Assessment of Some Ground Water Quality Parameters in Hapur District (Uttar Pradesh, India)

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***Abstract*— Fast increasing human population, urbanization and industrialization are responsible for degrading water quality and consequently public health is affected due to water pollution. Assessment of some water quality parameters like conductivity, total dissolved solid (TDS) and pH are useful and important parameters to measure the salinity and pollution assessment of water. In this research work, physicochemical parameters of ground water of five stations of Hapur District viz. Shiv Nagar, Shivpuri, Kothigate, SSV College and Delhi Road were analyzed. Conductivity or electrical conductivity and TDS are directly proportional to each other (TDS = k EC, at 298K) for water samples collected from different sources used for domestic and irrigation purposes in Hapur district. There is strong correlation between EC and TDS. Estimated TDS/EC ratio in water samples indicates water quality and is always influenced by salinity. Therefore, periodical monitoring and analysis of water quality parameters and treatment of water resources in all the area require immediate attention for proper planning, framing strategies, effective policy and better management of water resources to improve water quality for sustaining healthy ecosystems in the area.**

Index Terms: **water quality; TDS; EC; salinity; pollution; water management.**

I.INTRODUCTION

The method of determining TDS in water supplies most commonly used is the measurement of specific conductivity with a conductivity probe that detects the presence of ions in water. TDS concentration describes the present of inorganic salts and small amounts of organic matter in water and EC is the measure of water capacity to conduct electrical current [1]. *pH* is an important operational parameter in determining disinfection efficacy. Conductivity or electrical conductivity (EC) and total dissolved solids (TDS) are frequently used as water quality parameters and these are indicators of salinity level which make them very useful as one way in studying seawater intrusion [2–5]. The values of EC and TDS are correlated [6–8]. TDS analysis is very important and main parameter which can illustrate groundwater quality, particularly in understanding the effect of seawater intrusion better than EC analysis [9].The correlation of these two parameters can be estimated by the following equation: TDS (mg/L) = k x EC (µS/cm). The value of k shall increase along with the increase of ions in water. However, the relationship between conductivity and TDS is not directly linear; it depends on the activity of specific dissolved ions average activity of all ions in the liquid and ionic strength; the k value for natural water was formulated [10, 11, 12]. There is a strongest correlation between TDS and EC in natural was formulated. There is a strongest correlation between TDS and EC in natural water.

The contribution of TDS and EC ratio require further accuracy in monitoring and assessment, and further research is need for better results. Primary sources for TDS in receiving waters are agricultural runoff and residential (urban) runoff, clay-rich mountain waters, leaching of soil contamination, and point source water pollution discharge from industrial or sewage treatment plants. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride, which are found in nutrient runoff. The chemicals may be cations, anions, molecules or agglomerations on the order of one thousand or fewer molecules, so long as a soluble micro-granule is formed. More exotic and harmful elements of TDS are pesticides arising from surface

runoff. Certain naturally occurring total dissolved solids arise from the weathering and dissolution of rocks and soils.

TABLE 1. CORRELATION OF EC AND TDS IN VARIOUS TYPE OF WATER

S. No.	Water Sample	EC at 25 0C (µS⁄cm)	TDS/EC = (k)
1.	Natural water	500 − 3,000	0.55 – 0.75 [10]
2.	Distillate water	1 – 10	0.5 [12]
3.	Freshwater	300 – 800	0.55
4.	Seawater	45,000 − 60,000	0.7
5.	Brine water	65,000 − 85,000	0.75

II. MATERIALS AND METHOD

Study Area

Hapur District region is located at 25.98°N 78.27°E geographical coordinates. It has an average elevation of 190 meters. The people use hand pump water and submersible water for their daily need. The literature survey reveals that no water quality management studies are made in this region so far. Hence the present study was planned and undertaken.

