Study of Mustard Oil at low frequencies Measuring Ultrasonic Velocity

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***Abstract*: Mustard oil is very useful for our daily life cooking, medicines and in other useful areas mustard oil has perfect physico-chemical properties for health. It has perfect composition of saturated and unsaturated fatty acids. These acids balance the cholesterol level mustard oil is widely consumed in India. For centuries but sometimes in market it adulated. So this paper focuses the study of ultrasonic velocity at different frequencies in different samples. Ultrasonic technology is a powerful technology over other traditional techniques. It is more inexpensive and capable to check more rapidly and precise measurements. In the present paper, velocity of ultrasound was measured in pure and branded samples of mustard oil at the frequencies 1, 2,3,4,5 MHz frequencies using ultrasonic multi frequency interferometer at temperature. The present study helps to understand the purity of these samples and present data will be useful to identity the adulteration in oils.**

***Keywords*: Ultrasonic velocity, mustard oil, Frequency, Physico-chemical, Temperature.**

I. INTRODUCTION

Different type's oils are very used in our life. The physico-chemical and dynamic properties of oils depend upon their applications. Vegetables oils have very important role in human diet. Among different vegetables oils mustard oil is very useful for human diet. Oils are composed of triglycerides. Mustard oil is used for cooking and also for medicines [1]. The mustard oil is good for heart disease due to its unique composition of monosaturated fatty acid, erucic along with other mono and polysaturated fatty acids. Mustard oil is used as antibacterial, antifungal properties, which is used for many medicinal utilities [2]. Different varieties of techniques are used to detect the adulteration of mustard oil like X-Ray diffraction, density, refraction measurements (RI), Nuclear magnetic resonance (NMR), Neutron scattering and differentia scanning calorimetry DSC ultrasonic techniques is used as an alternate means of characterization of oils over other techniques used conventionally [3]. Ultrasonic technique is better than other techniques because it is more economic, efficient, convenient and capable to check the sample more rapidly. It is nondestructive and noninvasive [4]. Ultrasonic velocity study in different samples of mustard oil were carried out by several researchers and scientists to check the physico-chemical properties of oils ultrasonic studies have attracted the attention of number of scientists due to its beneficial use ultrasonic technology used in phase transition [5]. Fluoresence spectroscopy technique is used to study the refined and unrefined vegetable oil. Ultrasonic velocity was measured in healthy and infected area of oil and it is observed the ultrasonic velocity of infected area is lower than healthy area. Variation of ultrasonic velocity and absorption with temperature and frequency in high viscous vegetable oil were measured and it is observed that ultrasonic velocity of vegetable oils decreases with the increase of temperature.

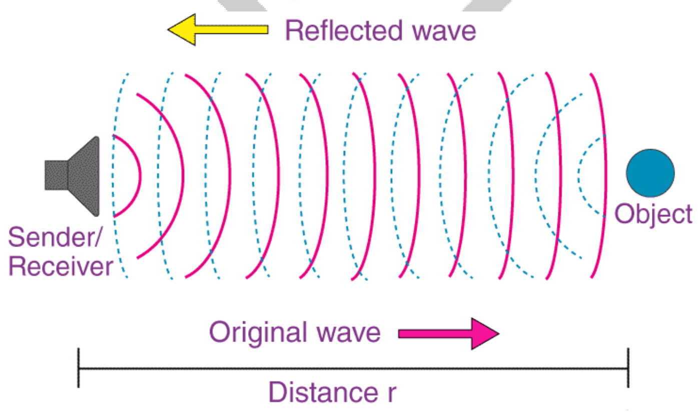


Fig 1- Ultrasound Waves

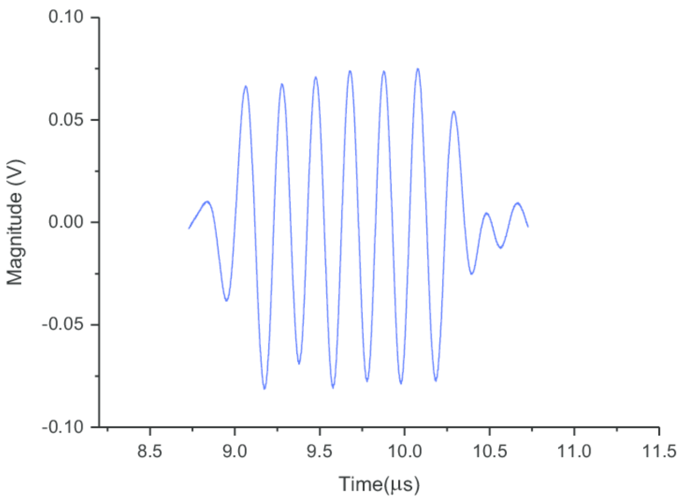


Fig 2- Received nonlinear ultrasonic waves

II. MATERIAL AND METHODS

Sample of pure and branded mustard oils are collected from industry and other source. An ultrasonic interferometer operating at frequencies of 1, 2, 3,4,5,6 MHz with at least count of 0.001 cm of its micrometer was used to determine the velocity of ultrasound in these oils samples taken into the interferometer chamber at room temperature. The ultrasonic interferometer consists of its two parts following as.

