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EVALUATION OF CV TECHNOLOGY FOR REDUCING LEVELS OF HEAVY METALS IN TREATED SEWAGE STP WATER AND GROWTH CHARACTERS OF *CHANNA STRIATA.*

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ABSTRACT

Globally about 172.32 billion cubic meters of sewage water is released untreated yearly this becomes of economic constrains for construction and maintenance of sewage water treatment plants (STPs) ,even the treated water of STPs not reusable due to presence of heavy metals but with an indigenous technology the heavy metals reduced from sewage water for the evaluation of the water, Channa striata fish grown in STP treated water ,control osmania university campus pond water and sewage water with indigenous technology .where the heavy metals of STP treated water and even control water shown effects on weight, length and distributional characters of Channa striata. Heavy metals are stable and are determined as environmental contaminants since they cannot be degraded or destroyed; therefore they accumulate in the soils, water and sediments. Three water i.e., control water (osmania university pond), treated STP water were collected from Hyderabad area which were analyzed to investigate the concentration of heavy metals like Cr, Mn, Fe and Co etc... In the present study polluted sewage water was treated by using C.V. Technology from 2019 to 2022. The results indicated that concentrations of heavy metals were high in STP treated water and few are present in osmania university pond water compared to sewage water treated with CV technology, which were within the permissible levels.

Keywords: CV technology, Heavy metals, STP water, Osmania University, treated water and channa striata.

1. INTRODUCTION

Scientists behind the study at the Utrecht University and the United Nations University found that “globally, about 359 billion cubic meters of Waste Sewage water is produced each year” and of that “48 percent of that water is currently released untreated”.

The key narrative of the study is stressing that the reason we are only treating around 50 percent of our wastewater worldwide, is that developing countries are lagging behind.

This paper discusses the potential of wastewater as a resource and the associated challenges and opportunities. The paper starts with a brief explanation of the current global situation regarding sewage wastewater and a simple overview of waste sewage water treatment in STPS before going into more detail about the resources that can be recovered from it and how. To conclude, a summary of the challenges and opportunities involved in using sewage waste water as a resource in provided with a new technological of the treatment of STPs for the reuse as safe water.

It is a bony fish with endoskeleton ribcage, grows up to a meter in length, though because of fishing, this size is rarely found in the wild. It has a widespread range covering southern China, Pakistan, most of India, southern Nepal, Bangladesh, Sri Lanka, and most of Southeast Asia. It has more recently been introduced to the outermost parts of Indonesia, the Philippines, and Mauritius. Reports beginning in the early 20th century that it was introduced into the wild in Hawaii, particularly the island of Oahu, as well as later reports from Madagascar, are the result of misidentifications of *C. maculata* The only currently confirmed Hawaiian establishment of *C. striata* is on a commercial fish farm. Popular media and the United States Fish and Wildlife Service were perpetuating this apparent mistake as recently as 2002 Early- to mid-20th century reports and texts referring to its introduction in California appear to be the result of a misunderstanding.

Background

Volumes of Sewage wastewater have been steadily increasing over time the growing population, improvements in water supply enhanced living standards and economic growth. Each year, 380 billion m3 of municipal Sewage wastewater is generated globally. Sewage water production is expected to increase by 24% by 2030 and 51% by 2050. However, as the common perception remains that wastewater is a source of pollution that needs to be treated and disposed of or reused wastewater is perceived as a growing problem rather than a valuable and sustainable source of water, energy and nutrients.

A paradigm shift is currently underway, with developed countries taking a proactive interest in improved wastewater management. The goal is to go beyond pollution abatement and to seek to obtain value from sewage water. As a result, the Sewage water sector in developed countries has started moving away from simply treating sewage water in sewage water treatment plants (STPs) and has instead started seeing the potential of these plants as water resource recovery facilities. These recovery facilities can produce clean water, recover nutrients.

Despite the opportunities that sewage water presents, the global reality is that only a very small portion of the total sewage water produced is collected and treated in STPs lit alone exploited for the recovery of resources. It is estimated that, globally, over 80% of all sewage water produced is discharged into the environment without adequate treatment although the level varies across different regions, which is being polluting ponds, reservoirs, rivers along with drinking water.

According to high-income countries treat on average about 70% of the municipal and industrial wastewater they generate. This UN water ratio drops to 38% in upper middle-income countries. In low-income countries, only 8% of wastewater generated undergoes treatment of any kind.

The latest study indicates Sewage generation per day in India is about 26,254 million liters per day (Ml/d) of sewage/wastewater are generated in the 921 Class I cities and Class II towns in India.

As per the report published by Central Pollution Control Board (CPCB) in March, 2021, sewage generation from urban areas in the Country is estimated at 72,368 million litres per day (MLD), against which sewage treatment capacity of 31,841 MLD was available. The sewage water (1 Domestic, industrial and storm) treatment is followed physical (pre-primary treatment where screens, traps, grit chambers etc employed to remove suspended solids by equipment), biological process where the sewage water stored in a basin for setting solids are removed, than the sewage water is transferred for biological (secondary) treatment remove suspended (Biological) solids and also dissolved solids (sugar, fats, Hydrocarbons, undigested matter and so on) by using aerobic bacteria by providing aeration of sewage water and anaerobic bacteria is also used. The tertiary treatment treated sewage water is further cleaned before it is discharged into ecosystem. Several methods employed further for disinfection than sand bed filters to remove particulate matter. To remove high level of phosphorus polyphosphate organism used for absorption (Bio solids), these organisms removed, than to remove nitrogen, used nitrifying bacteria, this totally called biological process. In the chemical treatment, PH Chemicals used to adjust PH, coagulants used to coagulate pathogens, organic deformer and foaming chemical but heavy metal removing process is not there in the entire process of STP (even in CETP) treatment further application RO is much costliest. There is no technology available to treat the total heavy metals and treat the physico-chemical parameters. The average STPs treating sewage water at 10.5 - 13.5 NCP/1, in 24 hours which is lengthier, that too the STP treated water contain lot of impurities in treated water. This because performance of state owned sewage treatment plants, for treating wastewater, is not complying with prescribed standards. Thus, making effluent from these plants, often, not suitable for household purpose and reuse of the waste water is mostly restricted, thus this water is nothing but semi treated.

It is indirectly into the rivers/lakes/pond/creeks in 118 cities; on to the agriculture land in 63 cities directly into rivers in 41 cities. in 44 cities, it is discharged both into rivers and on agriculture land. In many of the coastal cities, the wastewater finds its way into estuaries, creeks, bays etc. (Around 25% of total wastewater)

India has largest wetland in “East Kolkata, named East Kolkata Wetlands (EKW)” and or Sewage fed Fisheries and or Berries, covering around 12,000 ha area.

It was declared as RAMSAR site on August 19, 2022 and EKW has been functional since 1930, which is World’s largest waste water aquaculture, with an area of 4000 ha which produce fish production of 5 tons/hectare. Edward and Pulling determined that East Kolkata Wetlands/ Sewage fed systems receive 5, 50,000 m3 untreated waste water per day. But bioaccumulation of cu, pb, Zn and Cr - detected in fish grown in sewage - fed heel ecosystem (Deb and Santra, 1997; Further bio-accumulation of heavy metals found in fishes of in vitro experimental study of a sewage fed ecosystem (Environmentalist 17.27-32). The present available treatment processes unable to produce reusable standards of treated water, hence an indigenous technology invented (Chinna Venkateshwar, Professor OU) patented. Indian Patent for the sewage water treatment. Here the evaluation is carried out by growing C. striata fish in (OU Pond) natural water, STP treated sewage water and CVR-Technologically treated water.

2. RESEARCH AND METHODOLOGY

1. Study Period:- The work carried out for one year 2017, 2018, but it has been repeated for one more year 2018 - 2019.

2. Experimental Fish Channa striata (Bloch, 1793).

The seeds of experimental fish i.e. Channa Striata were collected from fisheries departmental nursery aquaculture farm located in Medak district, Telangana state and utilized for the exposure studies. These seeds were transported in well oxygenated plastic cases with oxygen supply along the transport to the laboratory. In the lab they were screened for any pathological signs and after that the fish were acclimatized for 15 days before introducing into the experimental tanks.

