CHAPTER NO. 5
SUMMARY AND CONCLUSIONS:-

SECTION -I

PHYSICO CHEMICAL CHARACTERISTICS OF TAPTI RIVER WATER, AQUATIC SEDIMENTS AND NEAR BY SOIL SAMPLES.

Rapid progress of the industrialization, population and modern methods in agriculture generate many types of hazardous contaminants. These toxic wastes are released into the environment and thus pose a threat to living biota. These toxic contaminants enter into aquatic environment or accumulate on the soil surface, move down to deeper layer and change directly or indirectly the physico-chemical properties. They can affect whole living ecosystem. Rivers play an important role in the social development, is the most active part of the topographic process and ecosystem.

Physico chemical characteristics are best indicator of water quality parameters of the rivers. During the present study physico-chemical parameters were analyzed. All samples were collected from Sulwade Tal. Shindkheda, Dist. Dhule. (Maharashtra) to Ukai Dam (Gujarat State). The results thus obtained are being summarized, concluded and discussed under the following sub headings

Section-I.

Physico chemical characteristics of Tapti River water, aquatic sediment and nearby soil samples.

pH:-
During study period the concentration of pH in water sediment and nearby soil were found to be in the range of 6.7-8.5, 7.14-10.2, and 6.02 -8.12 respectively. The pH of water is slightly acidic to alkaline in nature at all the water sampling stations, were within the permissible limit (6.5 to 8.5) prescribed by WHO and BIS limit. Also river water quality was excellent to good and includes class-I, water quality for irrigation regarding the pH is also suitable for fish eggs. (Limit 6.8 to 8.25). The concentration of pH in sediment was alkaline in nature. The concentration of pH in soil was acidic to alkaline in nature. It is fair quality for plant growth when compared with irrigated soil criteria. So the farmer needs to add some amount of Gypsum to reducing alkalinity.

Electrical Conductivity (EC):-
The conductivity in water, sediments and nearby soil were found to be in the range of 107.3-301.2 µmhos/cm, 200-670.12 µmhos/cm and 640.0-1010.0 µmhos/cm respectively.
The water sample except S3 station in wet season and S3, S2 and S1 stations in dry season, exceed slightly the conductivity levels prescribed WHO. The slightly high EC is due to dilution effect, discharge of effluent into River and human anthropogenic activity. River water quality was unfit for irrigation prescribed by limit. The conductivity of sediment samples was higher than water due to soil and metallic particles, those may have settled down. The conductivity of soil sample is high as compared to water and sediment. So all soil samples are injurious to all crops prescribed by limits. This result indicates high degree of water and soil pollution.

**Total alkalinity (TA)**
The Alkalinity of water, sediment and soil samples varied from 121.3-237.3 mg/L, 280.5-587.1 mg/L and 198.4-311.3 mg/L respectively. The water sample in wet season at S5 station and in dry season S1, S2 and S4, station exceed the permissible limit (200 mg/L) prescribed by WHO due to industrial and domestic effluent discharge, erosion of rocks, agricultural run-off, increases alkalinity. River water was not suitable for irrigation prescribed by limit (1-100 mg/L).

**Chloride:**
Chloride plays a very important role in deciding the pH. The concentration of chloride in water, sediment and soil varies from 89.8-192.3 mg/L, 215.4-577.4 mg/L, and 44.3-97.6 mg/L respectively. All the water samples were below the detection limit prescribed by WHO and BIS. River water samples are excellent to good and include class-I and Class-II, water quality, for irrigation regarding the chloride.

**Bicarbonate:**
The concentration of bicarbonate in water, sediment and soil samples ranged from 21.2-50.3 mg/L, 313.3-1012.3 mg/L and 0.238-0.491 mg/L respectively. During study period it was observed that all water samples were within permissible limit. WHO, BIS have not recommended any limits. Tapti River water is suitable for irrigation purposes. Prescribe by irrigation water quality standards regarding Bicarbonates.

**Phosphate:**
The concentration of phosphate in water, sediment and nearby soil samples was found to in the range of 0.01-1.2 mg/L, 50.4-85.2 mg/L and 23.4-42.0 mg/L respectively. Regarding the concentration of phosphate in all water samples, only S1 and S2 stations in wet season and S1, S2, S3 and S5 stations in dry season, are below the detection limit (0.1 mg/L) prescribed by BIS and USPH standards.

