COST EFFECTIVE METHOD TO REDUCE POLLUTION DUE TO TEXTILE WASTE WATER

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ABSTRACT

Earth the Blue planet, has very less quantity of potable water which can sufficiently be used for different human activities from life sustenance to developmental activities. One such activity which requires large volumes of water for its different processes is the textile industry. Large volumes of water gets mixed with chemicals during different textile processes and causes pollution wherever it is discharged, as it cannot be cleaned by normal biological processes. In this paper a very simple and economical method to clean such hazardous water is suggested, with special reference to water scarce area of western Rajasthan. An ornamental plant English money plant(epipremnumaureum)which generally is used for decoration purposes was used to set up a waste water treatment plant to effectively clean such chemical rich water. This water can then be reused in the same textile industry or for some other purposes elsewhere.

Keywords: Waste Water Treatment, Hazardous Chemicals, Dyes, Textile, Discharge.

I. INTRODUCTION

All living things, humans, plants & animals depend on water to sustain life. Water has a number of critical biological & eco system functions. Humans use water for consumption, sanitation & recreation among a range of other uses. People also use water in their business activities. Water is also used in biological process such as water cycle. The water distribution on earth shows that most water in the earth's atmosphere & crust comes from the world ocean's saline sea water, while freshwater accounts for only 2.5% of the total as the oceans covers roughly 71% of the area of the earth that reflects blue light, the earth appears blue from space & is often referred to as the blue planet. In present scnerio our earth cosists 97% saline sea water and 3% fresh water which is used by all living organisms.

Development of various industries is a reflection of a country's progress. It contributes in the in the increasing revenue and employment opportunities to the citizens of the country. Among the plethora of developing industries in India, textile colouring and printing industry is one of most ancient industry which not only has developed but also attained a respectable position in world. In the present scenario, particularly in Rajasthan a wide area of western Rajasthan is into this textile hub.

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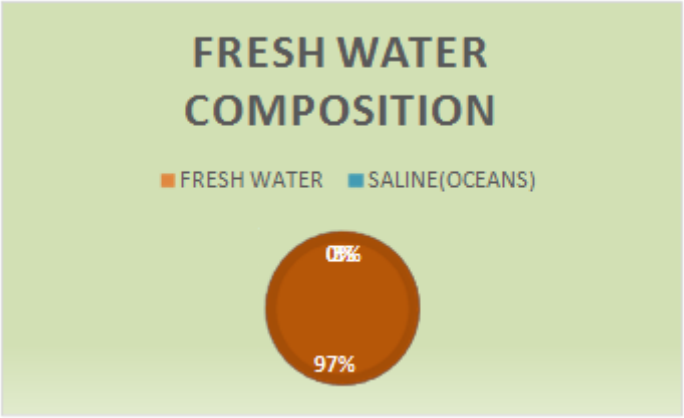
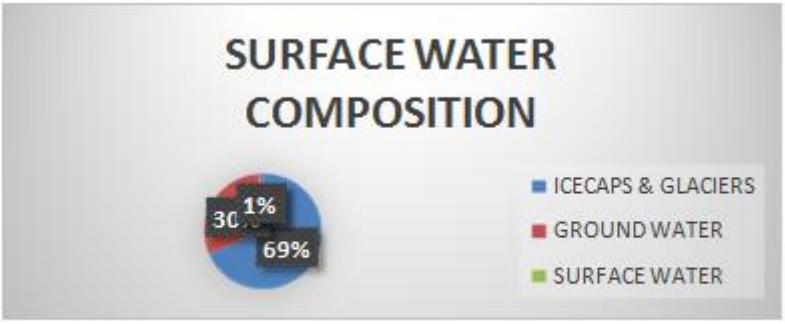
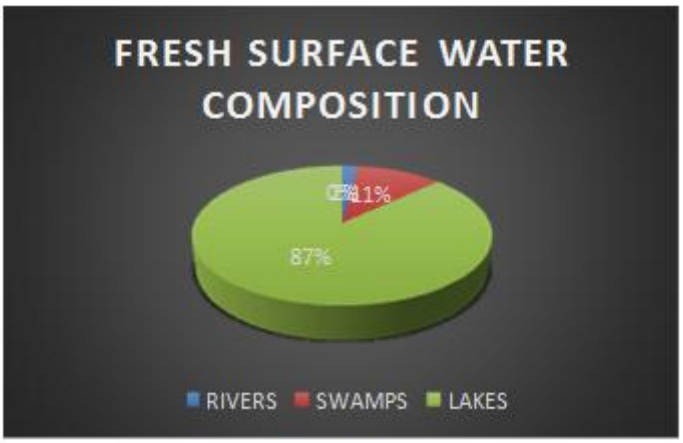


