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THE TECHNOLOGICAL PROBLEMATIC OF GUIDE MARKS IN THERMOPLASTIC COMPOSITE MATERIALS

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Summary:
In this writing we present the technological problematic of guide marks in composite thermoplastic materials, armed with an array of additives, used in industry. The technological problematic of thermoplastic materials is based on the synergy between high performance fibers (the armature and the matrix). The new problematic that is posed in the manufacturing technology of the modern composite materials is to replace natural reinforcement strings with micro powders and colored metallic powders: copper and aluminum. The accession percentage being very small and modifying only morphologically, the surfaces of polyamide parts, accentuating the color and shine proprieties.

1. PLASTIC MATERIALS

The first plastic ever produced by human beings was discovered by Alexander Parkes in 1862, at the Great Exposition in London. Plastic material is an organic material derived from celluloses that once heated could be matrix-ed. With this product, industry begins to produce, for the first time, a kind of material that is as frequently used as a natural substance. Fourty years later, in 1909, a belgian chemist that emigrated to the US, Leo Hendrik Backeland (1863-1944) discovers bakelite, the first plastic considered to be an aesthetic material. From chemicals point of view, bakelite represents a revolution. The base materials used until then for producing plastic were obtained from natural materials. Bakelite however, is mate entirely from industrial products. As such, bakelite constitutes the first synthetic plastic material. Bakelite was used in the fabrication of a large number of objects such as telephones and jewels, radio's etc.

From the 1950's, plastic grew in a great industry that affects our lives – starting from the better wrapping of our foods and goods to the insurance of new textiles, ending with the permission to produce new wonderful products and state-of-the-art technologies like television sets ,cars or computers.

Plastic allows even doctors to substitute injured or damaged parts of the human body allowing people to lead longer and more productive lives. In fact, starting 1976, plastic was the world's most used material and it's appearance was voted among the first in the top 100 of the greatest news stories of the century.

The term "plastic" is applied to substances with distinct structures, it's proprieties being elasticity and flexibility, that allow the material to shape and adapt itself to different shapes.

Plastic is a substance that contains, as an essential ingredient an organic substance of molecular mass named polymer.

2. THE PROPRIETIES OF PLASTIC MASSES

Plastic masses have a low density, are impermeable, have proved resistance to many chemical factors, are easily processed and can be recycled.

Processing plastic: using pressure and air vacuum. ; Forming the product: is realized in a matrix.

Technique: one of them is using injection, after cooling, this has to be eliminated together with it's opening, removal of the part being part of the injection cycle.

3. COMPOSITE MATERIALS

Composite materials emerged to replace conventional materials. A composite material is obtained by merging two materials of different natures, that complement one-another and that allow the obtain of a material with superior performances comparing to the elements that are taken separately.

A composite material consists of a continuous faze that is named a matrix and a discontinuous faze that is named re-enforcement. The non-metallic matrix can be made out of cellulose, wood, plastic material, etc. The re-enforcement can be made out of technical ceramics, glass, synthetic bdelliums, etc. The composite materials are glass fiber and polyester.

Plastic materials armed with glas fiber can be easily produced. As advantages, we have the unlimited resistance to the actions of processes determined by atmospheric agents (oxidation, corrosion, high capacity of vibration amortization).As disadvantages, we can note the running-out of the materials by friction, that is equal to tearing and deformation.

4. GENERALITIES OF POLYAMIDE 6

Polyamide 6 is a semi crystalline thermoplastic that has mechanical endurance, tenacity and resistance to elevated impacts, and also has a good behavior when treated with an aggregate, MoS2.

5. CHARACTERISTICS

Work temperature: -40 to +90 degrees Celsius.

High mechanical endurance

The technological problematic of creating composite materials based on polyamides. For exemplification, we present the composite material based on polyamide and wood.

6. MATERIALS

For the realization of composite materials with a matrix of thermoplastic polymer we have used the following materials: copolyamidic polymer – powder with a granulation of 300-400 μm; wood material taking the shape of splints.

