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Ultrasonic Study On Moringa Oliefera Solution Before And After Laser Exposure

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Abstract:

The aim of the work is to measure the ultrasonic velocity, density, compressibility of MORINGA OLIEFERA solution before and after laser exposure at room temperature and to use and interpret the results with a view to bring out the type of molecular interaction, existing in the MORINGA OLIEFERA solution before and after laser exposure..

Keywords

Ultrasonic velocity, density, compressibility,*Moringa oliefera.*

INTRODUCTION

There are two fundamental problems in discussing the structure of liquids. The first is that understanding the nature of molecular interaction. In general terms, it can be said that the force are repulsive for small molecular separation, but a detailed knowledge is necessary for the understanding of liquid properties. The second fundamental problem is that of relating bulk or macroscopic properties of a system to the microscopic or molecular properties and in particular to the potential energy function which describes the way in which an isolated describes the way in which an isolated pair of the molecules interacts.

Liquid is often considered to be intermediate in its properties between solid and gas. This statement should not be taken to mean that every property of a liquid is intermediate (or average) in value between those of the other two states. If the numerical values are compared, it is noticed that in a great majority of cases, the values of the coefficient representing a property of a liquid is quite close to either that of a gas. The behavior of intermediateness then, is a statistical one. Liquid has some of the properties of a solid and some others, of the corresponding gas.

Peculiarities of liquid state:

The most obvious resemblance between liquid and gases is their lack, of rigidity. As such, neither of them offers a permanent resistance to a shearing stress. An immediate consequence of this that, neither liquid nor a gas possesses a shape of its own. Both assume the shape of the container. Every solid on the other hand possesses a definite form and will always offer a resistance to shearing stress. Between liquids and solids, the most prominent similarity is that both posses cohesion, which enables them to maintain a free surface whereas a gas always fills any container. The next and less fundamental property common to liquids and solids is their relative incompressibility compared to gases. While the compressibility of solids is usually of the order of 10^{-6} atm. $^{-1}$, those of liquids are only slightly larger, 10^{-5} atm.$^{-1}$.

The problem of packing so many spheres into a given volume does not permit a large variation from the regular close packed structure. In fact the only reasonable modifications are:

1. There may be logical irregularities, caused by the groups of molecules coming together, leaving wider space elsewhere in the structure.
2. There may be gradual distortions of structure as we go from molecule to molecule, so that the pattern becomes irregular over a large distance, although the

pattern in the immediate neighborhood of a given molecule may be quite regular.

EXPERIMENTAL METHODS

Ultrasonic interferometer:

Use:

- o calculate the velocity of ultrasonic sound through different liquid media.
- o calculate the adiabatic compressibility of the given liquid.

Theory: Ultrasonics:

Ultrasonic sound refers to sound pressure with a frequency greater than the human audible range (20 Hz to 20 KHz). When an ultrasonic wave propagates through a medium, the molecules in that medium vibrate over very short distance in a direction parallel to the longitudinal wave. During this vibration, momentum is transferred among molecules. This causes the wave to pass through the medium.

