“SALT - PHYSICS APPROACH”

PROJECT REPORT

Submitted by

1140-19-468-126: N SHIVA CHENNAIAH

1140-19-441-030: K SAI KUMAR

1140-19-441-021: G SRINATH

1140-19-441-023: G UDAY KIRAN

1140-19-468-040: D SHIVA KUMAR

1140-19-468-060: G VEERESH RAO

Under the supervision of

N. CHANDANA

Asst. Prof of Physics

GOVERNMENT DEGREE COLLEGE , KHAIRATABAD

Affiliated to Osmania University

Re-Accredited with ‘ B’ Grade by NAAC.

ACKNOWLEDGEMENT

We are greatly proud of our **GOVERNMENT DEGREE COLLEGE, KHAIRATABAD, HYDERABAD,** for providing us the needful education. We are very much thankful to our Principal, **Dr. B. Rajendra Kumar** Sir for encouraging us in the successful completion of the project work.

We also thank our Head of the Department of Physics, Smt. N. Chandana, who has provided us a chance to do this project. We also feel very much proud to have her with us in our successful completion of the project under her excellent supervision.

We are also very much thankful to all our faculty members and lab coordinators of Departments of Physics who gave us valuable suggestions for the successful completion of this project.

Student Signatures:

1.

2.

3.

4.

5.

6.

GOVERNMENT DEGREE COLLEGE,KHAIRATABAD

HYDERABAD

Affiliated to Osmania University

Re-Accredited with `**B**' Grade by NAAC

CERTIFICATE

This is to certify that

N SHIVA CHENNAIAH	1140-19-468-126
K SAI KUMAR	1140-19-441-030
G SRINATH	1140-19-441-021
G UDAY KIRAN	1140-19-441-023
D SHIVA KUMAR	1140-19-468-040
G VEERESH RAO	1140-19-468-060

of Government Degree College, Khairatabad, Hyderabad submitted the Project Work on **"SALT - PHYSICS APPROACH"** to **JIGNASA STUDENT STUDY PROJECTS 2021-22**.

Supervisor **Head of the Department** **Principal**

CONTENTS

HYPOTHESIS

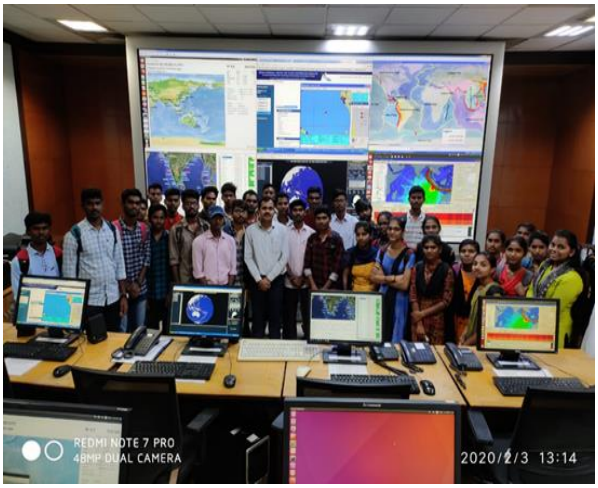
We have been to **INCOIS – Indian National Center for Ocean Information Services,** Hyderabad on 03.02.2020 **(our II Sem)** as a Field Trip organized by Dept. of Physics, GDC Khairatabad where we got inspired about the Oceanographic studies– Disaster management system, Information management system, GSLV, PSLV launching and communications.

Also, we have determined the Dispersive Power of **Crown Glass Prism in IV Semester –Optics Practicals** where we have measured refractive indices for different wavelengths using white light as the source. Since then, we are waiting for the right **time to measure the refractive index of ocean water post covid-19 pandemic situation.**

We know that salt is present in vast quantities in seawater. The open ocean has about 35 grams of solids per litre of sea water, a salinity of 3.5%. The salinity of salt water can be measured using different methods.

The following table gives the Salinity (%) and aquatic animals in the five oceans:

OCEAN	SALINITY (%)	AQUATIC ANIMALS
PACIFIC	3.55	Hammer shark, Sea otter, Green sea turtle
ATLANTIC	3.5	Fin Whale, Moon Jelly, Dosky dolphin
INDIAN	3.45	Cuttlefish, Butterfly fish, Blue shark
SOUTHERN	3.64	Seiwhale, King crab, Weddel seal
ARCTIC	3.2	Bowhead whale, fur seal, blue whale



INCOIS VISIT

IV SEM DISPERSIVE POWER OF PRISM

Refractive index is one of the most important optical properties of a medium. It plays vital role in many areas of material science with special reference to thin film technology and

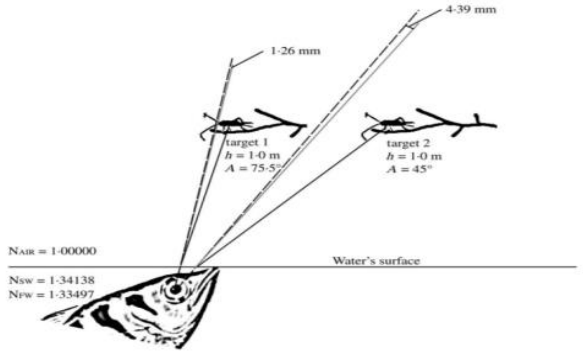
fiber optics. The refractive index is one such kind of an optical property of the salt water which depends on its salinity[1].

