**Effect of Organo-Modified Sepiolite Content on Thermal and Mechanical Properties of Poly(ethylene oxide) Composite Films.**

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**Highlights**

* α-Sepiolite is modified with poly(ethylene glycol) through hydrogen bonding interactions.
* Thermal stability of the composite is improved with modified α-sepiolite.
* Tensile properties are enhanced by modified clay addition to the structure.

**1. Introduction**

The incorporation of inorganic additives into a polymer matrix can improve the properties such as thermal stability, mechanical strength, ion exchange abilities, and solvent resistance [1,2]. Recently, clays have become increasingly popular as inorganic fillers in the field of organic-inorganic hybrid materials due to their superior properties such as their high surface area for polymer–filler interactions, small particle size, lightweight and low cost. In the present study, organo-modification of α-sepiolite, a natural clay, was performed using poly(ethylene glycol) (PEG) to improve the compatibility of the inorganic phase with the organic matrix. The modified α-sepiolite was introduced in the poly(ethylene oxide) (PEO) matrix to develop a composite film. The effect of modified clay additive on the mechanical and thermal properties was studied by comparing with the neat PEO film.

**2. Methods**

α-Sepiolite (Eskisehir/Turkey) was dried at 105°C for 24 hours and then ground into powder. PEG (Mw=950–1050) and α-sepiolite (1:1, wt/wt)) were added to water-ethanol (99.8%) (1:2, v/v) solution and ultrasonicated for 30 minutes. The resulting mixture was stirred overnight. Finally, the solution was poured into a petri dish, dried at 105°C for 24 hours and ground into powder. The obtained organo-modified clay was named PEG\_α-Sepiolite. PEG\_α-Sepiolite was distributed homogeneously in ethanol by ultrasonic mixing. PEO (Mw=40000) was dissolved in water (10%, w/v) under constant stirring at 70°C for 24 hours. The resulting transparent and viscous PEO solution was transferred into a beaker and the previously prepared PEG\_α-Sepiolite/ethanol mixture was added gradually under ultrasonic mixing. The obtained PEO solution with 1% PEG\_α-Sepiolite additive was casted onto a flat glass substrate (20 cm x 20 cm) and dried at 50°C for 24 hours. The resultant semi-transparent film named PEO/PEG\_α-Sepiolite composite film. Neat PEO film was prepared following the same film preparation procedure except for the PEG\_α-Sepiolite addition for comparison purposes and named PEO\_control film. FTIR spectra of neat and PEG\_α-Sepiolite samples were recorded as KBr pellets using a Frontier spectrometer (Perkin Elmer). Thermogravimetric analysis (TGA) of the film samples was performed using a STA6000 thermogravimetric analyzer (Perkin Elmer) with a heating rate of 10oC/min, under flowing nitrogen at a rate of 50 mL/min. The mechanical tests of the films were carried out using an Instron Mechanical Testing Machine 5581 test system following ASTM D882 method.

**3. Results and discussion**

FTIR spectra of the natural α-sepiolite and PEG\_α-Sepiolite are presented in Figure 1. The shoulder, observed at 3690 cm-1 in the FTIR spectrum of neat α-sepiolite, is assigned to the -OH stretching vibrations of Mg-OH constituent of α-sepiolite and shifted to 3685 cm-1 with PEG modification. The wide band at 3570 cm-1, indicating the -OH stretching vibration of bound water, shifted to 3566 cm-1 with PEG modification. The weak bands, observed at 1211 and 1018 cm-1 in the FTIR spectrum of neat α-sepiolite, corresponding to the stretching of Si–O in the Si–O–Si groups [3] disappeared after organo-modification with PEG. A new peak, indicating C-H stretching, was formed at 2932 cm-1 after the organo-modification. These differences may be resulting from the formation of new hydrogen bonding interactions between surface hydroxyl groups of α-sepiolite and PEG molecules, indicating the compatibility of α-sepiolite with PEG. Based on the TGA thermograms of the PEO\_control and PEO/PEG\_α-Sepiolite composite films, shown in Figure 2, both films represent a single-step thermal degradation behavior and the decomposition temperature increases from 355oC to 370oC with α-sepiolite incorporation. Tensile strength was increased from 12 MPa to 18 MPa and Young's modulus increased from 240 MPa to 360 MPa by α-sepiolite addition to the structure.

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| **Figure 1.** FTIR spectra of the natural α-sepiolite and PEG\_α-Sepiolite. | **Figure 2.** TGA thermograms of the PEO\_control and PEO/PEG\_α-Sepiolite composite films. |

**4. Conclusions**

Based on the newly formed, disappeared, and shifted frequencies in the FTIR spectra after the modification process, it can be concluded that the organo-modification was achieved. α-Sepiolite, distributed at 1% by weight in the polymer matrix, has improved the thermal stability and mechanical strength of the resulting composite material. Considering the biocompatibility characteristic of PEO and α-sepiolite, potential use of the developed composite film in biomedical fields such as drug release and tissue engineering can be investigated in further studies.

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