Received: 14 May 2021 | Revised: 13 August 2021 | Accepted: 16 August 2021

DOI: 10.1002/app.51640

ARTICLE

Applied Polymer SCIENCE WILEY

Synergistic effects of hybrid nanofillers on graphene oxide reinforced epoxy coating on corrosion resistance and fire retardancy

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Funding information
Fundamental Research Grant Scheme, Grant/Award Number: FRGS/1/2017/TK05/UTM/02/4/R.J130000.7846.4F978; GUP, Grant/Award Numbers: 13H29 12J81 10H94 17H66, RDU200341

Abstract

This study investigated the synergistic effects of two different type of nanofillers, that is, halloysite nanotube (HNT) and montmorillonite (MMT) on anticorrosion performance and flame retardancy properties of graphene oxide reinforced epoxy coatings for structural steel application. Electrochemical impedance spectroscopy (EIS), Tafel polarization, salt spray test (SST) and limiting oxygen index (LOI) tests were conducted to reveal the effects of hybrid nanofillers on corrosion protection and flame retardancy performance of the coatings. The dispersion of the nanofillers with the matrix was characterized via transmission electron microscopy (TEM). The results showed, EGO0.6 coatings exhibited the best anticorrosion performance ($R_{ct} = 2.105 \times 10^9$ Ω.cm) compared to E0 coating ($R_{ct} = 6.420 \times 10^8$ Ω.cm) and epoxy filled with single nanofiller. The coating reinforced with hybrid nanofillers, EGO0.6H0.3 showed further improvement in corrosion resistance, compared to other single and hybrid nanofillers coatings studied. All epoxy coating samples filled with nanofillers showed slow burning behavior in the LOI test. The incorporation of hybrid nanofillers increased the LOI value of EGO0.6H0.4 coating up to 25.0 from 21.0 for neat epoxy coating. The LOI data shows a good correlation with char formation from thermogravimetric analysis analysis. TEM results revealed a positive effect of the nanofillers on HNT/GO/epoxy coating showing a well-dispersed and enhanced barrier properties.

KEYWORDS
coatings, electrochemistry, flame retardance

1 | INTRODUCTION

Coatings are applied to prevent corrosion of structural steel pipelines used to transport oil/gas. The pipelines tend to suffer from premature failure and exhibit defects due to high temperatures, leading to corrosion issues. In addition, oil and gas industries also face the risk of fire and explosion due to ignition of flammable vapors or gases. Various techniques are being practiced for corrosion protection of pipeline[1–4]; however, separate arrangements are made for fire protection, which not only add to the cost but also increase the maintenance cost of the coatings. Some coatings add up a lot of weight to the structure, which possibly change the intrinsic properties

