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Wastewater Treatment and Reuse a Review of its Applications and Health Implications

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Abstract:

In many parts of the world, there is a water scarcity problem, and millions do not have access to fresh water. Agriculture is widely practiced in many countries using untreated wastewater. Public health and environmental concerns are at an all-time high in this area. A eco-friendlier and more effective alternative to untreated wastewater is treated wastewater. Additionally, exposure to solid wastes is a leading cause of environmental toxicity. This review proposes a multidisciplinary approach to wastewater handling to address the problems associated with untreated wastewater. Agriculture could benefit from this resource. As an example of efficient wastewater treatment and the utilization of solid waste in fertilizers, we propose a model. The water is using for daily activities and also used for several in present study, an extensive investigation of physic Hyderabad was carried out. For this area sampling affected areas like Water samples collected at five sampling sites in rural and urban areas of Hyderabad; each site has a 10km distance variation. Water sampling locations are Site-1-Peerjadiguda, Site-2-Parvathapur, Site-3-Kachavanisingaram, Site-4-Muthawaliguda and Site-5-Pratapsingaram. To assess groundwater quality report samples of river Musi located in rural and urban areas of Hyderabad has to be investigated., Five groundwater samples were collected from different locations during pre-monsoons of 2022. In addition to health concerns, the study points out the harmful effects of untreated wastewater on farmers who work in wastewater-

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irrigated fields. This review paper discusses the health implications of consuming crops irrigated by wastewater. The results of this review indicate that advances in treatment methods will provide us with tremendous opportunities for improving wastewater treatment and its use in agriculture.

INTRODUCTION

Musi River that flows adjacent to Hyderabad has an upstream flow of 70 km before it enters Hyderabad and downstream flow of 186 km to ultimately join Krishna River. The river is clean when it enters Hyderabad, becomes the dirtiest and polluted as soon it leaves it. The river is joined by several streams from north-west. The river water is completely stopped 20 km above with an cuts and the water is used for drinking purpose in the city. However, the city's sewers join the river to make it one of the perennial rivers in the downstream of the city. The problem starts exactly here. The city's sewerage water meters about 280 million liters per day (MLD). There is a make-believe sewerage treatment plant at the end of the city at Amberpet, that leaves 95 percent of sewerage untreated as it has no capacity to treat. In addition, there is a pipe line from Jeedimetla industrial estate that carries 4.5 MLD of untreated chemical effluents to join Musi. The city's sewer contains suspended solids, plastics, metals, alkali lines, acids, chemical effluents situated within the city like, chromium hexane from tanneries, cyanide and cadmium from goldsmiths and silver bromide photo studios, oil and grease from automobiles, lead from batteries, organic waste etc. Besides these, the industrial chemical effluents include metals, inorganic and organic compounds of several varieties. All these have been flowing into Musi for the past two decades and more.

The downstream villages have an interesting history of irrigation. The region supplies more than one lakh liters of milk, mostly supplied to the city of Hyderabad. The diary industry is active right from the beginning of the Musi down downstream. In fact, within the peri-urban basin, when much of the land cultivation was crippled by pollution, slowly the land was converted into high breed grass cultivation on the banks of

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Musi. The grass is also sold to several dairy farms in the city. Besides these, we have seen large-scale poultry industry in the area raising chicken and ducks which can also be affected by the air and water pollution. The villages have traditional occupations of service castes such as washing, pottery, ironsmiths, goldsmiths, weavers, toddy tapping, fishermen, and agricultural labour. The villages have modern occupations like teachers, health workers, pesticide dealers, petty shop keepers etc. The region has the famous handloom industry called Pochampally silk and cotton handloom. There is quite a big range of population that stands threatened by the problem of pouting.

