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Polypropylene nanocomposites with UV light absorption properties

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Abstract – Metal nanoparticles were used to produce polypropylene (PP) nanocomposite with UV absorption properties. To evaluate the UV protection of bottles made from nanocomposites, a natural pigment solution was kept into these bottles under UV chamber testing for 24 h. Based on the color aspects and spectrophotometry results of the natural pigment, it was verified that the PP/metal nanocomposites can increase the shelf-life of the UV light sensitive foods.

The functions of packaging are contain, protect, and sell the conditioned product. Concerning to protection it involves preserving the maximum product quality, creating conditions that reduce the causes of food degradation, such as chemical, biochemical, and microbiological changing [1]. The active packaging is, certainly, one of the most important innovations in this field. Active packages are those that interact with food in order to provide security, improving quality and extend the shelf- life of the product [2]. In that context, the Quattor Petroquimica has employed nanomaterials into its polypropylene (PP) resins focusing the design of food packaging with UV light protection. The metal nanoparticles and polypropylene resins were blended by twin screw extruder ZSK 26 (L/D = 44), with screw speed of 500 rpm and feed rate of 30 kg/h. From the nanocomposite pellets were obtained injected discs with 1.5 mm of thickness for optical characterization; and blown bottles for UV chamber testing. The table 1 shows the optical properties (yellow index, haze and gloss) for virgin polypropylene and for PP/metal nanoparticles. In comparison to virgin polypropylene resin, these results indicated that the haze and gloss properties were lost with metal nanoparticles addition, mainly in higher loading, but the haze level of 12% is acceptable in many food packaging applications, as showed by one of nanocomposite compositions. Concerning to yellow index (YI), the higher nanoparticle amount the lower yellow index, suggesting that the nanoparticles act as optical brightener. To verify the effective UV protection of nanoparticle, a UV sensitive natural pigment solution was added inside of the bottles and kept in a UV chamber for 24 h. The color aspect of the solution after the UV chamber testing can be visualized in a Fig 1, and the UV spectrophotometry results in a Fig 2. Based on these, it could be observed that the bottles made from PP/metal nanoparticles protected the natural pigment against the UV exposure. In a real application, the use of PP/metal nanoparticles can be a good option for bottles manufacturing to increase the shelf-life of UV light sensitive foods.

Table 1: Optical properties of virgin PP and PP/metal nanoparticles

Nanoparticle (ppm)	YI	Haze (%)	Gloss (%)
0	2,0	9	85,2
X	-0,35	12	81,0
2X	-1,91	15	77,0
3X	-3,02	19	73,1
4X	-3,54	22	69,5

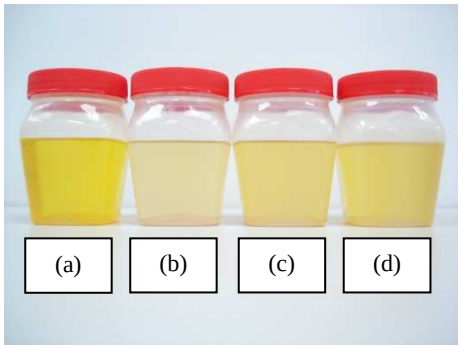

Figure 1 – Color aspects of natural solution after 24h in a UV chamber testing: (a) Control, (b) Virgin PP, (c) Nano - X ppm and (d) Nano – 2X ppm

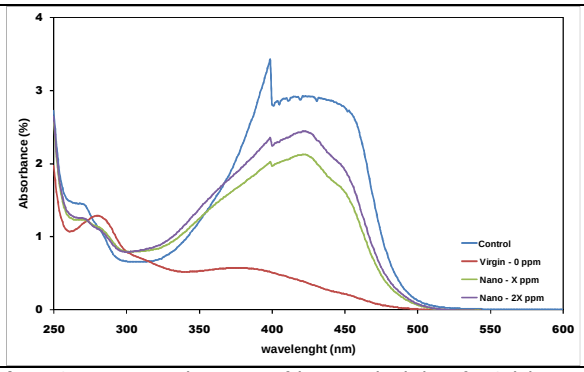

Figure 2 - UV spectrophotometry of the natural solution after 24h in a UV chamber testing

References

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