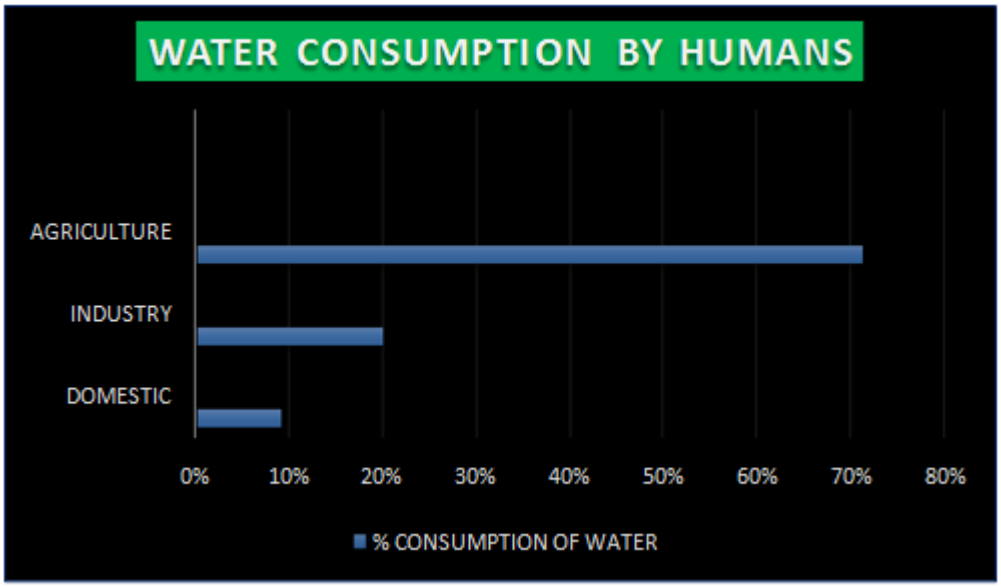
There are some textile cluster in western Rajasthan such as Jodhpur, Pali , Balotra etc. which are the main causes of water pollution in Rajasthan. Millions of clothes are widely dyed and coloured with the help of harmful chemicals daily; which not only pollute the environment but is also hazardous for the people living in these localities. Dyes are intensely coloured synthetic compounds which have wide spread applications ,as they are used in textile industries for dying nylon, polyacylonitrile ,i.e., modified nylon , wool, silk, cotton etc. Around 10,000 different dyes with an annual production of more than $7x10^5$ metric tons, worldwide are commercially available and are intensively used in textile processing, paper printing, pharmaceutical, food and other industries . The textile industry alone consumes up to 80% of the total dye stuffs produced in India.

Textile dyes are classified as acid, reactive metal complex leased dyes, direct ,basic, mordant , disperse , pigment dye, anionic and ingrain dye , sulphur, solvent and other such are based on the colour index . The largest group of all synthetic dyes represent 70% of all organic dyes used by the textile industry.





All these chemicals are not contained in the final product prepared and cause disposal problems along with large volumes of wastewater. These wastewaters contain various salts of heavy meals along with other chemicals, and if not treated properly degrade the water quality in the water scarce region of western Rajasthan. The important parameters like-temperature, turbidity, colour, total alkalinity, total hardness, calcium, magnesium, carbonate, fluoride, sulphide, phosphate, nitrate, TDS, dissolved oxygen, BOD and COD are monitored . The quality of water is found to be highly unsatisfactory for drinking purpose and other human consumption. It is expected that the possibility of disease like contact dermatitis, asthma, chronic bronchitis, fluorosis and cancer may be increased due to polluted water. The fluoride concentration is so high that children are now born with twisted bones.



Water pollution is controlled in this area by checking the said pollution by de- salination and use of activated carbon, activated alumina and modified fly ash, but these steps are not satisfactory and Balotra's water is not even fit for bathing. Our project is all about how to check the problems of water pollution and saltiness of water in Rajasthan and to make the water satisfactory for drinking.

The association of dyes, particularly acidic dyes with related health problems is not a new phenomenon. A lot of well-established literature is already available on the role of dyes as a major cause in skin and respiratory disease. The absorbent which are of low cost, locally available and are relatively new for their acidic dyes removal capacity from aqueous solutions were investigated. Bagasse , cow dunk, groundnut shells, used tea leaves , wheat straw were used in their charcoal form whereas brick kiln ash and cement kiln ash absorbent were used as such for the removal of acid violet 17, acid violet 49, acid violet 54, acid blue 15 and acid red 119 .The effect of various experimental parameters, initial pH, dye concentration, sorbent dosage and optical experimental conditions were decided.

