**On the tribological behavior of polymer-based composites filled with solid lubricants**

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Among many types of materials, polymer have recently witnessed a rapid growth as an ecological, economic and energy efficient technology. Unfortunately, the mechanical and tribological properties of these materials cannot sustain the severity of many mechanical systems. Therefore, it is necessary to improve the tribological performance of polymer by filling them with wear-resisting materials. In this regard, micro-scale and nano-scale fillers such as carbon-based particles, h-BN and others may be incorporated in organic binders to enhance their tribological performances.

In the first part of our contribution, we focused on the tribological and mechanical properties of thermoplastic composites containing different weight fractions of solid lubricant filler. For the thermoplastic matrixes, we choose polyamide 6-6 (PA) and polycarbonate (PC) and the solid lubricants considered were graphite and molybdenum disulfide (MoS2). Composites were developed by direct injection molding process as a first methodology. A second one is also used based on particles pretreatment before injection molding in order to improve the adhesion in the filler/matrix interface. Friction experiments were conducted using a reciprocating microtribometer. The effect of the development methodology on the adhesion properties in the filler/matrix interface was explored. The experimental tools were principally based on uniaxial tensile tests coupled to scratch tests and complementary microstructural characterizations (fractography, X-ray tomography). The measured mechanical and micromechanical properties were correlated to the microstructural observations. The best friction and wear improvement were obtained when MoS2 is added to PC matrix and graphite is Added to PA matrix. Solid lubricant particles pretreatment using amino-silane coupling agent improved mechanical and tribological properties.

The second part of our contribution was dedicated to study the influence of incorporating carbon nanoparticles into an elastomer on its mechanical and tribological properties. Elastomeric nanocomposites with high structural, thermal and mechanical performance have been manufactured. For the elastomeric matrix, we selected Carboxylated Nitrile Butadiene Rubber (XNBR), known for its high hydrocarbon resistance and wide use in the manufacture of seals. The addition particles considered are graphene and graphene oxide. The synthesis of nanoparticles including graphene and graphene oxide has been described. Graphene oxide (OGe) nanosheet were obtained by chemical oxidation of the graphite followed by exfoliation via sonification. A chemical or thermal reduction was then carried out to produce graphene nanosheet. The development of nanocomposites was carried out using a first direct mixing methodology and a second development methodology, involving the mixing of latex elastomers with an aqueous solution of the addition nanoparticles in order to achieve a homogeneous dispersion of the nanofillers in the matrix. The nanocomposites developed were characterized by uniaxial tensile tests. For the various composites developed, the tribological behavior was analyzed using a rotating ball on disc tribometer. The impact of the nanofiller synthesis process and the nanocomposite development method on friction and wear response was explored. The improvements obtained in the selected properties following the incorporation of nanoparticles into the elastomer matrix make it possible to envisage a substantial increase in the performance of elastomers in many applications.

The deposition of protective coatings from thermosetting polymer powders is one of the most effective methods to reduce friction and protect contacting surfaces from wear. Nevertheless, polymers coatings are generally weak materials compared to metals and ceramics which obviously results in some limitations. To overcome this drawback different types of reinforcements, e.g. fibers and particles, are often applied which results in structured composite coatings materials with excellent specific properties. This is typically to improve mechanical properties but also in many cases for enhanced friction and wear control. Therefore, the knowledge of the coating properties in terms of scratch resistance is of paramount importance in order to prevent the formation of severe damages. In this context, the third part of our contribution tried, firstly to analyze the friction and wear behavior of electrostatically sprayed polyester or epoxy powder coatings filled with different solid lubricants and deposited on an aluminum substrate and, secondly, to focus on the response of these thermosetting composite coatings to micromechanical deformation under progressive scratch test loading. The effects of graphite and hexagonal boron nitride (hBN) solid lubricant fillers on the friction and wear behavior of polyester composite coatings were evaluated using a reciprocating tribometer under dry friction condition. A comparative evaluation of the tribological performances as well as the scratch resistance of two thermosetting powder coatings filled with different weight fraction of molybdenum disulfide solid lubricant was also performed. The SEM analysis was used to characterize the wear mechanism and coating damage.