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Comparative study of chemical physical properties of vegetable oils (surface tension and viscosity)

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ABSTRACT

The measurement of the viscosity was carried out and the spreading of vegetable oils (Colza oil, Sunflower oil, Olive oil and the Argan oil), depending on the temperature (between 20 and 80 ° C) on an aluminum alloy support generally used in the manufacture of internal combustion engines. The viscosity decreases as the temperature increase according to the law of Arrhenius. The contact angle measurements showed that the spread of different vegetable oils increases with increasing temperature (remarkable decrease in the contact angle of the investigated oils). The results also showed that the oil used in the lubrication of internal combustion engines is spread depending on the temperature such as vegetable oils (decrease in contact angle after the temperature increase), and the tendency the contact angle is in good agreement with the viscosity variation of all this we can learn that we can use such oils as lubricants combustion engines (Diesel or Petrol).

Key words: vegetable oils, viscosity, contact angle, combustion engine.

INTRODUCTION

The engine oil, generally used for the lubrication of combustion or combustion engines, is a mineral oil, semi-synthetic or synthetic, derived from oil and enriched with technical additives [1]. It lubricates, cleans, inhibits corrosion, improves sealing and helps to remove the heat of friction and combustion, so that the engine parts remain within operating tolerances. Operation of the lubrication system is designed to reduce resistance due to friction in moving parts. In an engine, a good lubrication increases the yield by reducing the mechanical losses due to friction [2]. It must reduce friction (less wear), remove the heat created by the friction, protect against oxidation and corrosion, remove debris from contact areas, reduce operating noise, provide part of the engine cooling (piston heads, shirts, camshaft, etc.) participate in the seal between segments and folders and remove combustion residues and metal particles [3].

The objective of this study is to characterize vegetable oils and make a comparison with the oil used in the lubrication of internal combustion engines. This characterization has been carried out by the determination of the viscosity and the study of spreading by measuring the contact angle that determines the lubrication of these engines.

MATERIALS AND METHODS

2.1. Contact angle measurement

The contact angle measurements were performed using a goniometer (GBX instruments, France) by the sessile drop method [4]. This instrument is a standard goniometer with image analysis attachments (video camera, computer with monitor, and image analysis software).

The measurement of the contact angle reflects the ability of a liquid to spread on a surface wettability. The method consists in measuring the angle of the tangent of a drop profile deposited on the substrate with the surface of this one. It measures the surface energy of the liquid or solid.

The measurement of the contact angle provides access to the free energy of a surface. It also allows discrimination of polar or non-polar nature of the interactions at the liquid-solid interface and deduction of the hydrophilic or hydrophobic character of a surface.

2.1.1. Principle

When a drop of liquid is placed on a flat solid surface, the angle between the tangent to the drop at the contact point and the solid surface is called contact angle (θ).

It is specific for any given system and determined by the interactions across the three interfaces gaseous, liquid and solid (Fig.1).

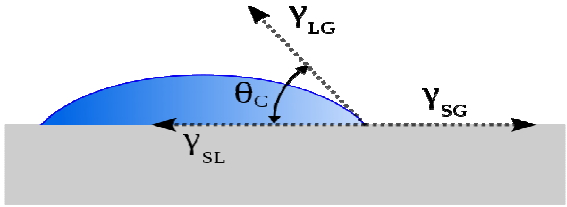

Figure 1: Contact angle

2.2. Viscosity Measurement

The viscosity is measured by a viscometer Osswald:

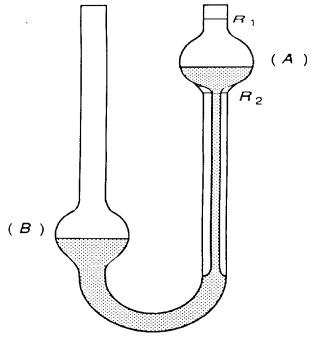

Figure 2: Oswald viscometer

Measuring the flow time of a volume V of fluid through a capillary tube. The viscosity is proportional to the flow of time: $V = K.\ \Delta t$

The constant K of the apparatus is given by the manufacturer of the viscometer.

RESULTS AND DISCUSSION

Vegetable oils as fuel in diesel engines were the subject of several studies worldwide. This paper summarizes the study of diesel surface energy and compare with the surface energy to various vegetable oils (Colza, Sunflower, Argan and Olive) and comparing the trend of the contact angle thereof with their viscosities.