265
Total Hardness:-
The total hardness of water, sediment and soil was found to be in range of 137.4 - 317.14 mg/L, 198.4-617.3 mg/L and 147.1-294.3 mg/L. Water hardness was caused by the Calcium and Magnesium ions present in water. Sr, Fe, Al, Zn and Mn etc. are also contributing to hardness. All the water samples are within the limits (100-500 mg/L) prescribed by WHO.

SECTION-II
DETECTION OF HAZARDOUS METALS IN TAPTI RIVER WATER, SEDIMENTS AND NEARBY SOIL SAMPLES BY ICP-AES TECHNIQUES.
This section is divided into two parts
A) Detection of exchangeable metals by flame photometry and complexometry.
B) Detection of hazardous metals by ICP-AES.

A) Detection of exchangeable metals by flame photometry and complexometry.
The concentration of divalent caution such as Calcium and Magnesium was analyzed by the complexometric method and monovalent cautions were detected by flame photometric technique. The results obtained from metals and their toxicity are discussed in detail in the thesis.

Sodium:-
The concentrations of Sodium in water, sediment and soil varied from 71.2-98.1 mg/L, 140.12-190.0 mg/L and 133.2-150.3 mg/L respectively during study period. All the water samples were below the permissible limit (200 mg/L) prescribed by WHO, BIS.

Potassium:-
The concentrations of Potassium in water, sediment and soil varied from 9.0-20.0 mg/L, 25.3-35.0 mg/L and 12.2-30.6 mg/L respectively. During study period concentration of Potassium in water was below the permissible limit. Also concentrations of Potassium in soil was within range (3.9 to 39.0 mg/L) prescribed for micronutrients in soil standards for Potassium.

Calcium:-
The concentrations of Calcium in water, sediment and soil varied from 23.12-43.92 mg/L, 3000.5-3840.0 mg/L and 1912.0-3400.0 mg/L respectively. The concentrations of Calcium in water in all station was below the permissible limit (100 mg/L) prescribe by WHO, BIS standards. During study period concentration of Calcium in soil was very much high, when compared with micronutrients range (2.0-100 mg/L) in soil.
Magnesium:-
The concentration of Magnesium in water, sediment and soil ranges from 8.71-20.02 mg/L, 234.0-312.0 mg/L and 275.0-633.1 mg/L respectively. The concentration of Magnesium in water was below the permissible limit (150.0 mg/L) prescribed by WHO and BIS drinking water standards. It is also observed that concentrations of Magnesium in soil was very much high compared with the micronutrients range (12.0-60.0 mg/L) for soil.

B) Detection of hazardous metals by ICP-AES.
The global production of chemicals has raised tremendously during the last decade. The manmade toxic chemicals and sewage effluents from cities and villages are discharged into river or land without any treatment. These hazardous chemicals interact with organic and inorganic species and form complexes. Metals which are least soluble in water get adsorbed and accumulate on the bottom sediments acting as a sink, which may affect the “health” of the aquatic ecosystem and may also affect the health of rural community that depends on the untreated river water directly for domestic use. The trace elements like Fe, Cu, Zn and toxic elements like Ni, Cd, Pb, Hg, As are essential for animals and plants in trace quantities for growth, but above certain level they becomes toxic. They get in to the human food chain from the environment; disturb the biochemical process, leading to fatal results. Therefore it is necessary to analyze the river water, aquatic sediment and nearby soils for the metallic contamination, and to study the impacts of contaminated water on ground water and nearby soil used for irrigation. There are several metals present in Industrial sewage effluents and agricultural waste discharged in to River water and nearby soil; we have analyzed only Fe, Cu, Zn, Ni, Cd, As, Hg and Pb by using ICP-AES technique at sophisticated instrument facility (SAIF) IIT, Mumbai. The results data given are as follows.

Iron:-
The concentration of Iron present in water, sediment and soil samples was found within the range of 0.01-82.425 mg/l, 0.01-0.091mg/l and 213.908-277.215 mg/l respectively WHO, BIS, recommended 0.1 and 0.3 mg/L permissible limit for drinking water ,S4 station samples in both seasons, was below permissible limit concentration of iron in sediment when compared with average shale value (4.72 ppm) was below the limit and concentration of Iron in soil compared with GLC guideline is highly contaminated.

