Abs Nr. OR-002

Reutilization of Industrial Solid Wastes for Industrial Effluent Treatments

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As the problem of solid wastes disposal has now attained complex dimensions, it becomes essential either to find suitable ways for the safe disposal of these wastes or to suggest novel use, considering them as by-products. Otherwise, these will remain as accumulated wastes, contributing significantly to environmental pollution. In the absence of uses for the waste materials there are added costs for building and maintaining the lagoons of these wastes. Finding a profitable use for this waste could further benefit the economics of the industry. Chromium (VI) compounds are used as corrosion inhibitors in cooling water systems in industries.

The wastewater containing Cr (VI) is treated by reducing Cr (VI) to Cr (III) using Fe (II), that is generated electrolytically. Fe (III)/Cr (III) ions produced are precipitated as hydroxide sludge using lime. The resulting Fe (III)/Cr (III) hydroxide sludge is discarded as waste.

In developing countries like India, industries cannot afford to use conventional wastewater treatment chemicals like alum, ferric chloride, polymer flocculants and activated carbon because they are not cost-effective. Among the treatment methods adsorption seems to be an effective method. As the manufacturing and regeneration cost of activated carbon is high, inexpensive and more easily available adsorbents would make the removal of pollutants an economically viable alternative. The abundance and easy availability makes "waste" Fe (III)/Cr (III) hydroxide, a strong candidate in the search for an economical adsorbent to remove heavy metals, dyes and pesticides from wastewaters. Namasivayam and co-workers have employed the "waste" Fe (III)/Cr (III) hydroxide for the treatment of wastewaters from industries such as dyeing, fertilizer, dairy, distillery, electroplating radiator manufacturing and tannery. The non-conventional adsorbent is also capable of removing Hg (II), As (III), As (V), toxic anions and pesticides. The efficiency of these nonconventional adsorbents/flocculants is more or less equal to and sometimes better than commercial adsorbents / flocculants. This paper includes studies on the adsorption kinetics of the removal of heavy metals from water by ‘waste’ Fe (III)/Cr (III) hydroxide and applications to the treatment of real industrial wastewaters containing the heavy metals.

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Abs Nr. OR-006

Geochemical Studies of Groundwater in Saharanpur, Uttar Pradesh

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The geochemical characteristics of ground water in Saharanpur city of Uttar Pradesh have been studied with a set of fifty water samples representing shallow ground water of the area, collected during January and April 2003, which represents a season not characterized by excessive precipitation or evaporation. The samples were analyzed for various water quality parameters such as pH, electric conductivity, total dissolved solids, calcium, magnesium, potassium, bicarbonate, sulphate and chloride. Five other ground water samples were analyzed for Sr isotopic composition. The water is mostly Ca-Mg-HCO_3 type and is derived from the carbonate lithology. A few rainwater samples were also analyzed. Chemical weathering process is the dominating factor for the overall water chemistry, however for the some parameter like SO_4, industrial discharge and/or precipitation could be a major source. Dominance of carbonate lithology on water chemistry is also observed by the Sr isotopic ratios ($^{87}Sr/^{86}Sr$) in waters. The high carbonate contents could be lead to scale formation, which is a major nuisance in the region for the industries.

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Abs Nr. OR-010

Delineation of Fresh Water Aquifers in Ramanathapuram Coast Tamil Nadu Using Vertical Electrical Sounding

K.Vaithiyanathan[1] and J.F.Lawrence[1]

A large part of the world's exploitable water resources is ed as groundwater. Especially in coastal region, fresh water is becoming a rare commodity due to improper ground water management practices. In this work, an attempt has been made to delineate fresh water resource in Ramanathapuram coast, Tamil Nadu using Geophysical Resistivity Method. Vertical Electrical Soundings have been carried out employing Schlumberger array in 50 predetermined locations. The field data have been processed both manually and with computer inversion techniques. With the digital output resistivity maps different layers and isoapparent resistivity maps different depths have been prepared using Surfer and GIS. From the interpretation a few fresh water locations have been identified along the coastal region.

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Abs Nr. OR-013

Concentration of Group iib Metals in the Drinking Water of Bharathiar University, Coimbatore and their Accumulation on a Freshwater Fish *Cyprinus carpio*

R. Rama[1], M. Ramesh[2] and V.Maruthappan[2]

Man's activities are measurably changing the chemical make up of soil, air and water; these changes are increasing with the growing world population and the per capita consumption of energy and materials; everything that Man injects into the biosphere, inorganic, organic or biological may finally reach natural waters. Metals are being used widely in industries like electronics, machines and the artifacts of every day life as well as high tech applications and consequently tend to reach the environment from a vast array of anthropogenic sources as well as natural geo-chemical processes. The metals, which are present in these industrial effluents, may enter into the aquatic ecosystem, which in turn reaches the human system through the food chain.

Among the metals zinc, cadmium and mercury comes under the group IIB metals. Zinc finds wide application in industry; agriculture and medicine and the varied industrial application of zinc stems from its chemical and metallurgical properties; extractive and power industry are the mine source of environmental contamination with zinc. Cadmium a non-essential and non-beneficial element is highly toxic in nature and the volcanic activity, exudates from vegetation, forest fire, wind blow dust and leaching of rocks have resulted with natural cadmium input in the biosphere. Mercury is a highly toxic heavy metal, which is bio-concentrated up through the food chain. A number of industrial process make use of mercury and the mercury containing effluents are discharged into the water body.

Coimbatore is one the leading industrial city in Tamil Nadu. There are more than 25,000 small, medium, large and tiny industries. The water resources include Bhavani, Noyyal and other small and large water bodies. The Noyyal water is highly polluted. Based on the above literature in the present study an attempt was made to study the concentration of zinc, cadmium and mercury in drinking water of Bharathiar University Campus and its accumulation was also noted in a freshwater fish under laboratory condition to implement the lab to field work analysis.

During the above study, a trace amount of zinc was noted in the drinking water (8.13ppm) whereas cadmium and mercury were below the detectable limits. When fishes were exposed to above metals the following accumulation trend was noted in the organs (kidney > liver > gill). The present study clearly indicated that the accumulation of zinc, cadmium and mercury level in freshwater fish are highly

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toxic to human beings. Since, Coimbatore is an industrial city the industries while discharging the effluents should follow the maximum permissible limits recommended by the Tamil Nadu Pollution Control Board.

Abs Nr. OR-014

Enhancement in Quality of Groundwater Due to Revitalization of Percolation Pond – A Case Study in Virudunagar District, Tamil Nadu

B. Umapathi[1] and J. F. Lawrence[2]

Virudunagar district is one of the economically backward and drought prone districts of Tamil Nadu. Hydrogeologicaly it is well known for the poor quality of formation water. The poor quality of formation water is attributed to thick black clay soil.

A pilot scheme was formulated and funded by Central Ground Water Board under Central Sector Scheme to revitalize an existing percolation pond on black clayey soil, which is impervious in nature, in Virudunagar district with the following objectives. i.) Better understanding of revitalization of percolation pond ii.) To study the long-term effects on groundwater regime after revitalization iii) Comparison and correlation of revitalized percolation ponds and non-revitalized ones iv.) Assess the economics of revitalization and v.) Study the possibilities of scope of extending revitalization to other similar areas.

A percolation pond at Vadapatti village, Sivakasi block, and Virudunagar district was selected and civil work was under taken by Agricultural Engineering Department. The criteria adopted for selection of percolation pond, the design of revitalizing structure, the impact on quality of formation water are discussed in this paper. The electrical conductivity of groundwater in the vicinity of percolation pond during pre monsoon prior to revitalization of percolation of pond was in the range of 1600 to 4500 micro siemens / cm at 25^0 C whereas after the revitalization of percolation pond the electrical conductivity of formation water was observed to be between 700 to 3300 micro siemens / cm at 25^0 C.

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Abs Nr. OR-015

Heavy Metal Contamination in the Groundwater of Tamil Nadu State, India

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Heavy metals, recognized as highly toxic and dangerous pollutants are placed second only to pesticides in environmental importance. The most important feature distinguishing metals from other toxic pollutants is that metals are not biodegradable, and they tend to bioaccumulate in different aquatic biota. Most of the heavy metals are essential at low levels, whereas at high concentration levels they become toxic. The toxicity of metal ranges from disruption of normal body functions to mutagenic, carcinogenic and teratogenic effects. Generally in natural waters the concentration of heavy metal are found to be low with the exception of Iron and manganese. Anthropogenic activities have increased the concentration of these metals to a considerable level in the aquatic environment.

Tamil Nadu is one of the industrialized states of India. The major polluting industrial sectors in the state are tanneries located in the districts of Vellore, Dindigul, Chrompet and Madhavaram in the suburban of Chennai, Textile industries located at the banks of Noyil river in Tirrupur town and in Erode district, Petrochemical, Fertilizer and other large and small scale metal based industries located in Manali, Ambattur Industrial areas etc. Central Ground Water Board through its Annual Action Plan every year undertakes Ground water pollution studies through out the state with emphasis to heavy metal pollution.

The studies carried out so far in different parts of Tamil Nadu reveals that the ground water of Tamil Nadu is adversely affected by the anthropogenic activities. In the tannery belt of Vellore and Dindigul districts heavy metals like Chromium, Iron, Lead, Manganese and Nickel are present at higher levels than the Bureau of Indian Standards (BIS) prescribed limits. The range of heavy metal found in the groundwater of Vellore district is as follows. Chromium: BDL to 0.17mg/l, Iron: BDL to 7.26 mg/l, Manganese: BDL to 6.62 mg/l, Nickel: BDL to 0.24 mg/l and Lead: BDL to 0.84 mg/l etc. In Dindigul district the concentration of chromium was BDL to 0.141 mg/l, Iron BDL to 3.48 mg/l, Lead BDL to 1.056 mg/l etc. Similarly high levels of heavy metal concentrations are noticed in the industrial areas of Tirupur, Ambatur and Manali industrial areas. The occurrence of various heavy metals in the groundwater of Tamil Nadu, its causes and remedial measures are discussed in this paper.

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Abs Nr. OR-016

Over Exploitation of Coastal Aquifer in Tiruvanmiyur Belt, Kancheepuram District, Chennai

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The impact of urbanisation is felt in and around Chennai urban agglomeration, particularly along the fresh water belt in east-coast road. An area of about 80 sq.km bordering sea from Tiruvanmiyur to Muttukadu is having floating lense of fresh water in the sedimentary formation.

Ground water is commonly exploited by the number of dug wells and shallow tube wells in the past two decades. The efforts of metrowater in regulating the ground water withdrawals and preventing of mining and transportation by tanker have controlled the over exploitation to certain extent. However, the increase in settlements and absence of assured piped water supply for the domestic requirement has forced the people to depend only on ground water. The limited knowledge of ground water hydraulics and safe level of extraction of this fresh water resource has resulted in the ground water mining by over pumping of wells. With increasing apartments, deeper tube wells and bore wells have come up in the area and already a part of Tiruvanmiyur aquifer near Valmiki Nagar has experienced seawater ingress.