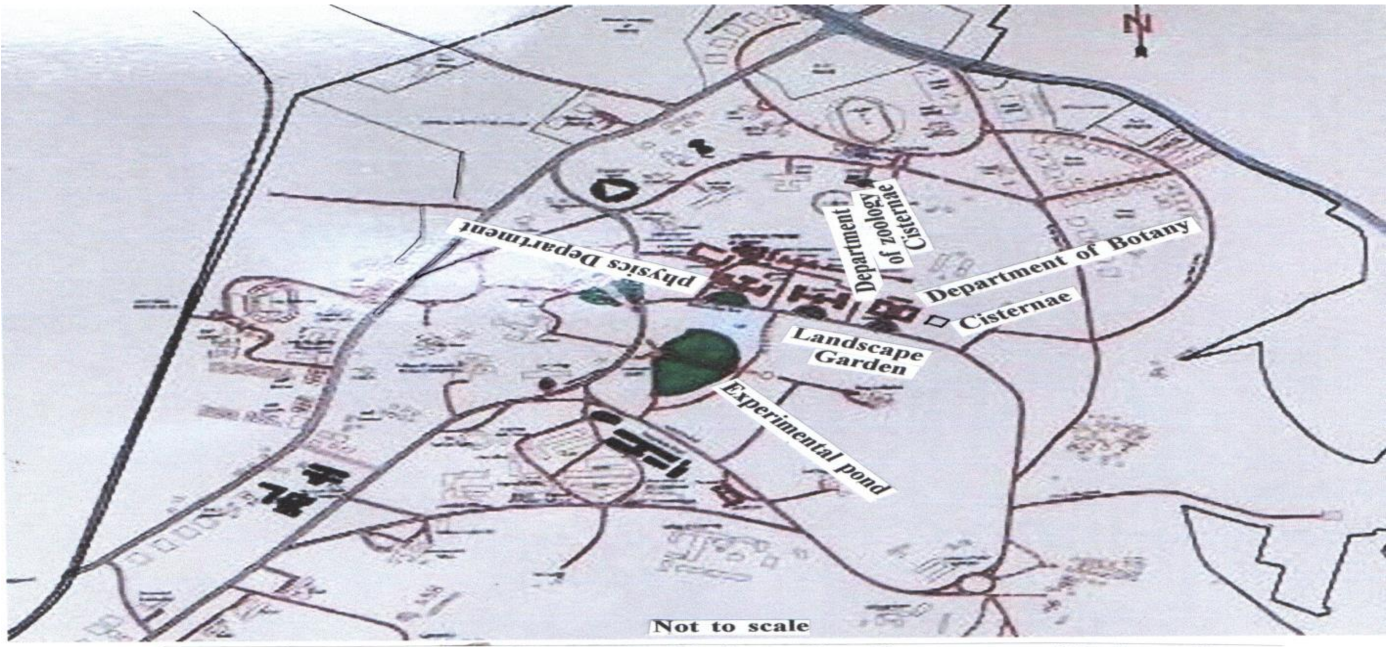
They were fed with commercial fish pellets and labium (40% protein content, chopped sheep liver) during the acclimatization period. The fish which were Kathy and showed active movements were selected and used for the experimentation.

Channa Striata: The striped snakehead is a species of snakehead fish. It is also known as the common snakehead, chevron snakehead, or snakehead murrel and mudfish. It is the native of South and Southeast Asia.

3. It is a state fish of Telangana state (India).
4. Exposure: I. Osmania University pond water (located opposite to Physics Department used as control water: sewage water treated in sewage treatment plants (STP treated water and C. Venkateshwar (Professor of Botany) indigenously developed sewage treatment process patented name as CVR - Tech treated sewage water.
One (1) feet unpolluted soil is evenly spread on the base of the STP - treated sewage water tank and on the base of CVR - Tech treated sewage water tank.

A. Rain water of pond of OU used as control water.

The rain water is flown into the OU pond come from Vegetation in open ground of 30 Acres which is situated opposite to physics department of University College of science, Osmania University (Tarnaka, Hyderabad, TS)
The rain water from nearly 30 Acer of space flows directly into the pond, but the traffic levels are very high. The road is nearly 1/2 Km only but the Arts college receives nearly 50. Four vehicles and nearly 150/160 two wheeler daily. Besides this the regularly 1000-1500 four wheelers and are 3000 to 4000 two wheelers this was the daily phenomena for the last 100 years. Due to the recently second road has been started from back side of the Arts college, that road is 1/2 Km away from the tank.
The overall the area receives maximum rain and all that flows directly into the pond only. This was happening for the last 100 years. The pond received water used to exist for six months i.e. for rain season and gets dried up because there in no way to release out the water.



Experimental site Osmania University Campus with locations

However, the pond water of 10, 00,000 approximately exists in the pond which is used as control water for the experiment.
B. Sewage water treatment plant (STP).
The Necklace Road 20 MLD STP working at kairathabad on Bulkampet in let nala of Hussainsagar Lake. The Khairathabad (Hyderabad, Telangana State, India) nala having inflow of 100 MLD (million liters per day). But 20 MLD is passed through various gut chamber screening equipment to remove various floating and suspended unwanted substances (Pre-primary cut chamber) then the sewage water enter into the equalizer tank where stored for removal of big particles to remove (primary treatment) then sewage water enters in to the aeration tank where external air is pumped into the sewage water where the aerobic bacteria oxidizes the hydro carbons of the sewage water, the agitation too helps in oxidation but unable to treat heavy metals (in the secondary treatment). Then intermediary treatment phosphorous, nitrogen and other are removed followed disinfection, after filtration the so called treated sewage water is released in to the streams and nalas. But in this STP treated water microbes, algae, fungi, nutrients (Nitrogen, Ammonia and Phosphorous) and fecal matter of micro - organisms remain in it therefore world over concern is still going on and new technologies are being investigated to overcome this problem of pollution occurring after the biological treatment in STPs.

C. STP AT NECKLACE ROAD, Khairathabad, Hyd.

The treated sewage water has been transported to O.U Campus, cistern of Zoology Department through water tankers and poured 1,000 lts into the cistern.

D. THE SEWAGE WATER TREATMENT PROCEDURE BY CVR TECHNOLOGY.
1. TWO REACTORS/TANKS BATCH PROCESS:

I. Step of treatment: After bar screen the sewage water can be filled into the Tank ‘A’ with known volume of sewage water. Then add AAS (Acidic Aluminum Sulphate 50%) required quantity of chemical AAS 0.5 gm for 1 Lt of sewage water there by the sewage water pH reaches to 5 pH 9it has to be), without increasing the TDS, then stir vigorously for (10-15 mints) so that the added chemical gets mixed properly with the sewage water, after that, immediately impurities of suspended particles and dissolved substance get precipitated and settle down on the bottom of the tank. The Precipitate is nothing but total suspended solid (TSS) Total dissolved solids (TDS). Biological demand of oxygen (BOD) chemical demand of oxygen (COD) phosphates, heavy metals nutrients (Nitrogen, phosphorous, ammonia), algae, fungi, bacteria and other elements gets precipitated as sludge on the bottom of the tank/reactor along with hydrocarbons, nitrogen compounds will be dissociated due to acidic nature thereby ammonia gas formed will escapes into the atmosphere and all heavy metals became sulphates in the sewage water. Then transferred the semi-treated sewage water into the second reactor/tank for the 2nd step of treatment. After shifting the semi-treated sewage water into the 2nd tank. The sludge (precipitate) leftover in the 1st tank has been filtered through sand bed filter, neutralized and composted (Bio gas also possible through this sludge).

