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Variation of conductivity of the different sources of water with temperature and concentration of electrolyte solution NaCl

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Abstract
In this study, one of the most important physical parameters of the water, electrical conductivity is investigated with the help of the conductivity meter. The aim of the work is to investigate the effect of the temperature and concentration of the electrolyte solution. Conductivities of Tap water, Underground water, Sewage, canals are computed and its variation with temperature also have been investigated from 40 ℃ to 70 ℃. Similarly, electrical conductivity of different water source are compared with that of a typical NaCl electrolyte solution by varying its concentration from 2.5% to 20%. Result shows that electrical conductivity of the different sources of water increases with the increase in temperature and concentration of the electrolyte solution.

Keywords: Electrolyte, conductivity, impurity, concentration

Introduction
Water is one of the most important matters in the nature and widely used for different purposes in a variety of applications [1, 2]. Water is used in various applications for electricity production, irrigation, domestic, industrial and commercial purposes [3]. It is directly related to the economic development and human health [4]. Electrical conductivity can be regarded as a crude indicator of water quality for many purposes and it has been measured in practice for more than 100 years. It is still important and widely used to analyze the water parameters today. Electrical conductivity is one of the main physical parameters, which allows to monitor the ionic impurities dissolved in water [5, 6] and wide range of different types of water (pure, drinking and natural water) and it is also used to determine the concentration of conductive chemicals [7]. The main aim of the work is to measure and compare the electrical conductivity of water, underground water, canals and Tap water along with those of different concentration of NaCl electrolyte solution and with different temperatures. The measurement of electrical conductivity always gives the pollution level and purity of water.

Material and methods
First, sample from the four different sources namely sewage water, underground water, canals and Tap water were collected in clean plastic bottles of one liters for analysis. The bottles were rinsed before sampling and tightly sealed after collection and labeled in the field. Sample of canals and Sewage were collected from near the National highway-15, underground water was collected through the borehole from premise of campus and tap water is also collected from campus premise provided by DAV College. The data analysis was carried out on the same day with the help of deluxe conductivity meter in our laboratory. Data was taken three times on the intervals of 15 days from the same place to find the average value of the given parameter.

Results and discussion
Variation of Conductivity with Temperature
An increase in a solution's temperature will cause a in decrease in viscosity and increase in the mobility of the ions in the solution. An increase in temperature may also cause an increase in number of ions in the solution due to the dissociation of the molecules. As a result, there will be increase in conductivity of the solution. The variation of the electrical conductivity different water sources with temperature is shown in fig.1.

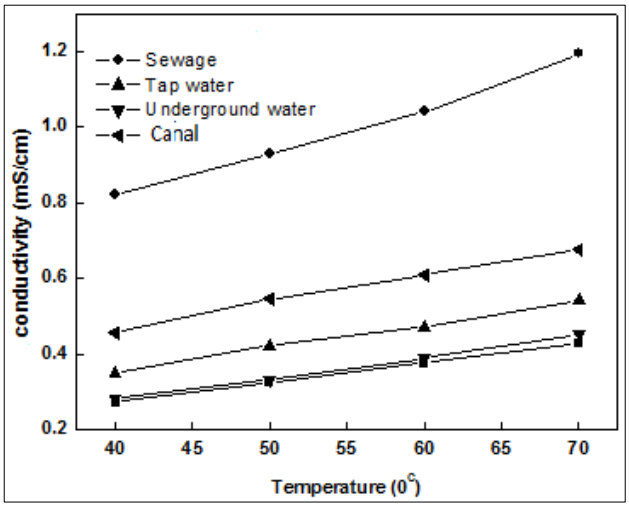

Fig 1: Variation of Conductivity with Temperature

In all samples, when temperature is increased from 40 ℃ to 70 ℃., the electrical conductivity will increased by more than 50%. The increased in conductivity of the water samples are due to the increase in mobility of the ions. The result also shows that conductivity of water sample ranges from .28 to 0.82 mS/cm at 40 ℃ during the study. The minimum was found at canal and highest conductivity was found in the Sewage.

As we know that Sewage collects the domestic, municipal and industrial waste, so it has high value of dissolved organic and inorganic matter. On the other hand, canal is natural started from mountain region. It has very low probability of contamination from domestic and municipal waste materials. Due to the high value of the dissolved solids content, Sewagehas maximum and canal has least value of conductivity.

Variation of Conductivity with Concentration of NaCl

Sodium chloride is the electrolytic solution and it is used as the impurity for the given water sample. The concentration of the NaCl is varied from 2.5% to 20% and it is shown in fig. 2.

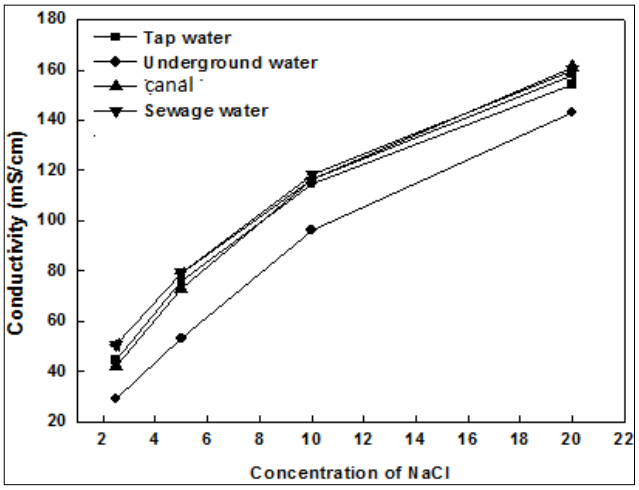

Fig 2: Variation of Conductivity of water with Concentration of NaCl

Result shows that the conductivity of the each water sample gradually increased as the concentration gradually increased. It is due to the presence of the excess of the ions in the water. Since the charges of the ions in the solution facilitate the flow of electrical current, the conductivity of a solution is highly (but not totally) proportional to its ions concentration. Over large conductivity ranges, conductivity will increase with concentration. Experimentally, it is found that as the concentration increased from 2.5% to 20%, the conductivity increases nearly by more than 300% in all sample.

Conclusion

An experimental study has been performed to bring out the influence of temperature and concentration of NaCl on the electrical conductivity of different water samples. It has been observed that the electrical conductivity of different water samples have positive correlation with temperature and concentration. It is concluded that parameters such as temperature and impurities (dissolved solids).

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