Copper:-
Concentration of Copper in water, sediment and soil samples collected in an around Tapti River were in range of 0.01-0.185 mg/L, 0.196-3.061 mg/L and 0.37-0.60 mg/L respectively. According to WHO (1.5 mg/L) and BIS (0.05 mg/L) drinking water standard in all the
sampling station was below the permissible limit. Sediments samples are below the average shale value (45 mg/L). All the soil samples exceeded the phytotoxic level (0.060-0.125 mg/L) regarding Copper content. All the soil samples are highly contaminated based on GLC guideline with respect to Copper content.

**Zinc:**

The Zinc concentrations in water, sediment and nearby soil were found to be in the range of 0.01-0.0736 mg/L, 6.084-127.532 mg/L and 14.882-44.221 mg/L respectively. All the water samples were within the permissible limits prescribed by WHO (5.0 mg/L) and BIS (5.0 mg/L). All the sediment samples except S5 station in wet and dry seasons are within limits of contaminated Zinc, when compared with average shale value (95.0 mg/L). All the soil samples exceed the phytotoxic level (0.07-0.400 mg/L) regarding Zinc content. According to GLC guidelines with respect to Zinc contamination all samples are heavily contaminated.

**Nickel:**

The concentration of Nickel in water, sediment and nearby soil samples are in range of less than 0.01 mg/L, 0.186-1.92 mg/L and 0.194-0.508 mg/L respectively. All the water samples are within the permissible limit (0.02 mg/L) prescribed by WHO. Concentration of Nickel in sediments samples were below the level (50.0 mg/L) prescribed by average shale values. All the soil samples exceed the Phytotoxic level (0.100 mg/L) regarding Nickel content. The soil samples A2, A3, A4 are contaminated and Al is heavily contaminated based on GLC guideline with respect to Nickel content.

**Cadmium:**

The concentration of Cadmium content in water, sediment and nearby soil are from 0.01-30.157 mg/L, less than 0.01 mg/L and less than 0.01 mg/L respectively. The water samples in dry season at station S1,S2,S3,S5 and in wet season at station S1,S2,S3,S5 exceed the WHO and BIS limit (0.01 mg/L) drinking water standards with respect to Cadmium content. All sediments samples are within the average shale value limit (0.3 mg/L) regarding cadmium content. All soil samples were, below the phytotoxic levels regarding to Cadmium content. All the soil samples were uncontaminated based on GLC guidelines with respect to Cadmium content.

**Arsenic:**

The concentration of Arsenic content in water, sediment and nearby soil were in the range of less than 0.01, mg/L less than 0.01 mg/L and less than 0.01 mg/L respectively. All water samples are well within desirable limit (0.05 mg/L) recommended by WHO, BIS drinking water standard with respect to Arsenic content.
All the sediment samples show values below the level, compared with arrange shale value (13.0 mg/L) limit with respective Arsenic content. The soil samples are below phytotoxic level regarding Arsenic content and also all soil samples were uncontaminated based on GLC guideline with respective Arsenic content.

**Mercury:**

The concentration of Mercury contentment in water, sediment and nearby soil samples were less than 0.001 mg/L, less than 0.01 mg/L and less than 0.01 mg/L respectively. All the water samples are within the permissible limits (0.001 mg/L) prescribed by WHO and BIS regarding Mercury content. All sediment samples are within the average shale value limit (0.18mg/L) regarding Mercury content. All soil samples are below the phytotoxic level regarding to Mercury content. All the soil samples were uncontaminated based on GLC guideline with respective Mercury content.

**Lead:**

The Show that the concentrations of lead in water, sediment and nearby soil varied from 0.01-0.091 mg/L, 0.01-26.789 mg/L and less than 0.01 mg/L. Water sample are compared with WHO and BIS limit (0.05 mg/L) except S1, station samples in both dry season and wet season exceeded the limit. The entire sediment samples except S3 station in wet season exceed the average shale value limit (20.0 mg/L). All soil samples are below the phytotoxic levels(0.100-400 mg/L) regarding Lead content and all soil samples are uncontaminated based on GLC guideline with respective Lead content.

