SYNTHESIS AND CHARACTERIZATION OF PHOSPHORUS-CONTAINING BUTADIENE RUBBER/EXPANDED PERLITE COMPOSITE

Edres Nada[1,2], Buniyatzadeh Irada[1], Turp Sinan Mehmet[3], Alosmanov Rasim[1]
[1]Baku State University, Faculty of Chemistry, Baku, Azerbaijan
[2]Khartum university, Faculty of Education, Department of Chemistry, Khartoum, Sudan
[3]Bitlis Eren University, Faculty of Engineering, Zonguldak, Turkey
nadaedres2010@gmail.com

The intensive demand for Mineral Polymer Composites in industrial and technology applications, including automotive, construction, biomedical, maritime, sport, and ballistic, has been dramatically increasing last years. Minerals with different shapes, sizes, and constituents show an excellent distribution and orientations in the polymer matrix and provide polymer composites of low cost, lightweight, rigid and high strength with efficiencies performance. Many investigation reports have been conducted on the preparation of polymer minerals composites. In view of this point, for the first time based on industrial scale polymer - butadiene rubber (BR) and expanded perlite (EP) new composite has been prepared. For this purpose, oxidative chlorophosphorylation reaction by phosphorus trichloride (PCl_3) in presence of oxygen has been used. Obtaining a well-dispersed polymer-mineral composition using various approaches has been achieved.

Expanded perlite is natural occurs minerals from volcanic rock-based mainly on silicon dioxide, it is amorphous and contains a considerable amount of water, when it is subjected to heat 850–900 °C water vapored and perlite expanding 7–16 times of original form. In this reaction ultrafine form of expanded perlite, which is free of water has been used due to high sensitivity of phosphorus trichloride to water.

BR was purchased from Voronezh Synthetic Rubber Manufactory (Russia). PCl_3, carbon tetrachloride (CCl_4), sulfuric acid (H_2SO_4) and acetone that were applied for chemical modification and their purification/washing were used without any further purification (Gorex Analyt GmbH). Oxygen was supplied to the reaction medium by purging through the concentrated H_2SO_4.

Firstly, suspension of EP in BR solution in carbon tetrachloride was prepared (weight ratio of BR and EP equal to 10:1). Then oxygen was bubbled through reaction mixture and PCl3 was add into reaction mixture in ratio of 1:3. The character of reaction is exothermic and the temperature increase up to 50 °C. After 20 min the reaction mixture being dark and after 1-hour polymer start precipitated. Total duration of reaction was 3 hours. After the reaction, liquid and solid phase separated each other using distillation under water pump. According to the reaction mechanism the obtained intermediate has $–P(O)Cl_2$ groups. Subsequently, solid phase hydrolysis for 1 hour under 50 °C and then neutralized using deionized water. The final product which contain $–P(O)(OH)_2$ groups dried in air, then under vacuum.

Secondly, EP was modified by oxidative chlorophosphorylation reaction, then solution of BR was add and the mixture was hold for the same reaction.

Thirdly, for preparation of the composite EP with $–P(O)(OH)_2$ groups and solution of BR was used.

UV-Vis spectroscopy and XRD analysis methods were used for characterization of the obtained products.