Central Ground Water Board has taken up detailed monitoring of these seawater ingress problems and the studies have shown over extraction resulting in upconing of salt water from the bottom as well as from lateral directions. The construction of wells of 30 to 40 m depth by sealing the top sedimentary zones, which has already been affected by ingress, is not the solution. The trapped water in the fractured rock will not be able to sustain the continuous extraction pattern. A pragmatic approach is necessary for tackling this situation and is detailed in the paper.

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Abs Nr. OR-017

Monitoring of Urban Pollution in Tirumanimuttar River in Salem and Namakkal Districts, Tamil Nadu

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Fresh water resources available for use of mankind in the earth is less than 1% of total quantum of water available in the earth. Tamil Nadu State, particularly parts of Coimbatore, Namakkal and Salem districts are known for groundwater over exploitation, water scarcity and water pollution. It is needless to mention about the stress on water managers in providing safe and protected water supply to the public, particularly in the fast developing urban areas. The sewage disposal is a major social and environmental issue in towns like Salem.

Tirumanimuttar River is a tributary of Cauvery river draining parts of Salem and Namakkal districts. The watershed is covered by crystalline and metamorphic rock complex with unique hydrogeological conditions. The depth of dug wells range from 20.5 to 31.6 m while bore wells are drilled down to a depth of 300 m for irrigation and industrial requirements. Out of total of 1838 sq.km area of Tirumanimuttar river watershed, about 40 sq.km between Salem town and Vennandur village is affected by sewerage water discharged into the river from Salem town. The area is partly waterlogged along the riverbed and the low grounds are saturated with recharge from this sewerage. The irrigation wells along the river course contain high levels of detergents in the pumped water giving “foamy discharge” and water in the select pockets along the river are not suitable for drinking with high TDS and bad odour. A network of monitoring wells are established by Central Ground Water Board as a part of surveillance of this urban pollution and water samples are being periodically analysed. The area of contamination and its impact on the water resources and quality is presented in the paper. The drought condition in Tamil Nadu during 2002 and 2003 has resulted in withering of many coconut farms in Namakkal and Salem districts. This sewerage affected area has the advantage of assured water supply to the coconut fields in spite of pollution and the real toxic components, if any, in such irrigation field produces including vegetables have to be studied.

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Abs Nr. OR-018

Quality of Formation Water in Tannery Belt in Dindigul, Tamil Nadu.

E. Sampath Kumar[1] and K.K.Sharma[2]

Water pollution by Tannery wastes in Tamil Nadu is very severe and there is large number of Tanneries in the state and the wastewater from the industry has caused considerable damage to water sources, affecting drinking water supply and irrigation.

Dindigul is one of the major industrial and commercial towns of Tamil Nadu and is the headquarters of Dindigul district. It is one of the important tanning centres in Tamil Nadu. There are about 60 registered medium and small scale tanneries in clusters, which are located in and around Dindigul town. Due to lack of integration of environmental considerations in the development of this region, the fast growth of the tanning industry in this belt has resulted in a drastic change in the environment. The tanneries which do not have effluent treatment plants discharge the untreated effluents laden with salts and other pollutants like chromium, lead etc. in large amounts indiscriminately in to the open lands, pits, channels, tanks and in low-lying areas. Lagooning of tannery wastes, or spreading on land for evaporation, together with the solid wastes has led to the contamination of ground water, which is the only source for drinking water and irrigation. The groundwater in large areas has become unsuitable for domestic and irrigation purposes due to contamination from these wastes.

The study was taken up by CGWB in collaboration with Department of Civil Engineering, Anna University, Chennai. An area of about 250 sq km covering Dindigul town and its environs has been taken up for intensive study under this project.

The Paper describes the conventional investigations carried out to study the Point and Non- Point Pollution of tannery effluent. The paper also describes the conceptualization of ground water system in Dindigul area to study the migration of Pollutants.

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Abs Nr. OR-019

Hydrochemistry of Lake Naivasha: A Rift Valley, Kenya.

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Lake Naivasha, situated in the Great Rift Valley, Kenya is a unique lake in that it is a fresh water lake in an area where all other lakes are saline. The lake provides water both for agriculture and fisheries for the people living in the surrounding area.

Hydrochemical investigations, which are important for the assessment of water quality, has been carried out to study the sources of dissolved ions in the lake.

Results indicate that the lake is alkaline in nature with an average pH value of 8. Electrical conductivity ranges between 220 and 2480 μS/cm. Sodium is the major cation while chloride and bicarbonate are the major anions. Silicate weathering seems to be the major contributing factor to the bicarbonate content in the Rift Valley Lake. The relatively high (Na+K)/TZ+ ratio and the low equivalent ratio of (Ca+Mg)/(Na+K) indicate that dissolved ions are contributed mainly by the weathering of aluminosilicate mineral. Fluoride content is very high ranging between 2-25 mg/l.

The observed chemical data of the lake was used to predict the mineral assemblages in the carbonate and silicate systems. Dolomite seems to be the possible mineral that is in equilibrium in Lake Naivasha system. Silicate system on the hand indicates that the water chemistry of the Lake is in the range of stability field of kaolinite.

Although the lake Naivasha water seems to be suitable for both irrigation and aquaculture purposes, the fluoride content is too high and might be detrimental to the users.

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Abs Nr. OR-020

Overexploitation and Salt Water Intrusion – A Case Study Along Cuddalore Coast, Tamil Nadu, South India

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Indian coastline offers an excellent opportunity for agriculture particularly on the East Coast, which has stretches of fertile alluvial soil. Coastal aquifers are normally found to be encroached by saline water with few fresh water pockets. Cuddalore is one such coastal town with agricultural and increased industrial activities in recent years. The present study is aimed to delineate the saline intrusion from fresh water zones of Cuddalore coast. The coastal tract comprises topsoil, alluvium and laterite of Quarternary period, which are underlain by Tertiary sandstone of miopliocene age, which are overlying cretaceous formations. From the long-term water level data, water level studies have been carried out which indicate the fluctuation of water table is higher towards Cuddalore coast. In the present study groundwater samples have been collected from 30 equally distributed locations. These samples have been analyzed for major cations and anions. From the chemical analyses data the following thematic maps have been prepared in GIS environment viz., TDS, Cl / (HCO_3 + CO_3) ratio, TA / TH ratio, Cl / SO_4 ratio, Na / Mg ratio for the study area. From these maps it is inferred that considerable area of Cuddalore coast have been occupied by saline water. This may be due to overexploitation of groundwater and rapid industrialization in and around Cuddalore. Unless the existing fresh water resources of the study area are not properly managed and enriched through artificial recharge methods such as rainwater harvesting etc., the entire Cuddalore coast may likely to be occupied by saline water in the near future.

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Abs Nr. OR-021

Hydrogeology of an Over-Exploited Hard Rock Watershed in Tamil Nadu, India, with Special Reference to Long-Term Behavior of Ground Water Levels

P. Nandakumaran[1] and S.G.D.Sridhar[2]

Vaniar watershed, in Dharmapuri and Salem districts of Tamil Nadu, India, having a total geographical area of about 1000 sq.km is a typical hard rock watershed, underlain by Archaean crystalline formations. Ground water occurs under phreatic conditions in the weathered zone and under semi-confined conditions in the deeper fractures. The long and unsustainable management of ground water resources in the watershed has led to the over-exploitation of the limited resources in the watershed, resulting in various consequences like decline in water levels and reduction of yields of wells, leading to severe environmental impacts.

The hydrogeological conditions in the watershed, with special reference to the long-term behavior of ground water levels are described in the paper. Various techniques have been employed to analyze the behavior of ground water levels and to study their spatial and temporal variability and their relation with rainfall in the area. The study helps provide insights into the interplay of factors resulting in over-exploitation of available resources in hard rock areas.

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Abs Nr. OR-025

Groundwater Quality Assessment in Part of the Chennai City, Tamil Nadu, India

D. Satheesh Herbert Singh[1] and J.F. Lawrence[1]

Water is essential for both animal and plant kingdom and also for industrial and agricultural needs. Nowadays, the available surface water is not fulfilling the needs of human beings. Hence they are going for the subsurface water. Chennai being one of the metropolitan cities of India, it is located on the southeastern coast of the Indian subcontinent. In Chennai people mainly depend on the groundwater for their daily uses. The quality of groundwater is as important as its quantity. For the present study, a part of Chennai city has been selected and 32 groundwater samples have been collected in a systematic way from the existing bore wells for both pre monsoon and post monsoon seasons. The water samples have been analysed for major cations and anions. With the analysed results, the water has been classified using HYCH programme. The following thematic maps have been prepared viz., total dissolved solids, total hardness, corrosivity ratio and chloride vs. bicarbonate ratio using GIS. From the above study, it is understood that the groundwater (bore well), of Chennai city, is of moderate quality. The dilution and quality enhancement in post monsoon season indicate recharge phenomena through rainwater. From this study, it is inferred that the groundwater of Chennai city is under going quality deterioration. Only a few fresh water pockets have been identified in the study area. The existing fresh water resources have to be utilized to its optimum level and managed properly. The regions in and around Chennai city needs more artificial recharge methods of groundwater like rainwater harvesting.

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Abs Nr. OR-027

Hydrogeochemical Studies for Saltwater Intrusion in Lower Gundar Basin, Tamil Nadu, India

B. Gowthaman[1] and J.F. Lawrence[1]

Lower Gundar Basin falls between 9° 00'00" and 9° 45' 00" North Latitudes and 78° 10'00" and 78° 45'00" East Longitudes. In present study, 33 groundwater samples have been collected for two seasons, Viz. Pre monsoon and Post monsoon. All the water samples have been analysed various cations and anions and following thematic maps have been prepared viz., total dissolved solids, hardness, corrosivity ratio, chloride vs. bicarbonate ratio and salinity and sodium hazard using GIS. Groundwater in the study area is characterized by moderate to fresh quality water. The poor quality water exceeding the limits prescribed by WHO standards occupy a few inland areas. Generally the groundwater existing in the north and central region are good to moderate in quality while the poor quality water occupies the southern region. From the hydrogeochemical studies, poor quality water is characterized by presence of high ionic content, which may be due to rising of salt water/freshwater interface in those areas. Little change in the quality with reference to season is observed. Therefore, it is suggested that groundwater along the north and central regions can be utilized for various domestic and industrial purposes. The groundwater present in the southern region has very little utility value.

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Abs Nr. OR-029

Treatment of Tannery Wastewater Using Cyanobacteria with Special Reference to Chromium – An Eco-friendly Technology

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There has been an ever-increasing public health problem due to pollution by rapid industrialization and anthropogenic activities. Indiscriminate release of industrial effluents, especially tannery wastewater from leather industry, into ground and surface water leads to their contamination with heavy metals and other toxicants, which are deleterious to flora and fauna. Leather industry is one of the major water consuming industry and needs large volumes of water with about 210 million litres being consumed daily in Indian tanneries. A huge quantity of effluent water containing toxic chemicals is being released into the environment. Majority of tannery effluents contain chromium in the trivalent state besides chlorides, sulphides, sulphates, total dissolved solids and suspended solids with high BOD and COD. Therefore, the recycling/treatment of this water assumes greater importance as they can be reused in tanneries or for agriculture besides preventing pollution of the land and water bodies. In the present work Cyanobacterial species have been used for purification and recycling of tannery wastewater. They are found to be very effective in removal of chromium and chlorides besides reducing BOD and COD levels. The effects of different concentrations of chromium on the growth response of these species in biomass and chlorophyll-a were also studied. Furthermore, the better performance in field conditions gave positive indication of their usefulness in treatment of tannery wastewater. The system when standardized would not only be economical but also eco-friendly and sustainable.