Wastewater Treatment Technologies:

The wastewater treatment plants are designed to achieve certain objectives by utilising different technologies. They aim to accelerate the natural processes by which water is cleaned. The most common type of municipal WWTP uses a biological treatment technology called the “activated sludge” which Favors the suspended growth of microorganisms The activated sludge systems include two stages: primary and secondary. In the primary treatment, solids are settled and removed and secondary treatment, uses biological processes to further improve the water quality Activated sludge is a wastewater process that utilizes biological processes and consists of one or more reactors, in which microorganisms responsible for treatment are kept in suspension and a solid-liquid separation is performed in a secondary clarifier. Such systems usually demand mechanical aeration which is costly and increases their carbon footprint compared to other technologies.

Wastewater follows a determined treatment path in order to achieve water quality standards, regardless of whether conventional treatment or advanced treatment systems are used. Wastewater is normally called influent as it passes through the wastewater treatment facility. Wastewater treatment plants help nature to defend water from excessive pollution. The degree and type of wastewater decides the nature of treatment and the engineering scale of the plant. Most wastewater treatment plants consist of primary and secondary treatment

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Primary Treatment

Primary treatment involves the separation and removal of solid matter and homogenization of the remaining liquid waste. This solid matter will either float or readily settle out due to gravity. Physical processes such as screening and grit removal may be used during primary treatment.Large objects, such as sticks or stones, which could block tank inlets or plug lines are removed during the screening process. Grit chambers are used to slow down the wastewater flow and allow grit to fall out. Solids that can settle in a sedimentation tank are pumped away.

Secondary Treatment

The secondary treatment involves a biological process. Wastewater is exposed to aerobic bacteria where the biological oxygen demand (BOD) is reduced. Aerobic bacteria are used to break down pathogens, other contaminants and suspended organic matter into carbon dioxide, water and biosolids. Aerobic bacteria are naturally supplied in wetland habitats. Baffles with a special coating of aerobic bacteria are often used by sewage treatment plants. Municipal wastewater is normally disinfected with the use of chlorine or other disinfecting compounds. Occasionally, ultraviolet light or ozone is used.

Tertiary Treatment

Tertiary treatment is carried out to improve the 'final look' of water, making it indistinguishable from any freshwater source. It is done to deodorize, decolor and further oxidize if required. There has been an increase in the number of wastewater treatment facilities that employ a tertiary treatment process. Tertiary treatment involves removing nutrients such as phosphorus and nitrogen from wastewater. The removal of nutrients is an important step in restricting downstream effects such as algal blooms and eutrophication, which destroy ecosystems and habitats. Based on the influent, wastewater treatment plants may be a sewage treatment, municipal wastewater treatment, industrial wastewater effluent treatment or agricultural wastewater plant.

LITERATURE REVIEW

Dr.PullaiahCheepi Musi et al (2012)Hyderabad is the 5th largest city in India. It has twin cities Viz.,

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Hyderabad and Secunderabad with its suburbs extending up to 16 miles. The core cities, together with its nine surrounding municipalities are covering an area of 500 square km. The Hyderabad city discharges about 600 million liters per day untreated sewerage water into Musi River. The economic impact and the problems created by the pollution is under taken with reference to sample households, the impact is studied under five sections, This section purely scientific tests were conducted for four sample villages, that are Physical, Chemical and Bacteriological water quality parameters are briefly explained through the water sample reports (Institute of Preventive Medicine Hyderabad Andhra Pradesh).

K.N.Sujatha et al (2016). A study has made on these selected areas of population for health hazards due water born diseases by sampling method. Finding. This paper discuss about Environmental sanitation, water pollution constitutes a serious problem particularly in the mega cities. City like Hyderabad has seen rapid economic development and urbanization which lead to the burden of illness and severity of skin and communicable diseases in and around MUSI River due to its worst contamination in recent days due to poor hygienic and to explore the importance of treated water supply.

