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DESK RESEARCH ON POLLUTANTS PERCEIVED IN SEA WATER FOR QUALITY CONTROL

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Abstract: ***Substances of foreign origin are called pollutants, plays a main part in alarming health hazards. The essentiality of Water is being used without considering the dreadful contaminants. Arsenic, the most potential and dreadful element is always ignored whenever there is a need for purification of water for the purpose of drinking. Rehabilitation of any affected area in view of health issues is highly mandatory as per the international provisions of Environmental legislations. In this work, we have tried to identify the potential pollutants, their sources and contamination limits toward hazardous health effects.***

***Keywords: Pollutants, Toxicants, Turbidity, Inorganic, Organic, Acidity and Alkalinity*.**

1. INTRODUCTION

Natural Water always mingles with many a dissolved organic and in organic matter due to its pathway through rock, soil and environment.

1.1 Inorganic materials in natural water

Sea water contains higher salt level (35grm / liter) than that of Rain water that contains only traces of dissolved matter like oxidized forms of sulfur, Nitrogenous toxicants from fuel combustion and Vegetation.

1.2 Organic materials in water

Organic contaminants gets purifies when it is passing through the ground water system. Main souses of organic pollutants are live organisms, decomposing matter, drainage, industrial pollution and atmospheric fall out.

1.3 Dissolved Organic substance

This is the source of Biological pollution such as proteins, Amino acids, Fats, Lignin, sugar, chlorophyll etc. These are drawn from natural and synthetic compounds (pesticides), decaying plants and animals.

1.4 Standards of water pollutants

Parameters **[1]** describing Natural water Quality involve many a factor. Different territories have different standards and factors in deciding the natural water quality. European system uses about 64 factors while rules established by Polish require only 51 factors in deciding the natural water quality. The stringent rules as framed by Environmental Protection Agency (EPA 1995) do require around 120 factors.

1.5 Indication By Colour of water

Color of water is the better indicator of toxic contents that is mostly due to stains from textile industrial waste. Apparent colour indicates dissolved particles in colloidal state and dissolved platinum (Potassium Hexa Chloro platinum IV - K2PtCl6) along with complex of Cobalt.

1.6 Various techniques to determine pollutants in water.

Photometry

This is a technique of light measurement using principle of absorbance of light by liquid. The photo detector is placed on one side of the sample solution when a monochromatic light is passed through the other side. The light absorbed by sample is calculated based on Beer-Lambert's law. Appropriate wavelength filters are suggested based on colour of the sample. Based on the absorbance of light, the amount of ingredients can be determined. This paper work of Desk Research on Pollutants is mainly useful for Scientists in NIOT –National Institute of Ocean Technology, CECRI [CSIR] -
Central Electro Chemical Research Institute. And extremely useful for Worldwide researchers in water Quality control & rehabilitation, Pollutants detection - investigators & developers.

Coagulation and sedimentation

By coagulation and sedimentation of pollutant particles using alum the levels of toxic ingredients can be determined by analytical methods of analysis on sediment.

Turbidity

Turbidity is the principle of measurement of scattered light by turbid solution to determine the quantity of elementary and complex contents in the sample. Turbidity in water is due to the suspending organic and inorganic particles, staining complexes of aluminum, manganese and iron, Zooplankton and tiny life forms like pathogenic bacteria and Clay particles. Acceptable turbidity of drinking water is from 20 to 50mg / dm3.

- **Sources of pollutants in water.**

- Suspended solids
- Colloidal & Dissolved
- Dry residues **[2]**
- Inorganic chemicals can affect taste but not cause any odor
- Inorganic chemicals usually affect both taste and odor
- compounds are detectable @ extremely low concentration
- Organisms most often linked with taste and odor

    - Rust
    - Plant Fibers &
    - Algae and
    - Are – an indicator of bacterial or
    - Hazardous contamination (filtration)

- **Colloidal & Dissolved**
  Dry residues
    - Is a residue left after evaporation of water (drying in 105 0C) **[3]**
    - Mass of dissolved and insoluble inorganic and organic substances.
    - Taste and Odor
- **Inorganic chemicals (pollutants)** can affect taste but not cause any odor

    - Salt (NaCl)
    - Minerals and
    - Metals
    - Iron
    - Zinc
    - Manganese and
    - Copper