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Abs Nr. OR-032

A Study on the Dietary Intake of Po-210 and Pb-210 Through the Fishes by the Coastal Population of Palk Strait, India

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The present study deals with the bioaccumulation of Po-210 and Pb-210 in the seafood fishes and the dose transfer to the coastal population of Palk Strait through consumption. Palk Strait is a narrow channel, lies on the south east coast of India connecting Gulf of Mannar and Bay of Bengal (Long.78°50'-79°55'; Lat. 9°15' – 10°20'). It runs about 257 Km extending from Point Calimere in the northeastern corner to Rameshwaram in the southwest corner. Seafood organisms of this coast are largely consumed by the local population and exported to different countries. For the present study eight sampling stations were fixed along the stretch of the Palk Strait. Commonly consuming 16 species of fishes were collected and their edible portion analysed for activity concentration of Po-210 and Pb-210. Po-210 measured by electrochemical deposition on a silver planchette and subsequent alpha counting (Flynn, 1968; Iyengar, 1983) and Lead – 210 by allowing equilibrium growth of Po-210 for three months and Po-210 electro deposited on a silver planchette and subsequent alpha counting (Iyengar, 1983). The activity concentration of Po-210 in the fishes tested ranged from 20.5 Bq/kg (*Epinephelus diacanthus*) to 117 Bq/kg *(Sardinella longiceps)* while that of Pb-210 ranged from 0.98 Bq/kg (Daysciaena albida) to 1.14 Bq/kg *(Epinephelus diacanthus)*. The variability in the accumulation of these radionuclides could also be based on bioavailability feeding habits, age, sex and reproductive cycle of fish (Hameed, 2001). Further in fish, direct absorption of Po-210 through gills takes place in addition to food intake (Skwarzec, 1988).

From the activity intake data and dose conversion factor of Po-210 (2.4×10^{-7} Sv/Bq) and Pb-210 (1.8×10^{-10}Sv/Bq) (ICRP, 1994), the dose to the individual member of the public was calculated. It was observed that the dose transferred fishes were highly variable. The observed dose equivalent for Po-210 through fish ranged from 10.0 to 224.6 µSv/y whereas the dose from Pb-210 negligibly very low (0.0005 to 0.0030 µSv/y). High dose transfer is expected via the consumption of fish *Sardinella longiceps*. The present study indicates that the dose transfer to coastal population of Palk Strait through Po-210 & Pb-210 intake was low compared to adjacent marine province Gulf of Mannar. The estimated total dose transfer from fish intake was about 1080.32 µSv/y of which the contribution from Po-210 was nearly 100% (1080.30 µSv/y) and the dose equivalent from Pb-210 is negligibly low (0.00161µSv/y). The quantum of dose

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transfer is influenced by activity concentration of radionuclides and percapita consumption of food organism. The present study points out that the total dose of 1.08 mSv/y transferred to humans through seafood consumption is well below the permissible limit of 5 mSv/y (ICRP 1994).

Abs Nr. OR-034

Hydro Geophysical Investigation of Groundwater for Rural Development – A Case Study of Mamandur, Kanchipuram District, Tamil Nadu

M. Suresh Kumar[1] and R. Sivakumar[1]

Electrical resistivity soundings employing Wenner electrode configuration were carried out in and around Mamandur area to delineate the bedrock topography and estimate the thickness and nature of the overlying sediments to assess the ground water resources for rural development. The area under study is generally a plain terrain. Geology of the area constitutes charnockites of Archean age with Gondwana sediments and alluvium and soil of sub-recent age. Electrical resistivity sounding curves in the area are of 'A' type and a combination of 'H' and 'A' type and could identify three to four layers apart from thin shallow surface layers of varying resistivities and thickness. Isoapparent resistivity maps or basement contour maps prepared from electrical resistivity sounding data indicate the presence of several basement, depressions and ridges. The depressions in the basement could be favourable locations for ground water developments. Thus Maiyur, Palaveli, Olalur, Manapakkam, Padalam and Kodithandalam are observed to be having a good ground water potential, since it shows low resistivity values.

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Abs Nr. OR-040

Nature of Solute Load in a Tidal River - A Case Study of River Rupsha, SW Bangladesh

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Throughout history, water has been considered a natural resource critical to human survival. The Rupsha River around the Khulna Metropolitan City of southwestern Bangladesh has a having tropical monsoonal climate, characterized by relatively high temperature, heavy rainfall, and excessive humidity and fairly marked seasonal variations. About 90% of annual rainfall occurs during monsoon period (May-Oct.) and the rest 10% occurs during non-monsoon period (Nov-Apr).

In the river water, chloride, bicarbonate, sodium, magnesium and sulfate are dominating constituents. The calculated hydrologic budget of the Khulna area are: the mean annual rainfall is about 1700 mm/yr and the surface water runoff are estimated to be 139 mm/yr. The average chloride concentration in river water is 337.89 mg/l in the monsoon period and in the non-monsoon period, it is 459.50 mg/l Cl^{-1} is abnormally high in all seasons. The total dissolved solids ranged from 574.87 mm/l to 1078.1 mm/l. TDS was higher in monsoon period in surface water shows enrichment of TDS in monsoon indicating the influence of weathering process. In monsoon HCO_3 is higher compared to other seasons suggesting the occurrence of maximum chemical weathering.

The sources of major ions in water indicates that the major mechanism controlling the water chemistry is chemical weathering of the denudation regime in the monsoon period and that of evaporation-crystallization regime in the non-monsoon period (Gibbs 1970). The alkali earth elements viz., Ca and Mg constitutes 40-50% of the total cations, while the bicarbonates make up 30-40% of the total anions.

Stallard and Edmond (1987) mentioned that a 1:1 relationship should exist between (Ca+Mg) and HCO_3 on an equivalent basis in a carbonate dominated water chemistry. Excellent positive correlation exists between HCO_3 with Ca and Mg (r=0.8 and 0.4 respectively).

Statistics of surface water show poor-good correlation with other ions. The few ion pairs like EC-Ca^{+2}, Ca^{+2}-HCO_3, Cl-Ca^{+2}, Cl–Na^{+}, SO_4-$Mg^{+2,}$ EC-Na^{+}, TDS with EC, SO_4, Cl^{-}, Ca^{+2}, Mg^{+2} and Na^{+} show moderate to good correlation. Good correlation indicates chemical weathering and leaching of secondary salts followed by multiple source inputs of industrial effluents. The suitability of river water for irrigation and industrial purposes varies from place to place with and season.

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Abs Nr. OR-042

Heavy Metal Contamination in Select Wetlands of Tamil Nadu

S. Muralidharan[1] and R. Jayakumar[1]

Functioning of a wetland ecosystem is more fragile and dynamic when compared with other ecosystems. While there could be a combination of ecological factors responsible for a wetland to turn unproductive or face any disturbance in its functioning, of late role of environmental contaminants due to agricultural inputs and industrial discharges has become a major concern. A study was conducted to document the status of organic and inorganic contamination in wetlands across the country using fish as an indicator. This paper deals with the level of heavy metal contamination in select wetlands of Tamil Nadu. Totally 254 fishes comprising 15 species from 22 wetlands were collected during 2001 and analyzed for metals, namely copper, cadmium, chromium, zinc and lead using Atomic Absorption Spectrophotometer. Of all the wetlands, Vadavoor Lake in Mannargudi taluk recorded the maximum level of copper (1.74 ppm) and zinc (23.6 ppm) while Ariyakulam and Alwarkuruchi wetlands recorded the maximum level of lead (13.18 ppm) and cadmium (0.99 ppm) respectively. Chromium contamination was the highest in Vandiyur tank in Madurai district. The variation in contamination level among the wetlands was very significant ($p<0.005$). Among the species included in the study, *Heteropneustes fossilis* had the highest level of lead (13.18 ppm) and chromium (1.15 ppm). Levels accumulated by *Puntius dorsalis*, *Notopterus notopterus* and *Labeo rohita* were also considerable and indicative of physiological disturbance. The study also looked at the dietary intake of metals by human beings and compared with guidelines suggested by certain statutory bodies. Based on the magnitude of contamination, the wetlands have been prioritized for conservation needs.

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Abs Nr. OR-045

Heavy Metal Pollution in Sediments of Hussain Sagar Lake: Comparison of Microwave and Conventional Digestion Methods

D. Motati Suneela[1], Malleshwara Reddy[1], K. Saritha and M. S. Sastry[1]

The present study deals with the heavy metal content in sediments of Hussain Sagar Lake and the use of microwave heating over conventional heating procedure and the two techniques were compared with each other.

Five sediment samples (coded as KN, BN, PN, VH, and HSJ) were collected at different locations with respect to the inflow water coming into the lake during August- October 2002. The experiments were performed on three sets of sub-samples. Conventional digestion was accomplished on the hot plate to dryness using conical flask, while microwave digestion in CEM (HP-500 plus) vessels was performed in a microwave oven (CEM MARS-5).

Recoveries of heavy metals from the sediment samples using the both techniques were reasonably comparable, in spite of big difference in time required. Higher results were obtained in Microwave extraction technique than the conventional one. The above scheme allows shortening the sequential extraction time from days to minutes. The order of the contamination in the studied sediments was Zn>Pb>Cu>Ni. Among the five sediments tested the order of most contaminated sediments are KN>BN>PN>VH>HSJ.

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Abs Nr. OR-046

Biogeochemical Studies of Flood Plain Sediments of Yamuna River Basin (Sub-basin of Ganga) During Recent Past (Holocene)

D.P. Saxena[1] and V. Subramanian[1]

"Present is key to past " on this famous geological phrase we can also add that past is an alarm to the present. To understand ice age, global warming and sea level rise etc, it is necessary to understand the properties of drainage basin and their role in the past and their present behaviour in order to extrapolate it to the future.

Floodplains are in large measures produced by physical process of river deposition. Floodplains have a history of recording the environmental changes of recent past. It can be an important accumulation zones for pollutants that are dispersed by fluvial activities.

In the present study, Floodplains of River Yamuna was studied, which is the largest tributary of the river Ganga, guided by the Himalayas watershed. The core samples were collected by manual drilling up to local water table from the floodplains of Yamuna basin, at five sampling stations, Sharanpur (next to Himalayas), Delhi, Jagmanpur, Hamirpur, and Allahabad. Core sediments were used for metal Analysis (Pb, Zn, Fe, Cu, Ni, Cr, Ti, Ba, Ca, and Al), Carbon, Sulphur and Phosphorous. Age of the core was calculated by Pb^{210}.

All the metals show higher concentration in the upper part of the cores except, Jagmanpur core sediments. The higher values are due to the increase of industrialization and urbanization in the recent past. All the metals at Delhi region reported higher values in comparison to the locations. Delhi is a highly industrialized area in the entire basin. The industrial effluents of Delhi contribute large amount of metals to the main stream and other drainage channels carry them from the catchment area and deposit in the flood plain sediments.