Sampling and sampling stations

The samples were collected in clean polythene bottles without any air bubbles as per requirements. The bottles were rinsed before sampling and tightly sealed after collection. Temperature, odor, taste and colour of the samples were measured at the study stations itself and at the time of collection of samples. The physicochemical parameters of ground water of five stations of Hapur District viz. Shiv Nagar, Shivpuri, Kothigate, SSV College and Delhi Road werestudied. These all stations are located in the radius of 20 km area. The ground water was collected mainly from hand pumps in these stations during the months of January 2020 to March 2020. The depth of the hand pumps ranged from 90-130 feet at all these stations. The sampling sites/ locations of source and corresponding habitats are shown in table 2.1.

Analysis was carried out for various water quality parameters such as colour, odour, temperature, pH, electrical conductivity (EC), total dissolved solids (TDS) etc. Electrical conductivity is a measure of the inorganic ion content of water and is not of direct concern for public health. High conductivity may be an indicator of acceptability in high total dissolved solids (TDS) waters, and sudden changes can be an indicator of pollution in the area. It may therefore be a useful indicator or operational parameter. All values obtained were compared with standard limit recommended by WHO and ISI (Table 2.2) [13]. Concentrations of TDS in water vary considerably in different geological regions owing to differences in the solubilities of minerals.

The reagents used for the analysis were AR Grade and distilled water was used for preparations of solutions.TDS concentration describes the presence of inorganic salts and small amounts of organic matter in water and EC is the measure of water capacity to conduct electrical current by all

TABLE 2.1: SAMPLE STATION SPECIFICATIONS FOR GROUND WATER SAMPLES

S. No.	Sample Station No.	Sample Station Name	Habitat
1	SS1	Shiv Nagar	Residential/Agricultural area
2	SS2	Shivpuri	Residential/Agricultural area
3	SS3	Kothigate	Residential/Agricultural area
4	SS4	SSV College	Residential/Agricultural area
5	SS5	Delhi Road	Residential/Agricultural area

TABLE 2.2: DRINKING WATER STANDARD LIMITS

S. No.	Parameter	Indian Standard	WHO
1	pH	6.5-8.5	7.0-8.0
2	EC	1500 µS/cm	400 µS/cm
3	TDS	500 mg/L	300 mg/L

types of ions. Water is an absolutely necessity of life as well as a universal solvent. It contains dissolved materials ad suspended particles even in it's natural state [1,14]. The sources of material in TDS and EC can come from nature, i.e. geological condition and seawater, and from human activities, i.e. domestic and industrial waste and also agriculture [7,8, 15, 16]. There are many standards that govern TDS and EC in water. For health reason, desirable limit for TDS is between 500 mg/L and 1,000 mg/L and for EC is no more than 1,500 µS/cm [17]. Salinity level is other main water quality parameter [18, 19]. TDS has also been classified into four types:

- Freshwater with TDS < 1,000 mg/L.
- Brackish water with TDS between 1,000 and 10,000 mg/L.

- Saline water with TDS from 10,000 till 100,000 mg/L.
- Brine water with TDS > 100,000 mg/L [18].

Classification of water based on EC is divided into 6 types:

- Non-saline, if EC < 700 µS/cm.
- Slightly saline, if EC between 700 and 2,000 µS/cm.
- Moderately saline, if EC higher than 2,000 and less than 10,000 µS/cm.
- Highly saline with EC value from 10,000 till 25,000 µS/cm.
- Very highly saline, if EC value between 25,000 and 45,000 µS/cm.
- Brine water with EC more than 45,000 µS/cm. [19].

III. RESULTS & DISCUSSION

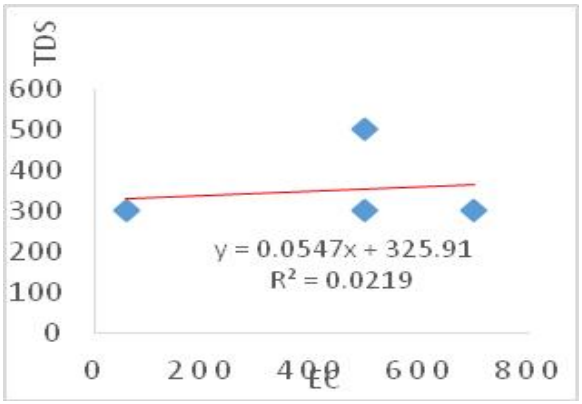
A. Correlation of TDS-EC in freshwater of five sample stations

