Study on the Possibility to Utilize Clay with Layered Silicate Structure for Leather Finishing

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Abstract

Finishing operations are processes those aim to improve the leather that has completed its wet end operations to have desired color and certain resistances. In this processes mixtures that contain various polymers are applied in order to have a layer on the surface of the leather to improve resistances to abrasion, water, heat, soiling, light. To achieve these resistances, dispersion of polyacrylates, polyurethanes, polybutadienes which are flexible, thermoplastic and have film forming aspects are used. To achieve required resistances on the finished leather, fore mentioned polymers are improved with certain chemicals that are harmful to human health and environment. Even with these improvements, the resistances are not satisfactory and better solutions are researched.

In this study polymer-clay nanocomposites structures were formed by using montmorillonite and bentonite with many polymers that are used in different stages of leather finishing.

During study, ultrasound was used to inflate the clay structure while ultrasound levels, types and application times were documented. During these trials ultrasonic probe was found out to be the most efficient method for this application. Ultrasound was applied as probe to increase the distance between clay levels to prepare to be mixed with polymer structure.

At the second stage of the study, acrylic and polyurethane type polymers were mixed with ultrasound applied clay at different percentages (0-10%) and homogenized. Later these polymer-clay mixtures were dried in order to form films and those films were analyzed with XRD. XRD results showed that clays with nanocomposite structure transform into intercalated or exfoliated structures.

On the final stage of the study, polymer-clay nanocomposite material was used for shoe upper leather finishing in basecoat and fixation coat. After physical tests and visual inspection it was found out that wet and dry rub fastness were improved, thermal resistance of the finishing increased while full grain look was preserved.

Keywords: Polymer/clay nanocomposites,layered silicates,Leather finishing

Introduction

Nanocomposites can be defined as macro structures which have embedded nano sized particles within. Nanoparticles have much greater surface area when compared with their weight percentage in the total weight of the composite structure. Because of this property, they can make significant changes to macro structures. By combining nano particles with polymer matrixes, properties like mechanical, optical, thermal stability, conductivity, molecular barrier aspect, corrosion resistance can be changed significantly. To this aim many nano particles can be used. Polymer nanocomposites prepared with clay has importance for nanocomposites. Shape and size of silicate particles dispersed within polymer matrix makes these nanocomposites unique. These particles are very small, a typical silicate layer has thickness of 1 nm (10^{-9}m) and length of 1000 nm.

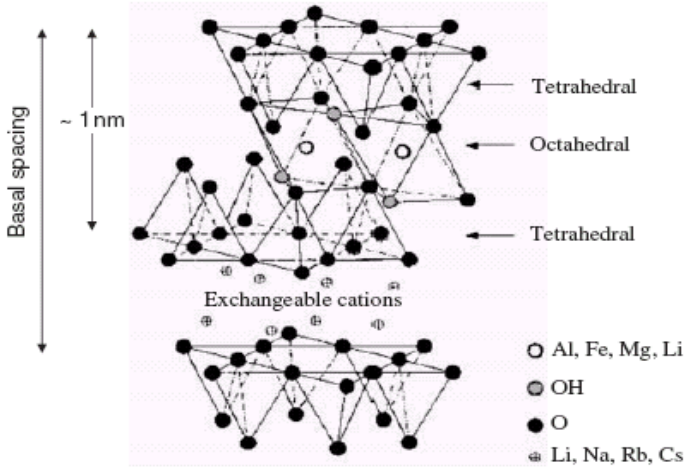

Figure 1. General structure of layered silicates

Smectite group clays have ordered layers and are widely used for preparation of polymer nanocomposites. Polymer-clay composites can be grouped in three types, based on clay dispersion within polymer structure. First type is conventional micro composites in which clay is dispersed within polymer with closely stacked layers. The other two types consist of nanocomposites in which clay is partially or completely exfoliated within polymer structure. Within these three types of structures, structures that have completely exfoliated clay within polymer structure are the most suitable.

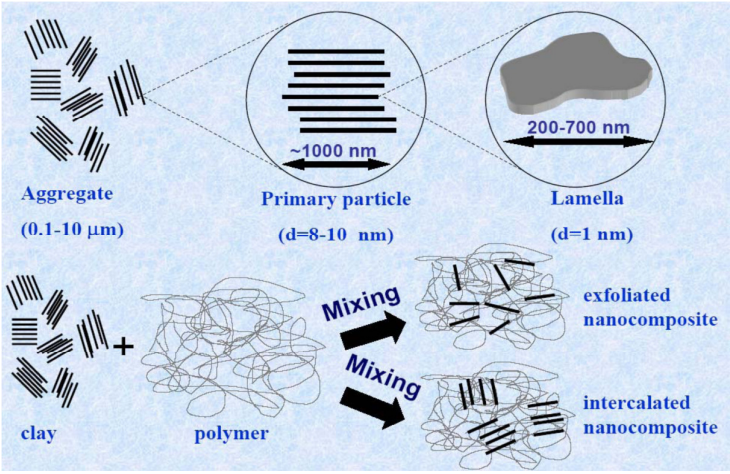

Figure 2. Models of intercalated and exfoliated polymer-layered silicate nanocomposites

Experimental procedures

Ultrasound method was used to prepare polymer-clay nanocomposites. Bandelin- Sonopuls HD 3200 device was used with TT-13 ultrasonic probe and Bandelin Sonorex RK 100 H ultrasonic bath. During the studies Purified Hydrophilic Bentonite and TCN 1.34 Montmorillonite Clay from Sigma-Aldrich company were utilized. As polymers, topcoat polyurethane with 12% dry content and an acrylic resin with 30% dry content were used.