Mohammed zakirhussain et al (2020).The area under the Musi river basin is severely affected by the heavy metal contamination. This River originates in Ranga Reddy district and contributes to the flow of drinking water reservoirs viz. Osman Sagar and Himayat Sagar, the latter through its tributary, the 'Musi' for the city of Hyderabad. The information on the influence of sewage water on soil, water and food chain for this region is restricted to research stations only. Therefore, with this background, the present research work was undertaken in the farmer's field to study the extent and magnitude of micronutrients and heavy metal contamination in soil due to irrigation with sewage water over years.

P. Chandra Shekhar, et al (2017) Environment and social evaluation can be carried out as part of the Long Term Transportation Strategy for the study area to understand the sustainability of the strategy and its likely implications

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on the environment and social conditions of the region. The evaluation has been carried out for the indented network development and for alternative scenarios.

Srikanth K and Viplav Duth Shukla et al (2016).The most threatening problem of Musi river pollution is from water soluble, non volatile, fairly reactive heavy metals. These exhibit properties of high toxicity, bioaccumulation (or) carcinogenicity when they combine with organic molecules. These have applications as chemical intermediates in the manufacture of pharmaceuticals, chemicals, paints, dyes etc. The discharges from the industrial units engaged in these activities in and around Hyderabad, find their way into Musi River and environment.

Syeda Amena Kausar&K.Shailaja et al (2018)Pollution is a worldwide problem. Heavy metals are well established environmental pollutants of a great concern due to their serious implications in plant, animal and human health. Higher levels of heavy metals in soil, water and animals have been reported in different parts of India. Present study investigates heavy metal contamination of soil and its uptake by fodder grass (Brach ariamulticar) collected from field sites covering areas across the Musi River, Hyderabad. The soil and plant samples were collected from the field and the control sites during the summer season for two consecutive years and analyzed for heavy metal content by atomic absorption spectroscopy.

B. Vijayashree, y. R. Ahuja1 et al (2005).The bacterial vitotox® genotoxicity test was used to screen water samples collected from three different stations along the banks of the river Musi, in Hyderabad, India. Water was collected at three stations that differed from each other in the nature of the surrounding industrial and other activities.

MATERIALS AND METHODS

Lang term and indiscriminate application of raw sewage effluents which contain heavy metals in association with suspended solid (sludge) to agricultural field without prior treat mart may cause accumulation of toxic metals in soils.

The present investigation entitled "Studies on the distribution and

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accumulation of heavy metals and other toxic pollutants in soil, water and agricultural produce in areas under Musi River Basin of Andhra Pradesh, was undertaken to find out the distribution and accumulation of heavy metal concentrations in soil, water and in some leafy vegetables in sewage irrigated areas.

The research site conducts along the Musi River, which runs through the city of Hyderabad in the state of Andhra Pradesh. The region is located in the semi arid tropics having eight months dryness, and the monsoon prevails from June to September. Hyderabad, the state capital of Andhra Pradesh, is fifth largest metropolis in India. The city has a population of approximately six million inhabitants in 500-squate kilometer and is one of the fastest growing cities in India.

The Musi River starts a few kilometers upstream from Hyderabad in the Ananthagiri Hills and flows from West to East across Andhra Pradesh. As a result of the large volume of sewage water from city, which is daily disposed off in the river, the Musi is now a perennial river.

The sewer network covers only sixty two percent of the rapidly growing urban area of Hyderabad. There is only one wastewater treatment plant with primary and secondary treatment and one more, which only has primary treatment facilities.

Materials and Methods

Colour: Colour in the water is the result of dissolved extracts from metals in rock, from organic matter in soil and plants and from industrial products. Colouridentified by visual method.

Odour: Odour is not a direct significance but it indicates the quality of water or pollution, Dark colour water usually gives unobjectable Odour.

pH (Hydrogen ion concentration): pH with a range of 0-14. pH meter is used to know pH of the samples.

Electrical conductivity (EC): EC expressed in µmho/cm. Standard conductivity meter has range of 1412 µmho/cm, electrical conductivity of samples are measured with EC meter.

