New Advanced Composite Materials with Applications in Automotive Industry. II

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The paper presents some experimental results obtained with different types and amounts of reinforcement in composite materials based on polypropylene matrix for automotive applications. There were characterized fourteen experimental samples. The reinforcing agents utilized were: particulate reinforcement (organic and biodegradable – powder wood and inorganic and non-biodegradable – talc powder) and fibrous reinforcement (organic biodegradable-short flax fibers).

Keywords: composite, polypropylene, flax fibers

Synthetic polymers, manufactured to be resistant to different environmental factors (light, oxygen, humidity, heat, microbial factors), became an important problem due to their accumulation in the environment, after the end of their lifetime. The new challenges regarding environmental preservation have imposed the need for new approaches in the field of biodegradable materials.

Composite materials used in the automotive industry have evolved rapidly in recent years due to the need of adapting to regulations in the field of environmental protection and conservation. Thus, materials with excellent qualities for specific domain applications and a high degree of biodegradability must be developed [1].

For these kinds of materials, the required characteristics are: low weight, easy handling and soundproofing, thermal insulation, resistance to vibration, cheaper manufacturing, lower energy consumption and recyclables [2].

Currently, the recycling of such composite materials is done by conventional mechanical or chemical methods, which require additional energy consumption and release harmful gases and pollutants. The materials which are the subject of this paper present a higher degree of degradability, under the influence of some micromycetes [3-5].

Experimental part

Raw materials

The composite materials were made starting from the polymeric matrix of polypropylene to which we added different reinforcing agents.

The materials which we are going to study are composite material based on polypropylene with the following composition [2]:

The following compositions were studied comparatively: Polypropylene – noted M; PP + 30% glass fiber + pigment – noted M1; PP + 30% wood flour + pigment – noted M2; PP + 5% flax fiber + 25% wood flour + pigment – noted M3; PP + 30% talc powder + pigment – noted M4; PP + 10% flax fiber + 20% wood flour + pigment – noted M5; PP + 10% wood flour + pigment – noted M6; PP + 20% wood flour + pigment – noted M7; PP + 30% wood flour + pigment – noted M8; PP + 30% talc powder + pigment – noted M9; PP + 30% glass fiber + pigment – noted M10; Fireproof PP + 5% flax fiber + pigment – noted M11; Fireproof PP + 10% EPDM + pigment – noted M12; Fireproof PP + 15% EPDM + pigment – noted M13; Fireproof PP + 20% wood flour + pigment – noted M14; Fireproof PP + 25% EPDM + pigment – noted M15.

Equipment

- Brinell Hardness – was determined on the Brinell Hardness Testing Machine

Experimental part

For the materials that were obtained we conducted the following tests:

a. Brinell hardness test;

b. Rapid estimation of materials lifetime through accelerated action of fungus on the composite materials [4];

c. Manufacturing of profiles.

Experimental results obtained are shown in table 1.
b. Rapid estimation of materials lifetime through accelerated action of fungus on the composite materials

By analyzing the results we observed the following:

After 45 days of exposure in the biodegradation environment, the M11 had the fastest biodegradation rate, registering a weight loss of 1.44%.

The other samples absorbed the water, after both 45 and 90 days, due to the presence of the wood flour. In these samples, the highest weight loss of 1.03% was recorded in the M8 sample, whiles the lowest weight loss of 0.16% was recorded in the M12 sample.

After 90 days of biodegradation the M11 composite material was the only composite material which registered a 3.45% weight loss, and the M12 composite material had the same initial weight. The remaining samples absorbed the water.

c. Manufacturing of profiles

The following profiles for auto vehicles were made from the optimal choice composite material: left door panel, front right door panel, ornamental hub cap, luggage boot lid.

The profiles which were made from the optimum choice composite material are presented in figure 2.

Conclusions

The composite materials that we studied generally have mechanical properties which are slightly inferior to those of the composite polymeric material with an identical polymeric matrix but using fiberglass as reinforcement. Still, these materials are of significant importance due to biodegradability and light weight. These properties result from using natural reinforcing materials in the composite materials' composition.

The results which were obtained after mechanical, thermal and biological tests indicate an optimal choice. Autovehicles profiles were made from this optimal choice: front left door panel, front right door panel, ornamental hub cap, luggage boot lid.

The results of this research indicate de possibility of obtaining polymeric composite materials reinforced with wood flour and flax fibers with properties similar to those of polypropylene reinforced with fiberglass, which opens new perspectives for industrial production.
References

17. J. ZHAO, Rumin Wang Advance in application of vegetable cellulose in biodegradable composite – Suliao Gongye, China (2004), 32(11), pag.1-3, 18
31. V. AVADANEI, L.AVADANEI, O.C. BUJOR, S. GAL PAL „Valorificarea prin compostare a deșeurilor provenite din exploatarea și prelucrarea primară a masei lemnoase” (partea a doua) prezentata la Simpozionul „Impactul Acquis-ului comunitar asupra echipamentelor și tehnologiilor de mediu” Acquisistem (2009) Agihea

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