Delhi sediments shows highest values for all the metals, but not of Calcium, which is lithogenic in origin. It reflects high pollution flux in the mainstream and catchment area, due to industrial discharges.

Phosphorous concentration ranges from 272 ug/g to 940 ug/g. This is comparable to the range of average content of phosphorous in the sediments of Indian rivers, 11000 mg/g (Subramanian 1989). Delhi sediments reported highest value of 321-940 mg/g. Carbon and sulhpur values were higher in younger strata (upper) than older strata of floodplain. It signifies the change in nutrient dynamics of basin in recent past as a result of anthropogenic activity.

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Abs. Nr. OR-049

Over-Exploitation of Ground Water and Salt Water Intrusion: Problems and Prospects

D. Rudrappan[1]

Water is central to human life for basic health and survival and is vital to the survival of ecosystems and the plants and animals that live in and in turn ecosystems help to regulate the quality and quantity of water. Thus, water development underpins food security, people's livelihoods, industrial growth and environmental sustainability throughout the world. Conservation and efficient management of water resources is vital for all countries, particularly for predominant agrarian economies where development of sustainable agriculture is essential for food security, environment security and all round prosperity. Therefore, water resource forms an internal component of over-all economic development of mankind. The essence of sustainable development is that natural resources must be used in ways that will not limit their availability for future generations. India is one among the countries in the world where food production growth is keeping pace with population growth. However, in recent years, long-term sustainability of food security and environmental security are being questioned mainly due to water constraint. The study, based on data from a research study conducted in northern districts of Tamil Nadu, attempts to assess the issues of changing pattern of irrigation and cultivation and their threat to environment. In doing so, the paper focuses primarily on the State of Tamil Nadu. To raise awareness and galvanize action to better manage and protect this crucial resource, the United Nations General Assembly has proclaimed 2003 as the International Year of Fresh Water (Water Year 2003). It is interesting to note that only 3% of the world's water resources are fresh, of which one-third is inaccessible. Despite having assured annual monsoon rainfall, India suffers from recurring floods and droughts. This is attributed to uneven distribution of rainfall over time and space. Over the years, rising population along with increasing demand for food grains, growing industrialization and urbanization have caused increased dependence on water, besides reducing the per capita availability of water. With such an increased growth rate, it has been predicted that by 2050, an estimated 65% world population will live in areas of water shortage. Green revolution with its chemical fertilizer and pesticides consumption has irreparably damaged the soil and the environment, besides changing the pattern of irrigation. At the village level, the shrinking water potential has led to water lordism. Considering the acute problems of water scarcity that many are likely to face in the near future, it would seem prudent not to ignore the management of ground water along with the direct management of nature's simplest and most fundamental source of renewable fresh water- rain.

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As the incidence of rural poverty is universally related to both the rate of growth of crop output and the irrigation factor, investment in irrigation becomes an indirect instrument for eradicating much of the rural poverty in India. However, excessive exploitation of ground water leads to a permanent decline in the water table in inland regions and seawater intrusion in coastal areas. Consequently, the cost of exploiting ground water increases. Farmers having shallow, old wells have been affected adversely in terms of production, productivity and income. Excessive dependence on ground water and declining dominance of canal and tank irrigation have led to a conflict in property rights, i.e., water management and water ownership. Further, it has also led to greater economic and social tensions, inequalities and environmental damage.

Thus, the paper is devoted to sketching the problems of over-exploitation of ground water and suggests remedial measures for environment security.

Abs. Nr. OR-050

Photosynthetic Rate of *Rhizoclonium riparium* (Chlorophyta Cladophorales) *E*xposed to Copper and its Use Like Bioindicator.

W. Montoya[1], E.J.Pena[2], and R. Benitez[3].

Algae have been used as bioindicators by having several advantages such as short life cycles, take up nutrients directly from water, are generally easy to collect in sufficient amounts from various habitats; and they readily accumulate compounds present in seawater, making tissue analyses reliable indicators of water quality. In order to evaluate the bioremoval capability of the green alga *Rhizoclonium riparium*, the photosynthetic responses to heavy metal pollution under different sublethal concentrations of copper was assessed. Photosynthetic rates were significantly low ($p < 0.05$) at low copper concentrations, between (0.01 y 10 mg/l). Maximum photosynthetic values were shown at 30 y 60 mg/l and almost Zero at 150 mg/l of Cu. During the first 24 hours of exposure there was a significant reduction ($p < 0.05$) of photosynthesis in all studied concentrations, whereas between 24 and 96 exposure times, rates increased significantly. These results suggested that plants exhibited an “alarm phase” related with diffusion processes and metal ions exchange at the cell wall level. The photosynthetic behaviour along the concentration gradient indicated the resistance and tolerance capacity of the alga as well as its potential use for copper removal in coastal waters.

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Abs. Nr. OR-052

Commercially Important and Endemic Fish Species and Management Issues in Major Rivers in Northern Philippines

E.V. Agasen[1]

The survey was conducted from January to November 2001 covering the areas of Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Tarlac and Pampanga. These areas are considered as commercial fishing grounds of commercially important and endemic fish species such as freshwater prawns, eel, goby, "ludong", etc. In the early 60's to 80's, fishing was considered as the major source of livelihood of the fisherfolk in the area.

Major management issues identified are the following: declining fish catch due to illegal fishing, i.e. cyanide fishing, electro-fishing and fishing with the use of fine-mesh net, excessive fishing effort, barricades, degraded habitat due to pollution caused by domestic wastes from household, agriculture and factories and conflict on water resources use.

Illegal fishing such as eletro-fishing, cyanide fishing, use of fine-mesh nets, excessive fishing efforts and construction of barricades is observed in all the areas surveyed except in Pampanga River Delta. Declining catch caused by domestic wastes from agriculture was reported in Laoag River. On the other hand, water pollution from factories is reported in some parts of Abra River and Pampanga River Delta.

Some rivers are partly dried up downstream and this maybe due to conflict of water resource use. Aside from increasing needs for human use, it was observed that great volume of water is diverted to irrigation for agricultural purposes. This may contribute to the decline or extinction of the migratory fish species because they may not be able to reach the sea and return to freshwater to complete their life cycle.

Some fishery management and conservation measures and anti-pollution laws already exist but they are not strictly implemented.

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Abs. Nr. OR-053

Biological Treatment of Tannery Soak Liquor in a Sequencing Batch Reactor Using Halophilic Bacteria

O. Lefebvre[1], N. Vasudevan[2], K. Thanasekaran[2] and R. Moletta[1]

The Indo French Cell for Bioprocesses of Environment has been created in 2002 to initiate the Indo-French cooperation on wastewater treatment. A first research field of common interest has been identified as being the treatment of hypersaline wastewater (i.e. wastewaters containing more than 35 g l^{-1} Total Dissolved Solids (TDS).

Hypersaline effluents are generated by various industrial activities. Those wastewaters, rich in both organic matter and TDS, are difficult to treat using conventional biological wastewater treatment processes. Use of halophilic bacteria is required. Biological treatment of those hypersaline effluents could represent up to 5% of the total effluents produced worldwide.

Among the industries generating hypersaline effluents, two categories are prominent in India, which are tanneries and textile industries. Tanning is one of the oldest professions in India, with 2000 units spread mostly across Tamil Nadu, West Bengal, Uttar Pradesh, Andhra Pradesh, Karnataka, Rajasthan and Punjab. Leather tanning is almost wholly a wet process from which a large volume of liquid waste is continuously generated. Due to the variety of chemicals added at different stages of processing of hides and skins, the wastewater has complex characteristics.

In this study, tannery wastewater from soak pit was treated in a bench scale bioreactor for the removal of organics. This soak liquor is characterised by high organic load, high suspended solids (lime, hairs, flesh, etc.) and high salinity. Because of the high salt content, this wastewater is generally segregated and sent to evaporation pans. Thus, tanneries require large areas to dispose the soak liquor and the salt obtained cannot be reused because of its high organic content. Then this salt is discharged and contributes to soil and water pollution. Treatment of this soak liquor in order to remove the excess of organic matter would:

Enhance the evaporation speed – inhibited by organic matter – thus reducing the surface required for evaporation pans

Improve the purity of the salt obtained, allowing it to be reused in the pickling stage of the tannery process, or to be sold

A bench scale bioreactor has been set up in the Centre for Environmental Studies (CES), Anna University, Chennai, India, in order to remove the organic content of the soak liquor. This bioreactor was designed as an aerobic Sequencing Batch Reactor (SBR) which works in a discontinuous way, each

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batch being divided into four stages: filling, reaction, settling and withdrawal. The SBR technology has the advantage to proceed with the reaction and settling stages in the same volume, thus reducing investments.

The 10l reactor was operated with an organic load of 0.6 kg m^{-3} d^{-1} Chemical Oxygen Demand (COD). A mixture of non-halophilic bacteria obtained from a sewage treatment plant and from a tannery common effluent treatment plant was first inoculated. Then a mixture of halophilic bacteria was added to the reactor in order to enhance its performances. Biodegradation of organic matter (COD, Ammonia (NH_3), Total Kjeldahl Nitrogen (TKN), Orthophosphates (PO_4^{3-}), suspended solids (SS) and growth of biomass (measured as Mixed Liquor Volatile Suspended Solids (MLVSS) in the reactor were measured.

The characterisation of the soak liquor showed that this effluent is biodegradable – though not easily – and highly variable depending on the origin and the nature of the hides. TDS was in the range of 23 to 57 g l^{-1} and COD was in the range of 2 to 3 g l^{-1}. Despite the variations in the quality of the soak liquor, the reactor achieved stable removal of organic matter performances, once the acclimation of the microorganisms was achieved. It could successfully remove Carbon, Nitrogen, Phosphorus and SS from the soak liquor. Breakdown yields up to 95, 94, 96, 93 and 83% were reached concerning COD, N-NH_3, N-TKN, P-PO_4^{3-} and SS respectively. Evolution of the biomass content in the reactor showed constant changes, due to the dynamic equilibrium and competition phenomenon between bacteria and protozoa.

Abs. Nr. OR-059

Eutrophication of Lakes in Urbanised Areas: Case of the Yaounde Municipal Lake in Cameroon (Central Africa)

N. Kemka[1], T. Njine [2], S.H. Zebaze Togouet[1], D. Niyitegeka[2], M. Nola[2], A. Monkiedje[2], J. Demanou[2], G. Ajegah[2] & S. Foto Menbohan [2]

The qualitative and quantitative evaluation of phytoplankton and chlorophyll-*a*, as well as some physico-chemical parameters were recorded at 3 stations (A, B and C) in a small shallow tropical lake (Z_{max} 4.3 m) in Cameroon: the Yaounde municipal lake (3°51'N, 11°30'E, and 710.8 m above sea level). Alongside, physico-chemical measurements were regularly done in its main tributary (Mingoa stream). Analyses were carried out on a weekly sampling basis, from November 1996 to December 1997, in order to assess the health status of the lake and to measures of controlling its degradation process.