Preparation of Nanocomposites

Preparations to be used during study are prepared as clay to dry content of topcoat polyurethane ratios of 1%, 3%, 5%, 10% and put in Erlenmeyer flasks. To prepare Bentonite, 100 ml of water was added to 1 g of Bentonite. During trials it was seen that TCN 1.34 Montmorillonite cannot be prepared just with water, therefore for 1 g of TCN 1,34 Montmorillonite, 20 ml of Isopropyl Alcohol was added to disperse it later 80 ml of water was added. Preparations were stirred for 24 hours and for 1 hour, ultrasound of 100 W power was applied with a probe. After preparations were mixed with polymers, they were stirred with magnetic stirrer for 6 hours at 400 rpm and homogenized for 30 minutes. To analyze the efficiency of ultrasound process on clays with layered silicate structure, clay-polymer mixtures are dried to form films and those films were analyzed with XRD technique.

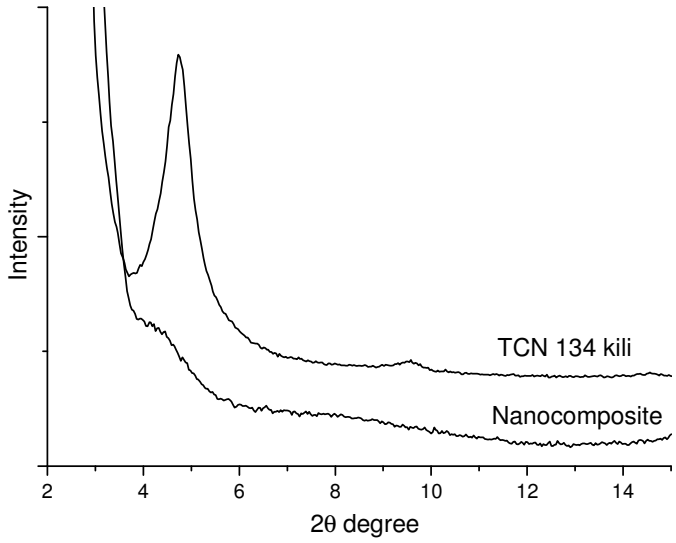

Figure 3. XRD analysis results of TCN 1.34 Montmorillonite and Topcoat nanocomposite.

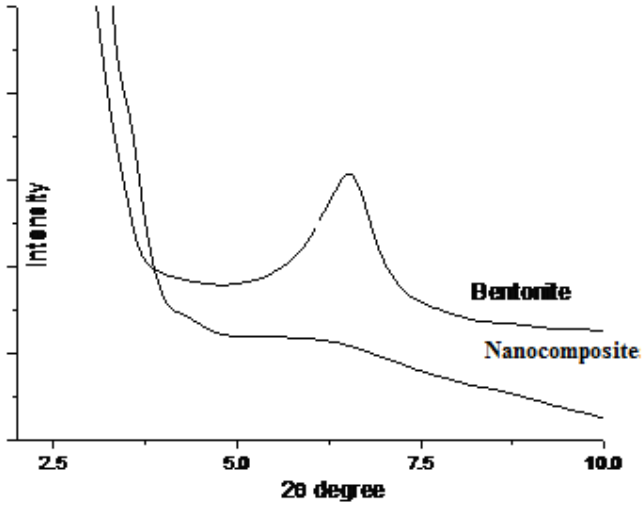

Figure 4. XRD analysis results of Bentonite and Topcoat nanocomposite.

Figure 3 and 4 shows the results for XRD analysis. It can be seen on Figure 3 that film clay-polymer film with TCN 1.34 Montmorillonite shows a decrease in intensity and has two lower theta values. This probably points out that the sample has intercalated and exfoliated mixed structure. Similar graphic is seen on Figure 4, Bentonite containing polymer-clay film has a lower intensity XRD peak, therefore can be judged that it also has intercalated and exfoliated mixed structure. These results show that method of application is more efficient.

Application to leather

The studies regarding utilizing polymer-clay compound in leather finishing are in progress. The trials are made for basecoat and topcoat applications. The preliminary results show that physical resistance results for finishing on leather show a clear improvement.

References

1. Xiaolei, Z., Qinglan, L.,Weiping, Z.,2005,Nanocomposites of Acrylate-Organsilicon Resin/Layered Silicate for Leather Finishing,JSLTC,90,250-253p

2. Jiangzong, M., Hu, J., Zongsui,Y., 2007, Preparation of Acrylic Resin/Nano-SiO2 for Leather Finishing Agent, Material and Manufacturing Processes,22,782-786p

3. Seydibeyoğlu, M, O., Güner, F, S., 2007, Poliüretan-Hektorit Nanokompozitlerinin Hazırlanması ve Karakterizasyonu,İtü dergisi, 8 (1),74-82p

4. Weickmann, H., 2005, Hybridnanopartikel und polymere Nanokomposite auf Basis von Bentonit und armierten Polymerlatizes, Albert-Ludwigs-Universität Freiburg,1-28p