7. OBTAINING COMPOSITE MATERIALS

So we can achieve the most homogeneous mixture of wood-polymer and the best division of the polymer on the surface of the wood particles, we have gone to a method of mixing the components of the mixture in two phases.

The first intermediate phase of pre-mixing the two materials. Before mixing, the polymer powder was dried for 4 hours at 70 degrees Celsius for clearing any water it sucked in. The presence of water can have a hydrolysis effect and can determine the formation of blank spots in the composite material. The wood material has also undergone a drying process at 90 degrees Celsius, until it reaches a residual humidity of 5%. The mixing of the components was done firstly in a palette mixer and then in an extruder: φ=20 mm and L/D=22. By extrusion, we obtain wood-polymer pellets with sizes of about 2-3 mm. In the second phase of creating the composite material, the pellets were dried at 70 degrees Celsius in an oven, until they reached a humidity lower than 2%. One of the steel shapes used in the creation of composite material plaques is covered with a teflon foyle, over which we place a forming frame. Inside this frame we place the pellets of wood-polymer and we dispense them in a uniform layer. Over the carpet of pellets we place another teflon foiled and the second plaque of steel of the matrix. The whole ensemble is introduced into a hot press, at 150 degrees Celsius and 2 MPa, for three minutes. Then the matrix is transferred into a cold press, where it is maintained under a pressure of 4-10 MPa untill the whole ensemble cooled down. The wood material taking the shape of splints was mixed in diverse proportions (30-70 %) with the thermoplastic polymer. For a better codification of the composite materials that were created, in all cases, the wood material was indicated between round brackets ().For example, codification MCLP (40) indicates a wood-polymer composite material in which 40% wood and 60% polymer was used.

8. CHARACTERIZING COMPOSITE MATERIALS

Termic Behaviour. – Termic analysis realized through DSC and DTG highlights the termic stability and physical modifications of composite materials according to temperature. The results of DSC determinations were centralized in Chart 1.

Chart 1. – Termic characteristics determined through DSC

Material	Tpeak (Degrees Celsius)	ΔHm (J/g)
Polymer	129	41,47
MCLP (30)	136	38,19
MCLP (40)	135	30,56
MCLP (50)	134	23,74
MCLP (60)	132	19,82
MCLP (70)	130	15,61

For all analyzed samples, the termic discomposure determined through DTG took place in several phases. In Chart 2,the main data regarding the behavior of composite materials is centralized, comparatively with the base materials: wood and polymer.

Chart 2. – Termic behavior of composite materials (wood-polymer)

Material	T50 (degr.C)	Ti (degr. C)	Tm (degr. C)	Tf (degr. C)	ΔWti-tf (%)
Wood	324	178	302	358	27
Polymer	428	310	430	480	43
MCLP (30)	392	320	405	458	32
MCLP (40)	410	390	419	465	16
MCLP (50)	402	366	384	420	8,5
MCLP (60)	398	330	342	360	6
MCLP (70)	385	310	315	340	3,5

T50 – temperature at wich weight loss is 50%
Ti – temperature at wich the main termic discomposure process begins
Tm – temperature at wich the speed of the termic discomposure is maximum
Tf – final temperature of the main termic discomposure process.
$\Delta W_{Ti\text{-}Tf}$ - weight loss during the main discomposure process.

Mechanical Proprieties:_ The morphology of the dispersion phase influences the physico-mechanical proprieties of the composite materials. Tests regarding endurance at traction, impact and recurvement offer information regarding the mechanical proprieties of the samples, depending on the adhesion between the matrix and the wood material. The physico-mechanical characteristics are presented in drawings 1,2,3.

