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Impact of Sugar Industry Effluent on Quality of Groundwater – Review

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Abstract—**Groundwater is an important part of the water cycle and it is major primary source of drinking water as well as agricultural purposes. The rapid industrialization causing serious issues regarding the exposure of groundwater contamination due to discharge of treated or partially treated wastewater from industries. So, it is necessary to assess the groundwater quality. The aim of this review paper is to find impact of sugar industry effluent on quality of groundwater based on groundwater quality index. Sugar industry is most important agro based industries in India. Sugar industries effluent mainly contains nitrates, phosphorous, alcohols, suspended solids and heavy metals such as cadmium. The discharge of sugar industry effluent percolates through soil which causes the contamination of groundwater, surface water and soil which furthermore increases some serious public health hazards. The overall water quality status described by Water Quality Index (WQI) through which numerical score obtained from integration of complex water quality parameters. One of the main aspects for prediction of different parameter ranges is correlation analysis within the degree of accuracy. In present review paper attempt has been made for the study of physico-chemical characteristics of sugar industry effluent, impact of sugar industry effluent on groundwater quality and soil, assessing Water Quality Index for groundwater, Regression and Correlation Coefficient among water quality parameters.**

Index Terms- Groundwater quality, Physico-chemical characteristics, Regression and Correlation coefficient, Sugar Industry effluent, Water Quality Index.

I. INTRODUCTION

Water is a precious prime natural resource on the planet earth which plays a vital role in various sectors like domestic applications, agriculture, industrial activities, hydropower generation, fisheries, livestock production, forestry and other creative activities. In the recent time, it is well known that what is the value or importance of freshwater to the all kind of animals, plant and human beings, because freshwater relates to their health. During the past decades, careless and unscientific patterns of disposal of industrial, agricultural, and domestic wastes have enlarged the problem of pollutants which are contaminating not only the surface waters but groundwater sources also.

Groundwater is the water located beneath the earth's urface in soil pore spaces and in the fractures of rock formations. Groundwater may be considered as one of the most precious and one of the basic requirements for human existence and the survival of mankind providing him the luxuries and comforts in addition to fulfilling his basic necessities of life. Increasing demand for domestic and irrigation purposes and imprudent use of groundwater has put its sustainability in danger due to its continuous depletion and deterioration of quality A Significant number of today's groundwater contamination problems from human's activities is one of the major reason of decrement in ground level. Further groundwater contamination mainly due to various types of industries as they were disposes wastewater effluents without treatment to the ground water bodies.

One of the major contributions for groundwater contamination is from sugar industry amongst all wastewater generating industries. Sugar industries are consumer of large amount of water and chemicals as well. All these chemicals used wash away with the wastewater discharged through industrial outlet. A large amount of waste is generated during manufacturing of sugar and it contains a suspended solids, organic matter, bagasse, press mud and air pollutants. This wastewater released from sugar industry into surface water bodies and into land, percolates the some pollutants through soil which causes contamination of groundwater and also affected the soil.

In present review paper attempt has been made to focus on impact of sugar industry effluent on quality of groundwater and Water Quality Index. And also focuses on to develop the regression equation and correlation coefficient among the water quality parameter.

II. LITERATURE REVIEW

In general literature review was carried out by referring some standard journals and reference books. The major work carried out by different researchers is summarized.

Agale et al, (2013) worked on 'Impact of sugar industry effluents on the quality of ground water from Dahiwad Village, Dist-Dhule'. The work aimed at assessing the ground water quality of sugar industry from Dahiwad village. The ground water samples were collected in the vicinity of Dahiwad village on a monthly basis for the period of 10 month and analyzed various parameters like pH, Nitrates, Chlorides, Phosphates, Total hardness, Sulphates,

Magnesium, and Alkalinity. Then obtained results compared with the BIS (1990) Standards for drinking water. It is concluded that ground water becomes polluted due to sugar industry effluents from surrounding areas. Hence, it is not suitable for human consumption without prior treatment. Moreover, the water is used for irrigation and domestic purposes in that area. On the basis analysis it can be said that the ground water in the vicinity of sugar factory was contaminated due to higher concentration of chlorides, nitrates, magnesium and total hardness which was higher than BIS (1990) standards for drinking water.