1- The high frequency electronic generator
2- The ultrasonic measuring all.

High frequency X-Ray generators fully rectify AC current and supply the tube with DC current This results in a constant stream of relatively consistent radiation hence the term kV is used now rather than kVp. A frequency generator is an electronic device that is used to electrocute separate organisms with the Syncrometer to find the frequency of a particular organism High Frequency AC (HFAC) power distribution system concerns the delivery of power at multi-kHz frequency via electric cables. High frequency operation can also improve the dynamic response of the system, and reduces or eliminates acoustic noise.

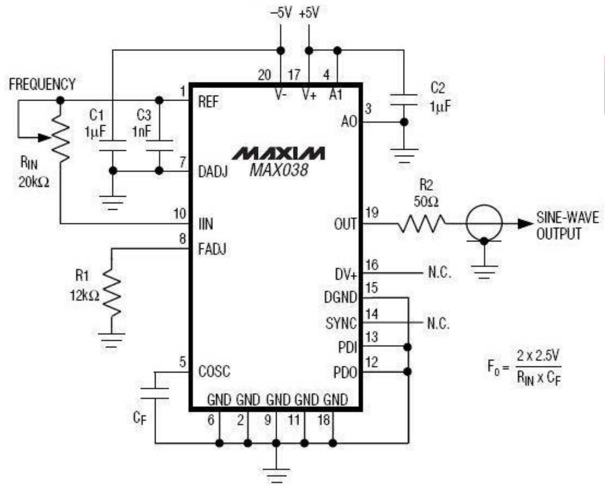


Fig 3- High frequency generator circuit

As the name indicates, ultrasonic / level sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic / level sensors measure the distance to the target by measuring the time between the emission and reception.

In this experiment a micrometer was used on the high frequency generator to observe the change in current. two controller are used to control the sensitivity regulation and initial adjustment of micro-ammeter the measuring cell is a double walled all for regulating the temperature of the sample during the experiment. The gold plated circular quartz crystal of 2.5cm diameter is used to send the ultrasonic waves normal to its plane which is reflected back by the movable metal reflector [6]. A fine micrometer screw has been provided at the top which can lower or raise the reflector plate in the cell through a known distance. The ultrasonic measuring cell was connected to the output terminal of the high frequency generator through a shielded cable [7]. The sample oil was introduction in the cell before switching on the generator. The ultrasonic velocity measurement is based on the accurate determination of the wavelength. When the sending the wave length in sample then the separation of quartz plate and reflector is exactly a whole multiple of one half the wave length of ultrasound.

Fig 4- Ultrasonic flow meter

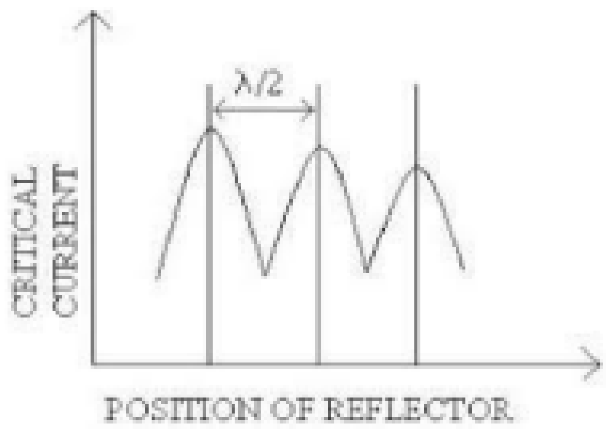


Fig 5- Critical current V/s Position of Reflector

Fig 6- Ultrasonic interferometer

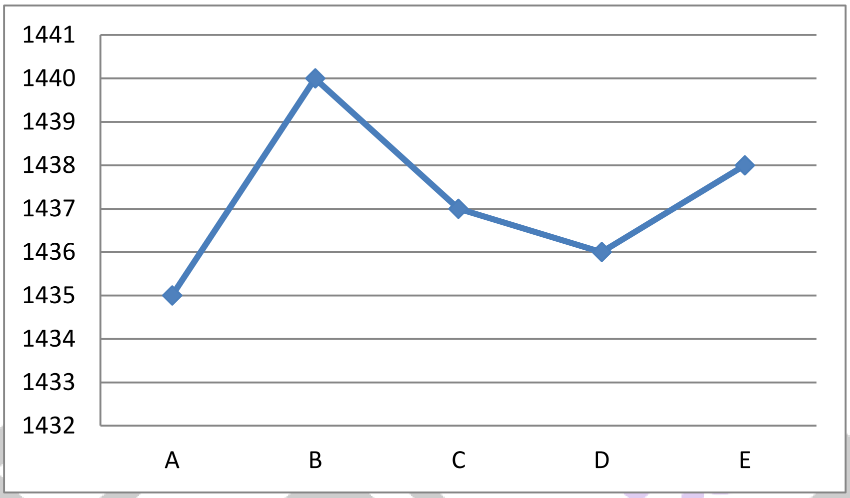
This acoustic resonance gives rise to an electrical reaction on the generator driving the quartz plate and the anode maximum.