The samples of freshwater were taken from groundwater of five sample stations and four spots of each station in study area. The main difference between the two locations is the EC value. Measured values of electrical conductivity and total dissolve solid with the names of sample stations and locations are given in the table 3. Figure A shows that TDS/EC ratio in freshwater is 0.65 (R2 = 0.97), this value is among the range which has been published [10]. Although figure B shows a higher ratio (R2 = 0.96).This indicates that the correlation of both parameters is strongly influenced by the EC values. However, all the findings are in accordance with the conclusion drawn by McNeil and Cox in which the obtained variation of TDS/EC ratio for freshwater can be vary 0.5 till ≥ 1.00 [20]. The important minerals of freshwater are generally sodium, calcium, magnesium, bicarbonate type or calcium, sodium, bicarbonate, chloride type. Accordingly, it has been found that the most correlated major ions, especially to TDS, are chloride, sodium, and magnesium [21].

Figure C shows the correlation of TDS-EC in freshwater, where correlation (R2 = 0.80). The TDS of all samples (except SS 5) is in the range of 500-2000 (mg/l) which is according to IS 10500:2012. Highest value for TDS is observed at SSV College and lowest at Delhi road in analysis. The highest EC is shown by SSV College station and this is due to less use of hand pump. Lowest EC is represented by Delhi road station. By analyzing it is observed that except SS5 all sample stations have fit drinking freshwater for utilization.

TABLE 3: MEASURED VALUES

Sample Stations		Conductivity (µS/cm)	TDS (mg/l)
1.Shiv Nagar	street 1	500	500
	street 2	500	300
	street 3	600	300
	street 4	700	300
2.Shivpuri	New shivpuri	600	300
	Devlok	500	300
	Tyaginagar	550	300
	Old shivpuri	540	280
3.Kothigate	Gali 1	500	300
	Gali 2	600	400
	Gali 3	600	300
	Gali 4	500	300
4.SSV College	Tap water	800	500
	Submercible	1000	600
	R.O.	200	200
	Handpump	1100	700
5.Delhi Road	Petrol pump	100	100
	Merino industries	100	100
	Ram swaroop	100	100
	JSS school	100	100
	Prakash regency		



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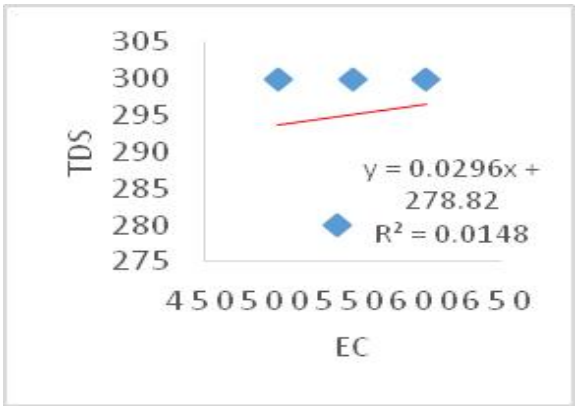

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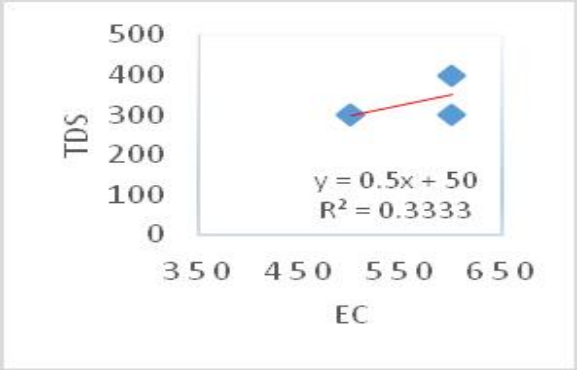