II. Step of treatment:

After shifting the semi-treated sewage water into 2nd reactor/tank again add required quantity of 0.1 gm of BCOH (Basic Calcium hydroxide) to the semi-treated water than stir vigorously for 10-15 min. There by TSS, TDS, BOD, COD, phosphates, heavy metals nutrients (Nitrogen, phosphorous, ammonia), algae, fungi, bacteria the heavy metal sulphates dissociate into hydrolyzed and became precipitate along with other left over and other elements get precipitated and settle down at the bottom of the tank/reactor. Similarly the hydrocarbons also get precipitated, nitrogen compounds will be dissociated thereby ammonia gas formed will escapes into the atmosphere from the sewage water. The Sodium and Potassium get precipitated when they are blinded with organic or inorganic compounds but in ionic state they will not be precipitated from sewage water. After treatment the water is stored tank from there one can use it for various usages. The precipitate formed in Ist and the IInd reaction in is mixed together and made 7.2 pH for further use, this type of treatment is called “Zero” discharge process.
The water generated has been tested through third party analysis for conformation (B.S. Enviro lab, Tarnaka, Hyd. Telangana State). Through it is chemical treatment process but after treatment no traces were found in the sewage treated water but they come into the sludge even they are edible chemicals.
Nearly 1, 00,000 lts of treated water filled in the cistern of Department of Botany.CVR - Tech treated sewage water filled and experiments conducted in cistern of Department of Botany under technology transfer, the Pennar, Industry located in Esnapur, R.R. Dist. Adopted the technology and able to treat 60 MLD, sewage water and obtaining the best results, the treated water in Pennar is being used for cropping, fish pond and Gardening. The expenses for the technology are as below.

TABLE NO.1

S.NO	PROCESS	UNITS	LAND REQUIREMENT	CAPITAL COST	O&M COST	EFFLUENT QUALITY BOD REDUCTION	REMARKS
1	Activated sludge process	screen degriting unit primary setting tank aeration tank setting tank sludge pump house. Drying beds this injection unit sludge digestions	2. acres (20,000 Sqm)	15 crores	39.75 laks/month i.e Rs.10.5 KL	upto 85% MPN 103 250-320	Disinfection unit required (additional charges)
2	Extended aeration process	screen degriting unit aeration tank setting tank sludge pump housesludge drying beds disinfection unit.	2. acres (17,500 Sqm)	15 crores	42.0 laks/month i.e Rs.9 KL	upto 97% MPN 103 270-350	Disinfection unit required (additional charges)
3	Innovative Chemical treatment CVR - technology	flash mixture setting tank sludge pump house centrifuge or sand bed filter	1000 sqm	20 crores	13.5 laks/month i.e Rs.6/- KL	up to 98% MPN-0 Ecoli-0	* No separate disinfection unit required

COMPARATIVE STATEMENT FOR 10 MLD of STP and CVR – Technology

Based on sewage water treatment expenses 6 MP/L. The separated sludge is digested in a digester and the left over is converted into manure/ vermin compost. (Zero discharge process). Sampling. The C. Striata fish 100 samples were collected from OU Pond, STP treated water and CVR - Tech treated sewage water. The samples were collected by using fisher men circularly throughing net at various locations of the OU Pond. STP treated tank and CVR - Tech treated water tank. The local fishermen operated fishing the C.Striata trapped in this manner was collected and stored in a cool box filled with ice cubes and then brought to the laboratory.

Observation of Fish samples. The total length (TL) of C. striata individuals were measured using a ruler with an accuracy of 0.1 cm and the weight was measured using a digital scale with an accuracy of 0.1 g. their sex was differentiated based on gonads (ovarian or testicular) presence determination and observation made through abdominal surgery. The results of eolith length and weight measurements between males and females showed no significant difference (t-test, $p<0.05$) so that subsequent analyzes did not distinguish between males and females.

Sediment sampling and sample preparation: - The sediment samples from the top layer (0.15cm) and sub layer (15-30 cm) were sampled separately. The samples were collected by hand - pushing plastic core tubes (7cm diameter) as far as possible into the sediment. The sediment cores retrieved in the field were sliced on arrival at the lab at 1 cm depth intervals for the first 15 cm, 2 cm depth intervals from 15-25 cm, and then every 5 cm for the deeper sections of the cores. Sediment samples from two different layers where mixed thoroughly, packed in polythene bags and kept in a dry place until analyses. Such sampling was done along different locations of the lake for two years, 2017 -2019.

Gross samples drawn for a year wise separately for two years, where air dried, grounded using agate mortar and sieved with a 0.5 mm mesh size sieve to remove stones, plant roots and have sediment sample of uniform particle size. Well-mixed samples of 2 g each were taken in 250 ml glass beakers and digested with 8 ml of aqua regia on a sand bath for 2h. After evaporation to near dryness, the samples where dissolved with 10 mL of 2% nitric acid, filtered through Whitman's No. 1 filter paper and then diluted with deionised water to give final volumes depending on the suspected level of the metals (Chen Mand Ma I.Q, 2001). The samples were subjected to nitric acid digestion using the microwave-assisted technique, setting pressure at 30 bars and power at 700 watts (Paar A, 1998; Clesceri L.S. 1998).

Heavy Metal Analysis by AAS Technique

The analysis for the majority of the trace metals like Copper (Cu), Lead (Pb), Zinc (Zn), Chromium (Cr), Cadmium (Cd), Nickel (Ni) and Cobalt (Co) was done by Flame Atomic Absorption Spectrophotometer. Concentrations of standard solutions. A reagent blank sample was analyzed and subtracted from the samples to correct for reagent impurities and other sources of errors from the environment. Average values of three replicates were taken for each determination per year and calculated average for year and the same repeated then the average of means has been represented for the exposures. The physico-chemical parameters of the three waters were measured in city: pH, EC, TDS, TSS, DO, BOD, COD, TH, Ca, Mg, Cl, Po, SO_4 Ammonical Nitrogen, Na, K, nitrate - nitrogen, nitrite - nitrogen, NH_4-N, and MPN were analyzed as per the procedure described by collection of water samples for APHA standards.

Waste water samples were collected from 2 different sites that is steel plant & that ipudi reservoir of Visakhapatnam city. Samples were collected in good quality screw capped high density pre sterilized polypropylene bottles, each of 1 It capacity, labelled properly and analyzed in laboratory for trace metals by Atomic Absorption Spectrometer (AAS). For assessment of the water quality, monitoring was done during Nov. 2011 to Feb. 2012. High pure (Anal R grade) chemicals and double distilled water were used for preparing solutions for analysis. Preservation and analysis of water samples were based on Standard Methods proposed by American Public Health Association (APHA). The selected heavy metals (Cd, Cr, Cu, Ni, Pb and Zn) were analyzed. The detection of traced metals in the environment are accomplished by various methods but here the AAS technique was used, which is relatively simple, versatile, accurate and free from interferes.

Digestion of Water Sample

The EPA vigorous digestion method described by Gregg (1989) was adopted. 100 mL of each of representative water samples were transferred into Pyrex beakers containing 10 ml of conc. HNO3. The samples were boiled slowly and then evaporated on a hot plate to the lowest possible volume (about 20 ml). The beakers were allowed to cool and another 5 ml of conc. Nitric acid was added. Heating was continued with addition of conc. Nitric acid as necessary until digestion was complete. The samples were evaporated again to dryness (but not baked) and the beakers were cooled, followed by addition of 5 ml of HCl solution (1:1 v/v). The solutions were warmed and 5 ml of 5 M NaOH was added, then filtered. The filtrates were transferred to 100 ml volumetric flasks and diluted to the mark with distilled water. This solution was then used for the elemental analysis.

Analysis of Heavy metals (Pb, Cu, Cd, Zn and Hg) has been done by using Atomic absorption spectroscopy. (Vijendra Singh and E.P. Sing, 2006; W. Robinson; Royal Society of Chemistry, 1992). The work has-been carried out for three months in a year and the calculated the mean and the same repeated for two years then the averages of two years has been represented.

Soil Sediment

Sample collection and preparation: Active surface sediment samples (n = 208) were collected from 0-10 cm depth. Sampling locations were chosen to provide good area coverage (Fig. 1). After sampling, sediment samples were dried in a thermostatically controlled oven for two days at 60^0C temperature. The dried sediments were then disaggregated in a porcelain mortar with a pestle, and sieved through a 2 mm nylon mesh. The samples were subsequently ground in agate swing grinding mill to fine powder for better homogenization of the sample, in order to obtain in representative aliquot for precise analytical results.

Two grams of each powdered sample was weighed using an analytical balance with a precision as low as 0.0001 g. Pressed pellets were afterwards prepared by using collapsible aluminum cups (Krishna et al., 2007). These cups are filled at the bottom with ~2.5 g of boric acid, and the 2g of the fine powdered sample is placed on the top, and "then" pressed under a hydraulic pressure of 25 tons to obtain the pellet of each sample.