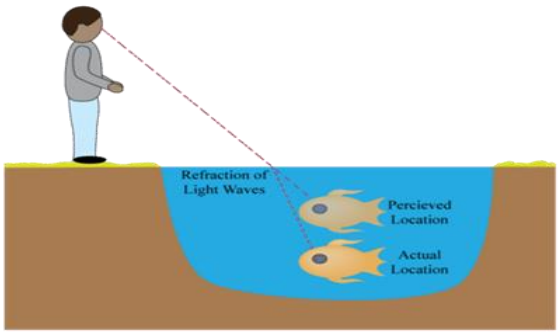
The refractive index of the salt water is directly proportional to its salinity (concentration of salt) at a particular wavelength[2].We the students of GDC, Khairatabad want to prove the dependency of refractive index of the salt solution with its salinity by the experiment we have performed during Sem IV Optics Practicals, where we have determined the refractive index of a crown glass prism.

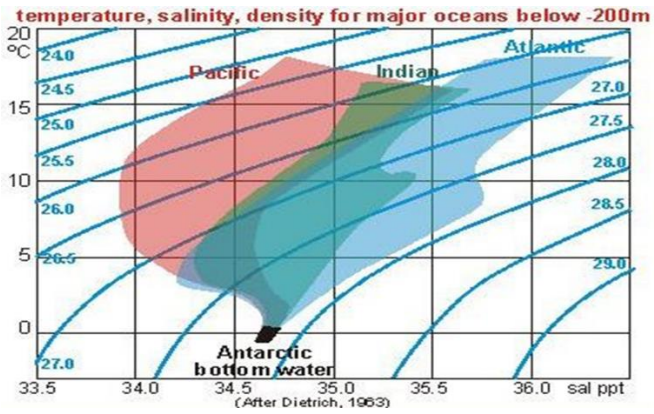
Here, a hollow prism(60ml) was used to measure the refractive index of liquids of different concentrations (2%,4%,6% and 8%) of edible salts with the help of an optical spectrometer and the results obtained were thoroughly compared and analyzed.

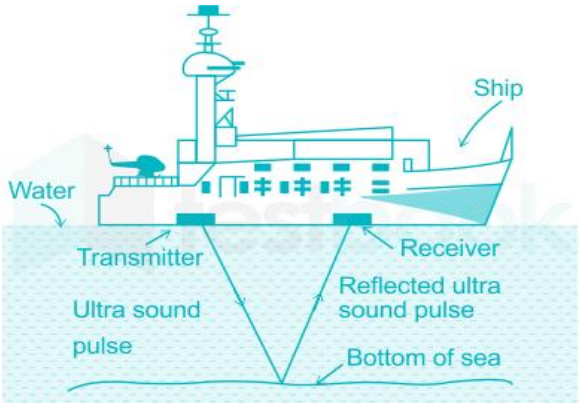
Significance of choosing this problem:

- The change in the refractive index between fresh and salt water was shown to cause a small shift in the apparent image location of an aerial object viewed from below the water's surface.
- This difference in refractive index causes the image of an object above the water's surface to appear smaller and further away than it is and, most importantly, changes the angle of line of sight from the viewer to the target[3].
- The refractive index of saline water has huge applications in SONAR.









Keywords: Edible salt, refractive index, hollow prism and concentration.

AIMS AND OBJECTIVES:

Aim:

- To understand the dependency of refractive index on the salinity of the salt solution.
- To obtain the relation between the refractive index and the composition of salt.

Objectives:

We the Physics students at Government Degree College, Khairatabad, Hyderabad have taken different edible salts and prepared various concentrated solutions of salt to prove that:

- The refractive index of the saltwater increases with the increase in its salinity.
- And also, the refractive index is not the same, for the same concentration of different edible salts which show that the refractive index depends on the composition of the edible salt along with its concentration(salinity).

REVIEW OF LITERATURE:

- We have determined the Dispersive Power of **Crown Glass Prism in IV Semester –Optics Practicals** where we have calculated the refractive indices for different wavelengths for crown glass prism.
- We have been to **INCOIS – Indian National Center for Ocean Information Services, Hyd** on **03.02.2020 as a Field Trip** organized by **Dept. Of Physics, GDC Khairatabad** where we got inspired by the ocean science and technology led to do this project.

- Based on the literature survey performed by six of us, according to U.V. Biradar and S.M. Dongarge in their International Journal published in December 2015 Refractive Index of Salt

(NaCl) from Aqueous Solution,**the refractive index of the salt water is directly proportional to its salinity (concentration of salt) at a particular wavelength**[4] .

- Remote monitoring of water salinity by using side-polished fiber-optic U-shaped sensor was published in a conference paper in September 2012.Here,the sensor system utilizes a side-polished U-shaped configuration in order to maximize the sensitivity and expand the measurement range. The implemented salinity sensor is made of a multimode plastic optical fiber, **and sensor determines the salinity by measuring the refractive inde**x performed by the faculty of Technical Sciences, University of Novi Sad, Serbia[5] .

RESEARCH METHODOLOGY:

Materials and Methods:

There are different methods to determine the refractive index of salts, solids (crystalline) and liquids. These methods are quite tedious. **A hollow prism is used along with optical spectrometer** at room temperature to determine refractive indices of aqueous solutions formed by four different edible salts.