Total dissolved solids (TDS): TDS concentration expressed in mg/L. A dish is evaporated at high temperature and cooled it in air and noted weight of the dish. Sample filtered through What

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manns filter paper, the filtrate taken in evaporating dish and dried at high temperature and cooled then weight recorded.

Turbidity: Turbidity it contains mud and some minerals. It also represents and measures of the water quality. It is calculated with Nephelometer.

Alkalinity: Alkalinity in the presence of hydroxide (OH) carbonate (CO3) and Bicarbonate (HCO3). The compounds are mostly the carbonates and bicarbonates of Sodium, Potassium, magnesium and Calcium ions. It is calculated the units are of CaCO3 mg/L by titration method.

Chloride: Chloride ions present in the sample reads with silver nitrate (AgNO3) and forms silver chloride. Chloride estimated on titration method in the laboratory. It is calculated in mg/L units.

Fluoride (F): Fluoride measured with Ion Meter, the fluoride content in surface and ground water will depend on availability of the minerals. Which contain fluoride the porosity of the rocks and the reading is taken in mg/L.

Nitirate (NO3-): Nitrates are salts of nitric acid. UVSpectrophotometeris used, Standard wavelengths are used toobtain and determine the nitrate. If it is more than standardwavelengths 10% sample taken to determine.

Sulphate: Sulphate measured by nephelometer the units are Nephelometer turbidity units (NTU), standard solution is used.

Sodium/Potassium (Na/K): A flame photo meter is an instrument used for measuring of metals. The estimation of sodium and potassium is based on emission spectroscopy, System gives Na, K readings.

Total hardness (TH): Ca and Mg: Total hardness determines the total concentration of calcium and magnesium ions reported as calcium carbonate. Hardness is due to the presence of carbonates, bicarbonates, chlorides and sulphates. TH is expressed as mg/L of CaCO3 and measured by titration method.

Biochemical Oxygen Demand (BOD): The Biochemical Oxygen Demand (BOD) is used as a parameter to express the strength of sewage and amount of organic matter. If the amount of organic matter in sewage is more, the more oxygen will be utilized by bacteria to degrade it. Domestic and industrial dumping in the river digests the organic

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compounds results sewage percentage increases. BOD is estimated with winkler method, BOD is measured by incubating the samples at 20oC for the five days in the dark under aerobic conditions.

Chemical Oxygen Demand (COD): Solid concentration is important characteristic of sewage water. COD determines the oxygen required for the chemical oxidation of organic matter. Hence chemical oxygen demand (COD) is a better estimate of the organic matter, which needs no sophistication. The amount of organic matter in water is estimated by their oxidability by chemical oxidants.

Collection of sewage Water

Sewage effluent samples were collected from sewage canal passing beside the villages. Five sewage water samples were collected. These samples were analyzed for various chemical characteristics including pollution causing parameters by following the standard methods prescribed for examination of water and wastewater.

RESULTS EXPLANATION

Sample Locations: Samples were collected at 5 sites in and around Hyderabad city, each site has 10km distance variation. Site-1-Peerjadiguda, Site-2-Parvathapur, Site-3-Kachavanisingaram, Site-4-Muthawaliguda and Site-5-Pratapsingaram.

Peerjadiguda: This place is situated at 17°24'25" North latitude and 78°35'17" East longitude. Ground water collected at this site, because this ground water is affected by Musi river.

Results and discussion of analyzed different parameters such as Colour, Odour, pH, EC, Total Dissolved Solids (TDS), Turbidity, Carbonate, Bicarbonate, Chloride, Fluoride, Nitrate, Sulphate, Sodium, Potassium, Calcium, Magnesium and Total hardness are within the permissible limit at some sites. BOD, COD exceeds WHO acceptable limits.