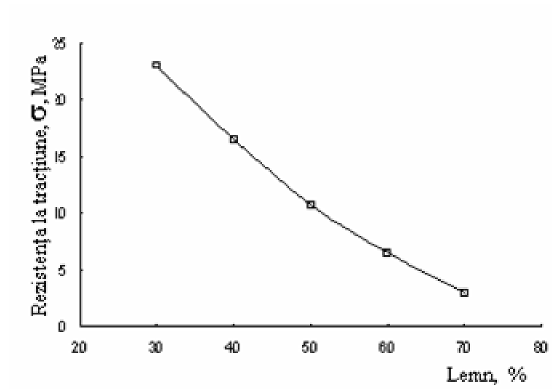

Fig. 1. Fraction strength of composite material

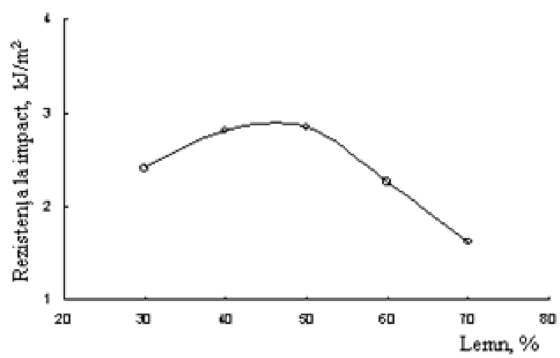

Fig. 2. Impact resistance of wood – polymer, composite material

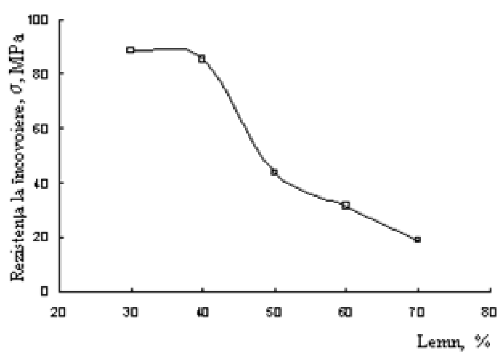

Fig. 3. Bend resistance of composite material

The problematic of creating thermoplastic composite materials with a polyamide matrix and fine metallic powder armature. Compared to the classic re-enforcement materials, a new aspect is brought in the composition of composite materials by metallic materials, because of their special proprieties. Until present times we are familiar with thermoplastic composite materials with a polyamide matrix and metallic powder armature (for example bronze), used in the fabrication of antifriction materials. The percentage of metallic powder is big enough: 60-70% of it's weight.

A novelty in the creation of these materials would be the reduction in a large amount of the metallic powder (1-3%).

Because of the physical phenomenon that appear in the synthesizing of the parts ,from polyamide, heating at 300 degrees Celsius, goes into a sluggy state of plastic masses, allows migration towards the surface of the parts and metallic powders where they are solidified, modifying the morphology of the part's surface. The thermoplastic material used as a matrix is polyamide 6.6,the proprieties being presented in Chart 4.

Chart 4. – Proprieties of used polymers for obtaining matrixes

Characteristics	Value (coPA)	Value (PEr)
Chemical composition	copolyamid 6/6,6/6,10	LDPE recycled
Granulation,mm	0,3 – 0,5	3 – 4
Density at 23 Degrees Celsius	1,11	0,92
Cristalinity (%)	58	37
The flow coefficient (MFI)	11,9	0,55
The melting interval (degr. C)	125 - 135	108 - 120
Melting heat (ΔH), J/g	41,5	108,1

The polymer-metallic powder mixture is heated up at 250 – 300 degrees Celsius, being injected and poured in centrifugally ,with the metallic parts being heated and covered at 300 degrees Celsius, after wich they are immersed into a fluidized bed. The polymeric matrix adheres to the metallic surface and the metal powders are caught above, the length being between 1-2 minutes.

The main characteristic of these new materials is their metallic active surface's proprieties.

CONCLUSIONS

By the morphologic modifying of active surfaces of thermoplastic materials through re-enforcement, positively modify antifriction proprieties.

By creating these new materials we can obtain a large array of color combinations of the plastic materials that are a treat to the eye and have a decorative purpose.

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