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Polyurethane nanocomposites with hydrophilic and organophilic clays

C. P. Garcia[(1,2)], M. C. Delpech[(1)*], F. M. B. Coutinho[(1)] and I. L. Mello[(1)]

(1) UERJ, Universidade Estadual do Rio de Janeiro, e-mail: mcd@uerj.br
(2) Sunchemical do Brasil Ltda. – Rio de Janeiro – RJ.
* Corresponding author.

Abstract – The polyurethanes (PU's) constitute a very important class of polymeric materials. The possibility of being synthesized with different types of monomers leads to versatile structures that can be obtained as elastomers, fibres, thermoplastics or thermorigids. These factors allies the advances concerned of engineering materials and the possibility of new applications, specially when the systems are obtained as nanocomposites. Currently, the study of polymer-clay nanocomposites, has been extensively studied. The objective of this work was the synthesis of non-polluting systems based on polyurethane aqueous dispersions with hydrophilic and organophilic clays.

Aqueous polyurethane dispersions (WPU's) were synthesized based on poly(propylene glycol) (PPG), dimethylolpropionic acid (DMPA), isophorone diisocyanate (IPDI) and hydrazine (HYD) as chain extender. The resins were modified with the addition of 1% of hydrophilic clay (Cloisite Na^+) or organophilic clay (Cloisite 30B), to prepare aqueous nanocomposite polyurethane dispersions (NWPU´s) with 35% of solids. The nanocomposites obtained were characterized by X-ray diffraction (XRD), scanning electronic microscopy (SEM) and thermogravimetry (TG). The mechanical properties were also evaluated.

X-Ray analysis showed that (Figure 1), after the incorporation of both clays in the WPU's, the absence of the peaks related to the pure clays, suggesting the possibility of exfoliated structures mixed in the dispersions, Figure 2 shows SEM micrographs of NWPU´s samples: (a) referring NWPU-Na^+ 1%, that exhibit exfoliated clay in the matrix of PU and (b) related to NWPU-30B 1%, suggesting tactoids formation. As a matter of fact, both formulations presented higher mechanical resistance when compared to the pure dispersions and the better performance was presented by the hydrophilic NWPU-Na^+ sample (hydrophilic clay).

The mechanical behavior, evaluated for the resistance assay the traction confirmed the biggest resistance mechanics of both the formularizations, in special of that one with hydrophilic clay, as Table 1.

DTG and TG curves (Figure 3) indicate that the addition of nanoparticles caused some influence in whole profile of the curves. This can be attributed to the fact that an inorganic material can hinder the expansion of heat reducing de rate of degradation of the material.

These results suggest the nanocomposites WPU/clay had been obtained.

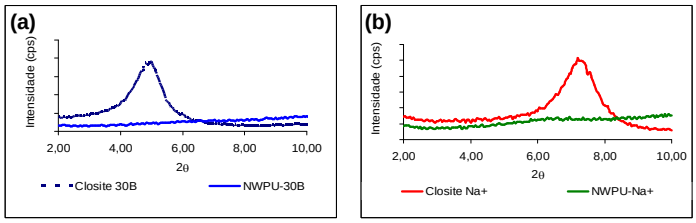

Figure 1: X- Ray data of pure clays and NWPU's cast films
(a) Cloisite 30B/NWPU-30B; **(b)** Cloisite Na^+/NWPU-Na^+.

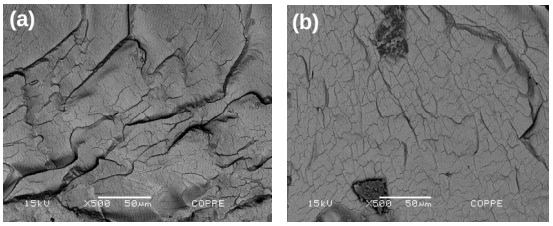

Figure 2: SEM micrographs of the films:
(a) NWPU-Na^+; **(b)** NWPU-30B.

Table 1: Mechanical properties of the cast films

Material	Tensile Strength (MPa)	Break Elongation (%)
WPU	6,47	302,8
NWPU-Na^+	17,87	647,1
NWPU-30B	7,84	359,2

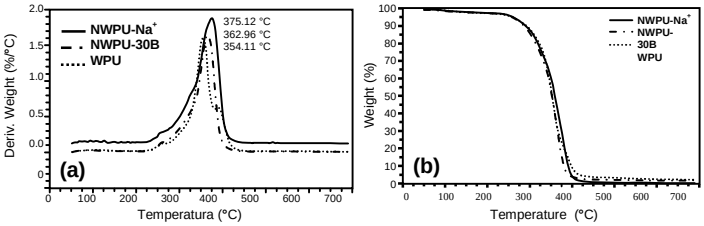

Figure 3: DTG (a) and TG (b) curves of the cast films of WPU, NWPU-NA^+ and NWPU-30B.

References

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