Colour: All sites data presents in Table-1. The colour is due to turbidity of suspended solid particles, pure water do not give any colour. Site-1 and Site-5 are colour less and other sites gives coloured water due to the waste dumping in the river

Site	Colour

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Site-1	Colourless
Site-2	Grey
Site-3	Black
Site-4	Black
Site-5	Colourless

Table-2Odour

Site	Odour
Site-1	Odourless
Site-2	Unobjectable
Site-3	Unobjectable
Site-4	Unobjectable
Site-5	Odourless

The UnobjectableOdour is because of waste dumping in theriver it became sewage.

pH: As per investigations highest value of pH found at site-1andminimumpHvalue atsite-5.

ElectricConductance(EC): Specific Electric Conductance(EC) is used as a measure of water quality it determines Total dissolved solids of water and represented at 25°C temperature. Itmakes unsuitable water. Investigations reported that EC at 25°Chave highest value at site-2 and minimum at site-1 and normalrange is 750. Suspended solids are the reason for highest ECvaluesat site-1(Figure-1).

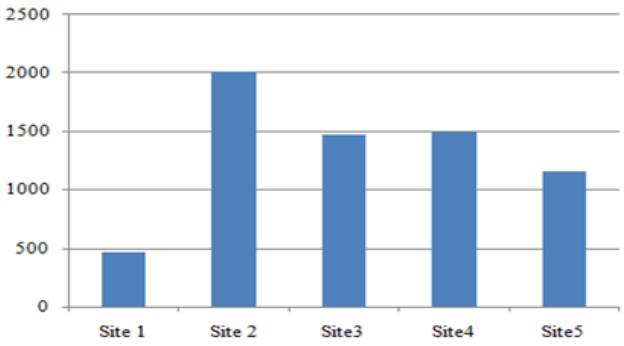

Figure-1 Electric Conductance (EC) investigated by proposed areas

Total Dissolved Solids: Total dissolved solids can be determined by measuring the EC. It is the measure of organic and inorganic substances dissolved in water are in suspended form. Results reveal that TDS is high at site-2. The high TDS is due to domestic wastage dump into the river and the site-2 do not having partial water treatment.

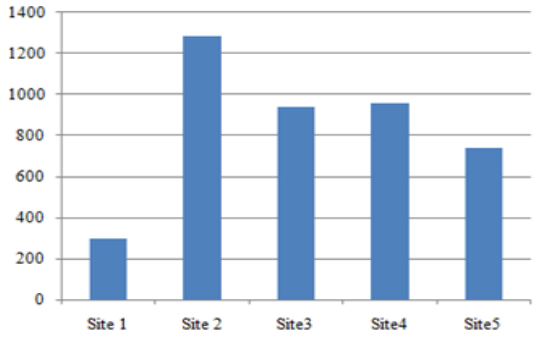

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Figure-2 Total Dissolved Solids investigated by proposed areas

Turbidity: Turbidity more at site-4 is because of more sewage than other sites(Figure-3).

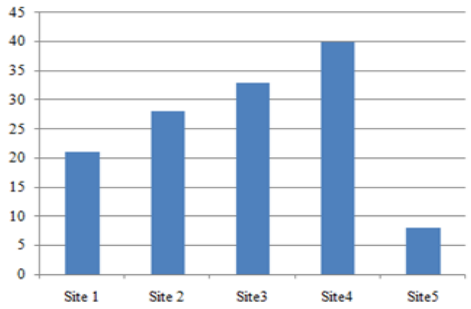

Figure-3 Turbidity investigated by proposed areas

Alkalinity: Carbonate: All proposed sites contain carbonate (CaCO3) mg/Lisnil. The presence of bicarbonates, specifically calcium carbonate, is what gives the water its alkalinity. Research demonstrates that alkalinity is low in the river during rainy seasons and is maximumatsite-2andminimum atsite-1. It is due to the addition of industrial and domestic waste water (Figure-4).

