Research Article

IJCRR
Section: General Science
Sci. Journal Impact Factor 4.016
ICV: 71.54

The Study of Organic Complexes Ultrasonic and Spectroscopic Method

N. Siddharthan[1], S. Jayakumar[2]

[1]Research scholar, SCSVMV University, Enathur, Kanchipuram-631 561, India & Department of Physics, P.T. Lee CNCET, Kanchipuram – 631 502, India; [2]Department of Physics, RKM Vivekananda College, Chennai – 600 004, India.

ABSTRACT

Objective: The study of organic complexes gives information about the molecules involved in the binding. Ultrasonic and Spectroscopic method may be used to detect complex formation in a)Iodine – Hexaneb)Iodine – Toluenec) Iodine– benzene. Molecular interaction depends on shape, size, and polarity of the molecules.

Material and Method: Ultrasonic and spectroscopic methods areused to detect complex formation.

Results: The strength of complex formation for $I_2 - Hexane > I_2 - Toluene > I_2 - Benzene$ donor acceptor complex.

Conclusion: The charge transfer interaction is formed between electron donor and electron acceptor.

Key Words: Complexes, Stability, Ultrasonic, Spectroscopy

INTRODUCTION

Organic complexes play a key role in understanding molecular interaction studies.Organic complexes haveseveral applicationsin conducting and non-linear optical materials. There are many techniques to determine the complex formation such as NMR, IR, UV-visible, Mossbauer methods. These are spectroscopic methods. Ultrasonic method may be used to detect complex formation. Many researchers have studied molecular complexes and have obtained various physical-chemical properties. The stability of complexes depends on the nature of donor and strength of the acceptor interacting molecules. The strength of donor and acceptor depends on the ionization potential of the donor and electron affinity of the acceptor.

MATERIALS AND METHODS

AR grade chemicals (Merck) were used in this work. The purity of chemicals Iodine, Benzene, Hexane and Toluene were checked with physical and chemical properties.

The stability constant had been obtained fromultrasonic and UV visible spectroscopic method. The ultrasonic velocity *U* had been determined by single frequency 2MHz ultrasonic interferometer Mittal, New Delhi make. The temperature has been maintained by a thermostat at 303K. The UV visible spectra had been obtained from UV visible spectrophotometer Shimadzumake. Stock solutions of the complex were prepared by taking 0.05gm of Iodine in 250ml of Benzene, Hexane and Toluene. 1ml of stock solution is taken in 20ml of the solvent required for the interferometric measurement.

The stability constant had been determined from Yoshida and Osawa method[1,2]. The K_{YO} value is given by

$$K_{YO} = 2.0 \times \left(\frac{\sqrt{k}(c_1 + c_2) - (c_1 + kc_2)}{(c_1 - kc_2)} \right)$$

The stability constant is also determined by given formula Benesi Hildebrand[3] method

$$\frac{C_A^0}{d} = \frac{1}{K\varepsilon_{DA}C_D^0} + \frac{1}{\varepsilon_{DA}}$$

RESULTS

The data obtained from ultrasonic and spectroscopic methods tabled in Table 1, Table 2 and Table 3 respectively. Iodine-Hexane complexes is stable than Iodine-Toluene and Iodine-Benzene complexes respectively. The Figure 1 shows

Corresponding Author:
N. Siddharthan, Research scholar, SCSVMV University, Enathur, Kanchipuram-631561 &Asst. Professor Department of Physics, P.T. Lee CNCET, Kanchipuram – 631 502.; Mob: 9443642435; Email: n.siddharthan@gmail.com

ISSN: 2231-2196 (Print) **ISSN:** 0975-5241 (Online)

Received: 16.03.2017 **Revised:** 13.04.2017 **Accepted:** 10.05.2017

the UV spectra of Iodine with Hexane, Toluene and Benzene. Change in colour is observed when donor and acceptor are mixed. The colour of complex is shown in Figure 2. The strength of the complexes for

$$I_2 - Hexane > I_2 - Toluene > I_2 - Benzene$$

K value by spectroscopic method are

I_2-Hexane(5.002×10^{-5}), I_2-Toluene(1.38×10^{-5}) and I_2-Benzene (5.6×10^{-10}) respectively.Iodine acts as an electron acceptor and Hexane, Toluene, Benzene acts as an electron donor. Iodine is weak oxidation agent and act as weak electron acceptor. The electron affinity of Iodine acceptor is much less than bromine, chlorine and other halogen elements. The electron affinity of Iodine is 3.059 eV, the ionization potential of Benzene, Toluene and Hexane are 9.24 eV, 8.82 eV and 10.18 eV respectively. Charge transfer interaction is formed.