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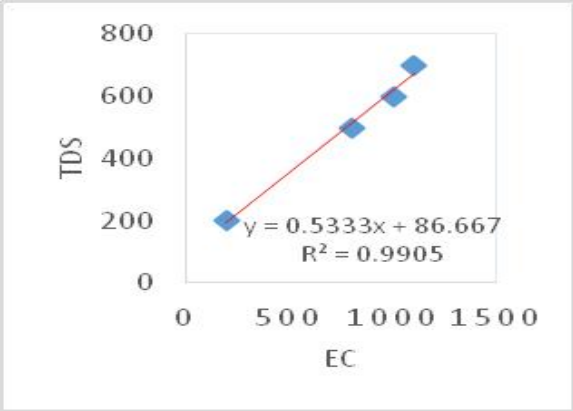

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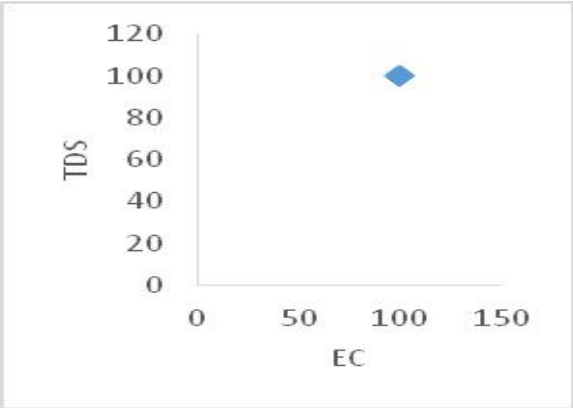
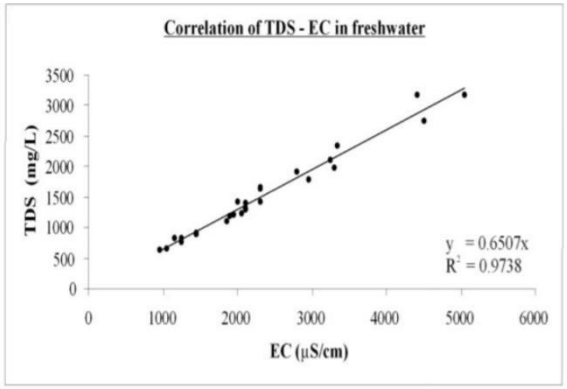


5.

The figures 1-5 given above are the graphical representation of correlation of EC and TDS.

B. Comparison of Correlation of TDS-EC in freshwater of three locations

At first location, the EC value is less than 6,000 µS/cm [22], while at second location the EC value is higher up to 10,000 µS/cm, and at third location the EC value is up to 1,000 µS/cm. Results were compared with samples from the first location with the values obtained in 2009 [22]. Similarly, obtained results were compared with the values obtained in analysis in 2019 for second location [23]. The correlation between these parameters is shown in figure A, B and C. However, the drinking water quality parameters are many and different for different sources, as to purify water from pathogens many polymer membranes are being used for many decays. PAN based polymers are one of them. The characterization of acrylic copolymer membranes were carried out by using various techniques such as FTIR, XRD, SEM etc. [24-26].One of the basic needs for every living being including human is purified water. The impact on water quality directly effects our ecosystem and environment. A number of researches have done and many are going on this topic. We have previously studied for many more parameters of water samples of Hapur (U.P., India).The need for the protection of environment becomes a necessity[27-28]. Figures A, B and C represent TDS and EC correlation in linear regression equation of fresh water samples for three different locations and regression determination coefficient (R^2) is calculated.