In this lake, the Secchi disk transparency is globally low and exceptionally exceeds 1 m. Water conductivity is higher near the lake bottom, reaching 422, 408 and 437 µS cm^{-1} at station A, B and C respectively. The more oxygenate superficial layers are in relation with an accumulation of phytoplanktonic elements, while strong deficiency in oxygen contents, and sometimes anoxia, recorded from 2.5 m depth lead to a production of high quantities of ammoniacal nitrogen reaching 17.74 mgNH_4^+ L^{-1}, and probably to a phosphorus release by sediments. The total phosphorus (TP) contents varied from 80 to 2290 µgP L^{-1}, and the total Kjeldahl nitrogen (TKN) contents fluctuated between 3 and 15 mgNH_4^+ L^{-1}. Upstream to the lake, the Mingoa exhibited TP contents ranging from 0.6 to 3.8 mgP L^{-1} (average 1.82 mg L^{-1}), and a TKN contents ranged from 10 to 22 mgNH_4^+ L^{-1} (average 14.07 mgNH_4^+ L^{-1}).

The fertility of this biotope favours a great development of phytoplanktonic algae (102 specific taxa), with more diversified Euglenophytes and especially Chlorophytes. Phytoplanktonic biomass and chlorophyll-*a* concentrations reached 225 µg ml^{-1} and 566 mg m^{-3} respectively. Analysis of the fluctuations of these parameters reveal the allogenic nature of the functioning of this ecosystem, particularly stressed by its permanent supply by great amounts of decayed organic matters. This is an alarm-cord pulled for this lake and many other water bodies in Cameroon, which are or could be affected by anthropogenic impacts. Urgent actions need to be taken, in order to rehabilitate this hypertrophic hydrosystem.

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Abs. Nr. OR-060

Dimensionless Toxicity Index – a Tool to Assess Freshwater Quality

K. Parvathi[1], Rajesh Banu[1], J, R. Naresh Kumar[1] and R. Nagendran[1]

Applicability of rapid bioassay tests in determining water quality has been reported by several workers. The feasibility of using an emerging water quality index - Dimensionless Toxicity Index (DTI) based on the ecophysiological responses of the common rotifer, *Brachionus calyciflorus* to assess the quality of freshwater has been examined in the present study.

Brachionus calyciflorus cultured and maintained in the laboratory was used as a bioindicator of freshwater quality in this study. During the six-month study, effects of raw dairy effluent and treated refinery effluent on some aspects of ecophysiology of *Brachionus calyciflorus* were recorded.

Raw dairy effluent and treated refinery effluent were collected from local units and characterized for physicochemical parameters employing standard methods. The slightly acidic dairy effluent exhibited higher values of biochemical oxygen demand, chemical oxygen demand and total solids as compared to the refinery effluent. The latter exhibited higher levels of oil and grease and phenol.

To compute the Dimensionless Toxicity Index as detailed in CPCB (1994), *Brachionus calyciflorus* was exposed to known concentrations of the two effluents and 100 % survival rate of individuals at the completion of 48 hours was recorded. Changes in physiological activity of the test individuals were measured in terms of feeding pattern, swimming activity and intrinsic rate of natural increase. The Dimensionless Toxicity Index for the organism exposed to dairy and refinery effluents indicated T_F values of 179 and 63, respectively. The rate of physiological activities of the organism decreased on exposure to the effluents.

Untreated dairy effluent, though considered a soft effluent, had more impact on the general physiology of the organisms studied, as compared to treated refinery effluent. The relative impacts of effluents on the quality of water have been assessed employing the Dimensionless Toxicity Index. The applicability and limitations of the tool have been discussed in the light of available literature.

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Abs. Nr. OR-061

Lithological Influence on the Groundwater Chemistry – Periyar District a Case Study

S.Chidambaram[1], AL. Ramanathan[2], K. Srinivasmoorthy[1], P. Anandhan[1], and S. Vasudevan[1]

Groundwater is one of the important vital sources for planning and development of a country. The Geochemical nature of the waters determines its various use for domestic, irrigation and industries. That too in a hard rock terrain like Periyar district, the lithological influence on the water plays a dominant role in determining its quality and its usage for various purposes. Hence an attempt has been made to study on the Lithological influence over water chemistry. Systematic sampling was carried out in Major litho units of the study area at four different seasons. Groundwater found to be colorless, odorless and alkaline in nature. EC and TDS show the water is good to moderate for general purpose. The silicate weathering, dissolution, leaching, vertical mixing and anthropogenic sources were noted to dominate the water chemistry. Statistical analysis points out the contribution of multiple sources of water chemistry.

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Abs. Nr. OR-062

Hydrogeochemistry and Quality Assessment of Groundwater from Industrial Town

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The increases usage of groundwater due to the insufficient surface water sources and failure in monsoon has depleted the quality of groundwater. That too in an industrial town like Mettur the groundwater quality is slowly detoriating. Hence, an attempt has been made in Mettur taluk, Salem district to assess the quality of groundwater and Geochemical factories that influence the water chemistry. Season wise samples were collected and noted the groundwater was colorless, odorless and alkaline in nature. pH and EC show the water is good and medium for general purposes. NO_3 and PO_4 were higher indicating anthropogenic sources and leaching. Cations were contributing by natural weathering process Na + K, Cl+SO_4 and Na+K-Cl+SO_4-HCO_3, are the dominant facies. Statistical studies indicate chemical weathering leaching of secondary salt and anthropogenic activity are the major contributors for certain ions in the study area.

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Abs. Nr. OR-064

Sea Water Desalination via Fuel Cell Operation Cycle

G. Marimuthu[1]

Fuel cells are considered as future source of electrical energy. Fuel cells generate electricity from hydrogen and oxygen. Final products are electricity and pure water. While discussing fuel cells, the attention is always focused on electricity production. The other product, namely, water is conveniently neglected. Fuel cells could be ideal source of pure water for domestic and industrial purpose if available technologies are strategically combined and applied.

Fuel cell requires hydrogen and oxygen for its operation to produce electricity and water, which is reverse of water electrolysis. The sources of hydrogen for fuel cells are ploughed back to fossil fuels and organic resources such as methanol and hydrocarbons. Seawater may be the source of hydrogen for fuel cells. The hydrogen in its pure form is obtained by electrolysis of purified seawater. Electrolysis of seawater generates chlorine, caustic soda besides hydrogen. The commodity chemicals, chlorine and caustic soda make the process economically viable and the cost of production of pure water becomes nil.

If fuel cells operate @ 65% efficiency to generate D.C. power (which is driven back again to electrolysis) based on electric power consumption for sea water electrolysis, other products are obtained at a cost of only deficiency in efficiency of fuel cells, estimated @ 35%. If values of chlorine and caustic soda are taken into calculation, pure water from sea water (indirectly through fuel cells) is obtained almost free of cost.

The paper discusses the progress made in this direction at our firm and economic viability data for implementation for 100 MLD pure water production plant.

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Abs. Nr. OR-067

Land Cover Mapping Using Remote Sensing and GPS Technologies for Shadegan Marsh, Southern Part of Iran

Saeed Saroei[1] and Parviz Zeaiean Firouzabadi [2]

Remote sensing and GPS technologies have shown their abilities to map our environment. In this research an attempt has been made to study the usefulness of remote sensing data to produce maps of coastal marsh of Shadegan area Southern part of Iran in the scale of 1:50000. This marsh had already a general land cover of types *Phragmites sp* and T*ypha sp*. As a result of drought since late 1998 in this area, these species have been replaced with other plant communities. In the managerial point of view, the recognition of the replaced new plant communities is very important for further marsh management. In this regard, Landsat ETM + geocoded data pertaining to the study area used to first generate an enhanced image data through fusion algorithm of GEOMATICA image processing software from ETM+ bands 2,3,4 and 8. Using this enhanced image data set and based on MLC algorithm a map showing 14 land cover plant categories was generated. It is resulted that the trend of plant species from center part of marsh to outer part observed to be from marsh species to non-marsh species. The overall classification accuracy was 97 percent in comparison with a sampling ground truth map (about 2 percent of total area).

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Abs. Nr. OR-068

Reversal Mapping of Heavy Metal Pollution in Receiving Water Systems

D. Walther[1], H.-D. Olbrisch[2], P. Selvapathy[3]

Heavy metals belong to the most common industrial pollutants in river, drainage and sewer systems serving as receiving watercourses of urban areas. They originate mostly from typical point-sources like industries, small industries or hospitals. The sources are numerous and difficult to locate. Thus a comprehensive control of these industrial pollutants is often not satisfactory or lacking.

Due to the characteristics of heavy metals to precipitate rather than to remain in solution they hardly can be traced in water unless it has been sampled close to the source. In most cases, heavy metal pollution occurs batch-wise and not continuously. Thus sampling becomes extremely difficult.

The city of Braunschweig is located in the centre of Germany close to one of the largest irrigation areas in a heath land region called “Lüneburger Heide”. Here a method has been developed to trace back contamination sources for industrial pollutants and from that a systematic approach for detection, recording, validating and controlling of the pollutants has been derived. Due to the success in generating a wastewater register for industrial pollutants allowing for separate collection and treatment, Braunschweig is one of the few places in Germany eligible to use wastewater for irrigation purposes.

A similar approach has been adapted to investigate heavy metal pollution in river Adyar/Chennai in a systematic way. The basic strategies and the results of the investigation will be presented in this paper.

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Abs. Nr. OR-069

Fresh Water Algalogical Studies of River Gomti of Lucknow-Uttar Pradesh

M.R. Suseela[1]

The ancient river Gomti originates from Pilibhat in the sub-Himalayan tarai belt and runs across nine districts of Uttar Pradesh and finally joins in the river Ganges at Gomti Mohana in the district Varanasi. Having length of 11.5km in the Lucknow city of Uttar Pradesh it is the backbone of its economy. About 70% of water supply is carried through this river for two million people of Lucknow. This dense population has also led to the industrialization of the city. Over the years several encroachments have sprung upon the banks of the river. The river banks are unusually abuzz due to untreated city sewage effluents from municipality, industries and run off from the land find their way into river. This has changed the natural composition of river water.

Therefore over the years Gomti river has become polluted. The analytical data on various parameters indicated that the river water quality is extremely poor and dissolved oxygen level of the river water has sharply decreased with significant elevations in BOD and COD levels. Monitoring by the state pollution control board reveals that the river water is unfit for consumption. The extent of pollution is such that the biodiversity of the river is being affected. As a part of conservation of biological diversity of fresh water algal flora the present investigation has been carried out.

The role of algae in self purification and pollution control of lotic water has met with causal attention in India. A total of 80 algal forms out of which 25 blue green algae, 10 green algae and the remaining 45 diatoms are reported. Predominance and seasonal variation of these algal forms are discussed in this paper.