Many dyes and pigments are hazardous and toxic at the concentration discharged to receiving water for human as well as aquatic life. The high concentration of dyes in water causes many water borne diseases and increases BOD of the receiving water because of the complex structure and large molecules of dyes. . Effluents from textile industries are complex mixtures of chemicals varying in quantity and quality. These industries generate

waste mixed with waste waters from the production processes, which leads to change in both biological and chemical parameters of the receiving water bodies.

The key environmental issues associated with textile industry are treatment and disposal of aqueous effluent. As in the case of many textile industries in Jodhpur region, the treated effluents are being discharged through drainage channels into the Jojari stream which subsequently affects the water quality of the stream. Also the stream has converted in a disposable block of textile industries. Depending on the dosage and exposure period, the effluents could be poisonous to plants, aquatic life and humans. Jodhpur being a large textile hub of India is going to face a large environmental crisis in future if this problem is not seriously taken today.

Dyeing of Fabrics

Fabrics after Dyeing

The presence of higher BOD indicates entry of organic water in the water sample. It is an indication of alarming conditions and hence treatment of water is needed before the use of water for various purposes. For drinking water,the fluoride contents vary from 0.6-2.8 mg/l. The permissible WHO limit for fluoride is 1.5 mg/l and it is excluded at few sites. It can be concluded that the Balotra city is highly polluted in terms of water pollution.

II. CHEMICAL PRESENT IN TEXTILE WASTE WATER

In industries such as textile, rubber, paper, plastic, cosmetics, etc. during processing a variety of chemicals are employed, depending on the nature of the raw material and product. These chemicals may vary from enzymes to detergents, dyes to soda or acids to salts, in their suspended form or aqueous form. Industrial processes generate wastewater containing heavy metal contaminants. Since most of heavy metals are non-degradable into non-toxic end products, their concentrations must be reduced to acceptable levels before discharging them into environment. Water pollution caused by industrial effluent discharges has become a worrisome phenomenon due to its impact on environmental health and safety. These compounds are of metal ions such as copper, cadmium, lead, iron, nitrate, sulphate, nickel, zinc, and chromium ions in aqueous as well as solid forms. These compounds contaminate the surface water, thereby making it unfit for irrigation and drinking. Since farmers are using water from Jojari River for agricultural purposes and the residents of the town are using both the surface and underground waters from the same area as potable water, it was quite unsafe to discharge this into nearby water body. The ecological and human health safety of continual discharge of this treated textile effluents into this river are undoubtedly under threat. The metal ions present in the wastewater are very harmful for humans and environment including plants and animals.

III. DAMAGING EFFECTS OF CHEMICALS PRESENT IN TEXTILE WASTE WATERS

The presence of Fe^{2+}, Ca^{2+}, Mg^{2+}, Cl^{-} and SO_4^{2-} wastewater from the metallurgical, cement and steel industries changes the nature of the water into which they are discharged, affecting its staining characteristics, hardness and salinity. Various oxidizing and reducing agents, such as the ammonia, nitrite, nitrate and sulphate discharged from the fertilizer, textile and dyeing industries, alter the chemical balance of the wastewater and cause problems with rapid oxygen depletion, etc. This not only decreases the nutritional value of the water but also causes foul odours and microbial growth. The discharge of acids and alkaline materials from the textile, coal-fuelled and chemical industries disrupts the pH buffer system of the natural water, reducing its potential to kill harmful micro-organisms.

From the numerous reports of industries in and around Jodhpur region, it was found that there are different kinds of metal ions such as cadmium, chromium, zinc, copper etc. are found in wastewater disposed from textile in Jojari River which causes much harmful and ill effect to humans as well as plants and animals and environment too. Some major ions and their related problems.-

A. *Chromium* –It was found to range from 0.163 to 0.927 mg/L. Growth of roots, stems and leaves along with germination process is altered due to high concentration of Chromium in water which is harmful for plant growth. Chromium is very poisonous for living organism as it blocks the respiratory organ or part of the living creature and disables it to breathe. In humans the respiratory tract is the major target organ for chromium toxicity, for acute and chronic inhalation exposures. Kidney damage, liver failure, blood cell damage happens due to its oxidation property. Pneumonia, asthma, skin ulcers and bronchitis are other problems caused by chromium.