Equipment Used for the study:

The following equipment is used to study the spectrum obtained after passing through liquid filled hollow prism.

a) The Optical Spectrometer:

It has four main parts.They are:

i) The Collimator:

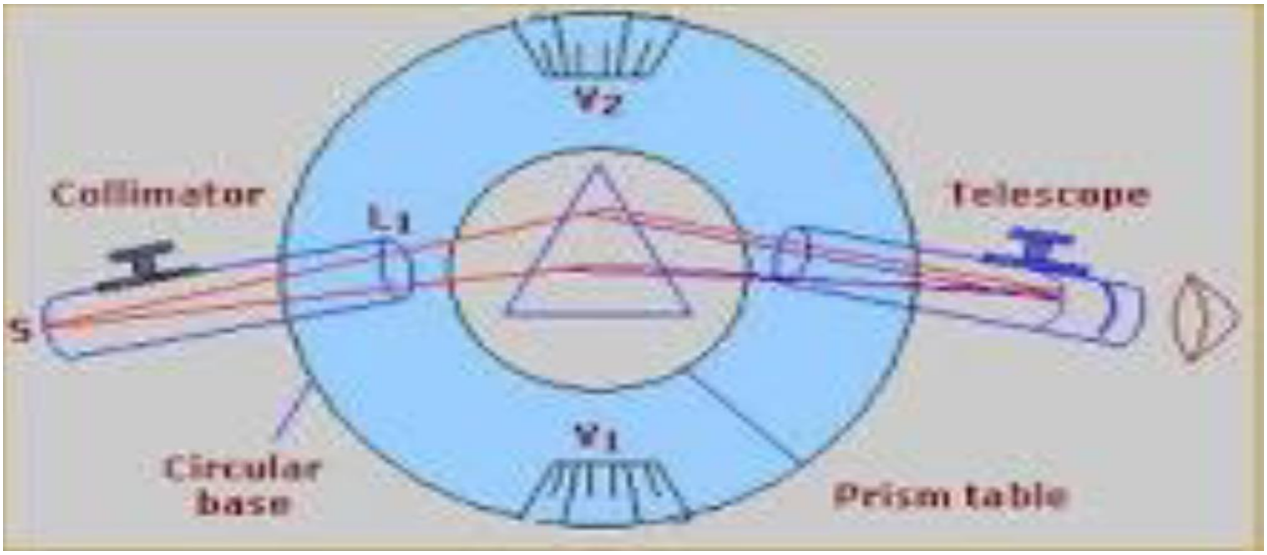
This is used to produce a parallel beam of light.

ii)The Slit:

It makes the collimated beam of light into narrow beam of light.

iii) The Telescope:

It is used to focus the spectrum obtained after passing through liquid filled hollow prism. Two verniers V_1 and V_2,180^0 a part fixed to the prism table are used to determine the position of the telescope.



iv)The prism table:

The prism is placed on this circular shaped table which has two plates separated by three springs.The height of the prism table can be adjusted by an adjustable screw provided below the plates. The spirit

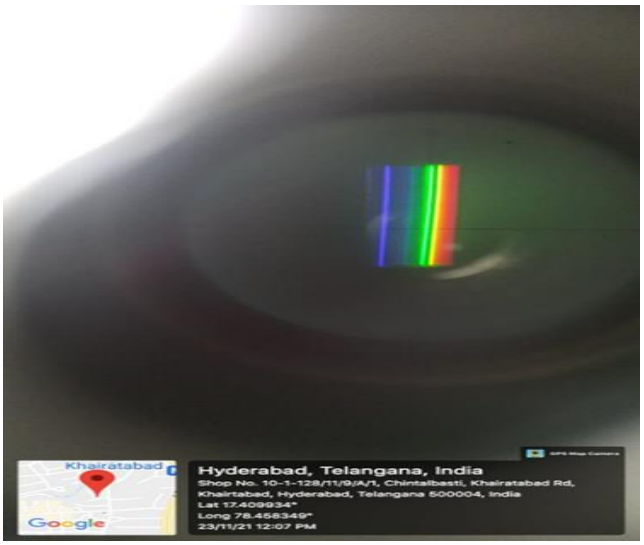
level is used to make the plates exactly balanced (parallel).The position of the prism table can be determined by vernier scale moving on the main scale (circular).

b) Mercury vapor lamp:

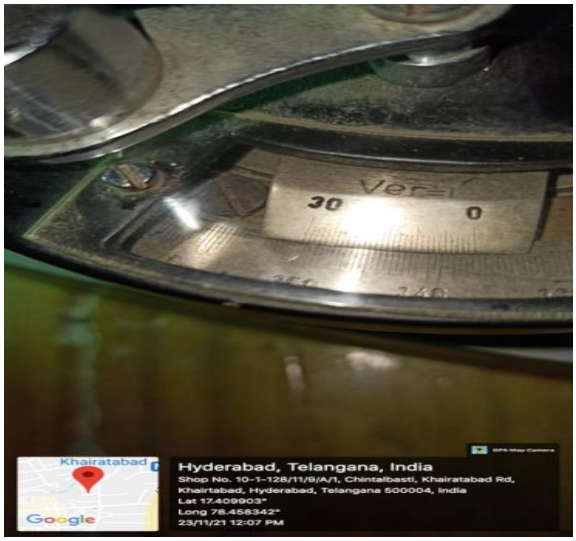
The mercury vapor lamp is used to produce chromatic(white) light for performing the experiment.