Instrumentation: Elemental composition was determined using an X-ray fluorescence spectrometer, type Philips MagiX PRO model PW2440 XRF with Rh 4KW tube. The MagiX PRO is a sequential instrument with a single goniometry-based measuring channel covering the element range from F to U. The instrument is microprocessor controlled for maximum flexibility. Its high level performance enables, therefore, a sensitive and accurate determination of major and trace elements (Co, Cd, Cu, Cr, Ni, Pb and Zn) presented in table 3.

Digestion procedure of fish Tissue samples

Fish gills, kidney, liver, muscle and brain parts were dried in an electric oven at 100 - 105^{0}C until constant weight was obtained. The samples were crushed using a clean mortar and pestle to produce powdered forms. A homogenized 0.5g of each grounded fish, powder sample was weighed using analytical balance. Each of 0.5 g of powder sample was then transferred into a digestion flask into volume 12 mL of a mixture of Nitric acid (70%, Spectosol) and hydrogen peroxide (35%, Riedel-de Haen) prepared in a 1:1 (v/v) ratio was added. The suspended mixture was digested for one hour, until a clear solution was obtained (Larissa et al., 2011). After that, it was allowed to cool and then filtered through Whitman filter paper No. 42. Finally, the filtrate so obtained was diluted to 50 mL in a volumetric flask with deionizer water and analyzed directly by Atomic Absorption Spectrophotometer (Varian AA20 Model).

The fish tissues like gill, muscle, brain liver and kidney were used for bioaccumulation study. The study was carried out once in three months per year and calculated the mean for year then repeated the same for one more year and the average of two means were clubbed and represented as average of means.

3. RESULTS AND DISCUSSION

HEAVY METALS IN WATER

1. Cadmium:

The solubility of cadmium in water is influenced by the nature of source of the cadmium and the acidity of water. Surface water that contain more than a few micrograms along with cadmium per litre have probably been contaminated by discharge of industrial wastes or from soils to which sewage sludge has been added (USPHS 1993). Acute effects have been reported where water has been contaminated with high concentrations of cadmium.

Cadmium ranks 64 in order of abundance in the earth's crust with an average concentration of 0.2 ppm (Taylor, 1964). The Cadmium concentration in polluted and also in fresh water may exceed the baseline levels (0.01-0.4 ppm) by several orders of magnitude. Norris et.al (1981) found filterable cadmium concentrations of 1.5 to 8.1 ppm in the South Esk River below where it was polluted as a result of tin and tungsten mining activities. The cadmium concentrations in Missouri, Lower Rhine, Mense, Necker and Coer D' Alene rivers reported to be 0.0008 ppm, 0.0055 ppm, 0.010 ppm, 0.22 ppm, and 0.450 ppm respectively (Forstner, 1980). Similarly, Moore and Ramamurthy (1984) reported cadmium concentrations up to 0.017 ppm in rivers and lakes of USA receiving mixed industrial effluents. In river Kalu. India the cadmium levels were reported as 0.01-0.12 ppm (Mhatre and Chaphekar, 1980). Durum etal. (1971) observed a medium concentration 1 mg/l in reconnaissance of metal contents of U.S. surface waters. NAS-NAL (1973) reports recommended upper limit for irrigation water is 10 mg/l.

WHO (1976) reported that Cd concentration should not exceed the maximum of 0.01 ppm in low drinking water supply and 0.5 ppm in irrigation water USEPA (1979) recommended maximum permissible Cd concentration as 0.04 and 0.02 ppm to protect aquatic life including Fish. The Cd levels in the present study were more than the recommended levels of USEPA (1979). Cd pollution resulted in the deterioration of the bones, weakening of joints, extreme pain, kidney damages and decrease in the body weight (Friberg, 1978).

In the present study the heavy metal Cadmium content 0.0455 +_ 0.0025 in control, was lesser than 1.09 +_ 0.053 of STP sw but higher than 0.02 +_ 0.005 of CVR-Techs W, however except CVR-Tech value all the values were exceeding the STP re-use water (0.01) EIA (0.1) and WHO standard (0.05). The highest content observed in STPSW and lowest in CVR-Tech sw. The Cd difference between the mean values of control and STPSW water were found to be significant during 2017-19 (1-332 24, df-10, P<0.05). The mean values between control and CVR-Tech sw water differed significantly during 2017-19 (t-203.64, df-10, P<0.05) (Table 2).

2. Cobalt:

The concentration of total cobalt in fresh waters is generally low (ug/L). Higher concentrations are generally associated with industrialized or mining areas. Concentrations of cobalt ranging from non- detectable (diction limit 0.1 ug/L) to 27, 0000 ug/l. Have been measured; the total and dissolved in ambient, uncontaminated environments are, however, generally below 5 ug/L. Cobalt is also found in low concentration in marine waters. Municipal and industrial wastes and effluents are primary sources of anthropogenic in the environment. Anthropogenic emissions, largely the burning of fossil fuels, account for 55% of all cobalt in the air. Windborne soil particles and sea salt spray are primary natural sources of cobalt to the atmosphere. Drinking water quality guideline for cobalt was not recommended due to lack of data in the literature. It is recommended that the interim maximum concentration of total cobalt should not exceed 110 ug/L to protect aquatic life in the freshwater environment from acute effects of cobalt. Heavy metal status of sediment in river Cauvery, Karnataka. In the present study the heavy Cobalt, (Co) value 0.366+_ 0.007 in control, was lower than 0.657+_ 0.028 of STPSW but higher than 0.045+_ 0.006 of CVR-Tech sw, however CVR-Techsw; found lowest content of Cobalt in water and the highest observed in STPSW. However, except CVR-Tech sw other two controls and STPSW values were exceeded the STP reuse water standards

The difference between the mean values of control and STPSW water were found to be significant during 2017-19 (1-9.8703, df=10, P<0.05). The mean values between control and CVR-Tech sw water differed significantly during 2017-19 (1-5.8273, DF=10, P<0.05) (Table 2)

3. Chromium:
Many authorities agree that chromium is used widely in domestic and industrial products. Hexavalent (Cr), is toxic and trivalent (Cr") is an essential nutrient. Chromium is the seventh most abundant element on each. Hexavalent chromium added to soils may be leached, reduced, absorbed, precipitated, or taken up by living organism (Bartlett and James, 1988), Chromium contaminated sediments may act as toxicant sense by releasing chromium to interstitial sediment poorer pore waters. Concentrations of chromium in natural water that have not been affecting by waste disposal are commonly less than 10 ug/l. The median value for the public water supplied was 0.43 ug/l (Beker and Summer Son 1961). Durum and Haffty (1963) reported 5.8 ug/l of Cr in North American rivers. Chromium enters the environment through natural and anthropogenic sources (Abbasi et al 1991). In fresh water, instances of anthropogenic ally introduced chromium contamination are occurring with increasing frequency. In polluted fresh water chromium levels up to 371 ppm recorded in river Iraja, Rio-de Janerio (Pfeiffer et al, 1980). In lake Balaton the levels of Chromium reported between 0.27-9,6 ppm, (Kovacs et al 1982). Elwood et al (1980) found 0.22 ppm of chromium levels in the White Oak Lake:

The chromium levels in the sediments of Little Centre Lake found 2330 ppm Pfeiffer et al (1980) reported 210-70000 ppm Chromium levels in Iraza Lake. Duval et al (1980) studied water bodies which receiving the tannery wastes found 25,000 mg/kg of Chromium in the sediment and similarly Brayan et al (1983) reported 30-52 mg/kg of chromium levels in sediments of lakes in UK.

