thickness was maintained within the range of 100+10 microns.

The potential of the painted panels with the epoxy silicone paints in 3% sodium chloride solution at room temperature is shown in the figure 27.

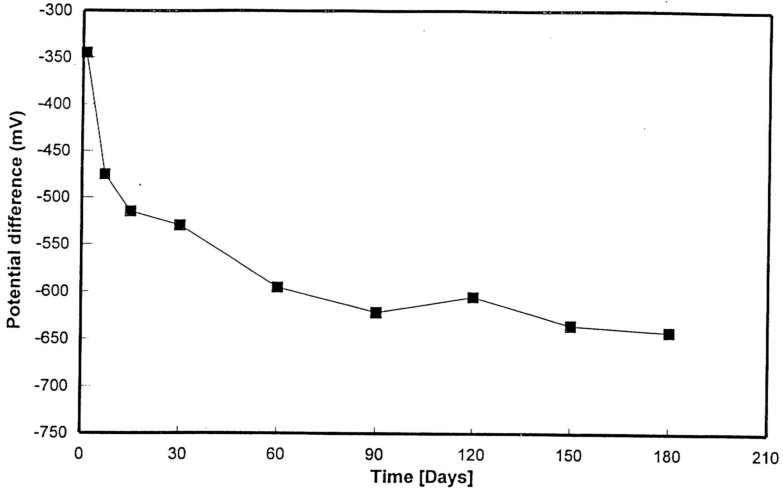
-300
-350
-400
-450
-500
-550
-600
-650
-700
-750
Potential difference (mV)
0
30
60
90
120
150
180
210
Time [Days]

FIGURE 27

The figure 27 shows that the epoxy silicone paints are not corroded for 180 days of immersion in the 3% sodium chloride solution. These studies shows that the coating will protect the mild steel structure against corrosion from corrosive environment.

Electro chemical Impedance Studies (EIS) show that the epoxy silicone coating will protect the mild steel structures from corrosive environment. The impedance measurements are made after immersing the painted panels in 3% sodium chloride solution at room temperature for different periods such as 1, 15 and 30 days [Ref : Figure 28, 29, 30]. The corresponding impedance values are found to be in the order of 1000000 ohm cm2 as obtained from the Niuist plots. These values confirm that the epoxy silicone coatings do not deteriorate under these conditions as shown in Figure 28, 29, 30.

The topography of the coating as observed by Scanning Electron Microscope (SEM) indicates an almost uniform distribution of white spots surrounded by a dark background (the resin coating). The white spots are due to extended pigment particles added to the resin coating such as titanium oxide, chromium oxide, mica and silica. The SEM examination illustrates the fact that the pigments present in the formation are well packed and effectively wetted by the epoxy –silicone binder (Ref: Figure 31).

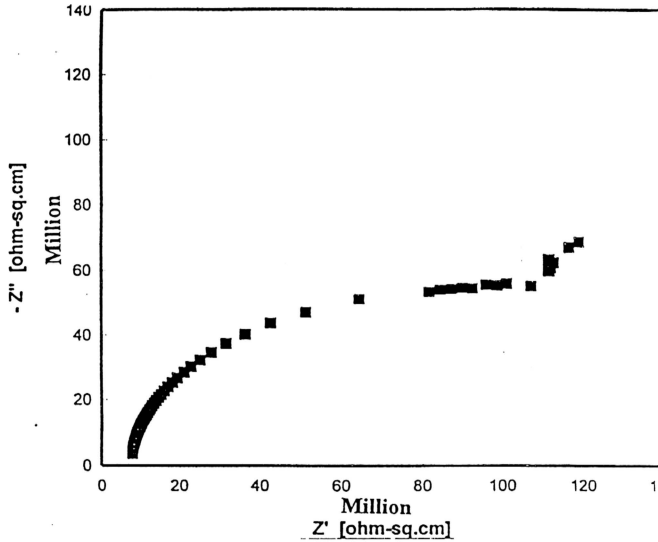
140
120
100
80
60
40
20
0
- Z'' [ohm-sq.cm]
Million
0
20
40
60
80
100
120
Million
Z' [ohm-sq.cm]

FIGURE 28

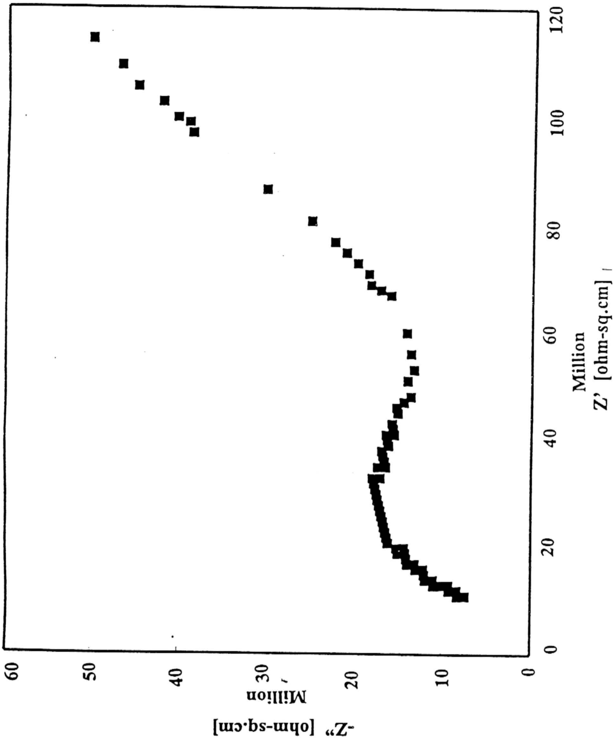
Million
Z' [ohm-sq.cm]
-Z'' [ohm-sq.cm]
Million
0
20
40
60
80
100
120
0
10
20
30
40
50
60