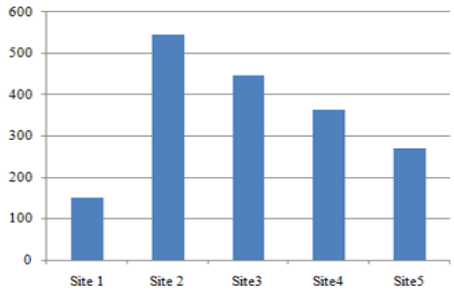

Figure-4 Bicarbonate investigated by proposed areas

Chloride: In the water chloride concentration is varies. It is themajor anion and generally available as Ca, Mg, Na chlorides. Site-2 hasmaximumandsite-1hasminimumvalues(Figure-).

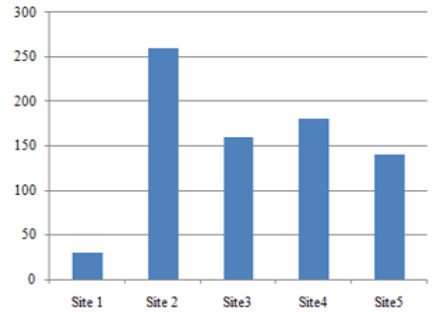

Figure-5 Chloride investigated by proposed areas

Flouride: Fluorosis is the result of excess of fluorine in water, if the water contains fluoride range more than 1.5 mg/L effects on bone and teeth of human beings. Investigated values reveals thatsite-2 has highest value, other sites are in within range it

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is due to the water treatment at various locations of the river (Figure-).

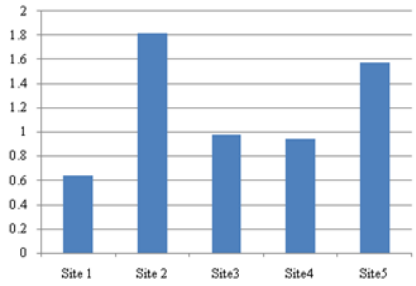

Figure-6 Flouride investigated by proposed areas

Nitrate: Due to the industrial wastage and domestic wastage nitrate concentration increases. Site-5 having maximum value itis because the site is affected by Musi River. This water is polluted and not useful for drinking and agricultural purpose (Figure).

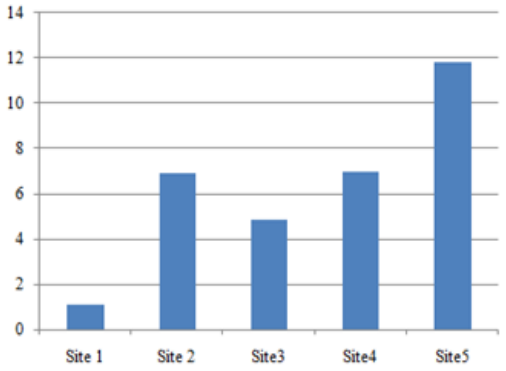

Figure-7 Nitrate investigated by proposed areas

Sulphate: In general sulphate occurs in natural water, it is also an important anion for the hardness of water. Site-1havingmaximumvaluewhichisi nnormal range

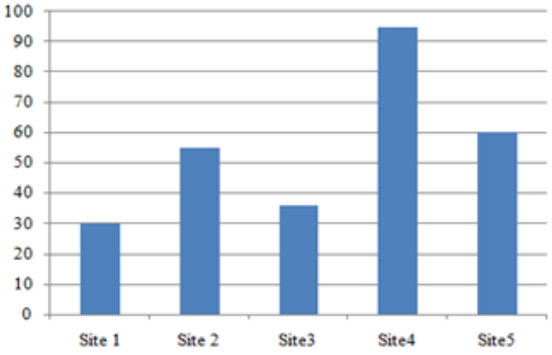

Figure-8 Sulphate investigated by proposed areas

Sodium: Generally, the sodium ions in water is good for health, risk level causes many diseases like high blood pressure, high content of sodium is also not suitable for agricultural purpose.Site-2 and site-3 are having high concentrations and site-4 andsite-5values are also more than marginal range, these are of very risk levels.