a) Mercury vapor lamp

b) Spectrometer



c)Hollow prism(60ml):



d) Four types of edible salts:

e) Magnetic Stirrer:

f) Digital balance:

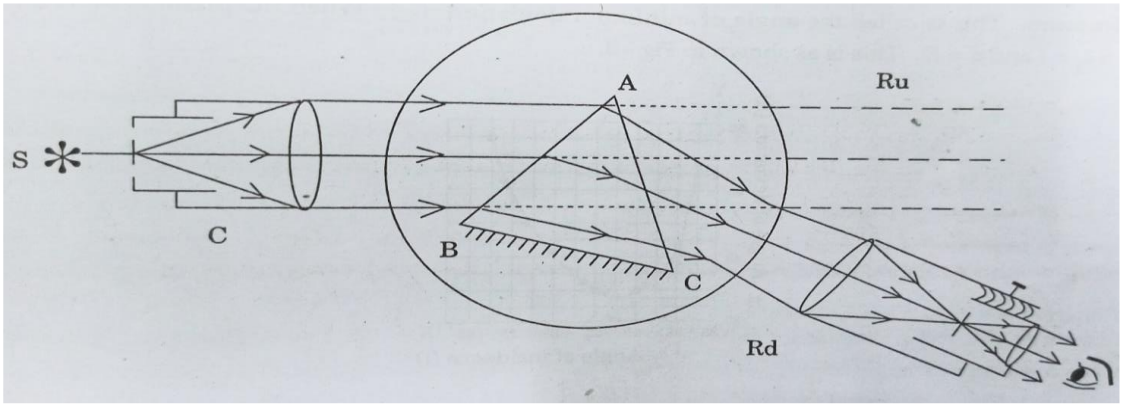
g) Spirit level:

h) Distilled water:

EXPERIMENTAL PROCEDURE:

Determination of Refractive Index of Salt Water:

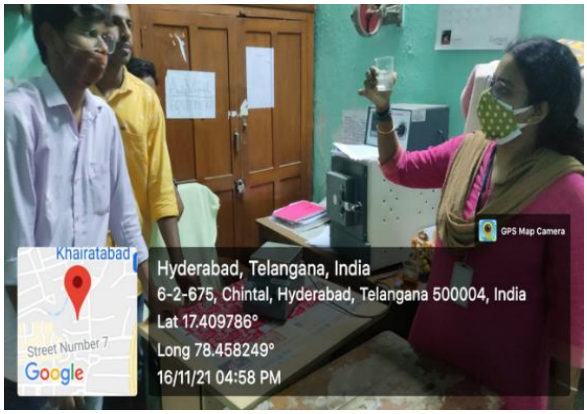
- Experimental arrangement used in our study is depicted in the figure below.
- A hollow prism(60ml) was used to measure the refractive index of salt solutions with the help of an optical spectrometer.
- To prepare various salt solutions, a digital balance is used for measurement of salts to obtain different concentrations.
- Weighed salts for the four types of edible salts are taken as T1,T2,T3,and T4 and solutions of required concentrations (2%,4%,6% and 8%) were prepared by dissolving the salts in 100 ml of water using magnetic stirrer.
- The prism ABC on the prism table is slightly rotated towards the right side and the light coming out of mercury vapour lamp is made to fall on AB of the prism. Then the refracted light emerges out of AC bending towards the base BC then we get spectrum of different colours.



- Now the telescope is adjusted to view the spectrum and green line is observed for measurement. Reading is noted using V1 and V2. Keeping the telescope fixed we rotate the prism slightly such that the green line moves towards right till the minimum deviation position is obtained (Dm).Now the telescope is made to focus on green line and measurement is taken using circular verniers V1 and V2.
- Thus the angle of minimum deviation is obtained denoted by Dm.
- This procedure is repeated for all the concentrations of solutions for different edible salts.
- If Dm denotes the angle of minimum deviation for a given prism of angle of Prism A, then the **refractive index of the material of the prism μ** is given by,

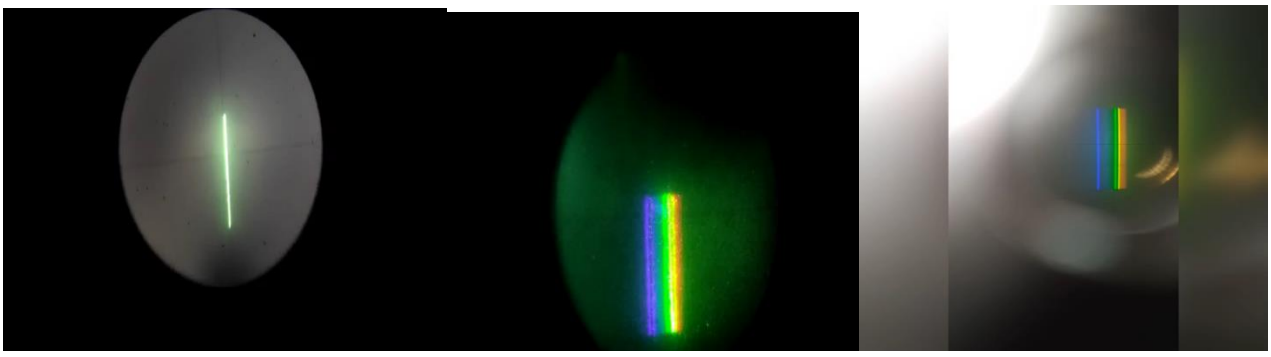
μ= sin(A+Dm/2)/sin(A/2)

equation has been employed to **calculate the refractive index of the liquids (water)** where, **A is angle of hollow prism** and **Dm is minimum deviation**