FIGURE 29

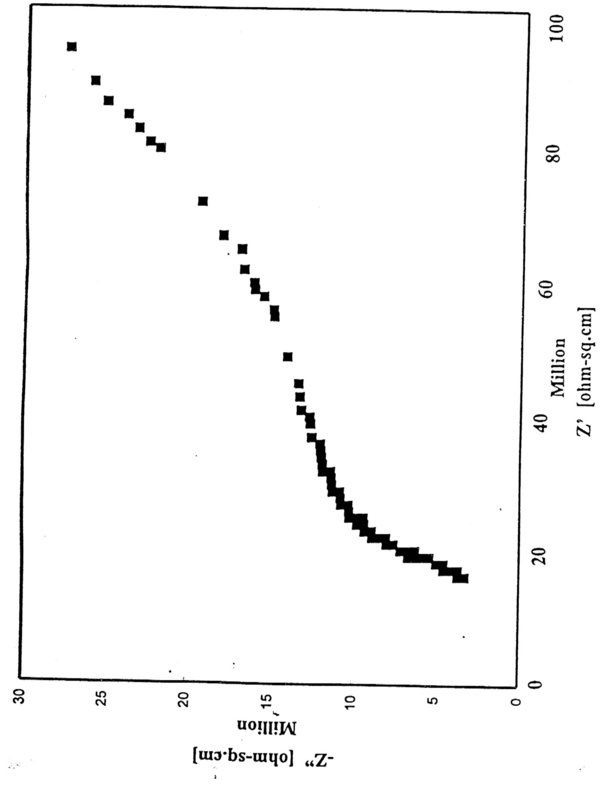

FIGURE 30

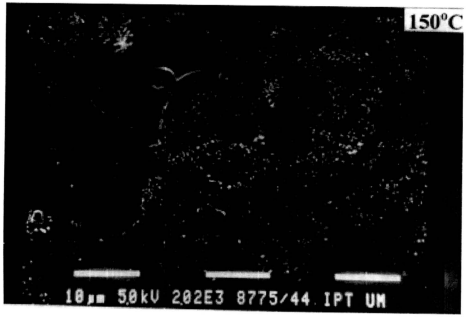

FIGURE - 31

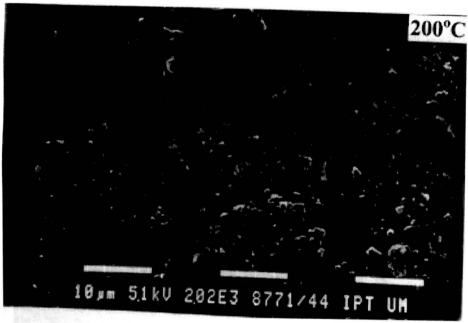

FIGURE - 32

FIGURE - 33

FIGURE - 34

The heat resistance test was carried out according to the ASTM specification D2485. After heating, the catastrophic nature are studied by observing the ex situ SEM topography as a function of annealing temperature of the coating (Ref: Figure 31 - 34). The coating (Figure : 31 and 32) remains intact on the coating surface up to 200 degree centigrade and no prominent difference is visible in the morphology of the coating up to this point. The coated panels heated at 225 degree centigrade show no visual cracks on the surface by naked eye. However, the SEM observation (Figure : 33 and 34) of these panels provide evidence for micro cracks on the surface. This is due to the break down of the cohesive bond between the substrate and the coating followed by oxidation of the mild steel substrate.

From the above studies, it can be seen that the epoxy silicone coatings are able to protect the mild steel surfaces up to 200 degree centigrade without deterioration in the corrosive environment. Since, the temperature in the effluent system is limited to 80^0 C in the liquid waste and 130^0 C in the gaseous waste, (in the industry under study), the silicone based epoxy paint developed and tested in the laboratory should perform well under site conditions. Also, the test panels immersed in the effluent for testing under actual condition for 90 days did not show any abnormalities on testing in the laboratory after the test period.

After obtaining satisfactory results on developing and testing the epoxy – silicone paint in the laboratory and at site under actual conditions, large scale areas have been painted at different locations on different material surfaces, which are highly prone to corrosion in an effluent generation areas and also the treatment system.

Since addition of silicone in optimum quantities enhances the properties of normal epoxy paint, they are found to be very cost effective in comparison to the commercially available expensive protective coatings/ paints.

As the parameters in the effluent causing corrosion is generally similar in effluents generated from other food related industries also, the epoxy – silicone paint developed and tested in the industries under study can find application in other related industries and / or effluent with similar characteristics.

The study confirms that the Epoxy – silicone paint will protect the materials used in the environmental protection systems against corrosion and enhances the useful life of plant and machinery at an affordable cost.