USEPA (1976) and ISA (1982) recommended 0.05 ppm of Cr in drinking water. Taylor et al (1979) reported that maximum allowable concentration of 0.1 ppm Cr recommended for irrigation water. Cr toxicity results in irritation of gastrointestinal mucosa, bronchopneumonia. Chronic bronchitis and tracheitis, Sudha Rani (2003) studied on the concentration of heavy metals in the highly polluted lake water, shown high content of heavy metals manganese, chromium, zinc, molybdenum, lead, cobalt, cadmium and iron, in this very high content of Fe, Zn & Co.
In the present study the heavy metal Chromium (Cr), value 0.533+_ 0.41 lower than the 5.34 +_ 0.041 of STPSW, but the lower than 0.073 +_ 0.004 of CVR - Tech, with this except CVR -Techsw value, the control and STPsw were exceeded the standards of STP-re-ut. use water (0.1), EiA (0.5) but all the three water value exceeded the WHO standard (0.003). The highest value observed in STPSW (Zn) and the lowest in CVR - Tech (Pb). The Cr difference between the mean values of control and STPSW water were found to be significant during 2017-19 (1-258.80, df-10. P<0.05). The mean values between control and CVR - Tech sw water differed significantly during 2017-19 (t-141.76, df-10, P<0.05) (Table. 2)

4. Copper (Cu):
Copper is naturally occurring in many waters. Water can be a significant source of copper intake depending upon the geographic location, water character, water temperature and the presence of copper pipes. The average copper level in potable waters is 0.03 mg/l and will range up to 0.6 mg/l in natural water from some areas. At levels above Img/l, copper can stain laundry and plumbing fixtures. Copper can also cause a greenish/blue tint to blond hair. Copper is an essential element at lower levels but levels above 5mg/l can cause gastrointestinal disturbances or other acute toxic effects. Copper occurs in nature as the metal and in minerals, most commonly cuprite (Cu_2O) and malachite (Cu, CO, (OH)2). The principal copper ores are sulphides, oxides and carbonates.

Allan (1975) reported high concentrations of 21, 000 mg/Kg of Copper in lake sediments in and around mining process areas of Canada. Thornton (1979) found 7.70 mg/kg of copper in sediments of streams in Wales and England. Johnson et al (1987) reported 707-2531 mg/kg of Copper in sediments in lakes of Swedan. Cruz et al (1994) found that the sediments of Lake Asosca, Nicaragu ranged between 36.6-73.7 mg/kg of copper.

Bodruzzaman et al (1999) reported that copper in the most common among the heavy metals and is toxic, found in trace amounts. They reported that maximum Cu concentrations as 59.45 and 52.28 mg/kg found in the top and bottom layers of sediment in Dhanmondi lake and 44.77 and 46.21 mg/kg of Cu in the sediment of Ramna lake, which was due to the industrial effluents and sewage entering into this lakes.

Copper reaches the aquatic environment through land run off, industrial, domestic and agricultural waste disposal Turekian (1969) reported that levels of copper 10 ug/l can be commonly expected in river water. Durfor and Becker (1964) gave a medium value of 8.3 ug/l for treated water from the public supply systems in the United States. Schroeder et al (1966) reported 50-100 ppm and 1 -7 ppm of copper levels against contaminated and non-contaminated water bodies.

Gallaway (1972) estimated that about 42,000 tonnes/year of copper released in to the environment through sewage. In fresh water receiving copper containing wastes from industrial and sewage wastes from municipal sectors the copper concentration up to 104.0 ppm reported in Common river. England by (Johnson and Thornton, 1987). Cruz et al (1994) found 2.0 ppm to 13.1 ppm of copper in Lake Asosca, Nicaragu.
In the present study the heavy metal copper exists in dissolved condition, in water 1.893 to 49 was observed in control water which was lesser than 25.36+_ 0.28 of STPSW, but higher than 0.745 +_ 0.004 of CVR - Tech sw, these all the values were exceeded the STP - reuse water (0.2), EIA (0.5) and also WHO (0.02) standards.

The Cu difference between the mean values of control and STPSW water were found to be significant during 2017-19 (t=4.0024, DF=10. P<0.05) the mean values between control and CVR - Tech sw water differed insignificantly during 2017-19 (t-2.0382, df-10, P>0.05).

5. Nickel (Ni):

Various activities release the nickel into the environment. Among them most common are discharge of industrial effluents containing nickel (>0.2-900 ppm), storm water run flow (0.009-0.58 ppm), sewage and sludge (20-8000 ppm) (Harrison, 1979). In Diyals lake Nickel ranged from 0.05 to 1.7 ppm (Khalaf et. al. 1984). In Canada, Lake Balaton ranged from 0.33-1.8 ppm (Kovacs et. al. 1982) and Lake Thampson ranged from 0.02 ppm (Moore, 1981).

In the present study the concentration of nickel in water was high due to the accumulation of heavy metals in the lake because of the discharge of sewage and industrial effluents in to the lake.

The World Health Organization (WHO) classified nickel compounds in Group 1 (human carcinogens) and metallic nickel in group 2 B (VSPHS 1993). Nickel is ubiquitous in the biosphere, Nickel is essential for the normal growth of many species, micro-organisms and vertebrates (NAS, 1975; USEPA, 1980; WHO, 1991, USPHS, 1993). Nickel enters natural waterways from sewage waste water because it is poorly removed by treatment process (Cain and Pafford, 1981). In Canada natural waters near industrial sites contained 50 to 2000 ug Ni/L (Chan and Kulikovsky-Cordicino, 1995).

Sediments from nickel contaminated sites have between 20 to 5000 mg of Ni/kg DW. These values were at least 100 times lower at comparable uncontaminated sites (Chan and Kulikovsky-Cardicro. 1995). Moore (1981) reported 45 mg/kg of Nickel in Thompson lake sediments in Canada. Similarly studies on Sudburry lake sediment reported as 1800 ppm of Nickel by Stokes and Szokali. (1977). Proctor et al (1976) reported 10-30 ppm in Missori Streams in USA.

Heavy metal pollution in the water of major canals originating from the river Yamuna in Haryana was studied. All these metals except Zn were found to be present in the Western Yamuna Canal (WYC) exceeding the maximum permissible limits. Concentrations of the metals were, however, relatively less in the highly eutrophicated water of Agra canal and Gurgaon canal as compared to that in WYC but Fe concentration were much higher (Kaushik 2003).

Tropic status of the lake is determined by physico-chemical and biological parameters which are interlinked with each other. On the basis of nutrient levels, they can be classified as oligo tropic (nutrient poor) eutrophic (nutrient rich) and senescent (Oldest with thick organic matter) lakes. Eutrophication is a treat to the conservation of natural communities. Since, it reduces the diversity of fresh water ecosystem. The process is both a physico-chemical as well as biological process; hence both criteria have been used. According to Wetzel (1975), the lakes are placed under oligo-eutrophic series, when they are found to be rich in bicarbonates calcium and phosphates but poor in the concentration of nitrates. According to Saha and Sinha (1969), high calcium content is an indicator of eutrophic waters.

During the present investigation all the water quality parameters are high and exceeding the permissible limits prescribed by Central Pollution Control Board (CPCB) and Indian Standards (IS). The results clearly indicate that, the lake was severely polluted due to sewage and other.

In the present study the heavy metal Ni content very high, 7.525+_ 0.738 in STPSW, was higher than 4.664+_0.550 of control and also 1.963+_ 0.061 of CVR - Techsw, however, all the values of STSW, CVR-Tech and control values were exceeded than the standards of STP reuse water (0.2) EIA (0.5) and WHO (0.02) Table2.

The highest Ni content was noticed in STPSW and the lowest in CVR-Tech. The difference between the mean values of control and STPSW water were found to be insignificant during 2017-19 (-1.28, df-10, P>0.05) The mean values between control and CVR-Tech sw water differed insignificantly during 2017-19 (-1.5661, dr-10, P>0.05) (Table 2).

6. Lead:

In water, lead is probably complexes with organic ligands giving soluble, colloidal and particulate compounds, the exact nature of these ligands is not known, although it is known that lead is sorbet by humid acids when not complexes, some of the main species of lead in solution are probably $PbCl_2$ lead acetate, lead nitrate. According to Bowen (1960), the lead concentration in natural waters ranged from 0.0006 ppm to 0.12 ppm. In a survey of stream waters in the USA. Kopp and Kroner (1970) found an average concentration of 0.023 ppm lead. Whereas the 0.03 ppm of concentration reported in a Japanese river, Maume (Kopp and Krener, 1970).Somasekar et al., 1982 found that range of lead was between 0.143-0.278 in river Kapila, India. Mhatre and Chaphekar (1980) reported 0.69 ppm lead in river Kalu, India.

Buckenberger et al., (1972) reported 0.5 ppm of Pb in lake Neveda, California and Durum (1971) revealed that dissolved lead concentrations of surface water of United States were 1 ug/l. Fishman and Herm (1976) stated occasional concentrations of dissolved lead in excess of 10 ug/l at many river-sampling stations in the NASQAN network.