Deshmukh (2014) conducted study on 'Environmental Impact of Sugar mill Effluent on the Quality of Groundwater from Sangamner, Ahmednagar, Maharashtra, India'. In this study aimed at conducting a detailed study of the impact of sugar mill effluent on the ground water quality in the vicinity of sugar mills in Sangamner. Groundwater samples were collected and then analyzed of various parameters such as pH, Electrical Conductivity, Total Dissolved Solids, Calcium, Magnesium, Sodium, Chlorides, Bicarbonates, Sulphate, Nitrate, phosphate, Potassium, Total Hardness. This result compared with the Indian Standard Drinking Water Specification IS 10500(1991). It is concluded that the parameters such as Total Hardness, Total Dissolved Solid, Calcium, Magnesium and Nitrate have exceeded the permissible limit in the majority of samples. It is clear that, this groundwater is not suitable for drinking purpose without treatment.

Yadav et al., (2014) carried out study on 'Effect of Sugar mill on Physico-Chemical Characteristics of Groundwater of Surrounding Area'. The present study was aimed to determine impacts of sugar industry on ground water quality of area around the sugar industry. Ground water samples were collected from 10 different locations around the Panipat Sugar Mill. Then analyzed various physico-chemical parameters include colour, taste, odour, temperature, pH, Alkalinity, Total Dissolved Solid, Total Suspended Solid, Total Solid, Dissolved Oxygen, Chemical Oxygen Demand and Biological Oxygen Demand. In this research paper results shows that some parameter like Alkalinity, Total Dissolved Solid, and Chemical Oxygen Demand of ground water have exceeded the permissible limit given by BIS Limit of drinking water. It is indicated that groundwater is unfit for drinking purpose due to the high level of alkalinity, COD,

TDS and low level of DO. This water can be used for irrigation purpose.

Matta et al., (2014) studied on 'Effect of industrial effluent on groundwater quality with special reference to DO, BOD and COD'. This present study was done by collecting groundwater samples from the different site (Star Paper Mill Industry, Distillery Industry, Ground water) from three different location of each site in Saharanpur district, Uttar Pradesh, India. This sample analyzed various physico-chemical parameters such as pH, temperature, dissolved oxygen, biological oxygen demand, chemical oxygen demand and heavy metals. It was found that all of the sampling sites, the value of different parameters varies significantly due to harmful chemicals in effluent and penetration of effluent into groundwater. So, it is concluded that the water quality in this area is not satisfactory. This groundwater after treatment can be reused in the industry itself and also used for irrigation.

Sharma et al., (2013) conducted the study on 'Assessment of Ground Water Quality in Vicinity of Industries and Along Yamuna River in Yamuna Nagar, Haryana, India'. In this study, to assess the suitability of groundwater quality for drinking and irrigation purposes in the vicinity of three selected industries (sugar mill, paper mill, thermal power plant) and along Yamuna River located in Yamuna Nagar District of Haryana state, India. The groundwater samples were collected from three industries of selected station and various parameters were analyzed like pH, Electrical Conductivity, Total Dissolved Solids, Dissolved Oxygen, Alkalinity, Total Hardness, Calcium, Sodium, Potassium, Chloride, Magnesium, Carbonate, Bicarbonate, and Turbidity. The obtained results compared with WHO 2004 (World Health Organization) and BIS 2003. Also analyzed sodium percentage (Na%), Sodium Absorption Ratio (SAR), Residual Sodium Carbonate (RSC), and Permeability Index (PI) for assessing of groundwater for agricultural purpose. This paper shows that some parameter like electrical conductivity, alkalinity, hardness, potassium, and magnesium of groundwater have exceeded the permissible limit, indicating that this area is characterized by hard water. SAR, Na%, RSC, and PI indicate that groundwater is suitable for irrigation purpose and after proper treatment can be used for drinking and domestic purposes.

Srinivas et al., (2013) conducted study on 'Determination of Water Quality Index in Industrial areas of Kakinada, Andhra Pradesh, India.' In this study aimed to Calculate Water Quality Index (WQI) of industrial areas of well water samples in Kakinada. The borewell samples were collected from different locations near industrial areas of Kakinada and analyzed of various water quality parameters like pH, Electrical Conductivity, Total Dissolved Solids, Total Solids, Dissolved Oxygen, Biological Oxygen Demand, Total Alkalinity, Total Hardness, Sulphate, Phosphate, Nitrate, and Chloride. Then calculate WQI by using standards of drinking water quality recommended by Indian council of Medical Research (ICMR), World Health Organization (WHO), and Bureau of Indian Standards (BIS). Water Quality Index of this area varied from 49.52 – 123.54 ppm indicating that level of pollution load in the bore waters. In this study indicate that some bore well waters are permissible limit. But some are exceeded permissible limit. In the paper, water was not conforming to drinking standards and hence it is suggested to take all the necessary treatment and precautions before water are sent into water distribution system.

