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CHANG ES OF MECHANICAL PROPERTIES OF POLYMER COMPOSITE REINFORCED WITH SISAL FIBERS AFTER CONTACT WITH OIL.

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Abstract. *The use of polymeric composite materials in the industry, has been growing gradually, throughout the world, these materials are used in the automotive, industrial, nautical, aerospace, chemical industries and mainly in the oil industry from building and repair of pipelines, for instance. The use of polymeric composite reinforced with natural fibers has gained importance in research throughout the world, , since these fibers are biodegradable have a lower cost of obtaining compared to synthetic fibers and comes from renewable sources. Given this context, this work aims to manufacture a polymer composite reinforced with sisal fibers of fabric and check their mechanical performance when it comes in contact with oil for a period of 180 days, for this study we used the ASTM D3039-00 and D 790 -03, to achieve the tensile uniaxial and flexural in three points, after the tests were performed SEM review in the region of the fracture of the specimens with and without contact with oil.*

Keywords: *Composite Materials,Sisal,Oil e Mechanical Properties*

1. INTRODUCTION

With the demand for new technologies and new materials for industry, research on polymer composites are gaining large space especially in the automotive industry where it is widely used. The term composite is used for the assembly of two or more different materials combined on a macroscopic scale, to function as a unit, to obtain a set of properties that none of the individual components present (Mendonça, 2005).

The composite materials are classified according to the type of reinforcement that they may present, they may be particulate or fibrous, fibrous reinforcements have to use both the use of synthetic fibers (carbon fibers, glass, aramids), such as natural fibers (pineapple fibers, banana, cannon, flax, palm fiber, jute, sisal, ramie). When using these fibrous reinforcements can come forward - that both in the form of chopped strands blanket, bidirectional or unidirectional fabrics, or continuous strand, which can provide all these configurations hybridization or not. Phase array of these materials may be ceramic origin, coal mining, metal and polymer. In the oil and gas industry, for example, polymeric composites can be applied to floors, handrails, rails for passage of electrical, sewer pipes and drinking water pipes in general and guard rails (protection bar on the edge of ships) platforms (DANTAS, and FELIPE FELIPE, 2008).

Among the natural ribs, pineapple fibers, for example, have been studied with respect to those of the same viscoelastic properties of polymer composites as can be seen in works such as George et al 1993, coconut fiber has also been studied. Among the fibrous reinforcement of plant origin, sisal is promising in the development of composite materials due to their properties and their availability in the market. This fiber has been studied in polymer composites with respect to their mechanical properties of tensile, flexural and impact, and injection molding of polypropylene fiber matrix (Mishra et al ,2001) work has also been developed with the fibers in different types matrix Li Y et al, 2000, studied the fiber in its different aspects regions and mechanical properties thereof. The sisal fiber is extracted from perennial sisalane agave leaf, is plant is originally from Mexico, and was implemented in Brazil in the early twentieth century, in the northeast, having as its main producing states of Bahia, Paraíba and Rio Grande do Norte.

From sisal fiber numerous advantages that we can quote sisal fiber is a light, non-toxic, which has high modulus and specific strength and costs about ten times less than the glass fiber. Among other advantages of sisal can point to the ease of surface modification, characteristic of vegetable fiber, its abundance in Brazil and ease of cultivation (Mochnacz et al, 2002),. However, they have some disadvantages such as mechanical and thermal degradation during processing requiring a high degree of shear, such as extrusion and injection (SEO et al, 2006,. Thomas et al., 1999).

The sisal fiber is widely used in cordarias sector, tapestries and has been introduced in the automotive industry and construction. The cultivation of fiber generates about 700mil direct and indirect jobs in the northeast of the country (Embrapa) and generates about U$ 80 million Dolores in foreign exchange for Brazil (Sindfibras).

Given this context, this work aims to manufacture a polymeric composites reinforced with sisal fiber fabric and check its mechanical performance when it comes in contact with oil for a period of 180 days for this study was used to ASTM D3039- 00 and ASTM D 790-03, to achieve the l tensile uniaxia and flexural in three points, after the tests were made SEM analyzes in the area of the fracture of the specimens with and without contact oil.

2. METHODOLOGY

2.1 Materials

For the manufacture of the composite material plate (polyester / sisal tissue) was used as matrix orthophthalic unsaturated polyester resin, G-120/08 pre-accelerated, manufactured by NOVOCOL, with the following characteristics (supplied by manufacturer): Density between 1.10 and 1.15 g / cm³; Brookfield viscosity at 25 ° C, between 260 and 300 cP. The catalyst used for the resin cure system is the methyl-ethyl-ketone (MEKP), manufactured by AKZO NOBEL. Preparation of tissue

For the manufacture of tissues, sisal fibers were separated by these strands and arranged in a handloom (Figure 1) with dimensions of (400 x 400) mm, to obtain the bidirectional tissues.