- Mean of two values were taken for each angle of minimum deviation(D).
- The refractive indices were determined for different compositions of the four edible salts by using the formula

μ= sin(A+Dm/2)/sin(A/2)

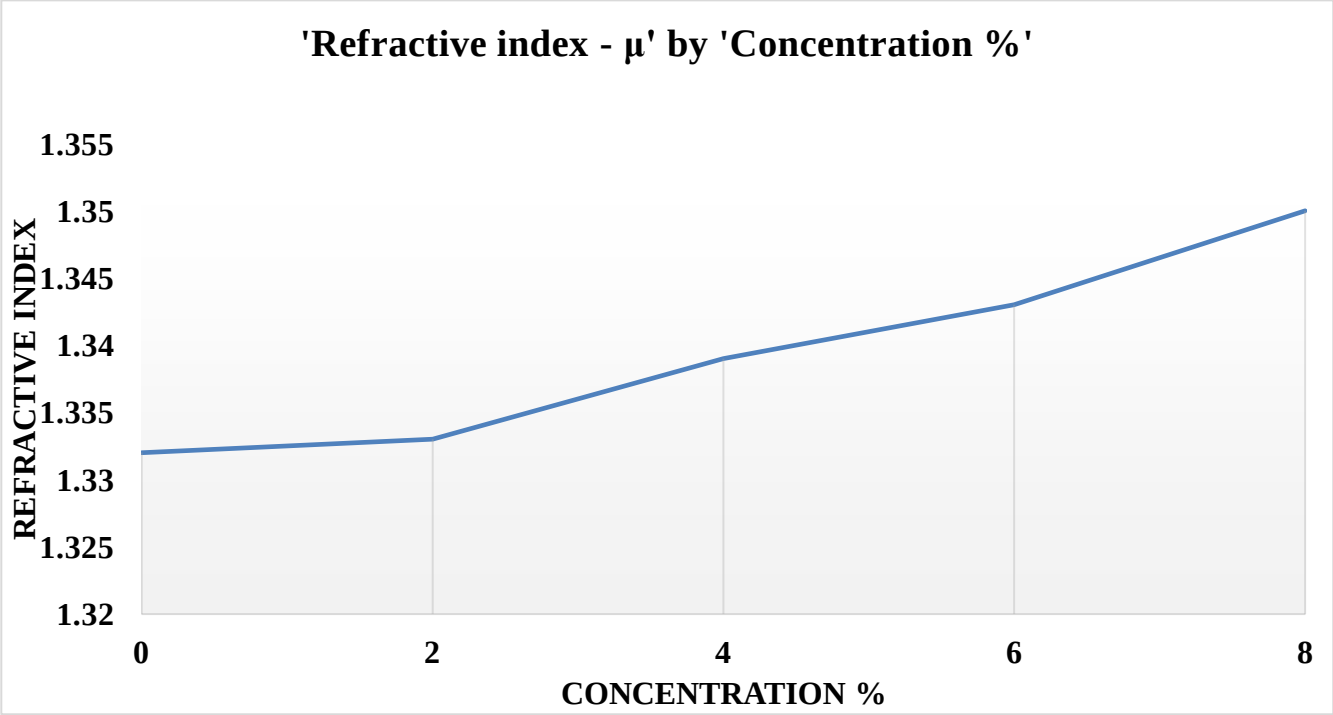


➢ DATA OBTAINED:

1.FOR TATA VACUUM EVAPORATED IODIZED: T_1

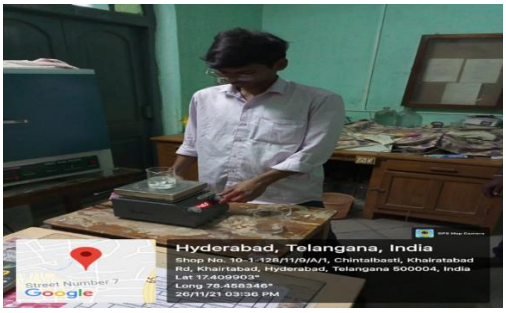
S.No	Concentration %	Angle of Min deviation (Dm)	Refractive index - μ
1	0	$23^{0}.32^{1}$	1.332
2	2	$23^{0}.36^{1}$	1.333
3	4	$24^{0}.04^{1}$	1.339
4	6	$24^{0}.24^{1}$	1.343
5	8	$24^{0}.56^{1}$	1.350

➢ The **graph plotted** between the **concentration of solution and refractive index for T1 salt** is as shown below:

