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Effect of different reactional conditions on the incorporation of zinc species in antimicrobial nanocomposites MMT-NPZn (MONTMORYLONITE-ZINC OXIDE NANOPARTICLES)

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Antimicrobial nanocomposites have aroused great scientific and technological interest in the active packaging and medical device industries. In particular, antibacterial nanocomposites have been studied with the aim of adding antimicrobial properties to polymeric materials and using them in the production of active polymeric packaging capable of increasing the shelf life of food and polymeric products for medical and hospital use without contamination. bacterial. In this study, antibacterial nanocomposites consisting of montmorillonite and zinc oxide nanoparticles (MMT-NPZn) were produced and characterized. As a difference, the synthesis of zinc oxide nanoparticles was carried out in reaction media containing montmorillonite, with the hypothesis that the basal spacing of the nanoclay contributes to the process of nucleation and reduction in the size of nanoparticles and polar agglomerates and, at the same time, favor the compatibility of zinc oxide nanoparticles with non-polar polymeric materials, such as polyethylene and polypropylenes. The syntheses were carried out in an aqueous medium using the hydrothermal method and in an environment with atmospheric pressure. An aqueous solution Zn(NO3)2.6H20 (1.0 M) was used as a zinc precursor and as neutralization solution, in reaction medium with different amounts of montmorillonite (Canadian montmorillonite) dispersed in a NaOH solution (0.5 M). In the process of obtaining the MMT-NPZn nanocomposite, the effect of process parameters on the percentage of zinc incorporated into the MMT-NPZn nanocomposite was evaluated in relation to the amount of zinc used in the precursor solution (called Zn Incorporation Efficiency), employing a planning full factorial experimental type 24 to define the experimental conditions. As interesting parameters were defined the concentration of montmorillonite (1.50g/80mL, 3.00g/80mL, 4.50g/80mL), the temperature of the reaction medium (75.0°C, 80.0°C, 85.0° C), the zinc precursor solution flow (1.0mL/min, 2.0mL/min, 3.0mL/min) and the stirring time (4h, 8h, 12h). For the characterizations, Scanning Electron Microscopy (SEM-FEG) and Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), Differential Thermal Analysis (DTA), Thermogravimetry (TGA) and Fourier Transform Infrared Spectroscopy (FTIR). The results indicate that the variation in the temperature of the reaction medium and the variation in the flow of the precursor do not have a significant effect on the Zn Incorporation Efficiency in the nanocomposite, that the increase in stirring time has a positive effect and the increase in the concentration of montmorillonite in the reaction medium has a negative effect. From these results it was possible to establish the best reaction condition to obtain the MMT-NPZn nanocomposite containing the greatest amount of Zn species.