Figure 1. Loom

After the process of manufacture of the strands, these were arranged in interwoven warp and the weft so as to obtain fabrics formed completely as can be seen in figure 2.

Figure 2. Tisuue sisal

The fabrics made in this work are specified in accordance with table 1.

Table 1. Specification of Sisal fabrics

Specification Fabric Sisal	
Fiber Type	Sisal
Weight g/m²	800
Title tissue (Denier)	465,93
Nº Fibers /cable	45
Nº de cable/cm	2/2
Average fiber diameter	0,181
Type of patterned fabric	Screen
Fabric Type	Flat

2.2 Manufacture of composite

The composites were produced by the hand lay up process (manual lamination), with 1% by volume catalyst related to the polyester resin.

2.3 Tensile Test

The tensile test was based according to ASTM D3039, made with 5 test samples having the following dimensions: 25 mm wide, 127 mm between the tabs and 250 mm in total length thereof Figure 3). Five samples were used for the tests taken and an average value of the properties, with a speed of 1 mm / min.

The samples were dipped in oil for a period of 180 days. The oil used in this analysis was given by PETROBRAS and was taken from a terrestrial wells located between Rio Grande do Norte and Ceará.

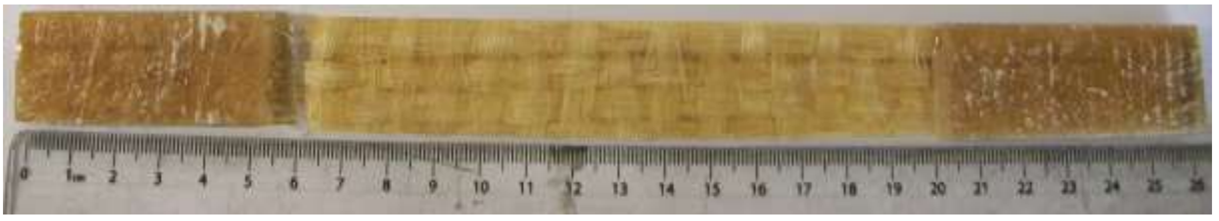

Figure 3. Tensile Specimen

2.4 Test Flexural

For this test were used five specimens in accordance with ASTM D790- 03 having the following dimensions: 12.7 mm wide, 61 mm long and 2 mm thick, the tests were performed with a speed of 1 mm / min and the distance between the supports of 44 mm (Figure 4).

At the same tensile immersion condition was held for flexural samples.

Figure 4. Specimen Flexural

3. RESULTS AND DISCUSSION

3.1 Traction Test Uniaxial

As can be seen in Figure 5 there is a decrease in the tensile strength limit of the material when it is in contact with the oil. As can be seen, a reduction in tensile strength that occurs from contact with this oil, ie there is a decrease of 22.22% in the final strength of the material, when it comes into contact with the fluid.

This reduction is characterized by infiltration of the fluid occurring in the matrix and the absorption thereof by sisal fiber (Figure 7), since the oil infiltrates the fiber / matrix interface, thereby decreasing the interaction between them, as can be seen without the immersion oil composite that there is good grip fiber matrix (figure 6), which grip is interrupted by oil leakage.