In the sediments of polluted water bodies in industrial area in Greece, Scoullos (1986) found 500-600 ug/kg/dry wt lead. In United States, Hart (1982) reported 0.0003-0.03 ppm of Pb sediment in natural freshwater while Forstner 1980 reported these levels as 0.002 ppm. Bowen (1960) reported 2-200 ppm of Pb in the world soils. Lead pollution resulted the damage of central nervous system in human beings, especially in children (Piska et al, 2004). In the present study the concentration of lead was high in water. This may be due to the discharge of sewage and industrial effluents into the lake.

Lead (Pb). In the present study the heavy metal Pb content observed 3.421 +_ 0.015 in STPSW higher than 1.555 +_0.002 of control and 0.082 +_0.006 of CVR-Tech sw, but all the values of control and STPsw were exceeded than the STP reuse water (0.01), and WHO (0.01) but the value of CVR-Tech sw was not exceeded than the EIA standard. The higher content of lead in STPsw was noticed and the lowest in CVR-Tech.

The Pb difference between the mean values of control and STPSW water were found to significant during 2017-2019 (t-9.4589, df-10. P<0.05) the mean values between control and CVR-Techsw water differed insignificantly during 2017-2019 (1-7.6798, df-10, P<0.05) (Table 2)

7. Zinc (Zn):

Zinc ubiquitous element, the earth's crust is estimated at 70 (Abbasi, 1989. Abbasi Soni, 1986 Levinson, percent of the earth's crust and the order abundance (Abbasi, 1989, Abbasi Soni, 1986). Zinc levels in 76.5 percent 1600 water samples United States ranged from <0.002 to 1.183 ppm, with mean (Ko00. 1970). Shepherd et (1980) reported 0.293 ppm zinc lake Palestine, Indiana and in Lake Thompson Canada 0.01-0.04 ppm Zn reported Moore (1981). Forstner (1976) reported Zn enrichment of 2.5-6.0 Lake Michigan, Lake Erie, this enrichment was mainly concentration ug/L all waters.

Abbasi et al. Studied seasonal variation of layers Kuttiadi lake North kerala, India, levels ranged 0.015-0.92, 0.018-0.15 ppm. The highest zinc observed during monsoons.

Maxfield (1974) 3200-4700 ppm Zinc levels in the sediment Coer Lake. Harding and Whitton reported 1035 mg/L Zinc the sediments polluted ppm Thompson lake Canada. Seidmann found 12.5 - 15.1 zinc in Jamaica Newyork, USA was due sewage effluent carried the largest quantities Zn the Bay. Aquatic populations frequently determinate in Zn polluted waters. Zinc in the aquatic environment is of particular importance because the gills of fish are physically damaged by high concentrations of zinc (NAS, 1979). Zinc discharged into global environment at a yearly rate estimated at 8.8 million tons; 96% of total was result of human activities (Leonard and Gerber, 1989). Zinc was ubiquitous in the tissues of plants and animals (Rosser and George, 1986) and was essential for normal growth, reproduction and wound healing (Prasad, 1979). Aquatic plants and fish relatively unaffected by suspended zinc, but many aquatic invertebrates and some fishes may adversely affect if they ingest enough zinc containing particulates (USEPA, 1987).

Zinc toxicities affect fresh water fishes by destruction of gill epithelium and consequent tissue hypoxia. Signs of acute zinc toxicities in fresh water fishes include osmo regulatory failure, acidosis and low oxygen tensions in arterial blood and disrupted gas exchange at the gill surface and at internal tissue sites (Spear, 1981).
In the present study the heavy metal Zn content in water observed 21.25 +_ 0.34 in STPSW was higher than 3.985 +_ 0.045 of control and 2.830 +_ 0.951 of CVR - Tech sw, however, values of control and STPSW were exceeded the standards of STP re-use water (2) EIA (2), but the value of CVR-Techsw was not exceeded the WHO standard (3). The total heavy metals content in water was very high 62.842 in STPSW. Very low in CVR-Techsw. based on EIA standard total heavy metal content in any treated Domestic sewage water, waste water contaminated storm water discharge into surface water for general application limit is 10 mg/L is specified, hence in comparison with that standard, except CVR-Techsw all the values of control and STPSW were exceed. (Table - 2).

TABLE NO.2
Mean average of control STP treated sewage water and CVR -technology treated sewage water Heavy metals and 2021-2022 were clubbed together than represented with average mean and SD for 2019-2020

S.NO	HEAVY METALS	MEAN+SD. OU POND CONTROL	STP WATER	CVR-TECH WATER	STP WATER REUSE STANDARDS	GUIDELINES EIA-WWTs	WHO STANDARD S
1	Cd (mg/L)	0.9455±0.0025	1.089±0.053	0.021±0.005	0.01	0.1	0.005
2	Co(mg/L)	0.366±0.007	0.657±0.028	0.045±0.006	0.05	-	-
3	Cr(mg/L)	0.533±0.41	5.034±0.041	0.073±0.004	0.1	0.5	0.063
4	Cu(mg/L)	3.891±0.49	25.367±0.738	0.745±0.004	0.2	0.5	0.02
5	Ni(mg/L)	4.654±0.550	7.525±0.738	1.963±0.61	0.2	0.5	0.02
6	Pb(mg/L)	1.555±0.002	3.921±0.015	0.082±0.006	0.01	0.1	0.01
7	Zn(mg/L)	6.985±0.045	21.25±0.34	2.830±0.451	2	2	3
8	Total heavy metals	14.042	62.842	0.78	2.57	3.7	3.103

The Zn difference between the mean values control and STPSW water were found to significant during 2017-2019 9-6.3246, di P<0.05). The mean values between control and CVR-Techsw water differed significantly during 2017-19 (-4, 8788, df-10, P<0.05).

SOIL SEDIMENTATION

Sediment contamination constitutes one of the worst environmental problems in marine ecosystems, acting as sinks and sources of contaminants in aquatic systems (Adams et al., 1992; Mucha et al., 2003) Sediments are preferred monitoring tools, since contaminant concentrations are orders of magnitude higher than in water, and they show less variation in time and space, allowing more consistent assessment of spatial and temporal contamination (Thornton and Webb. 1979; Howarth and Thornton, 1983; Tuncer et al., 2001; Caccia et al., 2003).

The Soil sedimentation values in control (OU pond), STPws tank and in CVR-Techsw tank are represented mean and SD values of 2017-2018 and 2018-2018 are added together than the averages of mean and SD valves are presented in Table 3.

1. Cadmium (Cd):

In the present study the Cadmium in the sediment was 1.385 +- 0.035 in control higher than 0.73+-0.032 of STPws and 0.72+-0.025 of CVR -Tech. The Cadmium content has been not exceeded than the EPA guide lines (<6).

In sediments, the cadmium levels may exceed the base line levels Bloom (1975) reported levels as high as 862 ppm in sediments from the Perwent Estuary, Hobart, below on electrolyte zinc wales and Norris et al (1981) found levels up to 133 ppm in sediments of the River South Esk, Tasmania. Beyer (1990) reported the levels of cadmium were more than mg Cd/kg in sediments of great lakes.

The difference between the mean values of Cr control and STPsw sediment of water were found to be significant during 2017-19 (t-5.2351, df 10, P<0.05). The mean values betweeen control and CVR-Techsw sediment of significantly during 2017-19. (1-7.0589, df-10, P<0.05) The difference between the mean values of STPsw and CVR-Techsw sediment of found to be significant during 2017-19. (- 3.8579, DF 10. P<0.05).

2. Cobalt (CO):

In the present study heavy metal Cobalt, 1.5 ± 0.12 in control, higher than 0.34 ± 0.081 of STPsw and CVR-Tech sw; Chromium 7.28 ± 0.47 ppm. Higher than 0.2 ± 0.008 of STPSW and CVR-Techsw. Both metal distributions were similar (cor-relation factor = 0.87), with the highest values localized in the internal part near to a waste metal recovery factory and decreasing toward the ria mouth. Nevertheless, along the northern margin in the middle ria, another Ni (35-40 ug g^{-1}) and Co (11-12 ug g^{-1}) increase was observed in the port area. A similar cobalt variation was also detected on the southern margin in the shipyard zone. Finally, the lowest metal presence occurred in the ria mouth (10-20 ug Ni g^{-1} and 5-7 ug Co g^{-1}), as was typical for other metals in the rias (Herbello et al., 1998) Ria-ocean zones poor in nickel and cobalt imply.

