Summary

Long ago the packaging science had a vital and important role in human life and this was due to its usage in the protection of foods. Nowadays packaging science no longer limited to be useful in food protection only; as it`s now become very important in many things where its main functions are still to make food and other products easy to transport.

From this point our study focus on the metallic package as it is exposed to very big danger called corrosion and this represents a big threat on the economy and human life. In our research we choose polyaniline as pigment in epoxy primer because of its electrical properties which make it very affect in corrosion inhibition. Firstly; we prepared nano-zinc phosphate tetra hydrate and then prepared polyaniline zinc phosphate nanocomposite by in situ polymerization. Polyaniline prepared was proved by FTIR technique, and its particle size was characterized by TEM which indicated that polyaniline lies in nano scale with average diameter equal (57nm); also XRD indicated that polyaniline nanocomposite prepared was semi crystalline unlike pure polyaniline which is amorphous. TGA also revealed that polyaniline nanocomposite is more stable than pure polyaniline.

Epoxy primer modified with different ratio of polyaniline prepared; then it was applied on the panels under investigations. The painted panels were immersed in NaCl solution (0.1M). The corrosion rate of tested panels and its inhibition was determined by

some known methods of corrosion rate measurements techniques such as:

1- ***Gravimetric techniques***

Generally, the corrosion rate of tested panels was found to be decreased with increasing the amounts of polyaniline nanocomposite, up to certain limit due to the largest molecules and the crowded between them which lead to irregular distribution. The best ratio of polyaniline was 0.2 gm.while the worst was 0.5 gm.

2- ***Physical tests***

Painted films formulations which contain different PANI- Zn3(PO4)2.4H2O nanocomposite ratio show better corrosion protection from the blank, and this is due to the role of PANI in corrosion protection where it is work by the virtue of its redox behavior. PANI is expected to capture the ions liberated during the corrosion reaction of steel in the presence of NaCl, water and oxygen get doped and liberate the dopant ions which form a passivating layer even when there is initiation of the corrosion process at the substrate. Thus, it acts as a self healing coating with improved corrosion resistance. Since the release of the ions by PANI would be facilitated if it is in the form of thin layer on nano- $Zn_3(PO_4)_2.4H_2O$ *support its corrosion prevention will become more effective than if it was in form of solid particle.*

The morphology of steel panels coated with epoxy only (Blank) and the panel coated with formulation containing

0.2gm polyaniline nanocomposite after immersed them in corrosive medium (NaCl 0.1M) by SEM; where it seems that, the formulation containing 0.2gm polyaniline nanocomposite gives the highest corrosion resistance due to the healing effect of polyaniline nanocomposite.

3- *Electrochemical methods*

Two polarization measurements were used to indicate the role of polyaniline in corrosion protection as the following:

a) *Potentiostatic technique*

The Potentiostatic measurements confirm that the addition of polyaniline hindered the corrosion attack on the surface of the steel electrode and suppressed the cathodic and anodic reactions. The data show that i_{corr} decreased with the addition of different amounts of polyaniline nanocomposite up to certain limit, due to the increase in the blocked fraction of the electrode surface (Θ).

b) *Potentiodynamic anodic polarization technique*

This technique was studied to determine the pitting potential of the tested panels at 0.1M of NaCl. The results indicate that at concentrations of a particular *no pitting reaction occurred.*

Generally; the mechanism of adsorption was also studied at different amounts of the polyaniline nanocomposite. It was found *that, the adsorption of polyaniline nanocomposite follows the Langmuir adsorption isotherm.*

List of Tables

List Of Figures

List Of Abbreviations

PANI	*Polyaniline*
nm	*Nanometer*
PNCs	*Polymer nanocomposites*
LDH	*Layer double hydroxide*
E	*Potential*
I	*Current*
P.V.C.	*pigment volume concentration*
C.P.V.C.	*critical pigments volume concentration*
$Zn_3 (NO_3)_2.6H_2O$	*zinc nitrate hexahydrate*
$(NH_4)_2HPO_4$	*Di-ammonium hydrogen orthophosphate*
APS	*Ammonium peroxodisulphate*
FTIR	*Fourier transform inferred*
GPC	*gel permeation chromatography*
TGA	*Thermal gravimetry analysis*
XRD	*X-ray diffraction*
$2\,\Theta$	*Angle of incidence of X-rays diffracting planes*
λ	*Wave length*

TEM	*Transmission electron microscope*
EDX	*Energy Dispersive X-ray photoelectron spectroscopy*
SEM	*Scanning Electron Microscope*
SCE	*Saturated calomel electrode*
W	*Corrosion rate in present of inhibitor*
W^o	*Corrosion rate in absence of inhibitor*
θ''	*Surface coverage*
A	*Surface area*
t	*Time of immersion in days*
IE	*Inhibition efficiency*
E_{corr}	*Corrosion potential*
i_{corr}	*Corrosion rates in present of inhibitor*
i^o_{corr}	*Corrosion rate in absence of inhibitor*
ε	*Dielectric constant*
L	*Thickness in m*
Cs	*Capacity in F*
M_w	*Average molecular weight*
M_n	*Number average*

mpy	*Mils per year (1mils= 0.0254mm)*
$\boldsymbol{amount_{inh}}$	*Inhibitor amount*
$\boldsymbol{K_{ads}}$	*The adsorption equilibrium constant*
$\boldsymbol{\Delta G_{ads}}$	*The change of the free energy*
R	General gas constant = 8.314 Joule/mole(k)
T	*Temperature with Kelvin*