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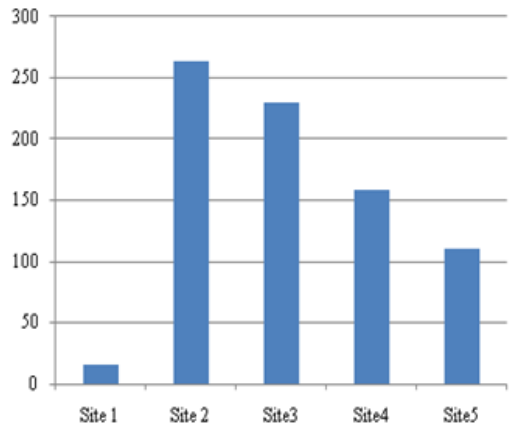


Figure-9 Sodiuminvestigatedbyproposedareas

Potassium: Potassium concentration is lower than sodium incommon and the role is same as sodium. Potassium is in watergives good health to the limiting range.Here the results showsthatthepotassiumiswithinrangea t allsites.

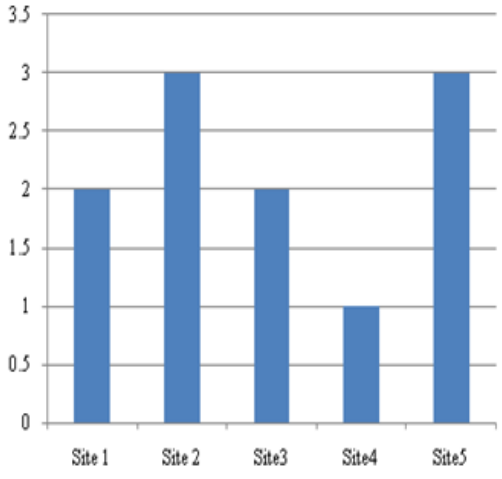


Figure-10 Proposed areas for potassium exploration

Calcium: Carbonate, bicarbonate, sulphate, and chloride are all chemical partners of calcium. It is the primary indicator of water hardness because it inhibits the creation of soap lather.Investigatingresultsrevealssit e-3hasmorecalciumconcentration

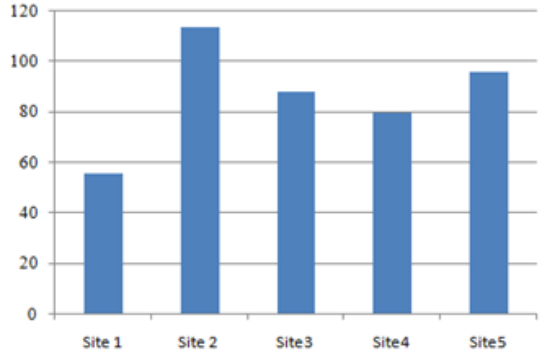
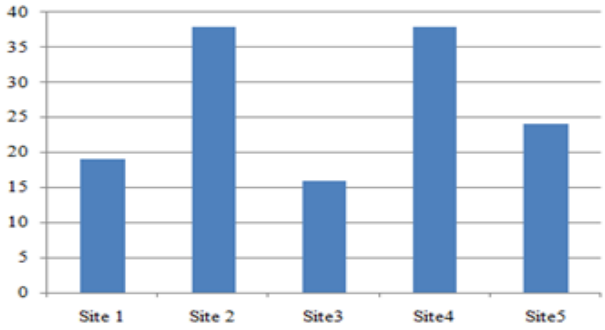


Figure: Calcium investigated by proposed areas

Magnesium: Magnesium also causes hardness to water it is available in water as $MgCO_3$, $MgSO_4$ and $MgCl_2$ the site-4 has maximum concentration.