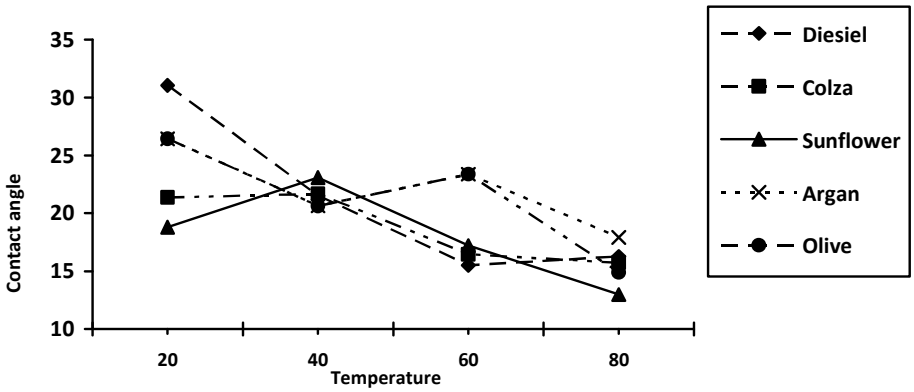

Figure 3: Contact angle values of various plant oils

In our figure (Fig. 3) we see that the contact angle for studying different oils and diesel decreases with temperature. If the temperature of a liquid increases, the thermal agitation of the molecules increases. They will therefore have a greater ability to leave the surface to move inward. As this force that attracts molecules inward is the surface tension, it should decrease as the temperature increases.

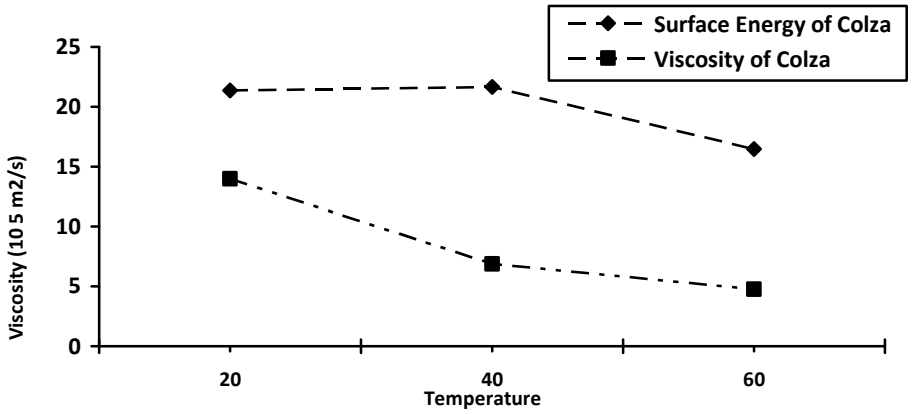

Figure 4: Variation of the viscosity and the contact angle of Colza according to the increase in temperature (° C)

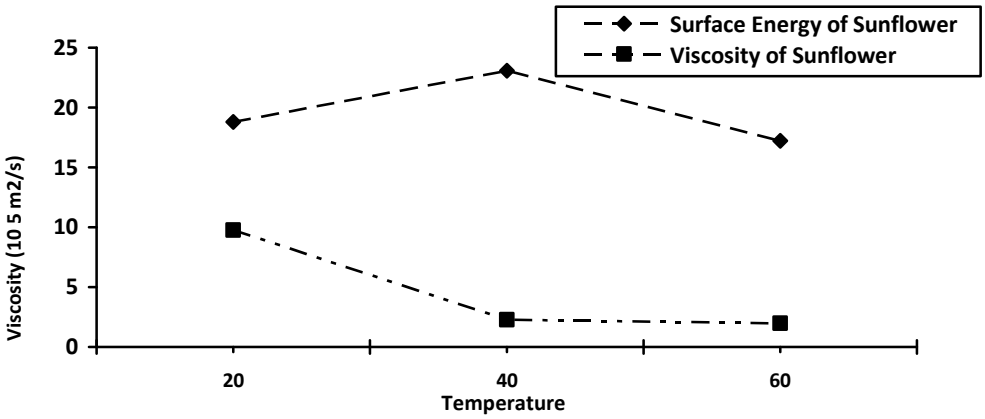

Figure 5: Variation of viscosity and contact angle of Sunflower oil according to the increase in temperature (° C)

