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Measurement of velocity of Ultrasonic sound in alkali halide solutions with different Normality

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Abstract

Velocity of sound in solutions is very large as compared to that in air, and this velocity is density dependent. In this experiment the alkali halide solutions of different normality was prepared and the velocity of sound was observed using Ultrasonic Interferometer at 2 M Hz of frequency. The velocity of sound was observed to be increasing with increasing Normality of solutions except for the potassium iodide solution, where this change is marginal. As an extension to this experiment sodium halide solutions were tested, and again the change in Sodium iodide was observed to be much less. This showed that the velocity of sound in alkali halide solutions was observed to be frequency dependent also that is at certain frequency for a solution velocity remains almost constant with change in normality.

OBJECTIVE:

Following are the objectives for this experiment:
1)To measure velocity of Ultrasonic sound in potassium halide solutions with different normality.
2) To check dependence of velocity of sound on parameter like frequency of sound itself.
3)To observe change in velocity of sound with increase in normality for sodium halide solutions as an extension.

METHODOLOGY:

The solutions of alkali halides were made in distilled water at room temperature. The normality was increased as per the molecular weight of compounds. The compounds were purchased from standard company. Each sample were made of 100 ml and then poured in Ultrasonic Interferometer which can produced sound wave at 2 M Hz. The inner diameter of tube of ultrasonic interferometer was 1.1 cm while the diameter of reflector rod was 1 cm. The solution was actually poured in cylinder at then fit it with movable reflector rod. Standing wave pattern was resulted due to reflector rod. As we move the rod the instrument showed deflections. The distance between two maxima was actually equal to $\lambda/2$ where λ is the wavelength of sound wave. This implied that the velocity of sound wave $v = f \times \lambda$ can be calculated as frequency f is constant. The least count for the measurement of velocity for the said apparatus was 0.0001 cm.

The velocity v was measured for many reading for each sample and then average value was considered. Normality and hence concentration of solution was increased from 0.1 N to 3N. it was observed that the value of velocity increased as compared to value of velocity of sound in distilled water at room temperature which was observed to be 1460 m/sec. the variations of velocity of sound with normality of solutions was plotted in a graphs showed in observations.

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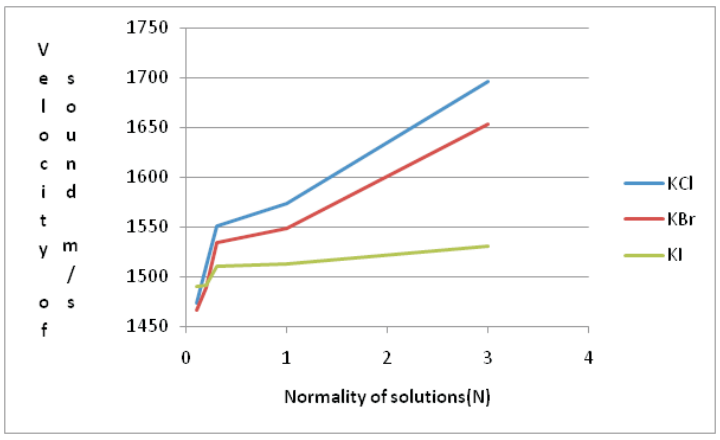
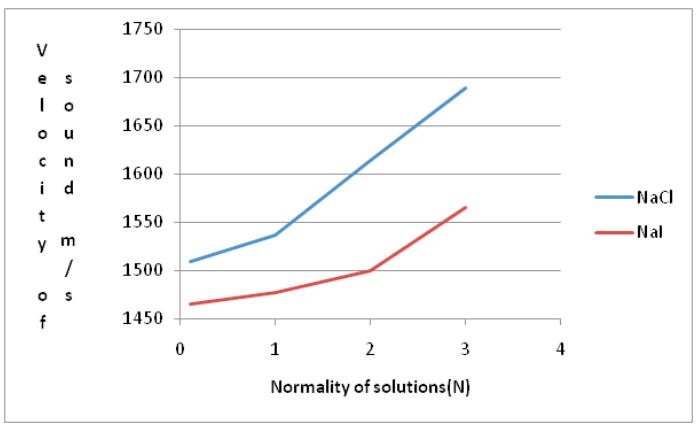
OBSERVATIONS:

Following are the graphs showing variations in velocity with increasing normality of solutions. With increase in normality it was observed that there was increase in velocity of sound but for potassium iodide solution this increase in velocity of sound was marginal. The velocity of sound was found to be more at every increase in normality for potassium chloride as compared to potassium bromide.

To check this frequency dependence of alkali halide solutions the similar experiment was carried with sodium chloride and sodium iodide solutions with varying Normality. The change in velocity of ultrasonic sound at 2 M Hz with change in normality was as shown in graph.





ANALYSIS:

1) The velocity of sound in distilled water was first measured and it was found to be 1460 m/sec. then different solutions with different normality were prepared depending upon their molar masses. Initially there was drastic increase in the velocity of sound with increase in normality that is from 0.1N to 0.3 N and then steady increase in velocity was observed with increase in normality of solutions which was expected from theory.

2) The velocity of alkali chloride was observed to be more than any other solutions but still the response with normality was observed to be almost linear,

3) The increase in velocity of ultrasonic sound in potassium iodide was very marginal and this showed that the effect of increase in normality and hence concentration on velocity of sound at 2 M Hz of frequency was negligible. This showed that the velocity of sound wave depends also on frequency for certain solutions. The similar experiment is recommended to be performed at variable frequencies on the same set of sample to check these findings.

4) As an extension instead of potassium halides the solutions with different concentrations of sodium halides were checked and it was observed that the change in velocity of ultrasonic sound in sodium iodide was much less as compared to sodium chloride. This also indicates that the solutions containing iodine showed less change ion velocity of sound at 2 M Hz. This element thus showed that at 2 M Hz frequency it decreases the velocity of sound for that solutions.

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CONCLUSIONS:

1) The velocity of sound increases rapidly with increase in Normality up to 0.3N and then change is somewhat linear up to 3 N for all alkali halide solutions.
2) The change in velocity of sound at 2 M Hz was found to be marginal in potassium iodide solutions as showed in graphs.
3) The velocity of sound at 2 M Hz in sodium iodide was also found to be much less as compared to sodium chloride solutions.
4) The velocity of sound in iodide solutions at different frequencies can be recommended.

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