# ASPECTS OVER VIEWING FRICTION PHENOMEN UPON COMPOSITE PLASTIC MATERIAL

**Patricia Ungur[1], Ioan Mihăilă**
University of Oradea, patrymode2005@yahoo.com[1]

Key words: plastic material composed, friction, friction coefficient.

Summary:
In this short writing we present aspects regarding friction phenomenon upon new composite plastic material, anticorrosive, antifriction, auto lubrication and decorative. The new materials analyzed and presented in this writing are armed plastic material based on big molecule polymers chained together by powerful intermolecular forces, especially those belonging to plastic material like calcites, aluminum silicates, colloidal graffiti, molybdenum bi-sulfur or metallic powders. Due to the theological behavior of thermoplastic materials in a liquid state, of Archimedes's law, in some processing conditions we can obtain multi-layer structures: Metal-Plastic-Metal, Metal-Plastic-Oxide, Metal-Plastic-Lubricant.

## 1. INTRODUCTION:

In the present time, we are familiar with composite plastic materials, made from thermoplastic base material or mineral ingredients. So that we can obtain composite materials with special proprieties, we can add non-ferrous metallic material to the base plastic material. The plastic-metal associations combine the friction qualities of plastic materials with the good conductivity of metals.

The covering of metals with thermoplastic macro-molecular composites is made for anticorrosive, antifriction and decorative purposes. We are familiar with procedures that cover metallic support such as: immersion in a fluidic coat, flame levigation, covering with a plaque, covering by normal levigation and powdering. These procedures are achieved with different technological machinery and equipment, specific to each way of covering. Many times the metallic support is covered by galvanization with a minimal layer of zinc and copper, which leads to a greater adhesion of the thermoplastic material and a better mechanical anchorage. The important parts in this kind of technique that undergo covering operations are nut's and slide bearings.

Usually the procedures of obtaining multi-layer structures from thermoplastic masses consisted of heating the metallic part at a greater temperature then the polyamide's melting temperature and the insertion of the heated part into a medium where plastic material particles are swirled. The plastic material particles that are in movement come in contact with the walls of the heated innards and melt, adhering to the metallic surface. By fusion with other particles a thin and homogeneous layer of plastic material is formed. The thickness of this layer is according to the nature of the material, it's thermic proprieties and the conservation time of the innards at the polyamide's melting temperature .In a short period of times the plastic cover goes into a viscous (viscid) state that solidifies after the innards is drawn out from the sedimentation area. After solidification, a cooling in water or oil takes place for ensuring a decorative aspect.

Before the covering is done, for a more effective protection of the varved polyamide layer. For a better adhesion the metallic parts can be galvanized using known procedures with stanium, copper, zinc, and etcetera. The very good results have been obtained with the PG6 polyamide taking the form of colored powders, achieved by the Chemical Factory of Savinesti.

The disadvantages of known procedures were the limited number of sedimentation choices, each one having an mat aspect and differing only by the polyamide's color.

In the following writing we present a new covering structure for metallic parts with polyamide pulbers that increase the array of known adhesion choices and that lead to the remission of metal loss caused by corrosion, getting a nice decorative aspect of the metallic pieces. The obtained structure is a multy-layer structure: Metal – Plastic – Metal.

## 2. ASPECTS REGARDING THE FRICTION OF COMPOSITE PLASTICS MATERIALS

From the theory and laws of friction determined experimentally by Coulomb, Leonardo da Vinci or Amontous we can draw the following conclusions:
The maximum friction force (FRmax) is directly proportional with the normal N force at the contact's interface

$$FRmax = \mu \cdot N \ (1)$$

Where μ is the proportionality coefficient called the drift friction coefficient .The friction force Fr has a value in the module between 0 and μ · N.

$$0 \leq Fr \leq \mu \cdot N \ (2)$$

The direction of the friction force is the same like the one of the body movement tendency, being situated in the tangent cadre in the surface's contact point. The direction of the friction force is opposite to the one of the movement.
The friction coefficient "μ" does not depend on the shape or size of the surface that is in contact (namely of the pressure between the two bodies).
The friction coefficient "μ" depends on the nature of the materials in contact (the material couple and it's degree of manufacturing).
The friction coefficient "μ" is a number without dimensions. The friction coefficient's value drops quickly if between the surfaces that are in contact, a lubricant layer is ingrained.