B. *Copper*: It is a common environmental metal and it was found to range between 0.24 to 0.795 mg/L Copper is toxic to plant roots. Causes root deformation, disruption of root cuticle and root hair proliferation.

Whereas in humansits high concentrations, can cause anaemia, liver and kidney damage, stomach and intestinal irritation.Problems like gastrointestinal ulcers and distress are experienced

C. *Cadmium*-It was found to range from 0.045 to 0.129 mg/L in and around Jodhpur area.Decreased growth rate and negative effects on embryonic development are some of the negative physiological effects on organism. For humans Cadmium is primarily toxic to the kidney, especially to the proximal tabular cells, the main site of accumulation. Bone demineralization and bone damage can also be caused by Cadmium. Lungs get damaged by breathing very high levels of cadmium.It does not break down in the environment but can change forms. Cadmium binds strongly to soil particles. Cadmium can easily dissolve in water.

D. *Zinc* –It was found to range from 0.15 to 0.186 mg/L. When high zinc content is found in water then it is non-toxic to plants. But in mammals, high concentration of zinc in water is most harmful to aquatic animals during early life stages thus affect humans through food chain

IV.TREATMENT OF VARIOUS HAZARDOUS CHEMICALS PRESENT IN TEXTILE WASTE WATER

Textile waste water treatment is an important aspect of textile production in almost all regions of the country. Here are some ways which can be executed to treat the textile waste water:

Bioremediation

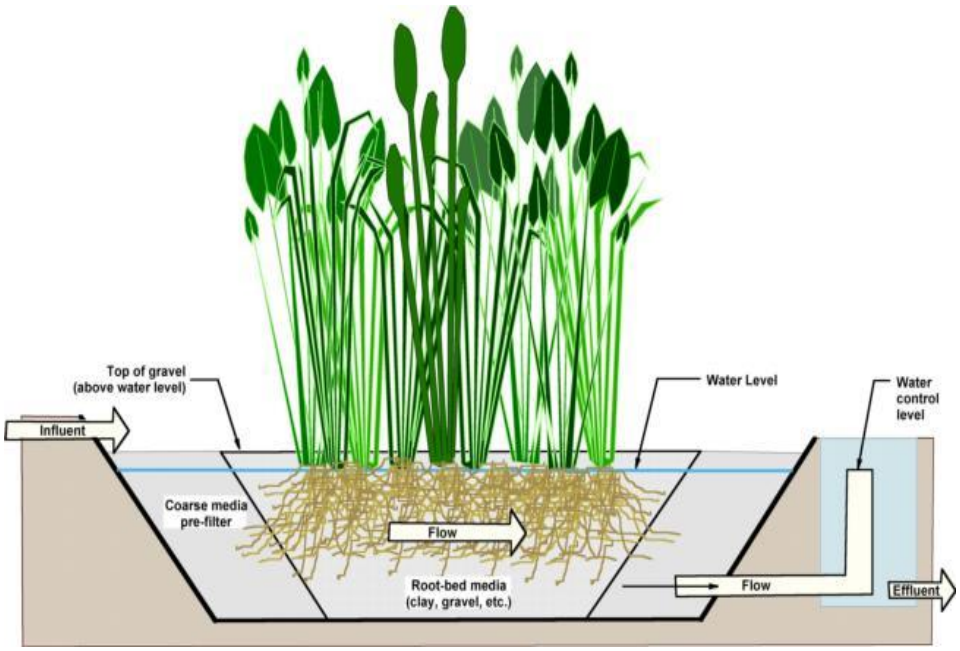
It is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site. It may occur on its own (natural attenuation) or may only effectively occur through the addition of fertilizers, oxygen, etc.; that help to encourage the growth of the pollution-eating microbes within the medium (bio stimulation).