**SECTION-III**

**DETECTION AND IDENTIFICATION OF ORGANIC COMPOUNDS LIKE B.H.C. AND D.D.T. IN TAPTI RIVER WATER SAMPLES BY GC/MS TECHNIQUES.**

In this section the analysis of organic compounds Tapti River water collected from different station in, dry and wet seasons during 2010-2012 by GC/MS (Hewlett Packard GCD 1800A) instruments at Sophisticated Analytical Instrument Facility (SAIF) IIT, Mumbai are discussed. The obtained GC/MS results showed the following organic compounds. We are trying to explain the discussion of identified organic compound individually, particularly with respect to name, structural formula, molecular formula and molecular weight and their physical properties given one by one. We conclude that B.H.C and D.D.T are not found in Tapti River water.
### Organic Compounds found in Tapti River water sample

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Organic Compound</th>
<th>Structure of organic compound</th>
<th>Molecular formula</th>
<th>Molecular weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Tetracosamethyl-cyclododecasiloxane</td>
<td><img src="image1.png" alt="Structure" /></td>
<td>C_{24}H_{72}O_{12}Si_{12}</td>
<td>448.5061</td>
</tr>
<tr>
<td>02</td>
<td>Cyclononasiloxane, octadecamethyl</td>
<td><img src="image2.png" alt="Structure" /></td>
<td>C_{18}H_{36}O_{9}Si_{9}</td>
<td>667.3855</td>
</tr>
<tr>
<td>03</td>
<td>1,2-Benzedicarboxylic acid, disiooctylester</td>
<td><img src="image3.png" alt="Structure" /></td>
<td>C_{26}H_{38}O_{4}</td>
<td>39390.5561</td>
</tr>
<tr>
<td>04</td>
<td>Phthalic acid, 6-ethyloct-3yl 2-ethylhexyl ester</td>
<td><img src="image4.png" alt="Structure" /></td>
<td>C_{26}H_{42}O_{4}</td>
<td>418.609</td>
</tr>
<tr>
<td>05</td>
<td>Isothiazole-5-carboxylic acid, 4-amino-3(4-fluorophenyl carbamoyl)</td>
<td><img src="image5.png" alt="Structure" /></td>
<td>C_{11}H_{14}FN_{3}O_{15}</td>
<td>281.027</td>
</tr>
<tr>
<td>06</td>
<td>Hexanoic acid, 2-ethyl-oxybis(2,1-ethanediyoxy-2, 1-ethenediy) ester</td>
<td><img src="image6.png" alt="Structure" /></td>
<td>C_{20}H_{46}O_{7}</td>
<td>446.6178</td>
</tr>
<tr>
<td>07</td>
<td>Octasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-hexadecamethyl.</td>
<td><img src="image7.png" alt="Structure" /></td>
<td>C_{16}H_{36}O_{7}Si_{8}</td>
<td>579.248</td>
</tr>
<tr>
<td>08</td>
<td>Heptasiloxane, hexadecamethyl</td>
<td><img src="image8.png" alt="Structure" /></td>
<td>C_{16}H_{42}O_{8}Si_{7}</td>
<td>532.00</td>
</tr>
<tr>
<td>09</td>
<td>1,1-Bicyclohexyl</td>
<td><img src="image9.png" alt="Structure" /></td>
<td>C_{12}H_{22}</td>
<td>166.3031</td>
</tr>
<tr>
<td>10</td>
<td>Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl</td>
<td><img src="image10.png" alt="Structure" /></td>
<td>C_{14}H_{42}O_{8}Si_{7}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical Name</td>
<td>Molecular Formula</td>
<td>Molecular Weight</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cyclodecasiloxane, eicosamethyl</td>
<td>C_{20}H_{60}O_{10}Si_{10}</td>
<td>741.5394</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Octadecane, 3-ethyl-5(2-ethyl butyl)</td>
<td>C_{26}H_{34}</td>
<td>366.71</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>3-[18-(3-Hydroxy-propyl)-3,3,7,12,17-Petamethyl-2,3,22,24-tetrahydroporphin-2yl]Propan-1-01</td>
<td>C_{31}H_{38}N_{4}O_{2}</td>
<td>498.29</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Tetratetracontane</td>
<td>C_{44}H_{90}</td>
<td>618.00</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Tetradecane</td>
<td>C_{14}H_{30}</td>
<td>198.3880</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Docosanoic acid 1,2,3-propanetriyl ester</td>
<td>C_{60}H_{133}O_{6}</td>
<td>1059.7987</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>2,2-Bis[4-[[4-chloro-6-C3-ethynylphenoxy]-1,3,5-triazin-z-yl]oxy]phenyl]Propane</td>
<td>C_{57}H_{23}Cl_{2}N_{4}O_{4}</td>
<td>687.53</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>1-cyclohexanone, 3,3-dimethyl-2-[5-methoxy-3-methyl-2,pentenylidene]</td>
<td>C_{13}H_{26}O_{2}</td>
<td>236.349</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>4-tert-Butylbenzo-18-crown-6</td>
<td>C_{26}H_{12}O_{6}</td>
<td>368.46</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Dodecane</td>
<td>C_{12}H_{26}</td>
<td>170.2034</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Hexadecane</td>
<td>C_{16}H_{34}</td>
<td>226.4412</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Octadecane</td>
<td>C_{18}H_{38}</td>
<td>254.500</td>
<td></td>
</tr>
</tbody>
</table>
Properties of Organic Compound found in Tapti River Water.