Lokhande et al., (2014) work carried out on 'Evaluation of Ground Water Quality of M. I. D. C. Area, Roha through Water Quality Index Assessment.' This present study, groundwater quality near the industrial area is evaluated by using water quality index method. In this study collecting the groundwater sample in the vicinity of an industrial area and analyzed the parameters includes pH, Total Hardness, Total Dissolved Solids, Alkalinity, Chlorides, Sulfate, Calcium,

Magnesium, Biochemical Oxygen Demand, Ammonia. It was found that electrical conductivity, dissolved oxygen, turbidity etc. were above the permissible limit. The water quality index values show that the quality of water is good.

Fatima et al., (2015) carried out the study on "A Correlation and Regression Study on the Groundwater Quality in Aligarh City, Uttar Pradesh." This study was aimed at a statistical regression analysis of Groundwater at 16 different locations of Aligarh city, Uttar Pradesh. A correlation study has been carried out amongst all possible pairs of 15 physico-chemical parameters like pH, Total Acidity, Phenolphthalein Alkalinity, Total Alkalinity, Total Hardness, Calcium, Magnesium, Dissolved Oxygen, Chemical Oxygen Demand, Turbidity, Electrical Conductivity, Total Solids, Total Dissolved Solid, Total Suspended Solid And Chloride to assess groundwater quality. A linear regression analysis technique has been proven to be a very useful tool for monitoring drinking water and has a good accuracy. It is concluded that the total dissolved solids and electrical conductivity are important physicochemical of drinking water quality parameters because they are correlated with most of the water parameters. This study showed or proved that all the physicochemical parameters of drinking water in Aligarh city are more or less correlated with each other, especially strong correlation observed between Total Hardness & Magnesium and Total Dissolved Solid & Total Solid.

Chaubey et al., (2015), conducted study on 'Correlation Study and Regression Analysis of Water Quality Assessment of Nagpur City, India.' In this paper, groundwater samples were collected from four different locations in the city. For this samples analyzed the physico-chemical such as pH, Electrical Conductivity, Turbidity, Total Dissolved Solids, Total Hardness, Calcium, Magnesium, Chloride, Sulphate, Total Alkalinity and Dissolved Oxygen. In this paper also calculated the coefficient of correlation between various drinking water quality parameters. These results were compared with World Health Organization (WHO) and it is concluded that most of the water samples are not suitable for drinking purpose.

Yadav et al., (2015) conducted the study on 'Impact of Sugar Industry Effluents on the Quality of Groundwater near Bankhedi Sugar Industry Dist. Narsinghpur (Mp) India.' The present study was focused on the impact of sugar mill effluent on groundwater which is used for domestic purpose. In this study analyzed the different water quality parameters such as pH, Electrical conductivity, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Alkalinity, Hardness, Chloride, Sulphate, Phosphate, Total Dissolved Solids in the nearby area of the sugar industry. From this study indicates that water quality parameter in the vicinity of sugar industry is higher and exceeds the permissible limits.

David et al., (2014) worked on 'Impact of Dyeing Industry Effluent on Groundwater Quality by Water Quality Index and Correlation Analysis.' This study was aimed at to study the impact of dyeing industry effluent on groundwater quality in Chinnalapatti, Tamilnadu, India. Groundwater were collected at from different locations at the vicinity of dyeing industries and analyzed various physico-chemical parameters such as pH, Electrical Conductivity, Hardness, Calcium, Magnesium, Sodium, Chloride, Total Dissolved Solids, Potassium and Sulphate. This result data compared with the drinking water quality standards. Then it is concluded that pH, Calcium, Magnesium were within the permissible as well as desirable limit and Sulphate, Sodium and Potassium were within the desirable limit only. Also in paper calculated Water Quality Index to assess the level of pollution and index is 61, indicates the pollution rate of groundwater in between slight and moderate. Then calculate coefficient of correlation for various water quality parameters to establish nature of relationship between them. From results, EC is positively correlated with Sodium; similarly TDS and Hardness are positively correlated with calcium.

III. CONCLUSION

- The treated or without treated effluent or improper disposal of effluent from industries affect the quality of groundwater as well as soil such as pH, TDS, Hardness and Chlorides found beyond the permissible limit and is not suitable for drinking purpose.
- The suggested measures to improve the groundwater quality, it is necessary that proper disposal of industrial effluent and install a wastewater treatment plant in industry to treat the effluent before discharge into water bodies and on land.

IV. REFERENCES

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