Data Article

Data supporting the elemental composition, the morphological and thermal properties of MnPhos/waterborne poly(urethane)(WPU) coatings for carbon steel

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Article history:
Received 30 August 2019
Accepted 3 January 2020
Available online 10 January 2020

Keywords:
Hureaulite
MnPhos/WPU coatings
Thermograms
Elemental composition
SEM micrographs

Abstract

The data set presented here offers evidence of the elemental composition related to a SEM micrograph of [Mn₅(PO₃(OH))₂(-PO₄)₂]·4H₂O (MnPhos) powders, known as hureaulite, and synthesized by the reflux method. In addition, it contains additional information of the glass transition, melting and decomposition temperatures and their weight loss percent of coatings based on MnPhos incorporated into waterborne poly(urethane) (WPU). These data are complementing of the article “Corrosion investigation of new hybrid organic/inorganic coatings for carbon steel substrates: electrochemical and surface characterizations”. © 2020 Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
A possibility to retard the corrosion of carbon steel (AISI 1018) is to produce hybrid coatings by combining the properties of an inorganic and an organic phase such as the MnPhos and waterborne poly(urethane) (WPU), which subsequently can be sprayed onto the metallic substrates [2,3]. The dataset of this work shows additional micrographs of the morphology of MnPhos powders synthesized by reflux method. Fig. 1 displays the SEM micrographs of MnPhos. Also, the EDS spectrum showed in Fig. 2 shows the number of counts (y-axis) and the energy of the X-rays (x-axis). The elemental composition, detected from a selected area of the micrographs, is reported in Table 1. Similarly, the thermogravimetric analysis is showed as TGA thermograms in Fig. 3. The glass transition temperature, melting temperature (Tm), decomposition temperature (Td) and the weight loss % (wt.%) in different stages of degradation are reported in Table 2 (see Fig. 4).

1. Data

A possibility to retard the corrosion of carbon steel (AISI 1018) is to produce hybrid coatings by combining the properties of an inorganic and an organic phase such as the MnPhos and waterborne poly(urethane) (WPU), which subsequently can be sprayed onto the metallic substrates [2,3].

The dataset of this work shows additional micrographs of the morphology of MnPhos powders synthesized by reflux method. Fig. 1 displays the SEM micrographs of MnPhos. Also, the EDS spectrum showed in Fig. 2 shows the number of counts (y-axis) and the energy of the X-rays (x-axis). The elemental composition, detected from a selected area of the micrographs, is reported in Table 1.

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2. Experimental design, materials, and methods

MnPhos powders were obtained by the reflux method as follows: 30 mmoles of Manganese(II) Dihydrogen Phosphate \([\text{Mn(H}_2\text{PO}_4]_2 \cdot 2\text{H}_2\text{O}]\) were dissolved in 100 mL of deionized water. 1.7 mL of a phosphoric acid (H₃PO₄) solution were added and refluxed under magnetic stirring at 100 °C for 12 h. Thereafter, 2 mL of sodium hypochlorite (NaClO) (>99.99%, Sigma-Aldrich) were added and stirred for other 20 min. The suspension was filtered, rinsed and dried at 60 °C for 12 h.

The morphology and the elemental composition of the MnPhos powders were studied by Energy Dispersive Spectroscopy (EDS) and Scanning Electron Microscopy (SEM) on a Quanta 3D FEG equipment from FEI Co. equipped with a field emission electron source. High vacuum and a secondary electron detector were used during the study to acquire the images. Micrographs were obtained at
magnifications of 5000 X and 10,000 X with a working distance (WD) of 3.6 mm at 5.0 Kv of accelerating voltage. Elemental composition was analyzed with an Apollo X Silicon Drift Detector (SDD) at 9126 counts per second (CPS), Dead time 20.6 s, 17.6 Lsec (spectrum acquisition time in live seconds).

A waterborne poly(urethane) (WPU) (U-5510®) was provided by COMEX® company. Hybrid coatings were synthesized by dispersing 2, 4 and 6 wt.% of MnPhos powders into a mixture of resin (component A, 10 g) and demineralized water (1 mL) by using the sonication method during 30 min. A component B, the catalysts was added into the mixture to complete the polymerization. This solution was sprayed onto a carbon steel substrate (AISI 1018). To study the thermal properties of these coatings, simultaneous thermal analysis was carried out in a Labsys Evo, Setaram equipment in the Differential Scanning Calorimetry (DSC)/thermogravimetric analysis (TGA) configuration using aluminium crucible of 80 µL of capacity. An amount of 10 mg was used; the samples were firstly heated at 30 °C and hold for 2 min and subsequently, the measurements were carried out in the range of 30–500 °C to evaluate

Table 1
Elemental composition of MnPhos powders detected from EDS analysis.

| Element | Weight (%) | Atomic (%) | Error (%) |
|---------|------------|------------|-----------|
| O       | 59.43      | 77.84      | 5.18      |
| Mn      | 17.93      | 6.84       | 7.76      |
| P       | 22.64      | 15.32      | 7.42      |
thermal degradation under argon atmosphere with a heating rate of 10 °C/min. Then, the samples were hold at 500 °C for 2 min followed by a cooling with the same rate. The heating until 500 °C was configured intentionally to evaluate the total degradation of the samples.

Fig. 3. TGA thermograms of MnPhos/WPU coatings showing three stages of decomposition.

Fig. 4. DSC thermograms of MnPhos/WPU coatings.
**Acknowledgments**

P. Salazar Bravo is grateful for postgraduate fellowship through CONACyT. The authors are also grateful for the financial support provided by the CONACYT Research Fellowship-IPN-CICATA Altamira agreement, 2014-1905 and CONACYT CB2015-252181 projects; Instituto Politécnico Nacional (IPN) through the SIP2019-6650, SIP2019-6670, SIP2019-6718 projects; as well as SNI-CONACyT.

**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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