- **Inorganic chemicals usually affect both taste and odor**
  - Humic substances
  - Hydrophilic Acids,
  - Carboxylic Acids,
  - Peptides ,
  - Hydro Carbons,
  - Biological Decay Products,
  - Petroleum Products and
  - Pesticides
- **These compounds are detectable @ extremely low concentration**
    - Chlordane
    - Dichlorobenzene
    - Trichloroethylene
  - Phenol
  - Chloro Phenol
  - Hydrogen Cyanide
- **Organisms most often linked with taste and odor problems**
  - Actino myocytes and
  - Various types of algae
  - Aquatic organisms such as
  - Protozoa and
  - Fungi
- **Earthy musty tastes and odors are produced by**
  - Cyanobacteria (Blue – Green Algae)
  - Actino myocytes and
  - Few Fungi
- **Growing algae produce numerous volatile & Nonvolatile organic Substances**
  - Aliphatic alcohols
  - aldehydes
  - Ketones
  - Esters **[4]**
  - Thioesters and
  - Sulphides
- **Occasionally, taste and odor problems in water are caused by**
  - Other Bacteria
  - Fungi
  - Zoo plankton and
  - Nemathelminths
  - Ferro bacteria **[5]**
  - Some species of pseudomonas

- **Sulphur** – containing amino acids
  - Hydrogen Sulphide (H_2S)
  - Methyl thiol and
  - Dimethyl ploy sulfide
  - (H2S decomposition of sulphide minerals + CO2)
  - Physicochemical Parameters
  - pH (ranges from 0 to14).
  - Acidic water is highly corrosive

Table 2: pH Value of different type of Water

Type of Water	Values in pH
Surface Water	6.5 – 8.0
Ground Water	5.5-7.5
Acid Rain	< 3.0
Drinking water	6.5 – 8.5

- **Temperature of surface water depends on**
  - Water origin
  - Climatic Zone
  - Season
  - Altitude
  - Degree of riparian Coverage
  - Inflow of Industrial (Power plants , Industrial Cooling) and
  - Municipal Sewage

- Temperature can exert great control over aquatic, communities,
- Especially influence on biological activity and growth.
- An increase of 10^0 C in water temperature almost doubles the speed of chemical and biological reactions Occurring in water.
- Temperature increase leads to
- Decrease the amount of dissolved oxygen (DO).
- Increase biochemical Oxygen Demand (BOD)
- Acceleration of Nitrification and Oxidation of ammonia to nitrates III and V which leads to Oxygen deficit in water.
- High Temperature increases
  Toxicity of many substances (Pesticides, heavy metals an susceptibility organism to toxicants) **[6]**
- Organisms (including fish) are also sensitive to temperature
- Acceptable temperature of water in Poland is 22 º C to 26 º C (Surface water)
- Table 2 describes that the range of PH
  Scale of different water.

Alkalinity

- Refers to the capability of water to neutralize acids
- Basic species responsible for alkalinity in water are
  - Bicarbonate ion
  - Carbonate ion and
  - Hydroxide ions
  - Calcium Carbonate or
  - Magnesium Carbonate (Compounds) **[7]**

- **Minor contributors to alkalinity**

    - Ammonia and
    - Conjugate bases of
        - Phosphoric,
        - * Silicic,
        - Boric and
        - * Organic Acids
- **Alkalinity** often related to hardness of water because, the main sources of alkalinity **[9]** is usually from
    - Carbonate rocks (lime stone) mostly CaCO3
    - Sodium Carbonate and
    - Potassium Carbonate (do not contribute to hardness)
- **Alkalinity (as well as pH)** can be determined using inexpensive test strips.
- More **[10]** sophisticated electromagnetic measurement is performed by Computer
- Aided Titrimeter (CAT) and the pH electrode Alkalinity is important for
    - Fish and
    - Aquatic life (best functions @ pH range of 6.0 to 9.0)
- Acidity of natural water system is the capacity of the water to neutralize

- **hydroxide ions (OH-)**
    - Acidity is due to presence of weak acids such as,
    - H_2PO_4-
    - H_2S
    - Proteins
    - Fatty Acids and
    - Acidic metal ions particularly Fe3+
    - Originate from atmosphere
    - Co2
    - Soil (Co2 and humic acids) **[8]**
    - H2SO4 and HCl in water
    - Hydrated metal ions
    - Pickling liquor (to remove corrosion from steel)
    - Acidic metal ions
    - Excess of strong acids
    - Conductivity is a measure of the capacity of an aqueous solution to carry an
- **Electric current**
    - Conductivity depends on the presence of ions
    - **Cations (+) And anions (-) in water**
    - Their total concentration
    - Mobility and valence
    - And on temperature of water
    - Conductivity good with amount of salt in water
    - Calcium,
    - magnesium,
    - sodium,
    - Potassium,
    - Carbonate,
    - Bi-Carbonate,
- Sulphate,
- Chloride,
- Nitrate **[11]**

