Corrosion protection properties of polybenzoxazine/organoclay nanocomposite coatings on mild steel

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Recently, polybenzoxazines are considered to be a better candidate over epoxies and traditional phenolic resins as a good organic coating material for corrosion protection due to their unique properties such as low water absorption, low surface free energy, near zero shrinkage, excellent dielectric properties, and so on.. In our previous studies, we prepared a novel silane-functional polybenzoxazine (PB-TMOS) coating with silane groups that could bond to the substrate, and the corrosion protection properties of PB-TMOS coated specimens was considerably enhanced by its high hydrophobicity and water resistance resulted from the dual cross-linking network of polybenzoxazine and Si-O-Si in PB-TMOS matrix[1]. In order to improve the corrosion resistance of PB-TMOS coating, nanometer size fillers had been incorporated into PB-TMOS to prepare hybrid coating. Considerable enhancement on corrosion protection performance was obtained by introducing SiO_2 nanoparticles through improving the coating's barrier properties against gas, water or other corrosion medium[2]. In comparison of SiO_2 nanoparticles, organoclay is considered as a good filler to reduce gas permeability of polymers due to its high ratio of diameter to thickness. In the polymer/organoclay composite system, the organoclay pillaring agents' functional groups can interact with the continuous phase matrix polymer to form different dispersion state in matrix polymer, which must play an important role on the coating's performance. But few researches focus on the relation between corrosion resistance of composite system and dispersion structure of organoclay, which is determined by the pillaring agent utilized.

Therefore, two types of organoclays, Nanocor's Nanomer I.44P and I.30P, at various concentrations were tested as nanofillers in PB-TMOS coatings applied on mild steel (MS). Coated steel panels were characterized in terms of microstructure and corrosion performance in 3.5 wt% NaCl solution. Dimethyl dioctadearyl quaternary ammoniums (in I.44P) promoted an intercalated structure for composites, and the *d*-spacing value of organoclay was increased by compositing with PB-TMOS, which was evident from X-ray diffraction (XRD) measurements (Fig. 1). An improvement on corrosion protection abilities of PB-TMOS was also observed at all studied amounts, evidently due to a favorable aspect ratio and orientation of the organoclay I.44P. Addition of organoclay I.30P with octadearyl quaternary ammonium as pillaring agent yielded coatings where the organoclays were relatively randomly oriented which introduced an exfoliated morphologies. The barrier and corrosion protection properties were clearly compromised for clay I.30P.

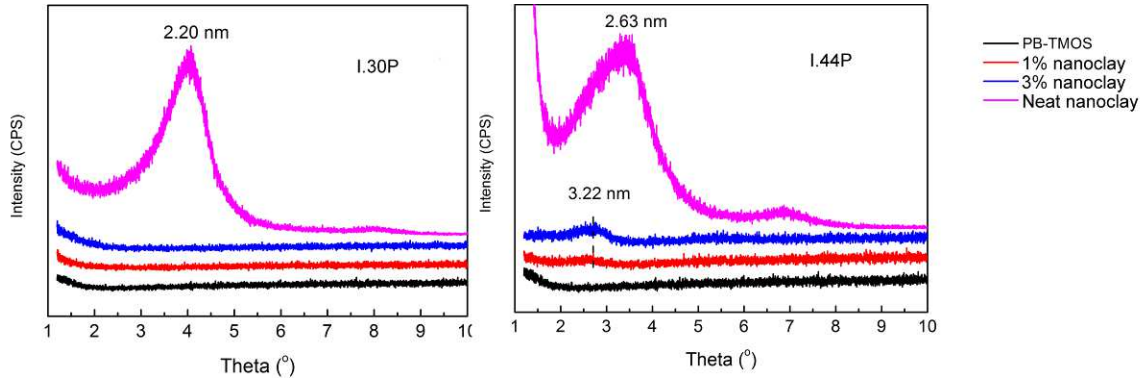


Figure 1 X-ray diffraction patterns of neat organoclay, neat PB-TMOS and PB-TMOS/organoclay nanocomposites

Keywords: Materials; Polymers; Polybenzoxazine; Coating; Nanomposite

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