



CARNAUBA OIL: FEASIBILITY STUDY FOR USE AS BIOLUBRICANT

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Abstract. Lubrication is responsible for reducing the wear on the friction protect the metal against oxidation, corrosion and dissipates excess heat, making it essential for the balance of a mechanical system, consequently prolonging the useful life of such a system. The origin of lubricating oils is usually mineral being extracted from the petroleum. But the search for a new source of production of lubricants and fuels it is necessary to meet future demands and reduce the possible environmental damage. For this reason, looked a alternative means to produce certain products derived from petroleum, such as biodiesel, for example. Returning to the area of lubricants, also one realizes this need for new raw materials for their production. Vegetable oil is a renewable resource and biodegradable, and its use entails advantages in environmental, social and economic. The development of this study analyzed the carnauba oil and presents the possibility for its use as a lubricant vegetable, or biolubricant. To analyze the carnauba oil were developed assays as checking acid index and pH. Later developed a corrosion test in which we analyzed the behavior of oil carnauba in contact with a metal.

Keywords: Carnauba oil, lubricant, biolubricant.

1. INTRODUCTION

The Lubrication is one of the most important items to keep a mechanical system in equilibrium, where the pieces are working in direct contact; it reduces wear on the friction, protects metal against rust, corrosion and dissipates excessive heat, prolonging life useful mechanical system. Their absence, misuse or poor, can cause serious damage and can compromise the system partially or totally.

The origin of lubricating oils is generally mineral being extracted from oil, but given the fact that oil is a nonrenewable resource, the search for a new source of production of lubricants and fuels it is necessary to supply future demands and for this reason, we look for alternative ways to produce certain products, such as biodiesel, for example. Returning to the area of lubricants, one also perceives the need for new raw materials for their production. Vegetable oil is a renewable resource and biodegradable, and its use entails advantages in environmental, social and economic, can be considered as an important factor for sustainable development especially in rural communities.

Lubricants based on renewable raw materials and their derivatives are drawing increased attraction in various applications. Here, the environmental awareness is the key factor of success (WAGNER et al., 2001).

The development of this study is to analyze the vegetable oil extracted from the seed of a palm tree common in northeastern Brazil, the carnauba. The scientific name is carnauba copernicia cerifera, is a tree of the family Palmae and is endemic in semi-arid northeastern Brazil (RODRIGUES, 2004).

Vegetable oils analyzed recent studies have satisfactory properties in comparison with mineral oils, demonstrating only some points that require correction due mainly to the high acidity and low oxidation stability. The triglyceride structure of vegetable oils provides qualities desirable in a lubricant. Long, polar fatty acid chains provide high strength lubricant films that Interact strongly with metallic surfaces, reducing both friction and wear (FOX et al., 2006).

The high acidity can cause accelerated wear on certain types of materials. This study developed tests where the focus was to analyze acidity of this carnauba oil and which can he cause in metallic materials. The acidity was measured through the assays of acid index and pH.

It was also analyzed the behavior of carnauba oil in contact with a metal in a copper corrosion test. The choice of this test is given, because mechanical systems consist of metallic materials, and mostly the bearings of these systems have copper coating.

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2. METHODOLOGY

The carnauba oil used in the tests was extracted at the Laboratory of Chemistry of the Federal University of Rio Grande do Norte, for greater certainty regarding its purity. After the extraction been developed tests for pH, acid index and copper corrosion.

2.1 Potential Hydrogen (pH)

To determine the pH of the carnauba oil two methods were used:

Measurement by pHmeter: The first method was through the pH meter equipment, manufactured by Digimed, which consists of a glass electrode coupled to a potentiometer. The pHmeter is a millivoltmeter with a scale that converts the potential difference detected by the electrode in pH units. To use this equipment it was calibrated with solution of pH 4, pH 7 and pH 9, Fig. 1.



Figure 1. pHmeter.

Measurement by indicator paper: The second method used was universal indicator paper of pH, Fig. 2.



Figure 2. PH indicator paper and tape used for the determination of the pH of carnauba oil.

In both methods, the procedure was quite simple, carnauba oil is placed into a flask and a meter is introduced for specified time.

2.2 Acid index

The method used to determine the acidity is through acid-base titration a sample with a solution of alkali, which is sodium hydroxide 0.1 M, using an alcoholic solution as indicator, the phenolphthalein, Fig. 3.

The material used was:

- Beaker of 50 mL;
- Erlenmeyer flask of 125 mL;
- Burette of 25 mL;
- Analytical balance;
- Volumetric pipette of 10 mL;
- Reagent phenolphthalein;
- Solution of sodium hydroxide 0.1 M.