- and others
    - It is commonly used to determine salinity
    - High Salinity interfere with growth of aquatic vegetation
    - Salt decreases the osmotic pressure
    - May cause leaf tips
    - Marginal leaf burn,
    - Bleaching or
    - Defoliation **[12]**
    - Hardness
- **Cations of Ca2+**
- **Mg2+ (Magnesium), iron Fe3+ and Mn2+ (Manganese)**
    - **Dissolved Oxygen (DO)**
    - Volume of oxygen present in water
    - Basic indicator of ecosystem health
    - **Bio Chemical Oxygen Demand (BOD)** is a measure of the quantity of Oxygen consumed by
    - Micro Organisms during decomposition of organic matter
    - BOD indicates poor water quality
    - **Chemical Oxygen Demand (COD)** is the amount of oxygen required for degradation of the organic compounds of waste water to occur
    - Potassium Permanganate ($KMnO_4$)
    - Potassium Dichromate ($K_2Cr_2O_7$)
    - Mercury Sulphate ($HgCl_2$) n or $HgCl_4$
    - Carbon dioxide (CO_2) is present in air the atmosphere and all kinds in natural water are
    - $CaCO_3$ **[13]**
    - Mg ($(OH)_2$)
    - Chlorine Present in water is toxic for living organisms
    - In elemental form does not exist in natural water
    - Sewage undergone
    - Chlorination with
    - Chlorine or
    - Chlorinated compounds
- **Ammonium Nitrate**
    - Presents in water reaction will lead to chloramines NH_2Cl, $NHCl_2$,
- **NCl_3**
    - Chlorine causes Oxidation of Iron II compounds
    - Manganese II
    - Nitrates III
    - Sulphides and
    - Sulphates (IV) and forms
    - Aliphatic and
    - Aromatic chloro-derivatives
- **Chlorides**
    - HCl
    - AgCl
- **Sulphur**
    - In natural water, sulphur is present in the form of dissolved
    - Hydrogen ,
    - Sulphide ,
    - Hydrogen Sulphides (HS-) or
    - Soluble and insoluble sulphides S2-

- **Sulphates**
  - Sulphates VI commonly occurs in natural waters
  - Sulphates rarely present in natural water
  - Sulphates are least toxic anions
  - Health disorder to occur (diarrhea type symptoms)
  - Bitter taste
- **Silica**
  - ColloidalSiO2 ,
  - Silica metal compounds like
  - Na2SiO3 ,
  - Ca2SiO3 ,
  - Mg2SiO3 ,
  - K2SiO3 and
  - Poly nuclear Silicate species such as
  - Si4O6 (OH) 62-or
  - Silicic acid H4SiO4
  - Sources of silica (in water)
  - Sodium feldspar albite (NaAISi3O8)
- **Calcium**
  - Cations found in most fresh water system, has highest concentration
  - Different mineral forms of $CaCO_3$
  - $CaSO_4$. $2H_2O$
  - Anhydrite ,
  - $CaSO_4$
  - Dolomite
  - $CaMg(CO_3)$ and
  - Calcite
  - Aragonite
- **Magnesium**
  - Mg like Calcium is a compound commonly found in natural water presents as Mg2+ ion Main source
  - Dolomite,
  - $Mg(CO_3)_2$
  - Mg2+ similar properties of Ca2+
- **Sodium**
  - Main sources of sodium in natural waters are
  - Hydrolytic decomposition of magma rocks
  - Presents in the form of
  - Nacl - Sodium Chloride
  - Sulphates (Na_2SO_4)
  - Salts of Carbonic Acid ($NaHCO_3$, Na_2CO_3) or
  - Nitrates ($NaNO_3$)
  - Well soluble in water
  - Sodium hydrocarbons – Hardness
- **Potassium**
  - Main sources of potassium in natural waters are hydrolytic decompositionof magna rock
  - Erosion of sedimentary rocks (mineral matter as feldspar KAISi3O 8
  - Due to weathering
  - Forest fire runoff
  - Municipal, industrial and agricultural sewage
  - Potassium Chloride (KCl) rarely in the form of Sulphates
  - K 2SO 4

- Salts of Carbonic Acid (KHCO3, K2CO3) or
- Nitrates (KNO3)
- All are very soluble in water