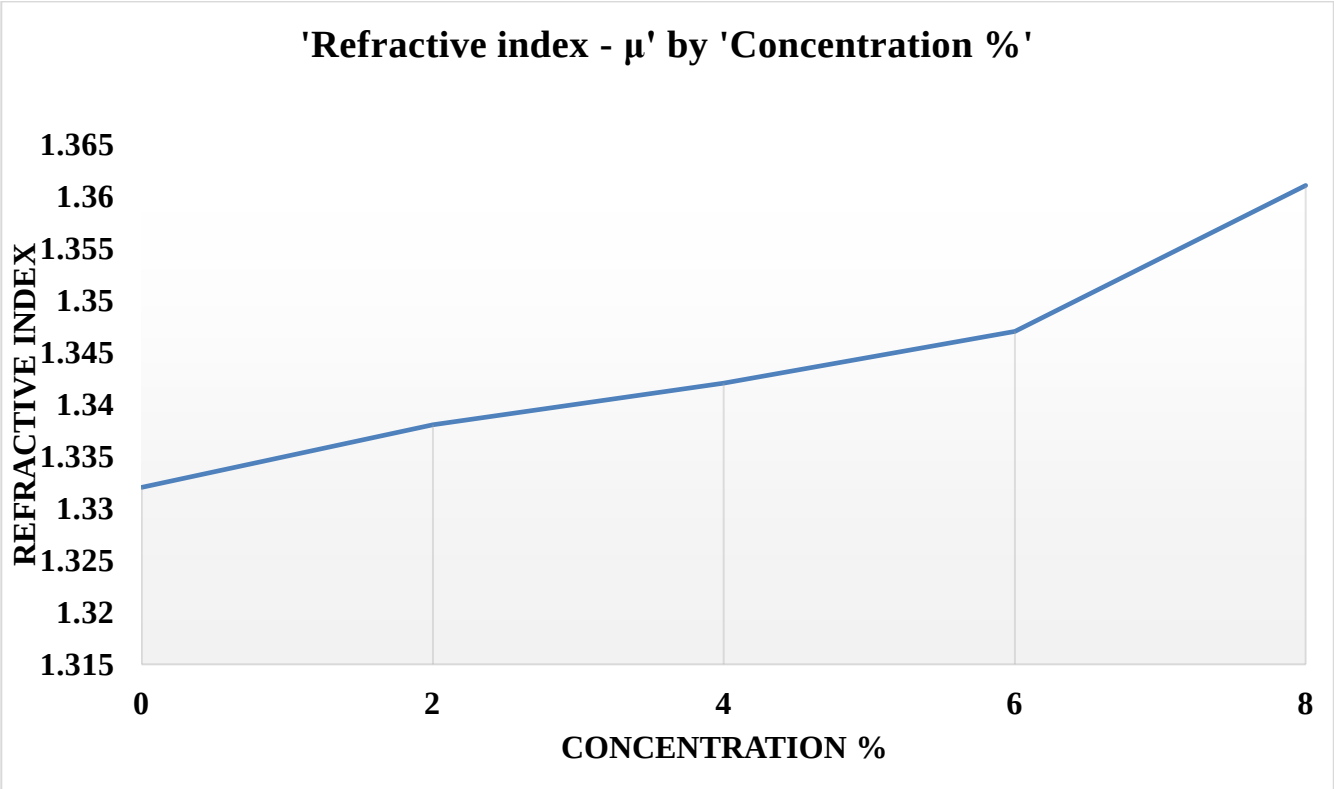


2.FOR TATA ROCK SALT :T_2

S.No	Concentration %	Angle of Min deviation (Dm)	Refractive index - μ
1	0	$23^{0}.32^{1}$	1.332
2	2	24^{0}	1.338
3	4	$24^{0}.18^{1}$	1.342
4	6	$24^{0}.42^{1}$	1.347
5	8	$25^{0}.1^{1}$	1.361



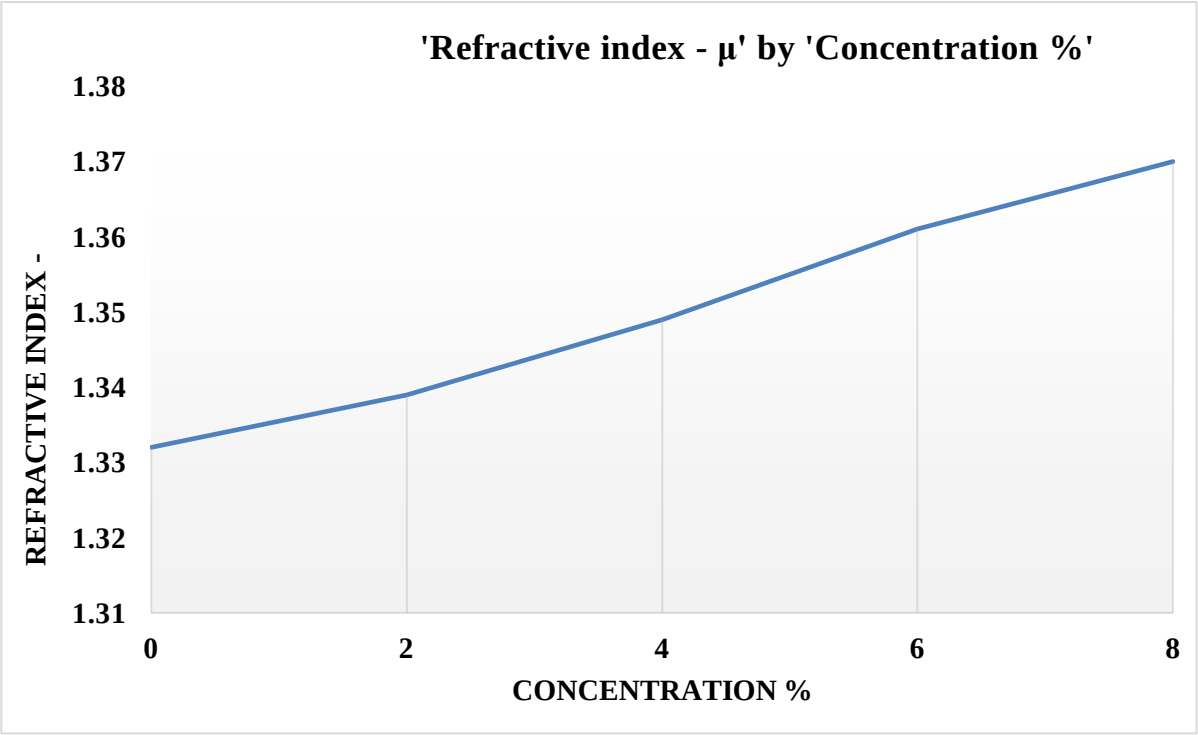
- The **graph plotted** between the **concentration of solution and refractive index for T2 salt** is as shown below:



3.FOR TATA SODIUM CURTAILED IODISED SALT: T_3

S.No	Concentration %	Angle of Min deviation (Dm)	Refractive index - μ
1	0	$23^{0}.32^{1}$	1.332
2	2	$24^{0}.04^{1}$	1.339
3	4	$24^{0}.5^{1}$	1.349
4	6	$25^{0}.1^{1}$	1.361
5	8	$26^{0}.3^{1}$	1.370

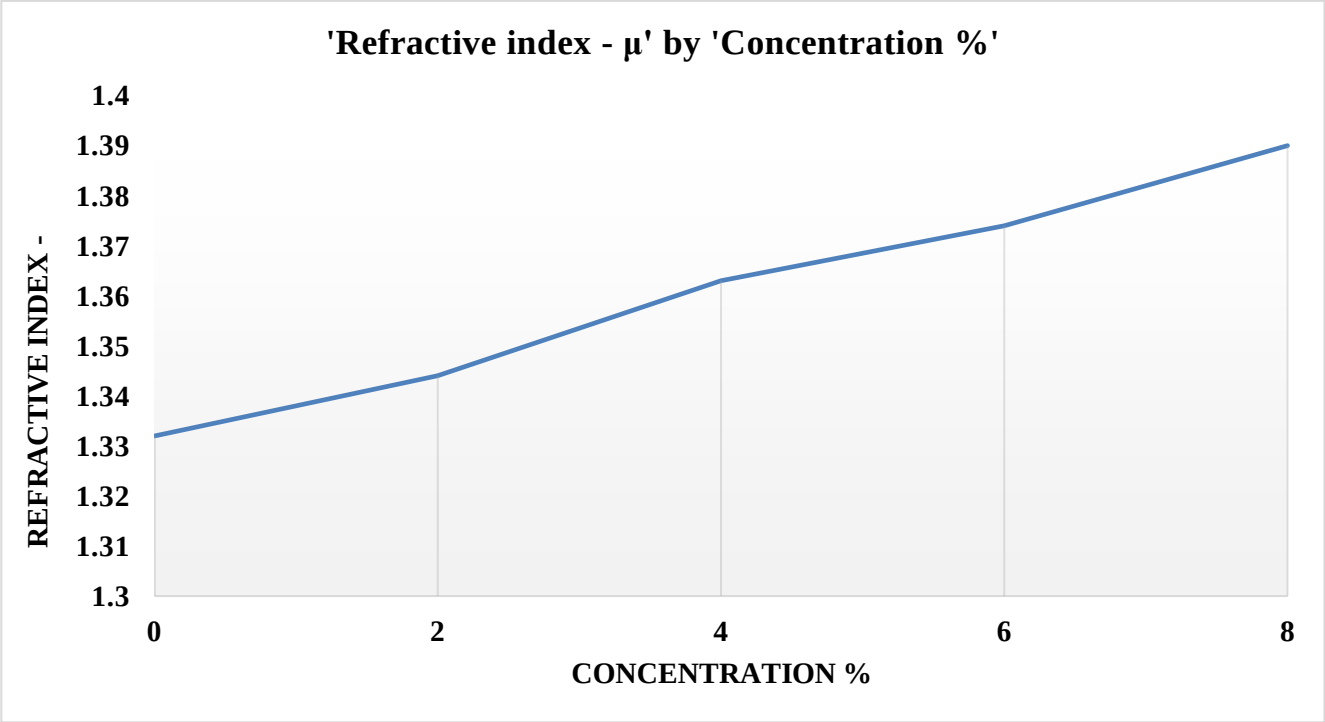
- The **graph plotted** between the **concentration of solution and refractive index for T3 salt** is as shown below:



4.FOR TATA CRYSTAL IODISED SALT: T_4

S.No	Concentration %	Angle of Min deviation (Dm)	Refractive index – μ
1	0	$23^0.32^1$	1.332
2	2	$24^0.3^1$	1.344
3	4	26^0	1.363
4	6	$26^0.5^1$	1.374
5	8	$28^0.4^1$	1.390

- The **graph plotted** between the **concentration of solution and refractive index for T4 salt** is as shown below:



➢ **FOR INDIAN OCEAN WATER :**

The refractive index obtained is 1.347.