DISCUSSION

Iodine is the π electron acceptor and Benzene, Hexane and Toluene are π donors. The molecular interaction of the complexes between donor and acceptor depends on nature of the donor and acceptor. Iodine is the smaller molecule compare to Hexane, Toluene and Benzene. Molecular interaction depends on shape, size and polarities of the molecules. The molecular interaction of Iodine-Hexane is greater than Iodine-Benzene andIodine-Toluene in the present work.Charger transfer complexes are formed between species which has low ionization potential and high electron affinity. Strong complex is formed between Iodine-Hexane and weak complex is formed between Iodine-benzene and Iodine-Toluene.

CONCLUSION

Ultrasonic and spectroscopic method is used to detect complex formation. The stability constant is obtained from spectroscopic and non-spectroscopic methods.

ACKNOWLEDGEMENT

The authors thank Management of P.T. Lee CNCET, Kanchipuram, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya University, Kanchipuram and RKM VivekanandaCollege, Chennai for keen support shown in this work.

Abbreviation

K_{YO} – Stability constant by Yoshida and Osawa method

c_1 – Concentration of component 1

c_2 – Concentration of component 2

C_A^0 – Concentration of acceptor

C_D^0 – Concentration of donor

k – Ratio of velocities at different concentrations

K –Stability constant

ε_{DA} – Molar extension coefficient for donor-acceptor

d – Optical density

REFERENCES

1. Yoshida and Osawa, Bull. Chem. Soc, Japan, 38, 140 (1965).
2. Marwein B.L and Bhat S.N, Acustica, Vol 58, 243-247 (1985).
3. Benesi and Hildebrand, J. Am. Chem. Soc., Vol.71, No.8, pp 2703–2707 (1949).

Table 1: Ultrasonic velocity data

Concentration g/ml	I_2– Benzene ms^{-1}	I_2– Toluene ms^{-1}	I_2– Hexane ms^{-1}
0.00001	1278.40	1305.60	1086.40
0.00002	1377.60	1312.00	1155.20
0.00003	1310.40	1387.20	1003.20
0.00004	1307.20	1398.40	1161.60
0.00005	1318.40	1382.40	1241.60
0.00006	1300.80	1369.60	998.40

Table 2: Computed Stability constant K_{YO}

Concentration g/ml	I_2 - Benzene	I_2 - Toluene	I_2 - Hexane
0.00001	0.07650	0.00490	0.06255
0.00002	0.04842	0.05857	0.13148
0.00003	0.00244	0.00813	0.20730
0.00004	0.00866	0.01129	0.07817
0.00005	0.01306	0.00912	0.17645
0.00006	0.00247	0.12384	0.10545

Table 3: UV visible spectral data (OD)

Wavelength λ nm	I_2 - Benzene	I_2 - Toluene	I_2 - Hexane
250	0.200	0.010	0.010
300	1.885	0.020	0.030
350	0.214	0.021	0.450
400	0.180	0.010	1.120

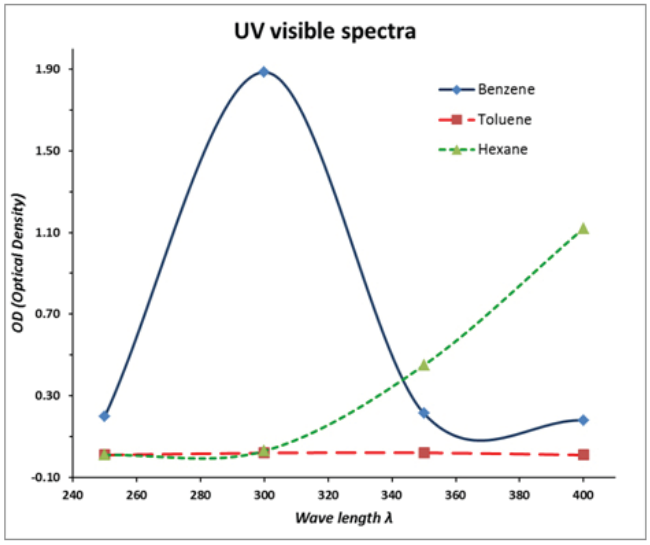

Figure 1: UV spectra.

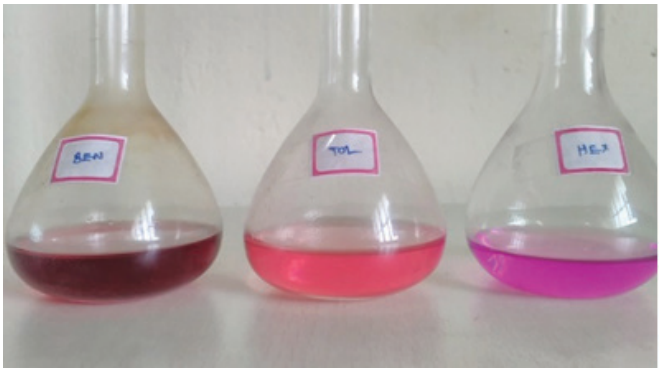

Figure 2: Colour of complexes.