<table>
<thead>
<tr>
<th>Molecular Formula</th>
<th>Molar Vol</th>
<th>Surface Tension</th>
<th>Flash Point</th>
<th>Boiling Point</th>
<th>Molar/ Refractivit y</th>
<th>Density</th>
<th>Index of Refractivity</th>
<th>Solubility</th>
<th>Melting Point</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_{24}H_{72}O_{12}Si_{12}</td>
<td>899.1cm^3</td>
<td>21.089 dyne/cm</td>
<td>260.581°C</td>
<td>518.644°C</td>
<td>237.092 cm^3</td>
<td>0.99/cm^3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{18}H_{34}O_{9}Si_{9}</td>
<td>679.256</td>
<td>20.448</td>
<td>198.147°C</td>
<td>415.671°C</td>
<td>-</td>
<td>0.983 g/cm^3</td>
<td>1.437</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{26}H_{46}O_{7}</td>
<td>397.067</td>
<td>35.428</td>
<td>-</td>
<td>-</td>
<td>114.577</td>
<td>0.984</td>
<td>1.489</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{18}H_{36}O_{10}Si_{9}</td>
<td>-</td>
<td>-</td>
<td>260.6°C</td>
<td>518.6°C</td>
<td>-</td>
<td>0.989</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{22}H_{46}O_{7}</td>
<td>170.027</td>
<td>87.008</td>
<td>154.214°C</td>
<td>331.380c</td>
<td>68.644</td>
<td>1.6549</td>
<td>1.738</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{16}H_{34}O_{9}Si_{8}</td>
<td>-</td>
<td>-</td>
<td>208.10°C</td>
<td>499.10°C</td>
<td>-</td>
<td>0.989</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{20}H_{46}O_{7}</td>
<td>-</td>
<td>-</td>
<td>168.9°C</td>
<td>270°C</td>
<td>-</td>
<td>0.917</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{18}H_{36}O_{4}</td>
<td>-</td>
<td>-</td>
<td>219.9°C</td>
<td>451.8°C</td>
<td>-</td>
<td>0.989</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{31}H_{38}N_{14}O_{2}</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>433°C</td>
<td>-</td>
<td>0.8115</td>
<td>1.4523</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{37}H_{24}Cl_{2}N_{6}O_{4}</td>
<td>-</td>
<td>-</td>
<td>324.272°C</td>
<td>918.989°C</td>
<td>326.883</td>
<td>0.899</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{20}H_{30}O_{6}</td>
<td>240.819</td>
<td>36.198</td>
<td>134.699°C</td>
<td>340.539°C</td>
<td>72.814</td>
<td>0.981</td>
<td>1.516</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{16}H_{34}O_{4}</td>
<td>-</td>
<td>-</td>
<td>71°C</td>
<td>214.218°C</td>
<td>-</td>
<td>750mg/L</td>
<td>1.421</td>
<td>-</td>
<td>-</td>
<td>1.34</td>
</tr>
<tr>
<td>C_{14}H_{30}O_{4}</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C_{18}H_{36}O_{4}</td>
<td>-</td>
<td>-</td>
<td>135°C</td>
<td>271.291°C</td>
<td>-</td>
<td>773 mg/ml</td>
<td>1.434</td>
<td>-</td>
<td>17-19°C</td>
<td>-</td>
</tr>
<tr>
<td>C_{18}H_{36}O_{4}</td>
<td>-</td>
<td>-</td>
<td>165°C</td>
<td>316-317°C</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>In solub le in water</td>
<td>28-30°C</td>
<td>-</td>
</tr>
</tbody>
</table>