$$\mu = \sin[(A+Dm)/2]/\sin(A/2)$$

$$Dm = 24^\circ\ 40' \text{ and } A = 60^\circ$$

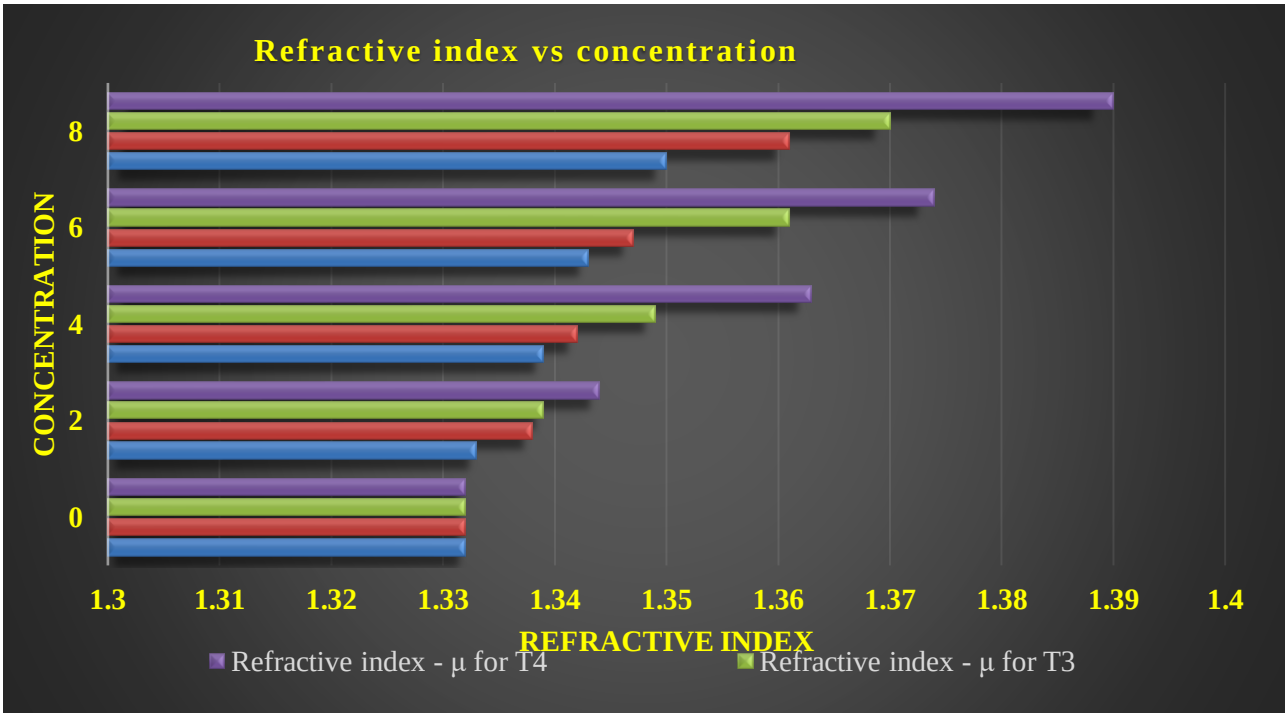
➢ **ANALYSIS OF DATA:**

RESULTS AND DISCUSSION:

- The results were compared for various types of Edible Salts for different concentrations.

Concentration %	Refractive index - μ for T1	Refractive index - μ for T2	Refractive index - μ for T3	Refractive index - μ for T4
0	1.332	1.332	1.332	1.332
2	1.333	1.338	1.339	1.344
4	1.339	1.342	1.349	1.363
6	1.343	1.347	1.361	1.374
8	1.350	1.361	1.370	1.390

➢ The Graph plotted between the Concentration of all the four types of salt Solutions and their respective Refractive Indices is as shown below:



➢ FINDINGS, CONCLUSIONS AND SUGGESTIONS:

Here, we conclude the following based on the analysis of the results obtained:

- The refractive index of the saltwater increases with the increase in its salinity.
- And the refractive index is not the same, for the same concentration of different edible salts which show that the refractive index depends on the composition of the edible salt along with its concentration(salinity).
- The refractive index has extreme significance in determination of concentration of various components present in their respective solutions
- Refractive index helps to determine the correct concentration of ether type additives on aviation fuels and in beverage industries, for measurement of sugar in soft drinks.
- We suggest for further research in determination of refractive indices of sea water in different oceans and there in obtain the survival conditions for different aquatic animals.

➢ OUTCOMES AND APPLICATIONS:

- In oceanographic studies – Physical properties of ocean water.
- Ecological balance of Aquatic animals –their presence –on salinity of Ocean water?
- To view closer distant objects – in air medium from ocean water - we use periscope - to navigate distance objects in ocean water – SONAR.
- In finding the concentration of a solute in an aqueous solution.
- Laser Sensor Technology for the Maritime and offshore Industries.

References:

1.https://en.wikipedia.org/wiki/Saline_water

2.https://www.britannica.com/science/seawater/Optical-properties

3.https://www.researchgate.net/publication/43498663_Effect_of_salinity_on_the_refractive_index_ of_water_Considerations_for_archer_fish_aerial_vision.

4. International Journal of Computer & Mathematical Sciences IJCMS ISSN 2347-8527 Volume 4 Issue 12 December 2015 Refractive Index of Salt (NaCl) from Aquous Solution U.V. Biradar and S.M. Dongarge.

5. Remote monitoring of water salinity by using side-polished fiber-optic U-shaped sensor Conference Paper in September 2012 athttps://www.researchgate.net/publication/261419326.