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Abs. Nr. OR-071

Waste Water Treatment Using Aerobic Filter Technology

K.V.Emmanuel[1] and R.A. James[1]

Treatment of domestic sewage has become an integral part of modern city management. While the situation with sewerage and sewage treatment in India still needs a lot of improvement, the few sewage treatment plants, which have been implemented, too were not functioning very satisfactorily. Almost all these treatment plants employed suspended growth aerobic systems after primary clarification, mostly aerated lagoon or activated sludge plants. The requirement of continuous power for these systems makes it quite costly in operation and dependent on high level of operation, monitoring and maintenance. It is seldom found easy for the plant authorities to ensure continuous power, which in turn, results in under-optimized performance of these units. Needless to say, a system, which is not as sensitive as the existing one, but can match the regulatory requirements, would be the need of the hour. The stringent stands laid down for treated sewage (20 mg/l BOD and 30 mg/l suspended solids) makes it quite difficult for anaerobic systems in itself to totally replace the aerated lagoon/activated sludge plants. Combination of anaerobic and simple aerobic systems e.g. a UASB followed by stabilization ponds could achieve the results, but it would be preferable to achieve the results using one-step treatment system and hence the interest in aerobic filters. The aerobic filters are quite suitable for sewage treatment, as on one hand it can provide the high efficiency required and on the other, the operation and maintenance of the system would be cheaper and easier. The technical details of the aerobic filters and its performance details are discussed.

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Abs. Nr. OR-076

Influence of Sea Water Intrusion on Soil Chemical Properties

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The Pondicherry region of the Union Territory of Pondicherry lies in the coastal belt of Bay of Bengal. The soils of this region are highly suitable for variety of crops, which are irrigated mostly with ground water. The Bahour commune is considered to be the rice bowl of Pondicherry region where the crop cultivation is mainly depending on ground water resources.

During the *sornawari* season (May – August) of 2002, the paddy crop suffered a serious set back resulting in complete failure in this commune. The field investigation of the affected area had shown the hydrogen sulphide injury as seen from the dark black colour of the surface soils and rotten egg smell. The root samples were also covered with the precipitate of iron sulphide resulting in root rot and die back symptoms. To investigate further, soil and water samples were collected from the affected area and analysed for various parameters.

The results have suggested that the soils of this commune are fine textured in nature, the clay content ranging from 25.90 to 43.15 per cent. Interestingly, the pH measurements taken in soil water suspension had shown drifting values, which was attributed to the high sulphate nature of the soil samples as indicated by Hesse (1994). As suggested by Dent (1986), the pH measurements were made in hydrogen peroxide medium, which had shown that the majority of the soil samples were acidic in nature with pH values ranging from 1.20 to 6.20. It was also seen that the organic C content of all the soils were unusually high which was attributed to the oxidation of pyrite in the soil samples as supported by Dent (1986). The calcium chloride extractable S registered very high values ranging from 78 to 2921 mg kg^{-1}. The other chemical properties had shown that the soils were saline, non-sodic with excess quantities of DTPA-Fe and Mn.

The water samples used for irrigating paddy were found to be very high saline, medium sodic to very high saline to high sodic as per USDA classification. The ionic composition of the ground water had suggested a clear indication of sea water intrusion into the ground water as seen from the relative decrease in the concentration of HCO_3^-, together with a relative increase in the concentration of Cl^- and SO_4^{2-} among the anions and decrease in the concentration of Ca^{2+} together with an increase in the concentration of Na^+ and Mg^{2+} among the cations as had been inferred by Krishna (1988). Based on the analytical results, it was concluded that the ground waters of Bahour commune were intruded with seawater. Irrigation with the seawater intruded ground water had resulted in the formation of potential saline acid sulphate soils, which was identified for the first time in the Pondicherry region.

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Abs. Nr. OR-077

Wastewater Irrigation

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With increasing global population, the gap between the supply and demand for water is widening and is reaching such alarming levels that in some parts of the world it is posing a threat to human existence. Scientists around the globe are working on new ways of conserving water. On the other hand disposal of municipal wastewater and industrial effluents are causing major environmental problems. In India, it is estimated that 3,650 m^3 of wastewater is generated from urban and local bodies and 750 million m^3 of wastewater is generated from industrial units every year. At present the water actually consumed by effluent reuse is only about 15 – 20% and the balance 80% is going as waste. The arid and semi arid areas of the world can easily augment 15 to 20% of their water supply through reuse of wastewater. There is a great scope in utilizing this water after treating the same to the extent necessary. If the used water in the municipalities and industries are reclaimed, it is estimated that more than one lakh acres can be brought under irrigation in Tamil Nadu alone. Wastewater reclamation and reuse may produce reliable source of water even in drought years. Applying wastewater to agricultural lands is a more economical alternative and more ecologically sound than uncontrolled dumping of municipal and industrial effluents into lakes and streams. In arid and semi arid regions where water is in short supply, wastewater reuse is one of the measures, which take care of the water needs, and concerns for environmental safety in a single stroke. Recycling of wastewater for irrigation thus proves to be an appropriate technology. Municipal wastewater and Agro based industrial wastewater irrigation with better management practices will reap rich benefits. A critical review about the wastewater irrigation has been presented in this paper.

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Abs. Nr. OR-078

Management Strategies to Control Seawater Intrusion

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Coastal aquifers are famous for copious fresh groundwater. But these groundwater aquifers are intruded by seawater due to over exploitation of groundwater. Practically the coastal aquifers are hydraulically continuous with the sea. Excessive pumping of groundwater disturbs the hydrodynamic equilibrium. Hence seawater rushes to fill the vacuum created by the depletion of groundwater. Such an alarming situation is existing at Minjur – Panjetty – Tamaraipakkam aquifers, North Chennai and Besant Nagar, Thiruvanmiyur, Palavakkam, Neelankarai and Injambakkam, South Chennai.

During last three decades the city achieved a phenomenal growth in industry. This situation has led to increase in population and consequent demand for water. Prior to 1965, the entire water need of the city was mostly met from surface sources such as Poondi Reservoir, Cholavaram Tank and Red Hills. Since 1968, more than one third of the water demand was met from three well fields known as Minjur, Panjetty and Tamaraipakkam of Chennai aquifer situated about 40 km North, North – West of Chennai. The well fields lie along a buried channel formed by the course of a perennial river that existed in the past. The well fields are listed in the order of their proximity to the Bay of Bengal. Of the three, the Minjur well field lies nearest to the Bay of Bengal, at a distance of 9 km from the coast which is hydraulically continuous to the sea. Minjur well field has been intruded by seawater since 1969 due to prolonged extensive extraction of groundwater for agricultural, industrial and domestic uses.

Minjur aquifer system is conceptualized as a two layer system with an upper water table aquifer and lower confined aquifer separated by an aquitard. The recharge to the unconfined aquifer is from rainfall and irrigation return flow. The recharge to the confined aquifer is longitudinal and exposed parts of lower aquifer. The withdrawal is for irrigation, industrial and domestic uses mostly from confined aquifer. The fifty year average annual rainfall is 1377 mm.

The freshwater – seawater interface was at a distance 4.9 km from the coast during the years 1969 to 1975 and it moved to 6.5 km in 1977 and continued up to 1982. Finally it has been occupying 10.5 km from the coast. The interface position is fixed based on chloride – bicarbonate ratio when it is more than one.

There has been progressive depletion and pollution of the groundwater by the virtue of supplying a large quantity of water to the Chennai city. This is purely due to lack of proper groundwater management during the development of civil and industrial settlements in this area during 1960 to 1990. In order to provide sustainable aquifer management, numerical models are used. Numerical models

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are valuable tools to assess the present aquifer condition, to predict future aquifer situations and is used to establish remedial action to attenuate the groundwater quality deterioration.

A three dimensional groundwater flow and solute transport model are used to simulate Minjur aquifer system. The steps involved in applying the theoretical model to field conditions are explained in detail. The model is calibrated, tested and projected for the period 1976 – 1982, 1983 – 1996 and 1997 – 2020 respectively. To fulfill the main objective, the model is used to find the sustainable solution to control and prevent seawater intrusion. Seawater encroachment in coastal aquifers can be controlled with the reduction and rearrangement of groundwater withdrawals or the injection of freshwater through which freshwater ridge can be maintained above mean sea level. Management strategies such as reduction in pumping or the injection of freshwater are tried through model and proposed to control and move back the freshwater – seawater Interface. So the model is tried for various pumping and recharging patterns to evaluate the aquifer behaviour.

Various Scenarios are listed below

No change in 1996 groundwater withdrawals

Ten percent increase in 1996 groundwater withdrawals

Elimination of groundwater withdrawals for industrial uses

Elimination of groundwater for irrigation uses

Elimination of all groundwater withdrawals

Optimal groundwater withdrawals

Optimal groundwater injection

It is found that the variations of head reached dynamic equilibrium sooner than the concentration. The concentration either increased or decreased rapidly in the first ten years and the changes are slower in the next ten years. This indicates that the system reachs dynamic equilibrium for concentration also. Through various simulation runs it is found that reducing the pumping is possible either by changing the agricultural pattern or buying the groundwater rights from the farmers. Purchasing the groundwater rights suggestion is now successful. Other alternative is to recharge treated waste water into the contaminated groundwater. Every year minimum of 35 million cubic meter of waste water is treated which can be utilized for groundwater recharge. Another alternative is, every year 100 million cubic meter of water surpluses in the drainage basin of the aquifer. Practicability of the above said three alternatives will be discussed in detail in the full paper.

Abs. Nr. OR-079

Groundwater Quality Studies in the Patiala Districts of Punjab

Manish Kumar[1] and AL. Ramanathan[1]

The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological strata of the particular region. In recent years use of fertilizers, pesticides for agriculture deteriorated the condition. In present study the chemical characteristics of ground water in different villages of Muktsar and Patiala districts in Punjab have been ascertained in different seasons with respect to its suitability for drinking and agricultural purposes. The water samples were collected and analyzed for physiochemical parameter in 2 seasons i.e. pre-monsoon and post-monsoon 2003 following the standard methods. The ground water is colourless and odourless with pH range 7-8.5. The analysis of cation and anions shows that the quality is comparatively better in post-monsoon than pre-monsoon. Phosphate and nitrate with high concentration at certain location in pre monsoon indicate the intensity of pollution. The dissolve heavy metals are below permissible limit except iron. Total dissolve solids, nitrate, fluoride, sulphate concentration have exceeded the maximum permissible limit at certain locations. The detailed perusal of chemical data in districts indicates that ground water is not suitable at most of the places for drinking purposes except few patches due to high salinity, high sodium and SAR it is also found to be not suitable for irrigation purposes in certain locations. However it is suggested that salt tolerant crops can be grown on soils having good drainage in study area.

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Abs. Nr. OR-080

Hydrogeochemistry of the Groundwater in Delhi Around Najafgarh and Other Drains

Bhawana[1] and AL. Ramanathan[1]

The water requirement for National Capital Territory of Delhi constitute mainly for the drinking water supply of its growing population. This study focuses on the quality of groundwater along Najafgarh drain and other drains joining it in the way to Yamuna River. Sampling was done at the end of June 2003 (pre-monsoon period). At some places water samples from drains have also taken. Analyses of pH, EC and HCO3- have done in the field.

EC is primary indicator of total mineral content of water and may also be related to problems such as excessive hardness, corrosive characteristics or other mineral contaminations. It showed a range from 453 to 37520 (Tikrikalan) µs/cm in groundwater and 173 to 1943 µs/cm in drain water. It was also high in Bhalaswa Lake (11400 µs/cm). These data indicate the presence of moderately to highly saline water. Very high salinity of groundwater in some places make it unsuitable even for agricultural purposes. The pH of drain water was higher (maximum 9.91, Rawta-Jhijhili Road) than groundwater (maximum 8.28) It was minimum in Bhalaswa Lake (6.5). At each site its value exceeded the desirable Limit (6.5) and in few sites it has crossed the Permissible Limit (8.5) also as fixed by IS: 10500, 1991 for drinking water. HCO_3^- ranges from 32 to 220 mg/L in groundwater and was 2.828 to 33.424 mg/L in drain water.