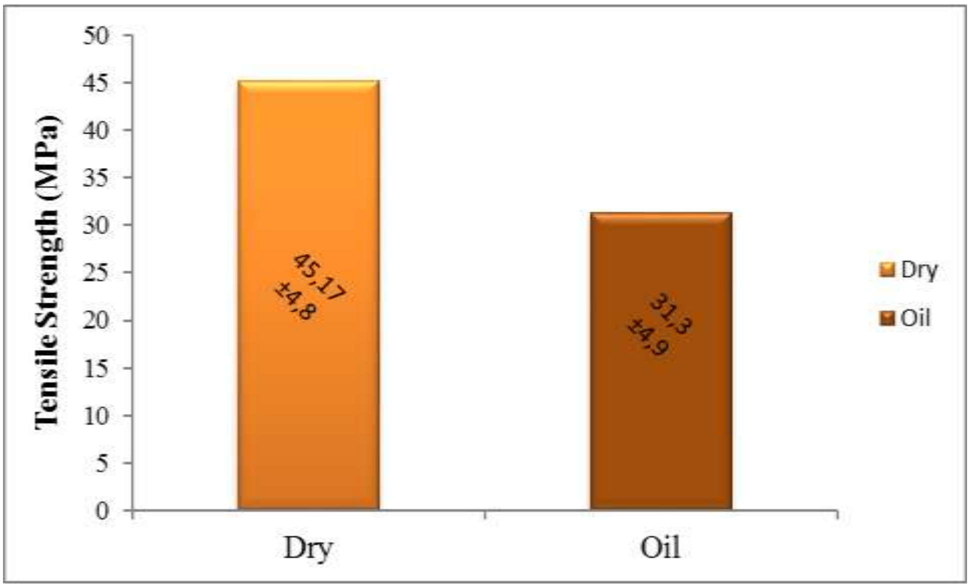

Figure 5. Limit Tensile Strength

Figure 6. Composite without immersion (dry) (SEM held at specimen fracture)

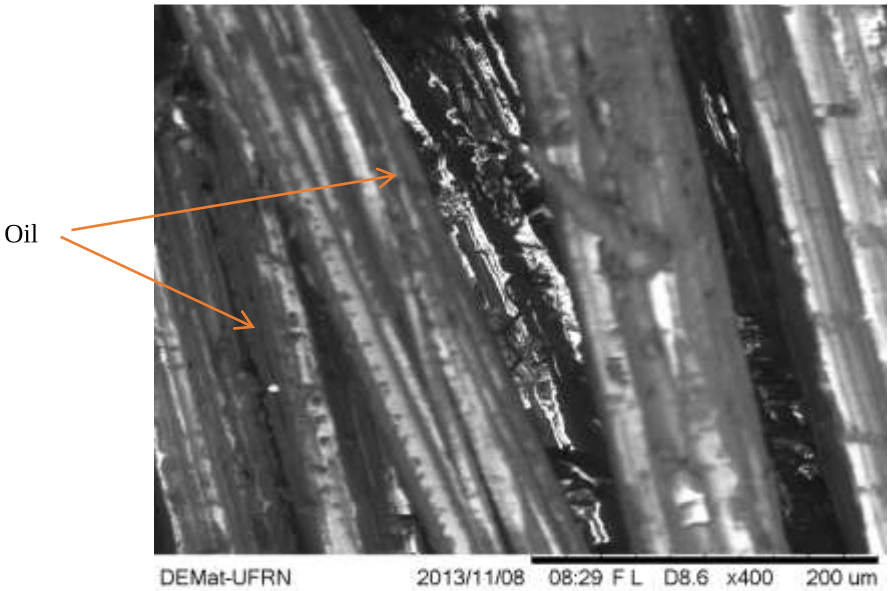

Figure 7. Composite immersed in oil (SEM held at specimen fracture)

With regard to material stiffness is a drop in the value observed when the composite passes from the dry state, i.e. without the immersion oil for the oil immersed state (Figure 8), causing a 46% loss in stiffness of the same, also due to loss of grip occurs in the fiber matrix material after immersion in the fluid studied.

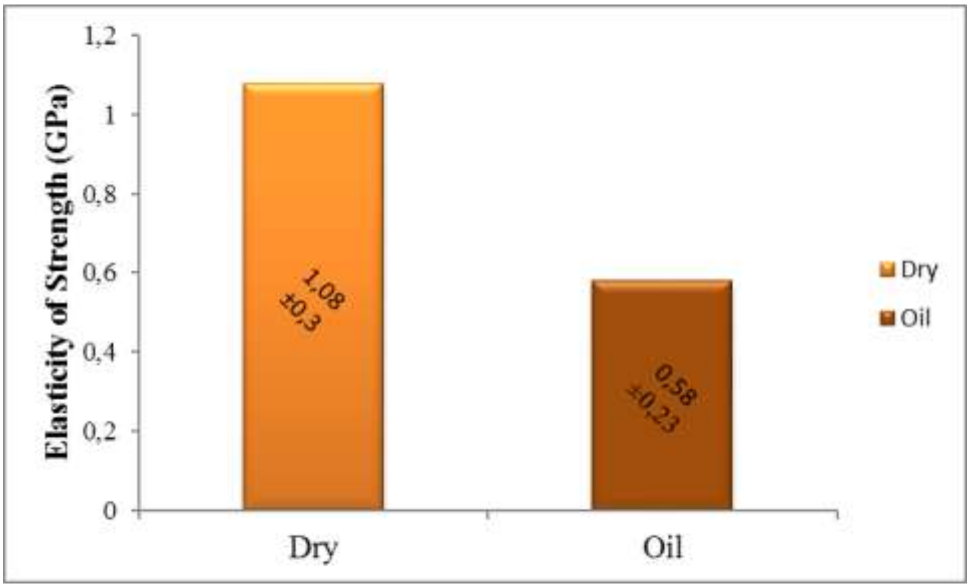

Figure 8.Limit Strenght Modulus

3.2 Flexural test in Three Points

As regards the mechanical analysis on three points flexural (Fig 9 and10) it is observed that the resistance of the material decreases by approximately 37.35% for the tensile strength and there is a loss of 6.25% of the stiffness field when it is subjected to immersion in oil.

