New Advanced Composite Materials with Applications in Automotive Industry. II

ALINA RUXANDRA CARAMITU[1]* CRISTINA BANCIU[1], SORINA MITREA[1], NICOLETA BURUNTIA[1], LIDIA AVADANEI[2], VIOREL NICOLAE[3]

[1]National Institute for Research and Development in Electrical Engineering ICPE-CA, 313 Splaiul Unirii Bucharest, 030138, Bucharest, Romania

[2]Research Institute for Synthetic Fibres ICEFS COM S.R.L.- Savinesti, Romania

[3] Pitesti University

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 where 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 PP and M_0; PP + 30% glass fiber + pigment – noted M_1; PP + 30% wood flour + pigment – noted M_2; PP + 5% flax fiber + 25% wood flour + pigment – noted M_3; PP + 30% talc powder + pigment – noted M_4; PP + 10% flax fiber + 20% wood flour + pigment – noted M_5; PP + 10% wood flour + pigment – noted M_6; PP + 20% wood flour + pigment – noted M_7; PP + 30% wood flour + pigment – noted M_8; PP + 5% flax fiber + 20% wood flour + pigment – noted M_9; PP + 30% glass fiber + pigment – noted M_{10}; Fireproof PP + 5% flax fiber + pigment – noted M_{11}; Fireproof PP V + pigment – noted M_{12}; Fireproof PP + 5% flax fiber + 5% EPDM + pigment – noted M_{13}; Fireproof PP + 5% flax fiber + 10% EPDM + pigment – noted M_{14}; Fireproof PP + 5% flax fiber + 15% EPDM + pigment – noted M_{15}.

* email: alina.caramitu@icpe-ca.ro; Tel.: (+40) 021 346 7231

Equipment

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

- Analysis of micromycetes action SR EN I SO 846/2000 – Materiale plastice. Evaluarea actiunii microorganismelor [4]

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.

a. Brinel Hardness test – was done on the M_o, M_2, M_3, M_4, and M_5 materials

- The M_0 polypropylene matrix has the highest Brinel Hardness. Adding any other reinforcing material regardless of its nature or percentage leads to a decrease in hardness.

- The composite material with granulary reinforcement (M_2 wood flour), displays a decrease by 12 units (approximately 10%) in hardness in comparison with the matrix.

- The composite material with granulary filler (talc powder M_4) displays a decrease by 10 units (approximately 9%) in hardness in comparison with the matrix.

- The advantage of using the composite material with wood flour is that it makes the final composite biodegradable and cost efficient.

- The experimental results which were obtained are shown in table 1.

Table 1
BRINEL HARDNESS HB 10/20

Composite material	Brinel Hardness HB 10/20
M_0	115
M_2	103
M_4	105.33
M_3	101.33
M_5	101

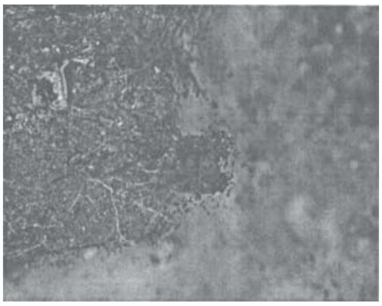

Fig. 1. Stachybotrys atra on M_{11} material

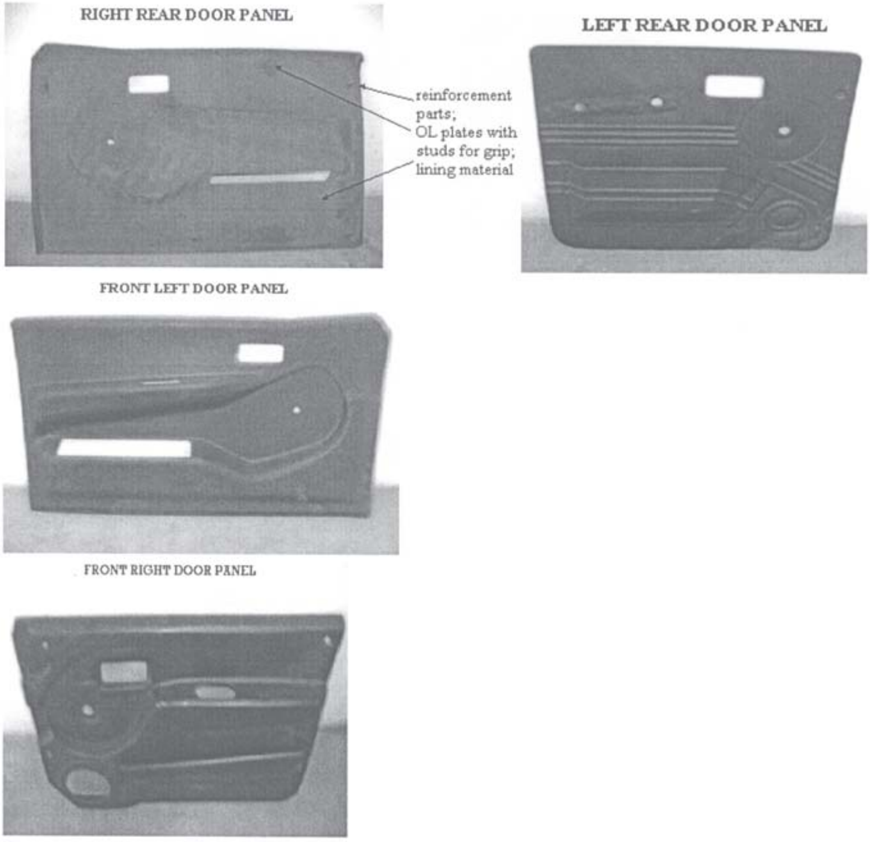

Fig. 2. Profiles made from composite material obtained as the best option

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 M_{11} 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 M_8 sample, whiles the lowest weight loss of 0.16& was recorded in the M_{12} sample.

After 90 days of biodegradation the M_{11} composite material was the only composite material which registered a 3.45% weight loss, and the M_{12} 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 buidegradability 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.

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