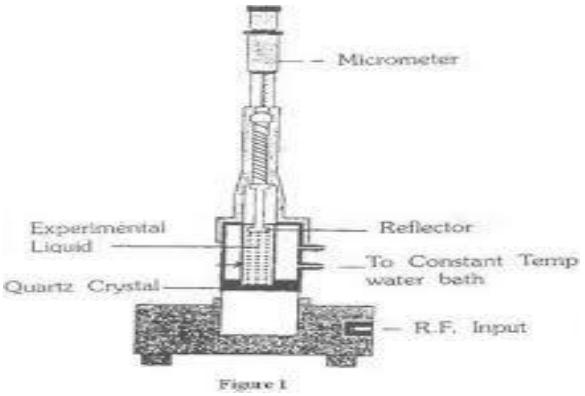


Figure 1

Table 1. Table example. In an ultrasonic interferometer, the ultrasonic waves are produced by the piezoelectric effect method. In a fixed frequency variable path interferometer, the wavelength of the sound in an experimental liquid medium is measured, and from this one can calculate its velocity through that medium. The apparatus consists of an ultrasonic cell, which is a double walled brass cell with chromium plated surfaces having a capacity of 10ml. the double wall allows water circulation around the experimental medium to maintain it at known constant temperature.The micrometer scale is marked in units of 0.001mm and has an overall length of 25mm. ultrasonic waves of known frequency are produced by a quartz crystal which is fixed at the bottom of the cell. There is a movable metallic plate parallel to the quartz plate, which reflects the waves. The wave interferes with their reflection, and if the separation between the plates is exactly an integer multiple of half-wavelength of sound, standing waves are produced in the liquid medium. Under these circumstances, acoustic resonance occurs. The resonant waves are a maximum in amplitude, causing a corresponding maximum in the anode Current of the piezoelectric generator.

If we increase or decrease the distance by exactly one half of the wavelength (λ/2) or an integer multiple of one half wavelength, the anode current again becomes maximum. If ***d*** is the separation between successive adjacent maxima of anode current, then,

$d=\lambda/2$

We have, the velocity (v) of a wave is related to its wavelength (λ) by the relation,

$v=\lambda f$

Where, f is the frequency of the wave. Then,

$v=\lambda f = 2df$

The velocity of ultrasonic is determined principally by the compressibility of the material of the medium. For a medium with high compressibility, the velocity will be less. Adiabatic compressibility of a fluid is a measure of the relative volume change of the fluid as a response to pressure change. Compressibility is the reciprocal of bulk modulus, and is usually denoted by Greek word

beta (β). The adiabatic compressibility of the material of the sample can be calculated using the equation,

$\beta=1/\rho v^2$

Where, ρ is the density of the material of the medium and v is the velocity of the sound wave through that medium.

The velocity of ultrasonic waves in the mixture has been measured by interferometer method. The interferometer consists of two parts namely high frequency generator and the measuring cell. The experimental setup for the continuous wave method shown in fig 3.1 the interferometer generates alternating field for various frequencies. The frequency of alternating field in the interferometer can be selected by changing the selector available on the front panel. Thus, alternating field of a fixed frequency is generated by the interferometer. The measuring the cell is a double walled vessel with a provision to circulate water from the water bath between the inner and outer walls. Thus the temperature of the mixture (taken in the inner cell) can b kept constant. At the top of the cell, a fine micrometer screw is fitted with a (metal) reflector which is immersed in the mixture. The reflector plane in the mixture can be raised or lowered through a know distance using a micrometer screw. The least count of micrometer screw is 0.001mm. A quartz crystal mounted at the bottom of the cell. The reflector plate and the quartz crystal are parallel to each other. The alternating field from the generator applied to the quartz crystal. Therefore, quartz crystal gets into resonant vibrations and hence generates longitudinal ultrasonic waves.

The longitudinal ultrasonic waves generate by the quartz crystal pass through the mixture and get reflected at the surface of the parallel reflector place. If the distance between the plate and the crystal is exactly an integral multiple of half wavelength, standing waves are formed within the medium. This leads to acoustic resonance, resulting in a change of potential difference at the generator which excites the quartz crystal. Thus, the anode current of the generator becomes maximum. The change in the anode current can be measured from the micro ammeter fitted with the frequency generator. The distance 'd' between the plate and crystal is slowly varied using the micrometer screw, the resulting in a decrease in anode current.

The micrometer screw is adjusted such that the anode current increases up to a maximum once again i.e., the needle in the ammeter complete oscillation. By nothing in the initial and final position of the micrometer for n complete movements (maxima-minima-maxima) of the micro-ammeter needle, one can determine the distance (d) moved by the reflector. The wavelength is calculated as,

$\lambda=2d/n$

Therefore, the velocity of the ultrasonic longitudinal waves in the mixture is given by,

$U=\lambda f$

Where, f is the frequency of the generator which is used to excite the crystal.