## 3. IN THE SITUATION OF THE FRICTION CUPS CONSISTING OF THE POLYMERIC MATERIALS THE TRANSITION TEMPERATURE HAS AN ALL- IMPORT ROLE IN FRICTION.

When the regime temperature is superior to the transition temperature, we can notice the flow of the viscid-elastic fluid (where the elastic deformations are recoverable, and the plastic ones irrecoverable).At an inferior temperature compared to the vitrous transition temperature Tg, we can notice the fragile tearing depending on the plastic material used.
In the case of simple elastomeres, we can notice plastically deformations being present. So that we can differentiate the behavior of plastic masses and other materials except metal at friction, the generalization of the fundamental friction equation is necessary, under the following form:

$$Fr = \mu \cdot N^x \ (3)$$

where x is a parameter that indicates the nature of the material.
In Chart 1 we give preventative values to x for some of the kinds of plastic material.

**Chart 1.**

| x | Types of plastic materials |
|---|---|
| 0,66 | Para plastic |
| 0,66-1 | general Para plastic materials |
| 0,85 | polytetrafluoroethylene (PTFE) |
| 1 | Metal, ceramics |

The friction coefficients of polymeric materials depends on temperature, the pressure between the surfaces in contact, the sliding speed, the material that it comes in contact with, the medium in which it is worked in time, of the solid materials belongs to polytetrafluoroethylene (PTFE),comparable with that between dampish ice on dampish ice. In Chart 2 we are given the values of the friction coefficient µ, for PTFE at different temperatures. Values of the friction coefficient.

**Chart 2.**

| Temperature | Friction coefficient µ | | |
|---|---|---|---|
| | PTFE/PETE | PETE/Steel | Steel/PTFE |
| 20 | 0.04 | 0,04 | 0,09 |
| 50 | 0,04 | 0,04 | 0,09 |
| 80 | 0,04 | 0,04 | 0,10 |
| 100 | 0,04 | 0,04 | 0,10 |
| 150 | 0,04 - 0,05 | 0,04 | 0,11 |
| 200 | 0,05 | 0,04 | 0,14 |

According to the law of dry friction, the friction force is independent of the contact surface, being dependent of pressure. In the case of PTFE, the friction coefficient depends on the pressure between contact surfaces having greater values at small pressures and going into remission once pressure grows. The friction coefficient falls back quickly at speeds under 3 m/ min. and grows in the same rate speed does. Between -45 and +100 degrees Celsius, the friction coefficient is constant, having greater values at temperatures under -45 degrees Celsius (0,2 at -80 degrees Celsius) and smaller at temperatures greater than 100 degrees Celsius. In Chart 3 we are orientatively given the friction coefficients for different plastic materials. Friction coefficients for different plastic materials.

**Chart 3.**

| Polymer | Steel-Polymer µ s | µ k | Polymer–Polymer (µ s) | µk |
|---|---|---|---|---|
| polytetrafluoroethylene | 0,10 | 0,05 | 0,04 | 0,04 |
| tetrafluoroethylene–hexafluoropropylene | 0,25 | 0,18 | - | - |
| low-density polyethylene (HD-PE) | 0,27 | 0,26 | 0,33 | 0,33 |
| high-density polyethylene (HD-PE) | 0,18 | 0,10 | 0,12 | 0,11 |
| homopolymeric acetalyc-bdellium (POM) | 0,14 | 0,13 | - | - |
| vinylidene polyfluorure | 0,33 | 0,25 | - | - |
| Polycarbonate (PC) | 0,60 | 0,53 | - | - |
| Polyethylenterephtalat (PET) | 0,29 | 0,29 | 0,27 | 0,20 |
| Polyamid 6.6 (PA66) | 0,37 | 0,34 | 0,42 | 0,35 |
| Polychlorotrifluoroethylene (CTFE) | 0,45 | 0,33 | 0,43 | 0,32 |
| Vinyl Polychlorure (PVC) | 0,45 | 0,40 | 0,50 | 0,40 |
| Vinylidene-Polychlorure | 0,58 | 0,45 | 0,90 | 0,52 |

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