Total Hardness: The sum of the effects of calcium and magnesium

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concentrations on water hardness. Hard water isn't to blame for water contamination, but it's not good for drinking or farming either. Based on the data, it appears that site 4 has the highest value, whereas the recommended sites do not offer a very good range.

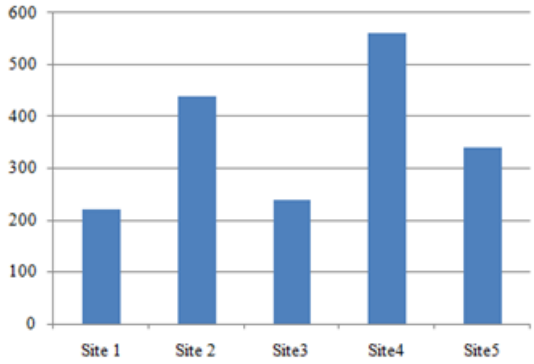

Figure-13 Total Hardness investigated by proposed areas

Biochemical Oxygen Demand: Site 4 has the highest BOD levels because of increased plastic waste and the influx of filthy water from Hussain Sagar; fish cannot survive in such water, thus fisherman further upstream have ceased using the Musi River.

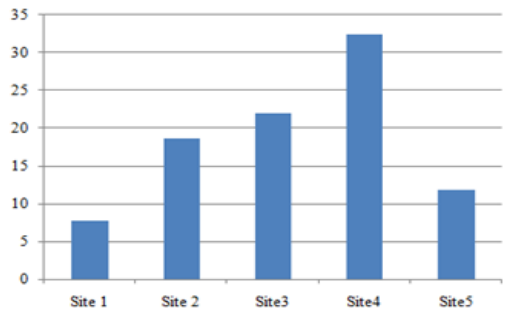

Figure-14 Biochemical Oxygen Demand investigated by proposedareas

Chemical Oxygen Demand: Site-4 has higher COD levels due to increased dumping and addition of Muthaliguda Water.

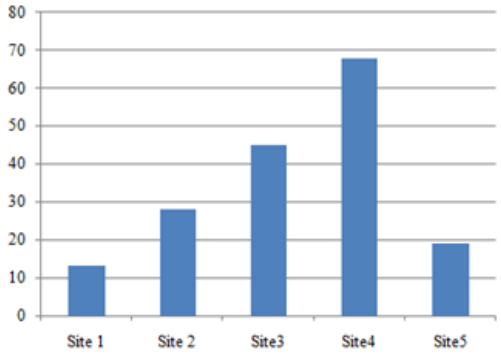

Figure-15 Chemical Oxygen Demand investigated by proposed areas

CONCLUSION

In conclusion analyzed different parameters such as Colour, Odour, pH, EC, Total Dissolved Solids (TDS),Turbidity, Carbonate, Bicarbonate, Chloride, Fluoride, Nitrate, Sulphate, Sodium, Potassium, Calcium, Magnesium and Total hardness are within the permissible limit at some sites. BOD, COD exceeds WHO acceptable limits. The high level indicates that there could be low oxygen

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available for living organisms in the waste water. Wastewater treatment and reuse known for a long time and the improvement in the treatment has been developed over the years. Rescue of untreated and treated wastewater in urban areas and other wastewater used for number of purposes. Especially, diverting human waste outside of urban areas gained more importance to make best use of it. Over the years, efforts have helped and provided an opportunity on understanding of processes; technologies related to treatment and development of international as well as national standards to control pollution around the world. Such activities provide a way for controlling pollution and to minimize health effects. By considering the importance from the point of health and economic values, treatment of wastewater and its reuse research would continue in the future as well. The future review will focus on management in terms of policy and regulations, microbial hazards, chemical hazards, wastewater reuse, wastewater treatment plants, wastewater disposal, sludge, and biosolids.

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