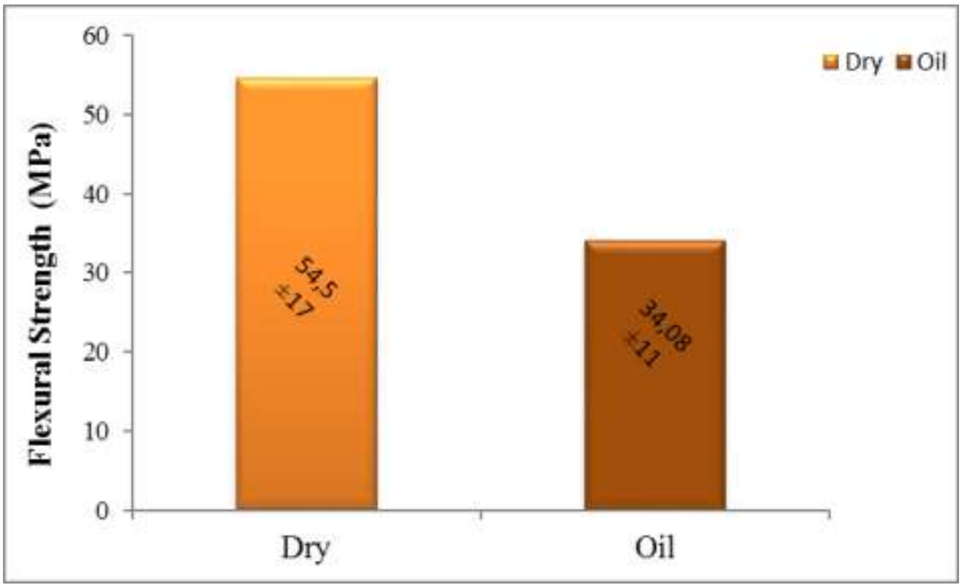

Figure 9. Limit Flexural Strenght

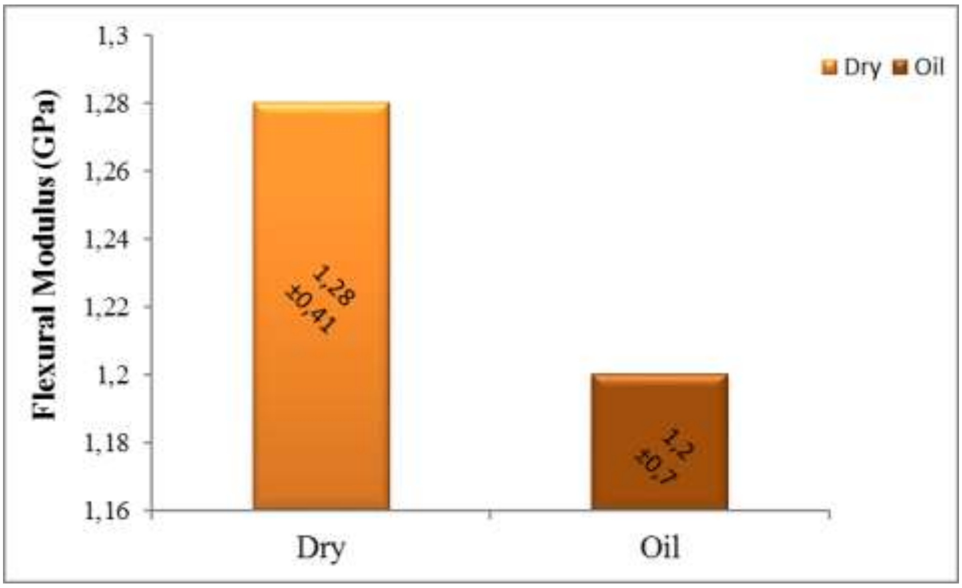

Figure 10. Limit Flexural Modulus

4. CONCLUSION

From the results presented in this study, one can conclude that oil significantly affects the mechanical properties of tensile and bending points in neat composites reinforced with natural fibers of sisal, causing the impossibility of using the same in the oil industry, since it can infiltrate the matrix, and once absorbed by the fiber it is passes to swell (swelling) it promotes cracking in the matrix.

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