- **Aluminium**
  - Al ions Al_3+ weak solubility, lower concentration in water
  - Sources industrial sewage etc.
  - Corrosion of aluminum tanks and
  - Water treatment process
    (coagulation) with the use of alum
  - $(Al_2(SO_4)_3)$
  - Aluminium salts are harmful to humans
- Microbiological Parameters
  - **Decease – causing (Pathogenic) organisms** including
  - Bacteria
  - Viruses
  - Protozoa
- Water has been polluted with feces of humans or other warm blooded animals
  - Coli count - Coli bacteria count present in water
  - Faucal Coliforms Indicates the presence of pollutions from animal or human feces
  - Raw sewage or
  - Untreated river water contains high levels of these bacteria
  - Chlorine used in water treatment process kill these bacteria
- Parameters concerning substances undesirable in excessive amount
- **Nitrates**
  - Some studies have shown that there may be a relation between the presence of nitrates in water and
  - Gastric **[14]** cancer methemoglobinemia, which in case infants are often referred to have
  - blue baby syndrome.

  - **Nitrite NO_2**
    - can be organic or
    - inorganic origin
- **Ammonia**
  - Organic origin
  - Easily under goes nitrification
  - Pollution if excess use of ammonia fertilizers, atmosphere and sewage
  - Ammonia is toxic for aquatic organisms
  - Increase body pH

- **Total Organic Carbon (TOC)**
  - Carbon enters bio sphere during photo synthesis
  - Co2 + H2O C6H12O6 + O2 + H2O and
  - Is returned to the biosphere in cellular respiration
  - O2 + H2O + C6H12O6 Co2 + H2O + energy
- **Hydrogen Sulphide**
  - Inorganic origin –
  - bio chemical decomposition of plant and animal proteins
  - Gives nuisance rotten egg smell and taste
  - Presence in drinking water known to cause nausea , illness and in extreme cases death

- **Iron**
  - Main sources of Iron in natural water is erosion of minerals from rock sand soil
  - Sewage from metallurgical dyeing and galvanizing plants, erosion pipelines etc.
  - Fe II and Fe III
  - Essential nutrition for blood formation
  - Large quantities in water cause turbidity
  - Yellowish colour and an unpleasant taste
- **Manganese**
  - Mn2+ , Mn4+
    - Source – Magna rock and sedimentary rocks
  - MnO2. H2O □ and its further sedimentation
- **Phosphorus**
  - Anions of Orth phosphoric acid
  - H3PO4,
  - H2PO4-
  - HPO42-

They are predominant in normal water pH range also

- present as organic phosphorus
  - Phosphates some time added to drinking water to reduce corrosion
- precipitation of certain compounds
  - **Fertilizer runoff form** agricultural human activity erosion of rocks (also mining) with
- domestic waster due to use of detergents industrial waste
- result of decay organic matter (plants and animals origin)
- Copper
- Fluoride
  - Present in minerals soils and naturally found in natural waters
  - Industrial sewage agricultural runoff and due to burning of coal
  - Fluoride in drinking water, leads to a substantial reduction of dental cavities
  - Harmful to bones and teeth
- Dissolved in emulsified hydro carbons mineral oils
  - Crude oil is a complex mixture of hydro carbons (90% Carbonatoms)
  - Minor properties of Sulphur,
  - Nitrogen and
  - Oxygen
- **Phenols**
  - Phenol,
  - O-cresol ,
  - M-cresol, P-cresol,
  - I-naphtol,
  - Hydrochinon and
  - Chlorophenol
  - Phenols are easily bio degradable substances, unless they are in
- Concentrations of toxic for micro organisms
  - Acute Toxicological effects of phenol, effects central nervous system and death can occur as soon as one half hour after exposure cause
    - Severe gastrointestinal, disturbances, kidney mal function, circulatory
- system failure, lung oedema convulsions
- **Surfactants** (surface active agents)
  - Synthetic detergent – component
  - 2 groups - Hydro phobic or

- Hydro philic (water liking)
- Harmful aquatic environment – fish, plankton, plants , human as well - higher concentration
- Parts of surfactants containing phosphates and poly Phosphates
- **Trihalomethanes (THMs)**
  - Group of 4 chemicals
  - Parameters concerning toxic substances
  - Affected by those toxicants can have serious influence on the aquatic ecosystems
  - and unsuitable for human consumption Causes of cancer,
  - such as carcinogenic substances,
  - exposure to irrigation and viruses and internal factor,
  - lowering of immune functions caused by
  - heredity,
  - agedness and
  - change in life style
  - According to report from World Health Organization (WHO) , 35% of carcinogenic substances are derived from food and drinks and
  - 30% are from smoking as the IInd rank

- **Heavy Metals**
- **Arsenic (III & V)**
  - Low concentration of Arsenic in drinking water – higher incidence of lung or bladder cancer
- **Cadmium**