There has been wide fluctuation in NO_3^- concentration in groundwater, which can be due to point, and non-point sources. In some sites it has exceeded desirable Limit (45 mg/L) and in a few, even Permissible Limit (100 mg/L). Higher concentration may be attributed to combined effect of contamination from domestic sewage, livestock rearing, landfills and runoff from fertilized fields. SO_4^{2-} of groundwater ranges between 7.41 to 6866.67 mg/L and that of drain between 1.28 to 53.70 mg/L. It was mostly below desirable Limit (200 mg/L) but in few sites even exceeded Permissible Limit (400 mg/L). In groundwater PO_4^{3-} ranges between 0.002 to 0.252 mg/L and in drain water it was higher ranges from 0.004 to 1.164 mg/L.

In the major cations Ca has crossed Desirable Limit (75 mg/L) in many sites. Na and K were also high. In few sites the concentration of Fe has crossed Permissible Limit (1 mg/L) in groundwater. But in drain water it was higher in nearly all sites and actually quite high indicating point sources, may be industries. Again, drain water has higher concentration of Pb crossing the Permissible Limit (0.05 mg/L) in all sites. It was higher in groundwater also. Concentration of Mn and Cu were nil to very low.

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Concentrations of different parameters have not shown any consistency in shallow and deep groundwater. But in Dhansa which is in Najafgarh depression area showed higher concentration of SO_4^{2-} and PO_4^{3-} in deeper level (75m) as compared to adjacent shallower ones.

Our study based on one time sampling indicates that the groundwater in most places of National Capital Territory of Delhi is not suitable for drinking purpose. Further sampling can be carried out to get an insight into the temporal and spatial variations in groundwater quality in NCT Delhi.

Abs. Nr. OR-084

Demarcation of Groundwater Pollution Zones By Using Seven Digit Coding System in PCMC Area, Maharahstra.

Shubhrangini Chauhan[1], N.J.Pawar[1] and Vishwas S.Kale[2]

The phenomenal growth of population during the last three decades coeval with rapid industrialization and urbanization has increased the geographical area of PCMC from a mere 86 km^2 to about 206 km^2. The extraordinary increase in the population and about 240% increase in the geographical area have enormously increased the pressure on the already limited land, soil and water resources, both in terms of quantity as well as quality. Rapid population and industrial growth has resulted in the problem of water pollution, mainly due to release of industrial and domestic effluents into the adjoining watercourses, use of wastewater for crops, leachates from landfill sites used for the disposal of solid wastes and leakages from sewerage network and septic tanks. In addition the adjoining villages recently merged with PCMC, with poor sanitation facilities and non-engineered designs of the privy waste systems cause degradation of soil that ultimately enters into the groundwater system. In sub-urban areas delays in the installation of water supply and sanitation facilities makes these areas dependent more on groundwater as the only source of drinking water which at places is polluted due to leakage in septic tanks. However, measures to stop or minimize the problem can be suggested only if a clear picture regarding the nature, causes, spatial variation and the extent and magnitude of groundwater pollution in the urban and sub-urban areas are available. It is with this view in mind that studies were initiated on groundwater pollution in the PCMC area.

The Major objective of the present study was to estimate the contribution to pollution from natural and man-made sources. Using chloride as groundwater pollution indicator proportion of sewage/industrial effluent was estimated on the basis of Δ_{cl} (%). The values of Δ_{cl} (%) for all the three seasons given in Table 5.1 indicate that there is undoubtedly mixing of polluted surface water with groundwater. The Δ_{cl} (%) values obtained for various seasons show that except for six samples (W-15, W-19, B-25, B-27, B-43 and B-45), all the remaining samples have values between 1.25 and 344% during summer (March-April, 2001). The six samples listed above reflect no mixing of sewage or industrial effluent. As against this, in the post-monsoon season (November-December, 2000) only four samples were free from mixing of wastewaters and the remaining samples depict values from 6.5 to 1300%. Interestingly, the samples collected during June-July, 2000 displayed values from 5.3 to 514% except three samples (B-27, S-7 and B-21), which are free from mixing of effluents. Thus, in general, the mixing proportion of sewage/industrial effluent is higher in the post-monsoon

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season (November-December, 2000) and lower during the summer season (March-April, 2001). It is most likely that during the rainy season the rainwater recharge, rich in pollutants from surface sources, rapidly mixes with the groundwater, because of shallow depth of the water table. The mixing is further favoured by hydraulic continuity between the streambed and the aquifer, and weathered, fractured and jointed nature of the upper rock strata. In comparison low Δ_{cl} (%) values during the summer (March-April, 2001) can be attributed to deeper water table depths, and confined nature of the pollutants at shallower depths.

Zones of polluted groundwater were identified by using seven-digit code represented by EC, hardness, chloride, Na, total microbial count, elevation of the area, and land use. Considering this coding system and data for 50 sample wells over three seasons the urban area of PCMC was divided into three categories such as 1] Slightly polluted 2] Polluted and 3] Highly polluted.

The slightly polluted groundwater areas were found between Pimpri and Kalewadi phata and an isolated spot at Nigadi. The remaining locations were classified as polluted to highly polluted in terms of the above parameters. Of these, the highly polluted locations include, Punawale, Sangvi, Wakad, Bopkhel, Dighi, Bhosari lake, Indrayani Nagar, Sambhajinagar (Nigadi), Dadulgaon, Charoli, Borde vasti. The last three have been included in the highly polluted class due to development of natural salinity. Besides these locations, all the remaining locations have been classified as polluted in terms of five parameters.

Further, classification of wells on the basis of relief and land use indicates that highly polluted wells are generally absent in the vegetated areas, irrespective of the relief category, and that the relative proportion of polluted to highly polluted wells is higher in the built-up area situated in the lower elevation zone. Wells in the barren and open area also indicate some evidence of pollution of groundwater. Some wells located close to river stretches with impounded water suggests that the pollution hazard increases.

Abs. Nr. OR-085

Design of Sewage Farms as Constructed Wetlands with Mixing Cell Method

Benny Joseph[1] and N.K. Ambujam[2]

In the 21st century developing countries around the world are still grappling with the problems of scarcity of clean water, wastewater treatment and disposal. Low cost-low energy treatment systems and reuse of wastewater are the few prime solutions in the horizon. Sewage farms and constructed wetlands are two of the low cost treatment systems which could be of high utility for a tropical country like India. Constructed wetlands emphasize on the treatment aspect of wastewater, whereas the sewage farms play the prima donna role of resource recovery in the form of farm produce in addition to substantial changes brought about in the characteristics of wastewater by way of reduction of organic matter content. In many parts of the world, water is scarce and often polluted. In many countries, population density and the location and size of reservoirs create water distribution problems. Inadequate wastewater collection and treatment facilities even in the richest countries allow untreated sewage into rivers, lakes and oceans. The impact of the discharge of urban wastewater into rivers, lakes, estuaries and the sea is a matter of great concern in most countries. Conventional solutions to wastewater treatment are not only expensive, but are designed to throw water away. Further they do not address issues of water scarcity and distribution or limited financial resources. The high cost of the some of the conventional treatment processes has produced economic pressures and has caused engineers to search for creative, cost effective and environmentally sound ways to control water pollution. As result of the above, alternative systems designed to mimic nature are operating around the world to address the problems of conventional wastewater treatment facilities. These alternative systems use man-made ponds, constructed wetlands and designed soil filters to transform wastewater into usable water resource. Compared to conventional treatment systems, constructed wetlands are low cost, are easily operated and maintained, and have a strong potential for application in developing countries, particularly by small rural communities. The combination of multiple treatment environments within constructed wetlands can provide water quality suitable for reuse. In 2000 Vogler et al proposed a model, again considering the constructed wetland as made up of number of CFSTRs and a much simpler derivation technique had resulted in predicted values comparable to the earlier models. In the above contest the need for a simpler model in terms of parametric requirements and concept, which could yield better results has been identified and taken up as the prime task of the present study.

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In this paper a design procedure is proposed for sewage farms with special reference to Indian conditions, making use of the proposed model for the removal of BOD from constructed wetlands.

Studies on Biological Liquefaction and Biomethanation of Organic Solid Waste Generated from Tanneries

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The tanning industry is one of the oldest and fastest growing industries in south and southeast Asia. There are more than 3000 tanneries located in India with a total processing capacity of 7,00,000 tonnes of hides and skins per year. In Tamil Nadu nearly 934 tanneries in which give 65% production share. More than 90% tanneries are in small and medium scale sector with processing capacities of less than 2-3 tons of hides/skins per day. They follow traditional practices, mostly unorganized and unplanned on environmental pollution control aspects.

Major solid waste generated from tanning industry are: fleshing, trimming, shavings, buffing dust and sludge from Effluent Treatment Plants (ETP). Such fleshing is dumped as land fill or disposed of along with other solid wastes. The unutilised fleshing containing high concentration of organic matter lime and sulfide, putrefy and produce obnoxious odour, causing groundwater pollution and attract flies and rodents. Due to high moisture content handling and transportation of such fleshing become difficult. To solve the disposal problem of fleshing, a study was carried out to digest it anaerobically after biological liquefaction.

The fleshing can be anaerobically digested in closed digesters and digested sludge used as manure. For efficient anaerobic digestion in UASB reactor, the fleshing has to be reduced in size. Though the biogas generated in the process can be recovered and used as energy. One of the major problems faced in biomethanation of fleshing is pulverisation for easy feeding and better digestion. One of the methods studied was liquefaction of fleshing and then biomethanation of the liquefied fleshing in UASB reactor.

Traditional disposal methods can produce odours in the local community and generate air pollutant emissions. For example, disposing of waste in landfills has the potential for leaching contaminants into the groundwater and also generating significant of global warming gases (Dave Ryan, 2001), land filling also results in making the soil anaerobic by depletion of dissolved oxygen, which makes the land unsuitable for plant and tree growth, Therefore, land filling its not a correct option. The most suited mode of disposal is incineration, but the rising cost of incineration and the need to maximize energy recovery and digestion of these solid wastes makes the anaerobic degradation process a very attractive alternative to the mass burn technology (Brac and Six, 1999). Moreover the high water content and organic fraction combination makes energy recovery by anaerobic digestion a favorable proposition (Marguerite Lake).

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The liquefied fleshing is mixed with tannery waste water and treated using UASB reactor for biogas recovery. The COD removal efficiency was increased to a maximum of 70 % from 10 %. The study was carried out for a period of 75 days. The reactor was monitored continuously for the parameters such as pH, VFA, COD, waste water flow and biogas production. The waste water was pumped into the UASB reactor using peristaltic pump. The quantity varies between 4 to 9.6 litres per day. The HRT maintained during the study period is in the range of 12 – 30 hours COD removal efficiency was very low during the start up period. Maximum COD removal efficiency of 70 % was observed only after 60 days of start up of the reactor with an average COD loading rate of 7 $kg/m^3/d$. This delay may be due to the acclimatization of the microorganisms present in the sludge to the substrate provided and less sludge activity etc during the startup period. The maximum biogas produced during the study period was about 6.7 litres per day. 230 to 275 ml of biogas was produced per gm of COD removed.