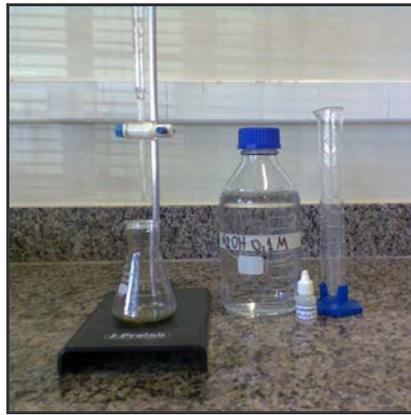


Figure 3. Preparation of test acid index.

The procedure for this assay with was initiated measuring two grams of carnauba oil in an Erlenmeyer flask of 125 mL, then added 50 mL distilled water and the this mixture was added four drops of phenolphthalein solution, after sample preparation added with a solution of sodium hydroxide 0.1 M until obtain a pink color.

2.3 Copper corrosion

For the test of copper corrosion were used the following materials and equipment:

- ASTM copper strip corrosion standards;
- Thermal bath brand Koehler Instrument Company, Inc.;
- 70 mL of oil carnauba;
- Copper strip;
- Paper silicon carbide grade P220 and P120;
- Solvent;
- Cotton.

Initially the cleaning is carried Copper Strip with paper silicon carbide grade P220, leaving free completely from surface blemishes, after with paper silicon carbide grade P120. Finally retires the residues with cotton dampened with solvent.

Immediately after these cleaning procedures the copper strip is immersed in the vessel containing the carnauba oil. This container was closed and placed in the thermal bath for 3 hours at a temperature of 100 ° Celsius, Fig. 4.



Figure 4. Equipment and materials corrosion test.

3. RESULTS AND DISCUSSION

3.1 Potential Hydrogen (pH)

In Tab. 1 are shown the pH values of the oil, carnauba measured by different methods.

Table 1. Results of pH measurements a temperature of 28 ° C.

Method of measuring the pH	pH of carnauba oil
pHmeter	6,02
Indicator paper	6

3.2 Acid index

According to the calculations performed the acid index in carnauba oil is 0.025 mg NaOH / g.

3.3 Copper corrosion

After the assay time course of the copper strip was removed from the container, washed with solvent and compared with the pattern of strips of copper corrosion ASTM, Fig. 5.



Figure 5: Comparison of the color of copper strip in ASTM standard after the test.

Analyzing the copper strip, one realizes that it is contained in the group slightly tarnished, more precisely in the classification 1b.

4. CONCLUSION

The carnauba oil unlike other vegetable oils, showed a low acidity. An important factor to be considered because high acidity can cause excessive wear on certain types of materials especially when the goal is to provide a lubricating film to protect them.

Analyzing the copper corrosion test, where we observed the behavior of carnauba oil in contact with a metal, it was noticed that the oil carnauba caused a slight change in the color of copper strip; carnauba oil has a low corrosivity.

The analyzes of the carnauba oil showed satisfactory results generating the possibility of using as a biolubrificante, but for achieving its use as a lubricant are still required some additional tests which consider other specific properties of a lubricant.

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6. REFERENCE

- FOX, N.J.; STACHOWIAK, G.W. Vegetable oil-based lubricants—A review of oxidation; Elsevier; Tribology International; n 40; p. 1035–1046; 2007.
- WAGNER, H.; LUTHER, R.; MANG, L. Lubricant base fluids based on renewable raw materials their catalytic manufacture and modification; Elsevier; n 221; p. 429-442; 2001.
- RODRIGUES, V. P. Coperniciaciferia Mart.: Aspectos Químicos e Farmacológicos de uma Palmeira Brasileira; Thesis submitted as a requirement for the degree of Master of Pharmaceutical Sciences, with the Faculdade de Farmácia da Universidade Federal do Rio de Janeiro; Rio de Janeiro, June de 2004.
- QUEIROGA, V. P.; RAMOS, G. A.; ASSUNÇÃO, M. V.; ALMEIDA, F. A. C. Carnaubeira: Tecnologias de Plantio e Aproveitamento Industrial. 1ª Edition; Editora Universidade de Campina Grande; 2013.
- OLIVEIRA, A. K. C.; SILVA, L. H. N.; SILVA, L. L. N.; OLIVEIRA, K. R. R.; SILVA, S. I. F.; COSTA, A. C. J. Produção e avaliação comparativa do biodiesel de soja e biodiesel de linhaça através de dois métodos de preparação aplicados aos óleos vegetais. In: Congresso Norte Nordeste de Pesquisa e Inovação, 7., 2012, Tocantins.
- AMERICAN SOCIETY FOR TESTING AND MATERIALS - ASTM. Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test. ASTM D - 130. West Conshohocken, PA, USA, 2004.
- MATOS, P. R. R. Utilização de Óleos Vegetais como Bases Lubrificantes. Thesis submitted as a requirement for obtaining a Master's degree at the University of Brasília; Brasília, 2011.
- CARRETEIRO, R. P.; BELMIRO, P. N. A. Lubrificantes e Lubrificação Industrial. Editora Interciência; Rio de Janeiro, 2008.

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