There is permissible acceptable concentration by WHO

- **Chromium**

Permissible acceptable concentration by WHO

- **Lead**

Excess quantity of lead may impact human health

- **Cyanides**

Cyanide is a deadly poisonous substance which exists in water as **HCN** (Very Weak Acid)

  - Used in Industry for metal cleaning and electro platting
  - **Cyanide** in water is indicative serious pollution problem
- **Selenium**
  - Naturally occurs in earth's crust- found in sedimentary rocks
  - Selenium in rocks combined with
  - **Sulfide** minerals or with
  - **Silver**
  - **Copper**
- **Lead** and
- **Nickel** minerals
- **Inorganic form**
  - Different oxidation states
  - II selenide
  - Elemental Selenium
  - +IV Selenite SeO_3 2-
- VI Selenate SeO32-
- **Organic form**
  - Organic **[15]** compounds and Methylated derivatives (used differs from their nutritional and toxic impact)
  - Less toxic form – volatile methylated selenium compounds –

- DimethylSelenide (DMSe), Dimethyldusekebude (DMDSe).

- **Radio active compounds**
  - Radio Activity is spontaneous
  - nuclear transformation of nuclide into another nuclide – by emission of nuclear radiation
  - Natural radio activity is caused by 226Ra , 222Ru, 239U, 230th, 210Pb, 40K and
  - Isotopes from atmosphere 3H and 14C
  - Acquired radio activity caused by water pollution with radioactive

- **Isotopes**
  90Sr, 89Sr, 90Y, 91Y, 131I, 132I, 137Cs, 141Cs, 144Ca, 32P
- **Radio Isotopes found in Sewage**
  24Na, 32P, 40K, 60Co, 85Zn, 90Sr, 131I, 137Cs
- **Mercury**
- **Most toxic Isotopes**
  90Sr, 90Y, 210Pb, 210Po, 226Ra, 238U
- **Persistent Organic Pollutants (POPs)**
  PAHs ,PCBs (include 200 different compounds in water environment, 60were determined)
- **Pesticides**
  - 3 Groups
  - Insecticides
  - Herbicides
  - Fungicide
- **Di Oxins**
  In Industrial Sewage.

2. Key Water Facts

Aquatic species ceases every year due to increased toxic pollutants from river following into the bay. A study from 1983 to 1993 showed a reduction of aquatic species from 840% to 75%. About 85% of the total pollutants by the rivers are flowing into the bay. Rivers clutch 90% of the earthly source of contaminants and nutrients into the Bhai Bay. Since 1990 up to2010 worsening of sea water quality both the extent of pollution and affected are increased continuously. In Singapore, recycling the unwanted used (polluted) water into purified drinking water as New Water. Assessment of waste water recycling in Kuwait and its blow on amount of pollutants released into the ocean. Kuwait has recently implemented a rigorous campaign that aims to reclaim and reuse all treated waste water and to preserve sea water quality. It has greatly reduced the amount of pollutants discharged into the sea. Results showed 50% reduction in volumes to waste water discharged into the sea has been achieved from year 2000 to 2010.

In the year **2020**, due to shortage of storage capacity for reclaimed waste water around **880 million** people may lack access to safe water. **About 3.6 million** people die every year due to illness originated through polluted water. Around 80 per cent of water borne casualties is in children. About 14 Percent of this Casualty are due to diarrhea. On an average about **65 billion** People are at peril of **arsenic toxicities** in **India, Bangladesh, and Nepal.**

CONCLUSION

Earth is covered about 79% of water of which 94.2% is in oceans and only 4.13% in the ground. Arsenic was a cumulative poison claiming loss of live due to cancer, cardiac ailments and other symptoms. Research works claims that as small as 3 parts per billion (ppb) of arsenic is a dreadful weapon causing loss of life. Arsenite (As3+) is the more toxic than Arsenate (As5+). 6 kilometers is the typical distance Africans and Asians walk to carry water. 98 % of casualties arise due water borne ailments the world. Waste water reuse is restricted for agricultural applications. The Ministry of Public Works (MPW) is expected to overcome this problem to a zero discharge of waste water into the sea. Ultimate aim in future development would be rehabilitation of polluted water and reuse of waste water project implementation in Tamil Nadu, India as like in Kuwait and Singapore. Arise due water borne ailments the world. Waste water reuse is restricted for agricultural applications. The Ministry of Public Works (MPW) is aiming at nil release of waste water into the sea. Ultimate aim in future development would be rehabilitation of polluted water and reuse of waste water project implementation in Tamil Nadu, India as like in Kuwait and Singapore

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