The Cobalt mean values between control and CVR-Techsw seemed of water differed significantly during 2017-19 (1-40.805, df 10, P<0.05). The difference between the mean values of STPsw and CVR-Tech sw sediment of water were found to be significant during 2017-19 (1-57.452, DF - 10, P<0.05).

3. Chromium (Cr):

Cr values in waiapalli water shed, nalgonda dist. AP. India. was ranged from 15.8 to 107.8 ppm, with an average of 60.6 ppm and is considerably little bit higher in the area surrounded by granitic rock, where normally Cr concentration was always below 50 ppm in granites (Keshav Krishna el al (2010). In the present study Cr content in sediment was 7.28 ± 0.47 in control higher than 0.20.008 of STPsw and 0.17 ± 0.055 of CVR-Tech, however all the sediment valves were within the permeable limit of EPA guide line (25-75 ppm

4. Copper (Cu):

In the present study the heavy metal Cobalt value in water was 6.94±0.19 control value higher than 0.37±0.021 ppm of STPsw and 0.66±0.046 of CVR-Tech, however all the exposure values are within the limit of EPA standard (25 - 50 ppm); The method was applied to the determination of nickel and cobalt in marine surface sediment samples from the Ria Ferrol. The distribution of nickel and cobalt in surface sediments is shown on the maps in Fig.4. Concentrations ranged between 11.3 and 67.2 ug g^{-1} for Ni and 5.0 and 21.0 ug g^{-1} for Co, with an average ria concentration of 32 ug g^{-1} for Ni and 10 ug g^{-1} for Co, and are inside the typical variation of UK estuarine concentrations; 14-58 and 6-26 ug g^{-1} for Ni and Co, respectively (Bryan and Langston, 1992). Higher ranges of 34-46 ug Ni g^{-1} and 11-15 ug Co g^{-1} for the same <63 um fraction have been recorded by Caballero et al. (1997) in five intertidal surface sediment samples in the Ria Ferrol.

The difference between the mean values of Copper in control and STPSW sediment were found to be significant during 2017-19 (1-34.748, df-10 P<0.05) the mean values between control and CVR-Tech sw copper in sediment differed significantly during 2017-19 (18.943, df-10 P<0.05). The difference between the mean values of STPSW and CVR-Techsw sediment were found, to be significant during 2017-19 (1-36,092, dr-10. P<0.05).

5. Nickel (Ni) :

The lowest metal (10-20 ug Ni g^{-1} and 5-7 ug Co g^{-1}) as was typical for other metals in the ria region (Herbello et al 1998). Sediments from nickel contaminated sites have between 20 to 5,000 ng of Ni/kg dry weight; these values were at least 100 times lower at comparable uncontaminated sites (Chan and Kulikovsky-Cardicro, 1995). Moore (1981) reported 45 mg/kg of Nickel in Thompson lake sediments in Canada. Similarly studies on Sudburry lake sediment reported as 1800 ppm of Nickel by Strokes and Szokali, (1977). Proctor et al., (1976) reported 10-30 in Missori Streams in USA In the present study the sediment content of Ni was 5.02±0.11 in control higher than 0.37±0.045 of STPSW and 0.33±0.066 of CVR-Tech sw, these all the sediment values are within the permissible limits of EPA standard (20-50 ppm).

The mean values of sediment between control and CVR-Techsw differed significantly during 2017-19 (1-2.5033, df-10, P<0.05) The difference between the mean values of STPsw and CVR-Techsw sediments were found to the significant during 2017-19 (1-, di-10, P<0.05).

6. Lead (Pb) :

In the present study the soil sediments are the major storing site of metals, holding more than 99% of the total amount of metals in the aquatic systems (Doong et al (2008). In addition, heavy rainfall leads to farm draining. It results in large amounts of pesticide-containing metal compounds, which are brought via surface runoff from the farms to the river and increases agriculture pollution. Trace element contaminated sediment may act as a secondary pollution source for the aquatic ecosystem, and elements concentrations in sediment are also helpful for estimating pollution trends (Odiete, 1999). Lead content 10.27±0.14 of control was higher than 0.55±0.018 of STPsw and 0.51±0.072 of CVR-Tech sw, but all these values are within the permissible limit of EPA guide line standard (40-60 ppm).

The mean values of Ni in sediment between control and CVR-Techsw differed significantly during 2017-19 (1=13,555, df-10, P<0.05). The difference between the mean values of STPsw and CVR-Techsw sediments were found to be significant during 2017-19 (1-3.529, df-10, P<0.05).

7. Zinc (Zn):

In the present study the Zn content in sediment was very high due to precipitation in basic waters of lakes.
Maxfield et al (1974) reported 3200-4700 ppm of Zinc levels in the sediment of Coer Lake. Harding and Whitton (1977) reported 1035 mg/L of Zinc in the sediments of polluted Derwent reservoir, United Kingdom. Moore (1981) found 65-225 ppm in the Thompson Lake in Canada. It is found 12.5 - 15.1 ppm of zinc in the Jamaica Bay sediments in Newyork, USA was due to sewage effluent carried the largest quantities of Zn to the Bay.
The content of Zinc 23.78±0.39 higher than 0.39±0.074 of STPWS and 0.31±0.068 of CVR-Techws.
KIDNEY The difference between the mean values of control and TPSW water were found to be significant during 2017-19 (1-3.535. df-10, P<0.05). The mean values between control and CVR-Techsw water differed significantly during 2017-19 (1-3.538, df-10, P<0.05). The difference between the mean values of STPSW and CVR-Techsw water were found to be significant during 2017-19 (t-3.529, df-10, P<0.05).

Growth comparison of Channa striata in different water
The finger lings were too small hence ten (10) member were weighted at a time with great patience because those were very active and jumping out of balance however the weight of the fish were calculated and representing Mean +SD of two years data .first individual 2019-2020 readings were taken mean +SD than both the years of 2019-2020 + 2020-2021 were clubbed together as an average of Mean+SD of both years.
The initial weight of Channa striata was -13.52 grm.

Table -3 (A) Channa striata final weights

S.NO	EXPOSURE OF THREE WATERS	SMALL		MEDIUM		BIG	
		mm	Weight	mm	Weight	mm	Weight
1	OU POND CONTROL WATER	150-200	227.7g	210-300	350g	310-340	600g
2	STP TREATED WATER	150-200	250g	210-300	300g	310-340	550g
3	CV -TECHNONOLOGY TREATED WATER	150-200	320.5g	210-300	460g	310-340	720g

Table 3. (B) MEAN+SD of OU pond, STPSW and CVR-Technology tank 2019-2022.

MEAN + SD				
METAL	CONTROL OU POND	STPSW	CVR-TECH -SW	EPA- GUIDELINES
Cd	1.385±0.035	0.73±0.032	0.72±0.025	<6
Co	1.5±0.12	0.34±0.081	0.31±0.043	-
Cr	7.28±0.47	0.2±0.008	0.170.055	25-75
Cu	6.94±0.19	0.37±0.021	0.36±0.046	25-50
Ni	5.02±0.11	0.37±0.045	0.33±0.066	20-50
Pb	10.27±0.14	0.55±0.018	0.51±0.072	40-60
Zn	23.78±0.39	0.39±0.074	0.31±0.068	-

All the values are with ppm and also in ppm
Fish data: The no. of C.Striata population based on sex distribution was females (25 No.) were higher than males (20 No. And number of fish was 45 and the percentage wise females percentage (55%) was higher than the male (44%) percentage and observed the ratio was 0.8 in control. Whereas males (23 No.) were dominated over females (22 No.) distributed and Females (52%) percentage dominated over males (48 No.) in percentage and the ratio was 1:04 in STPsw and there was reverse condition to the STPsw observed in CVR-Tech and the ratio was 0.9 in CVR-Tech, in distribution of C. Striata (Table 4).