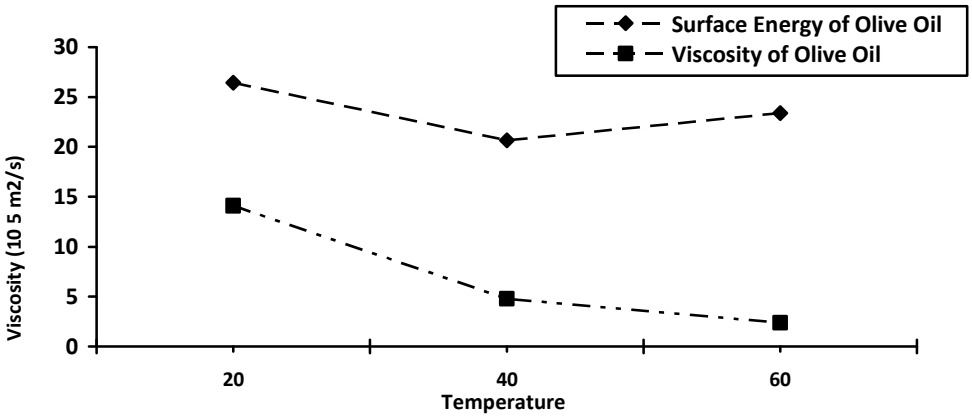

Figure 6: Variation of viscosity and contact angle of Olive oil according to the increase in temperature (° C)

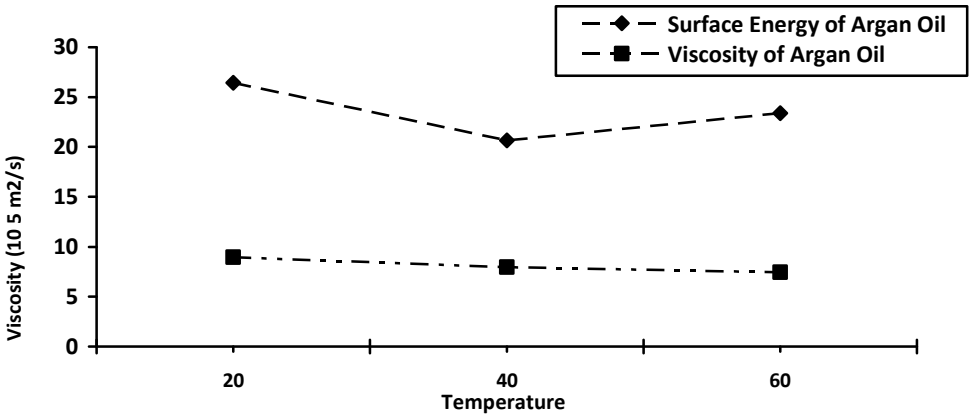

Figure 7: Variation of viscosity and contact angle of Argan oil according to the increase in temperature (° C)

At our figures, it is observed the tendency of the viscosity of vegetable oils and the contact angle thereof in accordance with the increase of temperature.

Vegetable oils have good carburizing characteristics own [5]. These characteristics differ from that of diesel oil. The most important of these characteristics is the kinematic viscosity of the oils which is higher than that of diesel and it increases with the saturation, the length of the carbon chains and temperature. It is 10 to 20 times higher than that of gas oil [6-7]. The viscosity of vegetable oils a major influence on the correct operation of the injection pump and can disturb the spraying, which leads to poor combustion [5], but our observation that curve is reduced when we heating them to 60 °C [8], where it has a viscosity similar to that of diesel. We can also notice, from the curves that colza oil and sunflower have a lower viscosity compared to that of olive oil and Argan oil at the highest temperature. This indicates that they can be used as biofuel at very high temperatures, which is useful for engines operating at high temperatures [9].

In our studies, we added another parameter that we can use to find out how good engine lubrication can be achieved. The measurement of the contact angle of vegetable oils and made to compare this study with the change in viscosity can be deduced that there is a great relationship between the viscosity of each oil and contact angle.

From the curves it is seen that the contact angle of the colza oil and sunflower decreases with the increase of the temperature that is to say, these two oils can beings used as lubricants, 2 cons for other oils (olive oil and Argan oil) did not react much with the temperature that is to say the reduction in viscosity and the contact angle was not too important.

CONCLUSION

The realization of lubricating engines may be by hydrodynamic lubrication is to say, a sufficient oil film to ensure separation of the moving areas, governed mainly by the oil viscosity which decreases with increasing temperature, therefore the pressure in the lubricant of the lubrication system and limited to the low pressure in the contact zone, that is why we conducted in our work in consideration of the viscosity and thus the contact angle of more vegetable

oils in relation to surface with increasing temperature (20 to 80 °C) that is to say, understand and calculate how come oil spreading to the motor surface can provided a good greasing wheels stagecoaches, mills, leather protection harnesses.

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