1) Octadecane:-

Is a higher chain alkene, have less use in petrochemical industry due to high flash point, making it an inefficient fuel. They are used as lubricants, transformer oils, and anticorrosion agents. They are chemically inactive, they are part of the paraffin or wax, Biologically occurring in nature (bacteria, fungi, plants or animals) Higher chain alkenes do not rank biologically among the essential materials but they play an important role in pheromones that
acts as a chemical messenger, transmitting information from one member of a species to another member of the same species.

2) **Dodecanese:-**

It is also known as dihexyl, bihexyl, alkane 12 or duodecane. It is a liquid alkane hydrocarbon, an oily liquid of the paraffin series. It has 355 isomers.

It is used as a solvent distillation chaser scintillate component. Moreover it is used as a diluents for tributyl phosphate (TBP) in plants reprocessing combustion reaction. The combustion reaction of Dodecanese is as follows.

\[
2C_{12}H_{26}(l) + 37O_2 (g) \rightarrow 24 CO_2 (g) + 26 H_2O (g)
\]

\[\Delta H^0 = -7513 \text{ KJ}\]

1) **Cyclohexasiloxane:-**

Primarily works as a skin conditioning agent and emollient like all other silicones this ingredient has a unique fluidity that makes it easily spreadable when applied to the skin, it gives a silky and slippery feeling to the touch and acts a mild water repellent by forming a protective barrier on the skin. It can also fill in fine lines/wrinkles giving the face, a temporary “Plump” look.

**SECTION: IV**

**Impact of polluted water on soil and nearby ground water**

Physico-chemical characteristics and concentration of heavy metals in soils irrigated with polluted water were found to be high compared with phytotoxic limits and GLC guidelines.

Effect of polluted water on ground water. The concentration of heavy metals and Physico-chemical parameters were below the WHO and BIS limits except for Cl and PO4 which were found to be above limits.
SECTION-V

DEVELOPMENT OF LOW COST METHODS FOR THE REMOVAL OF HEAVY METALS

A] LOW COST METHODS FOR REMOVAL OF NICKEL (II), LEAD (II) AND CADMIUM (II) BY USING ALMOND LEAVES AS AN ABSORBENT.

The analytical procedure and method was used to investigate the absorption of Ni(II), Pb(II) and Cd (II) using Bio waste adsorbent, Almond leaves powder(ALP), Neem Leaves powder and Mango peel powder have been described in detail. A grade chemicals and glass ware and deminerlised water was used for experimental work using digital pH meter to adjust the optimum pH level by using standard solutions. Different concentrations of aqueous solution were prepared for adsorption of Ni (II), Pb (II) and Cd (II) was analyzed spectrophotometrically using adsorbent. The effect of following parameters on adsorption was studied.

1) Effect of pH
2) Effect of contact time
3) Effect of initial concentration
4) Effect of adsorbent dosage

The experiments were carried at different pH, contact time, initial concentration and adsorbent at room temperature and their results are discussed below.

Conclusions FOR CADMIUM REMOVAL

*The optimum contact time for removal of Cadmium ion in an aqueous solution by using Mango peels powder was 180 minutes.
*The optimum adsorbent dosage for removal of cadmium ion in an aqueous solution was found to be 100 mg.
*The optimum removal of cadmium ion in an aqueous medium using mango peels powder at pH 5.
*The percentage of removal of cadmium ion in an aqueous solution for an initial concentration of 10 mg/L for a dosage of 100 mg of mango peels powder at pH 5 for a contact time 180
minutes was to be 91.3% but above 100 mg adsorbent dosage at same condition the % of Removal of cadmium attained equilibrium.