Table 4. Percentage of male and female in three waters						
EXPOSURE	MALE	FEMALE	NUMBER OF FISH	% MALE	% FEMALE	SEX RATIO
OU POND CONTROL	20	25	45	44	55	0.8
STP TREATED WATER	13	12	45	52	48	1.04
CV -TECHNONOLOGY TREATED WATER	22	23	45	48	51	0.9
	55	60	135	144	154	2.74

The length and frequency distribution of C. Striata observed that the fish was 15com to 31 cm were 16 in no were small and 21 cm to 30 cm were in 40 in number were medium in length and 31 cm to 34 cm were 44 in number noticed in control; whereas 15 cm to 28 cm were 28 in number small fish and 20 cm to 30 cm were 40 in number of medium fish and 31 cm to 34 cm were 30, in number of big fish in STPSW but 15 cm to 20 cm were 24 in no. small fish and 20 cm to 30 cm 50 in no. of medium fish and 31 to 42 cm 36 in no. of big fish were observed in CVR-Techsw. The small fish (28 No.) were more in STPsw and lower (16 No) in control where as medium lengthier fish were more (50 in No.) in CVR-Techsw but big fish were (44 in No.) followed (36 in No) CVR-Techsw fish

Table 5. spatial distribution of C. Striata by length in three sessions of three waters Mean+SD of individual 2019-2020 and 2020-2021 years are clubbed and the averages are								
S.NO	EXPOSURE	SMALL	15-20 CM	MEDIUM	21-30 CM	BIG	31-45 CM	TOTAL
1	OU POND CONTROL	150-200mm	16	210-300 mm	40	320-340 mm	44	100
2	STP TREATED WATER	150-200mm	28	210-300 mm	42	320-340 mm	30	100
3	CV -TECHNONOLOGY TREATED WATER	150-200mm	24	210-300 mm	40	320-340 mm	36	100
			68		132		110	

The weight and distribution of C. Striata observed that the fish was 170-200 gr. of 14 no. of small fish and 201-253 gr of 42 No. of medium fish and 254-309 gr. of 44 No. of fish observed in control where as 140-180 gr. of 29 No. of small fish and 181 gr to 200 gr of 41 no. of medium fish and 201-223 gr of 30 No. of big fish were observed in STPSW but 170 gr to 200 gr of 14 no. of small and 201gr to 280 gr. of 48 No. of medium fish and 281 gr. to 350 gr. of 38 No. of fish were observed in CVR-Tech sw. The 29 No. of small fish observed in STPsw but 48 No. of medium fish observed in CVR-Tech sw, however the 44 No. of big fish were observed in control followed 38 No. of fish of CVR-Tech sw (Table 6).

Table 6. spatial distribution of C. Striata by weight in three sessions of three waters Mean+SD of individual 2019-2020 and 2020-2021 years are clubbed and the averages are								
S.NO	EXPOSURE	SMALL	NO. FISH	MEDIUM	NO. FISH	BIG	NO. FISH	TOTAL
1	OU POND CONTROL	170-208 gr	14	201-253gr	42	254-309gr	44	100
2	STP TREATED WATER	140-180gr	29	181-200gr	41	201-223gr	30	100
3	CV -TECHNONOLOGY TREATED WATER	170-200gr	14	201-280gr	48	281-350gr	38	100

Physico - Chemical Parameters

The Physico-chemical parameters are important and influenced by natural man made and ecological activities. In the present study the PH mean and SD values 7.5±0.59 in control, 7.28±0.60 in CVR-Techsw, 8.08±1.74 basic in STPSW, however natural water bodies represented 6.5 to 8.5 which is also STP standard. (5.5-9) and also 7.2 to 8.7 mg/l suitable for aquatic organisms (Subbamma and Rama Sarma, 1922 and Kelein, 1973)

The pH of wastewater needs to remain between 6 and 9 to protect and be beneficial to organisms (USEPA, 2004). Aquatic organisms are very sensitive to pH changes in their environment because their metabolic activities are pH dependent. The results for pH in this study were slightly higher than the neutral pH but within the permissible standards of decrease of NESREA and WHO of 6 -9 and 6.5 -8.5, respectively. Hence the pH of the wastewater poses no threat to the aquatic organisms and the people using Wupa River. Similar result was recorded by Ogbu et al. (2013)

The alkaline pH provides the growth of natural food organisms and increases the productivity and fish yield. Similar reports made by Devi (1997), Piska et al (2000, 2001). Malu (2001) reported that the higher pH can be attributing to the high rate of photosynthetic activity in plants which will raise the pH. Das et al (2001) observed that pH between 6.5 and 9.0 supports a good fishery. It has direct effect on fish growth as well as on the growth and survival of fish food organisms. The present values obtained are within the guidelines of EIA and STP standards. The difference between the mean values of control and STPSW water were found to be significant during 2017-2019 (t-7.592, df-10, P<0.05). The mean values between control and CVR-Techsw water differed significantly during 2017-19. (T-2.4961, DF=10, p<0.05). (Table 1).

1. Electric Conductivity (EC)

The EC values (in us/cm) 802.2±4.99 in control is higher than 334.95±5.45 of CVR-Techsw but lower than 1.979±5.09 of STPws, according to olawale, 2016 reflects the status of inorganic and organic pollution and is measurement of total dissolved solid and ionisable species present in the water, the pH stands for the potential for Hydrogen ion-concentration in the water.

2. Electric conductivity (EC)

In natural water is the normalized measure of the water's ability to conduct electric current. This is mostly influenced by dissolved salts such as sodium chloride and potassium chloride. The common unit for electrical conductivity is Siemens per meter (S/m) or us/cm. Most freshwater sources will range between 0.001to 0.1S/m.

The EC of water depends on conducting ions present in the water. Conductivity reflects the nutrient status of the water and the distribution of macrophytes. Minimum conductivity may be due to less ingredients in the water it may be due to dilution by monsoon rains.

The conductivity value was high in STPsw (1.979±5.09us/cm) water. Higher values of conductivity may be due to decomposition of macrophytes, dead animals present in the reservoir, evaporation and evaporate-transpiration of the reservoir mainly higher TDS of the water. Conductivity is a good and rapid method to measure the total dissolved solids and is directly related to total solids. Higher the value of dissolved solids, greater will be the amount of greater conductivity ions in water (Bhatt et al. 1999; Piska, 2000).

Unni et al (1998) has reported that seasonal variation of conductivity showed maximum (4949 ms/cm) in summer in Tawa reservoir, Madhya Pradesh may be due to TDS carried by run-off water. The input of nutrient ions through thermal power effluents and its subsequent distribution and dilution resulted in the longitudinal decline of conductivity in the reservoir. Bhopal. Das (2000) studied the limno-chemistry of some important reservoirs of Andhra Pradesh and observed that specific conductivity was in the range of 316 to 610 ms/cm and majority of Indian reservoirs have lower values of specific conductivity as compared to Andhra Pradesh reservoirs. Chary (2003) reported the EC values as 585 - 1210 ms/cm in Durgam Cheruvu reservoir and Rao et al (2002) reported as 1545 to 1810 ms/cm in Julur Tank. In the present study the EC values were within limits of ICAR (1975), WHO (1964).

In the present study the electric conductivity 802.2±1.99 us/cm of control, 1.979 ± 5.09 us/cm of STP sw and 334.95±5.45 us/cm of CVR-Techsw, this indicates that according to Olawale, 2016 conductivity reflects the status of inorganic pollution and is a measure of total dissolved solids (TDS) and ionized species in the water. The high conductivity suggest that considerable amount of dissolved ionic substances present in water.

The EC difference between the mean values of control and STPSW water were found to be significant during 2017-19 (t=102.9912, df-10, P<0.05). The mean values between control and CVR-Techsw water differed significantly during 2017-19 (1-91.975, df-10, P<0.05). (Table-1)

4. CONCLUSION

All heavy metals are within the permissible limits in CV tech treated sewage water and also the fish growth was better than control and STP treated sewage water. Further this CV tech treated sewage water is reusable for fish cropping and also useful for irrigation purpose in water scarcity countries and in water scarcity areas. The STP treated sewage water should not be reused at all, because the heavy metal contamination and also other contaminants exist even after the treatment in the biological treatment process. And also lake such as OU pond water also should not be used because the runoff water collects heavy metals with water currents and also the previous year's deposition and gets dissolved in the water thus contamination occurs hence after the treatment that water can be used

5. ACKNOWLEDGEMENT

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