Abs. Nr. OR-094

Factors Influencing Suspended Load in the Meltwaters of Dokriani Glacier, Garhwal Himalaya

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Solute and suspended load in the meltwaters of the Dokriani glacier has been monitored during the ablation season. The suspended sediment concentration varied from a low of 22 mg/l to a high of up to 228 mg/l. Maximum suspended load was observed in the months of July and August coinciding with heavy monsoonal rainfall. The average suspended sediment load for 1999-2000 has been computed at about 16900 tons/km^2/year. There is a pronounced relationship between the amount and intensity of rainfall and the suspended load. The rainfall variation from year to year has been significantly high. The thick debris cover in the lower ablation zone of the glacier is a major factor contributing to the suspended load. The character of the glacier hydrological system also plays a significant role in controlling the sediment transport.

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Abs. Nr. OR-102

Benefits of the Networking of the Surplus Indian Rivers

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India is one of the wettest countries of the world. The country's wealth is the people, the land, the water and the sunshine. We have in India, an average rainfall of about 1,170 mm, spread over 100 rainy days and only in about 100 high intensity rainfall hours bringing in about 4,000 BCM (Billion Cubic Metre) of water. In this quantity about 2,631 BCM is lost as evaporation to atmosphere and seepage to the sub-surface, hence the available surface water potential of India is 1,869 BCM. But, the utilizable water is 690 BCM. In the utilizable resource also, it is likely to use it for irrigation in the order of about 381 BCM of live storage during the five-year plan periods (through completed projects 173.73 BCM, through on going projects 75.42 BCM and through proposed projects 132.30 BCM) as per the "Theme Paper on Five decades of water resources Development in India". Hence, even in the utilizable water resource, about 309 BCM is not likely to be utilized and this quantity is about 44.78% of the total utilizable resource. Therefore, the total quantity of water wasted into the sea is 1,488 BCM (1,179 + 309 BCM) or 52,548 tmcft. The percentage of water wasted into the sea in the Indian rivers works out to be 79.61.

Out of the 1,488 BCM or 52,548 tmcft of water which is being wasted into the sea annually in the normal monsoon years in the Indian rivers about 15,548 tmcft or about 30% is reserved for our future generation to use for domestic purpose, ecology, recreation, livestock, industry etc. Therefore, about 37,000 tmcft of water could be allocated to utilise for irrigation.

In Tamil Nadu one tmcft of running water irrigates about 7,500 to 8,000 acres. In one hectare at an average about 5.5 tons of paddy is produced, though some progressive farmers produce about 10 tons /hectare. If all the water saving, harvesting and management approaches are adopted, it is possible to irrigate about 10,000 acres (4000 ha) by utilizing one tmcft of water. The cost of one ton of Paddy is about Rs.5, 500. In addition to that, by utilizing the residual moisture left after paddy cultivation coupled with summer rain, it is possible to produce about 500 kg of black / green gram per hectare. The cost of one kg. Of black / green gram is Rs.20. So as per the above norms, by utilising the 37,000 tmcft of water by diverting it to all the scarcity regions of India through Inter-Basin water transfer, it is possible to create an additional potential of about 148 million hectare and to produce 814 million tons of paddy, which is worth of Rs.4.50 lakh crores. By utilizing the residual moisture and the summer rain it is possible to

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produce about 74 million tons of black/green gram, which is worth of Rs.1.48 lakh crores. So, the total money generated through paddy plus black / green gram is Rs.6.0 lakh crores. It is interesting to note that by utilizing one tmcft of water it is possible to earn about Rs.12.20 crores if paddy alone is raised or if a summer crop is raised in addition to paddy, and then it is possible to earn Rs.16.22 crores. Therefore, the cost of one tmcft of water wasted into the sea works out to Rs.12.20 crores or Rs.16.22 crores.

In the last 57 years, that too, after our independence and Self Rule, we have wasted Rs.342 lakh crores worth of food grain producing water into the sea as per the current rate of paddy. Agriculture is also an industry. To irrigate one hectare of land about 50 farm labourers are necessary. Every year it is possible to create about 7,400 million man-days for the farm labourers

For mitigation of drought and floods about Rs.2, 000 to Rs.3, 000 crores is being spent every year. Since floodwater is to be diverted to the drought prone area through inter basin transfer project, this expenditure could be curtailed to the barest minimum in future.

Irrigation potential of about 148 million ha could be created and it is possible to produce about 450 million tons of food grains needed by 2050 AD, for the projected population of 1.64 billions.

Whenever there is drought, mainly farm labourers used to migrate from their region to other water potential regions to seek their livelihood. Animals are also affected due to want of feed and water during this period. Such Socio-Economical problems could be avoided.

In the water deficit regions there used to be quarrels, deaths and litigations connected with sharing the meagre quantity of water. Such conflicts and social tensions could be averted.

In the flood prone area, a large quantity of the rich soil equal to 530 million tons per year is being eroded. Due to this, mainly the farmlands loose fertility and there is reduction in food grain production. In the drought and flood prone regions, the fauna and the flora become extinct due to water scarcity as well as water abundance. All these ecological imbalances could be solved by this approach.

The rejected groundwater recharge in the flood prone area and the declining groundwater level in the drought prone area could be improved through artificial groundwater recharge by utilizing the flood water for this purpose and thereby the groundwater recharge could be enhanced. It has been estimated that through artificial ground water recharge approach about 7,564 tmcft and 159 tmcft of additional groundwater potential could be created per annum in India and in the peninsular regions respectively.

Therefore, in the coastal regions it is possible to keep the groundwater level one foot above MSL and seawater ingress could be stopped. Due to the availability of the perennial groundwater recharge source, there is a possibility that the dark and over developed blocks will become gray and the gray blocks will become white. So, minor irrigation development due to the want of groundwater resource will not be affected. This will further enhance the income to farmers. With the additional groundwater recharge, it is possible to generate an additional income

of about Rs.1.24 lakh crores in India and about Rs.2, 579 crores in the peninsular region in terms of food grain production.

About 34 million-kilo watt-hour hydroelectric powers can be generated and the power crisis could be solved to a maximum extent in this country.

Along the Inter - basin transfer waterways, like channel and canal routes, recreation spots could be created and thereby promotion of tourism is also possible. In the flood prone area of North West, North and East India there is water logging which causes low crop yield. If the floodwater is diverted to the water deficit region then and there, the high groundwater level will decline due to non-stagnation of water and thereby the crop yield will improve.

Unite all the people of the country and give a developmental impetus of unprecedented magnitude. Avoid the losses of the type, which occurred during 2002 to the extent of Rs. 25,000 crores by the loss of crops due to drought conditions and flooding in many parts of the country.

Save Rs. 3,000 crores a year in foreign exchange by avoiding importing oil because of the cost-effective alternative navigation provided along the long coastline and the National Water Way, which will become a reality by implementing the project.

Provide for changing the security of the country by an additional water line of defense (along the western and northwestern borders with the river Saraswathi, and extension of Rajasthan Canal beyond Jaisalmer up to Gujarat and along the northern and north-eastern borders with the linking of the Brahmapurtra and the Ganga) and Provide National Water to complement the Railway and road networks.

Mitigate the flooding problems, which recur in the northeast and the north.

Solve the water scarcity situation in many parts of the country, particularly in the northwest, western and southern Bharath by providing alternative, perennial water resources.

The Fiscal deficit of our country stands at 52 among the 58 countries. It is proposed to achieve to 10 % GDP growth in the 10th Five-year plan. To reduce the fiscal deficit and to increase the GDP growth rate to the desired level inter-basin transfer is necessary.

The present foreign debt of our country is 105 billion US dollars (RS. 4.93 lakh crores.). The entire debt could be repaid within 3 to 5 years period from the money generated from food grains production after the completion of the project. This is the most important benefit of all benefits to be obtained through the Interbasin transfer water project.

The authors suggest a broad-minded approach to share the surplus water that is being wasted perennially in the surplus India Rivers even after 57 years of our Self Rule. The authors also suggest that to share the water – caste, community, creed, religion, language, ideology and political borders of countries / states should not be the barriers.

Abs. Nr. OR-119

Hydrogeochemsitry of the Achankovil River Basin, India

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A study of major cations and anions of the Achankovil river basin and its two major tributaries has been carried out to assess the geochemical and solute acquisition processes. The river has been sampled during February 2002 (Pre-monsoon), June/July 2002 (Monsoon) and October 2002 (Post-monsoon) and analyzed for various cations and anions. Cl, HCO_3 and H_4SiO_4 account for almost 90% of anions and Na and Ca 85% of major cations. This study shows that surface water was dominated by Cl>Ca+Mg/ HCO3 and Ca+Mg/Na+K and other ratio shows the major contribution of ions from precipitation induced silicate weathering followed by carbonate weathering with minor anthropogenic sources. High EC and TDS were observed in the monsoon and post monsoon samples. There is a minor seasonal variation in the TSM concentration that shows the abundance of highly resistant rocks in the river basin. The water is in equilibrium with Dolomite and Kaolinite minerals. Chemical weathering is predominant than physical weathering. The annual river discharge is 1.48 km^3/yr and delivers the solute load of 1389 X 10 6 t/yr. and suspended load of 27 X 10 6 tons/yr to the Vembanad Lake and in turn to the ocean. The amount of solute transfer is very high in comparison to its small drainage area and discharge.

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Pollution of Freshwater Ecosystems in Bangladesh

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The importance of freshwater ecosystems lies in the fact that the great civilizations developed in floodplains where the foundation of agriculture and the earliest settlements were laid (Gopal 1993). The freshwater ecosystems of Bangladesh constitute important repositories of fresh-water, and nutrient rich sediments. The Ganges-Brahmaputra-Meghna (G-B-M) is globally important because they are the primary conduit of an estimated 1060 million tons of suspended solids, more than 1330 km^3 of freshwater and more than 173 million tons of total dissolved load to the Bay of Bengal yearly (Milliman and others 1995). Because of low elevation (between 5 and 6 masl: Milliman and others 1989), frequent flooding (Rasid and Paul 1987) and Holocene sea level changes (Umitsu 1993) Bangladesh serves as a reservoir of the sediments and fresh water carried by the G-B-M system.

The freshwater ecosystem of Bangladesh also represents important sites of genetic resources, and provides habitat for a large number of plants and animals. About 260 indigenous fish species (belongs to 55 families), 150 species of birds, about 12 exotic species and 24 shrimp species and 24 species of tortoise and turtles live in freshwater ecosystem of Bangladesh (Sarker and Sarker 1988 in Ali 1997). These ecosystems supports nearly 50 to 56 percent of the total aquatic flora of the country, and 80 percent of the total inland freshwater capture fisheries (61 percent of the country's total fisheries), and thereby supports the livelihood of 10 million people (Khondker 1995).

Freshwater ecosystems in Bangladesh also meeting the increasing demands for water in industrial and municipal use. A considerable amount of irrigation water is also supplied by these freshwater bodies. Thus the freshwater ecosystems are important in Bangladesh both ecologically and economically

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