TABLE:1

Parameters/ name of the solution	Moringa solution before laser exposure	Moringa solution after 3 mints laser exposure	Moringa solution after 5 mints laser exposure	Moringa solution after 8 mints laser exposure
Velocity(m/s)	1496.24	1647.14	1677.514	1823.056
Density (kg/m^3)	0.995994	0.997905	0.987350	1.107441
Viscosity ($N\ S\ m^{-2}$)	0.795399	0.826557	0.831428	0.8844003

Temperature of study:

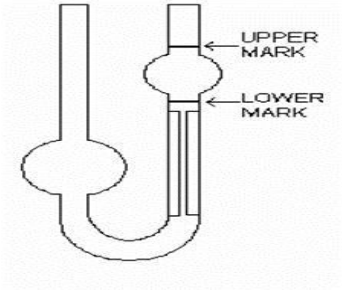
The constant temperature bath used could maintain the temperature correct to 0.01K. For the experimental study, the temperature was maintained at constant value of 308.15±0.01K.

Density measurement (ρ):

The density of the pure liquids, liquid mixtures and electrolytic solutions can be measured using relative measurement method. A clean and dry 10ml. specific gravity bottle is filled with the reference liquid namely, double distilled water and then immersed in a temperature controlled water bath. The temperature of the bath can be maintained at any desired constant temperature. The specific gravity bottle attains the temperature of the bath. The volume of the water in the specific gravity bottle is maintained constant and then its mw (w_2-w_1) i.e., the volume of the specific gravity bottle was ascertained by weighing the water at the experimental temperature (s). After standardizing the specific gravity bottle with water, the liquid whose density is to be determined is taken in the specific gravity bottle and the mass (m) of the mixture is determined at the experimental temperature as that of water. By using the following relation, the density of water (ρ) at different temperature were taken from literature

$$\rho_l = \frac{\rho_w m_l}{m_w}$$

The accuracy of the measurement of density in this method depends on the accuracy of mass measurement. The electric balanced used in this work can weight correct to 0.1mg.



Viscosity measurement:

Oswald Viscometer:

Thoroughly clean the viscometer with acetone and dry it before mounting it in the constant temperature (298^{0}K) water bath. Referring to Fig. the liquid under test is introduced into upper bulb up to the mark then forced under pressure into lower bulb until its meniscus is just above the mark. The liquid is then allowed to fall freely back into the upper bulb and the time interval which elapses between the meniscus passing marks is measured.

with a stop watch and recorded. The tube is then cleaned again and the procedure repeated. It can be measured using the following formula

$$\eta_l = \frac{\rho_l}{\rho_w}\frac{t_l}{t_w}\eta_w$$

Accuracy of measurement:

The binary mixtures were prepared by volume, by mixing the selected volume of liquid components in air tight glass bottles. In all the property measurements, an INSREF thermostat was used at a constant temperature display accrete to (±0.1mg) and the measurements was 0.0001g.cm^{-3}. A set of eleven compositions was prepared for each system and their physical properties were measured on the same day. A 10ml specific gravity bottle and electronic balance were used for the determination of density measurements. Speed of sound

was determined using constant frequency (2MHz) variable path ultrasonic Interferometer (model F-81, metal enterprises, New Delhi) with an accuracy of ±2 $m.s^{-1}$ and was calibrated using water and benzene.

CONCLUSION :

From the table it is observed that there is a significant definite changes taken place in the bio sample after laser irradiation, such that C-H bond broke transformed into two C-N bond, that is noticeable changes amidst amine groups of the bio sample. Similar variation taken place in the value of ultrasonic velocity, viscosity, adiabatic compressibility, and acoustic impedance.

Thus ultrasonic studies are highly useful to detect the changes taken place during laser exposure on the bio liquids.

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