III. Result and Discussion

The values of ultrasonic velocity with standard deviation of various samples of mustard oils at 1MHz frequency is shown in the table. It is observed that at the frequency 1MHz there is a marked difference in ultrasonic velocity in all samples of mustard oil. The variation of ultrasonic velocity ranges from 1435 m/s in samples to 1448 m/s in sample A with standard deviation. A significant change of 5 m/s from sample B to A at 1MHz frequency is shown graphically in fig. The variation of ultrasonic velocity with standard deviation at various frequencies of each sample of mustard oil is shown in table. In all sample ultrasonic velocity were found 100 being more in all samples or oils at 2MHz than 1MHz. It means there is a clear increase in velocity is observed with the increase of frequency from 1MHz to 2MHz. The observed increment in velocity is 5m/s I all samples when the frequency changed from 2 to 3 Hz the ultrasonic velocity is changed about to 2m/s in sample B and C but in sample D there is no changes at this frequency change. The variation of ultrasonic velocity of this sample with different frequency is shown graphically in fig.

Table 1- Data on velocity of ultrasound in vegetable oils at 1MHz frequency

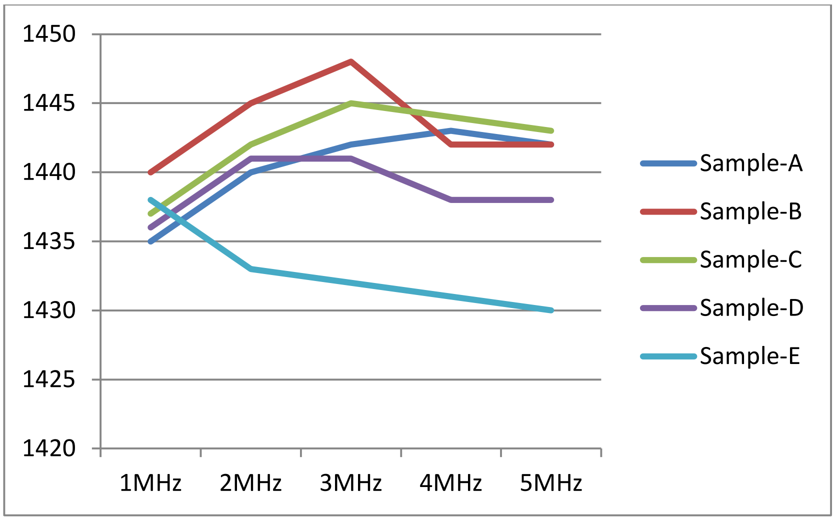
S.No	Common Name	Velocity samples at 1MHz frequency at room temperature (m/s)
1	Pure Mustard oil (A) Kacchi Ghani	1435±0.25
2	Sample (B) Bail Kholu	1440±0.95
3	Ravindra Brand(C)	1437±0.94
4	Patanjali (D)	1436±1.40
5	Fortune	1438±1.90



Graph 1- Ultrasonic velocity (m/s) of various samples of mustard oil at 1MHz

Table 2- Data on velocity of ultrasound in vegetable oil at different frequencies

Sr.No	Common Name	Frequency	Velocity m/s with standard deviation
1	Pure mustard oil (Kacchi ghani) Sample-A	1 2 3 4 5	1435±0.25 1440±1.42 1442±0.91 1443±1.00 1442±0.95
2	Bail kholu Brand Sample- B	1 2 3 4 5	1440±0.95 1445±0.92 1448±1.92 1442±1.00 1442±0.96
3	Ravindra Brand Sample- C	1 2 3 4 5	1437±1.90 1442±0.95 1445±1.25 1444±2.5 1443±1.00
4	Patanjali Brand Sample- D	1 2 3 4 5	1436±1.5 1441±0.25 1441±0.95 1438±1.00 1438±0.92
5	Fortune Brand Sample-E	1 2 3 4 5	1438±1.25 1433±1.35 1432±0.95 1431±1.20 1430±1.00



Graph 2- Ultrasonic velocity (m/s) of various samples of mustard oil at various frequencies (MHz)

IV. Conclusion

The study shows that ultrasonic velocity depends on the % of ultrasonic fatty acid and solid fatty acid contained by the various samples of oil for an initial increase of frequency from 1MHz to 2MHz, there is a significant change in ultrasonic velocity in all samples. No significant changes in all samples at 3 to 5MHz. Hence it is concluded that the frequency range from 1 to 2MHz the sample responded very well than at frequency 3 to 5MHz. Perhaps the ultrasonic velocity at 1 and 2MHz may be taken as the base values and can be used to detect any adulteration component if these are pure oils or adulterated.

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