* The adsorption of Cd (II) using Mango peels powder follows Freundlich isotherm. It was found to be linear over a wide range.

* Langmuir isotherm fits well in to the adsorption of Cd (II) using mango peels powder.

* The limitless separation factor (R_L) for Langmuir isotherm was found to be <1, hence it predicts a favorable adsorption.

**Conclusions for LEAD REMOVAL**

The optimum contact time for removal of lead ion in an aqueous solution using Neem Leaves powder was 180 minutes.

The optimum adsorbent dosage for removal of Pb (II) ion was 300 mg.

The optimum pH for adsorption of Pb (II) ion using Neem Leaves powder was to be 4.5.

The percentage of Removal of lead ion for an initial concentration of 10 mg/L for 300 mg of Neem Leaves powder at pH 4.5 was found but be 92%.

The adsorption of Pb (II) using Neem powder follows Freundlich isotherm it was found to be linear over a wide range.

The value of \( r^2 \) indicates Langmuir isotherm was well applicable in the adsorption of Pb (II) ion.

The limitless separation factor (R_L) for Langmuir isotherm was found to be <1 hence it is a favorable adsorption.

**Conclusion for NICKEL REMOVAL**

The optimum contact time for removal of Ni ion, using Almond leaves powder was 180 minutes. The optimum adsorbent dosage for removal of Nickel ion in an aqueous solution was found to be 800 mg. The optimum pH for adsorption of Ni ion from aqueous solution using Almond leaves powder was to be 6.

The percentage of Removal of Ni ion for an initial concentration of 20 mg/L for a dosage of 800 mg of almond leaves powder at pH 6 and for a contact time of 180 minutes was found to be 89.6% where for an above 100 mg/L under same condition it was found to be 40% removal. Indicating that at high concentration of metal ion the efficiency of the adsorbent decreases.

The adsorption of Ni (II) using ALP follows Freundlich isotherm it was found to be linear over a wide range.

Langmuir isotherm fitted well into the adsorption of Ni (II) using ALP.
The limitless separation factor (R_L) for Langmuir isotherm was found to be <1 hence it predicts a favorable adsorption.

SECTION:-VI

STATISTICAL ANALYSIS OF THE COLLECTED SAMPLES

The statistics obtained from the results reveals significant and interesting information about the variations and interrelationship. The value of SD (standard deviation) indicates, that the about 75% of the particular samples are having the values of the respective parameters between +/- of their values more the SD indicates the more variability in the data.

The SE (standard error) is the measure of reliability of the mean of a data. The value of SE conveys that if instead of one mean, several means were taken, then about two third of them will fluctuate by I of their SE values. The lesser the value of SE, the more reliable is the mean the 95% chances that the true mean of the respective parameter the value of the mean will be between of their average value with 95% CL value.

Recommendations:-

Water Recommendations:-

1. No discharge of effluent from any industry and urban and cities to nearby river without treatment.
2. There should be some system to monitor the water quality periodically.
3. There should be proper, well channeled system, from industrial unit and Municipal Corporation to common effluent treatment plant or disposal site should be constructed. It will reduce seepage of effluents into soil.
4. A medical checkup of the low income people who directly use river water for drinking purposes should be done periodically.
5. Some awareness programs are needed to educate the local villagers to safe guard the precious river and its surroundings.
6. The modern technology like biotechnology, membrane technology should be adopted for water treatment in addition to conventional methods.
7. The recycled water should be reused in the industry.
8. Some awareness program should be started for the people about water born diseases associated with them.
Soil recommendations

1. Testing of soil should be done every year, to understand and monitor pH, nutrient status of soil, Use of organic matter as compost manure should be increased.
2. The leguminous plants, which have capacity to fix nitrogen in soil, should be encouraged to alternate yearly crop.
3. Agricultural runoff through fields should be stopped. It minimizes the pollution of the soil.
4. Irrigation by polluted water (sewage water, industrial waste water deep well water, hard water should be avoided since it increases some ions in soil which disturbs the balance of cations and anions of the soil.
5. Organic matter should be in the soil because it acts as a storehouse of nutrients(N,P,S etc) it also increases exchange capacity, provides energy for micro organism activity.
LIST OF PUBLICATIONS