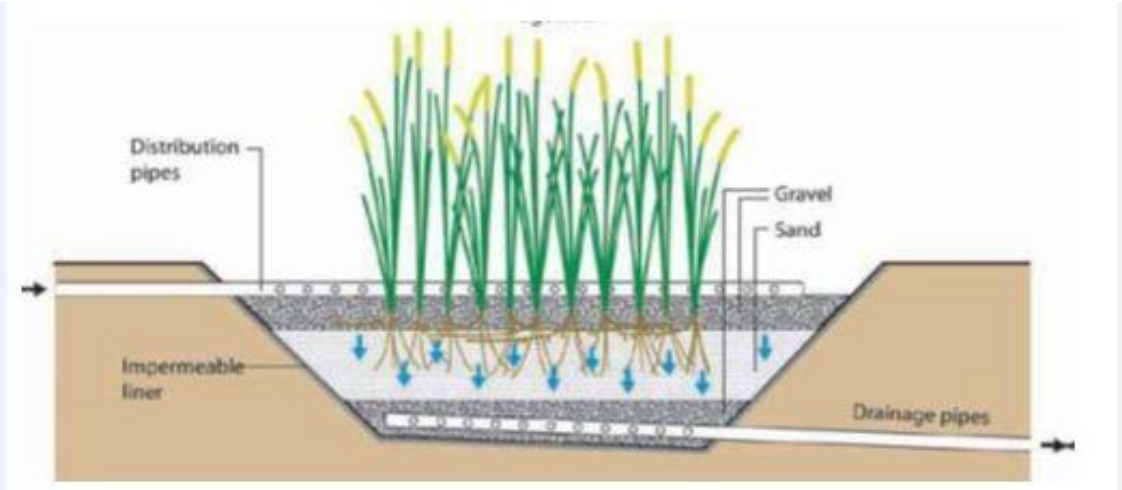
Phytoremediation

It is the direct use of living green plants for in situ, or in place, removal, degradation, or containment of contaminants in soils, sludge's , sediments, surface water & ground water. It is a low cost, solar energy driven clean-up technique, most useful at sites with shallow, low levels of contamination. It is mostly useful for treating a wide variety of environmental contaminants. It is effective with or in some cases in place of mechanical clean-up methods. This method is used in these circumstances because natural plants or transgenic plants are able to bio accumulate these toxins in their above ground parts, which are then harvested for removal. We also used this technology in our project.

V. METHODOLOGY

Our main aim was to analyse the physiochemical changes going on during the dyeing process & to setup such a treatment plant which can purify the textile waste water in such a way that the purified water can be reused in industry. English money plant(epipremnumaureum) is used as waste water treatment plant. By this setup, textile waste water can be treated effectively within a time lap of two months (approx.) and can be treated up to 40-60% to water with less impurities &then can again be send to the textiles for further use.





The textile waste water was allowed to flow in this set up and was observed for two months (appox).When the wateris passed through the setup, the roots of epipremnumaurem absorbs the major chemicals such as chloride,sulphur,etcand the water with lessimpurities passes through the roots to below the pebbles & gets collected thereand fromhere with the help of motor , the water is again sent back to textiles.

VI. OBSERVATION

The following tests were performed on water coming out from the textile industry,(before purification), waste water was left in open sun for two days and then the waste water concentrate(WWC) was taken for following tests:

1) Test for nitrate : WWC+freshly prepared $FeSO_4$ solution+ 1drop concept. HNO_3 added alongside of test tube = brown ring formed at junction of sol. & acid.

2) Test for sulphate :Barium chloride test: WWC + $BaCl_2$= white ppt (insoluble in conc. HCl)

WWC + Lead acetate (AQ)+acetic acid= white ppt (soluble in CH_3COONH_4)

3) Test for phosphate :WWC+dil. HNO_3+ammonium molybdate+boil=crystalline canaryyellow ppt

4)Test for acetate: pungent vapour with vinegar like smell on strong heating,

-WWC+conc. H_2SO_4 + ethanol=fruity smell of ester

-Ferric chloride test: WWC +$FeCl_3$(aq)=brick red colour+dil. HCl=red colour disappears

5)Test for magnesium: WWC + NH_4Cl+excess NH_4OH+ammonium phosphate=white ppt.

6) Test for Cd: WWC + H_2S = yellow ppt.

7) Test for chromium: WWC + NH_4Cl+excess NH_4OH = green ppt. which dissolves in excess sodium hydroxide.

Same test were performed with water obtained after the purification process was completed.

Observation Table

After our laboratory test, the following observations were obtained-

Name of test performed	Before treatment	After treatment
Nitrate test	Positive	Negative
Sulphatetest	Positive	Negative
Phosphate test	Positive	Negative
Acetate test	Positive	Negative
Magnesium test	Negative	Negative
Cadmium test	Positive	Negative
Chromium test	Positive	Negative

VII. RESULT AND CONCLUSION

From the above strategy and methods , we came to a conclusion that in the order to unified the dignity and prosperity of textile not only in western Rajasthan but in all over the world, the waste water has to be treated before it is disposed off to various water bodies. Basically, Jodhpur is a textile hub and also a very big exporter of cloth and textile product worldwide.With the help of above steps, precaution and methods, we can make our industries/textiles more safe,secure,better,powerful, more efficient and proper.

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