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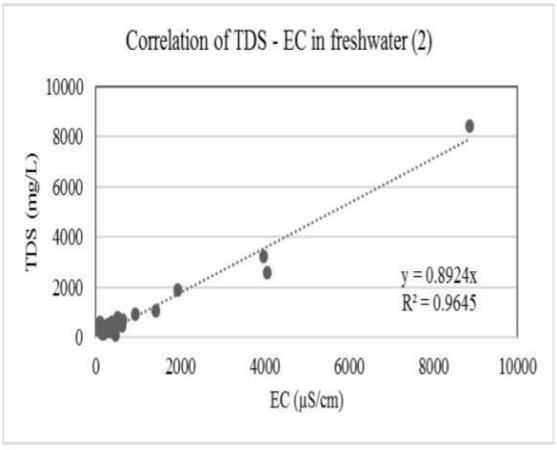

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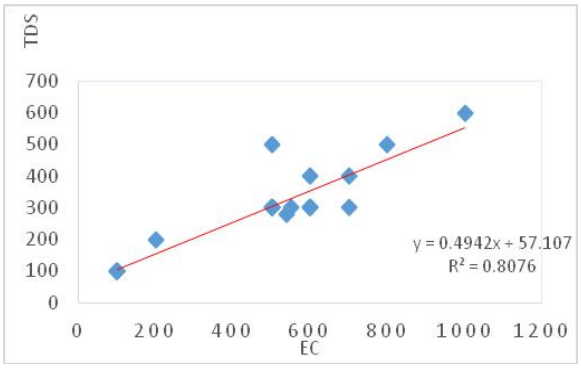

C

Figure C represents the location chosen by the authors of this paper. Figure A shows that TDS and EC ratio in freshwater is 0.65 (R^2 = 0.97) and it can be written as: TDS = 0.65 x EC. This value falls in the range which has been published and well documented [9]. Figure B shows that TDS and EC ratio is (R^2= 0.96) and it can be written as: TDS = 0.89 x EC. This value is among the range which is again in the documented range. Whereas figure C indicates that TDS and EC ratio is (R^2= 0.80) and it can be written as: TDS = 0.4942(EC) +57.107. This value is also compared with other results [10].

The difference indicates that the correlation of both parameters is strongly influenced by the EC values. All the results are in accordance with the conclusion drawn by McNeil and Cox, in which the obtained variation of TDS/EC ratio for freshwater can be vary 0.5 till ≥ 1.00. The important ions of freshwater are generally sodium, calcium, magnesium, bicarbonate type or calcium, sodium, bicarbonate, chloride type [20] and these play role in TDS/EC ratio. Among all most correlated major ions contributing for TDS are chloride, sodium, and magnesium [21]. TDS in water supplies originate from natural sources, sewage, urban and agricultural run-off, and industrial wastewater.

IV. CONCLUSIONS

Salinity is the indication of property of both water and soil and is characterized by amount of dissolved salts present and expressed as grams of salt present in one kilogram of water or soil with a unit of parts per thousand or ppt. Dissolution of salts results in higher density of salty water than fresh water. EC and TDS are water quality parameters which indicate level of salinity. Measurement and calculation of TDS value are based on EC value and depends on many parameters which contribute for water quality. The TDS/EC ratio for freshwater can be vary in the range of 0.5 till ≥ 1.00. The relationship between TDS and EC is may be linear or nonlinear and depends only on water salinity and type of material dissolved in water. Higher salinity level shows more complex mathematical equations to describe these parameters. Gravimetric analysis provides better results for of TDS concentration. Salinity is the total concentration of all dissolved salts in water. TDS combines the sum of all ion particles (organic & inorganic both) that are smaller than 2µ. TDS is important to analyze ground water quality, particularly to understand the effect of seawater intrusion better than conductivity results. The correlation of TDS and conductivity are not always linear.

In areas where the TDS content of the water supply is very high, the individual constituents should be identified because it can be useful for public health department. Drinking water generally has a TDS below 500 mg/L, however, higher TDS Fresh Water is drinkable but taste may be objectionable. Total dissolved solids (TDS) concentration is the total cations (positively charged) and anions (negatively charged) ions in the water and TDS test gives a qualitative measure of the number of dissolved ions but does not tell us ion relationships. Total dissolved solids test is used as an indicator test to determine the general quality of the water, sources of total dissolved solids can include all of the dissolved cations and anions. Effective policy and better planning are needed to improve water quality through integrated water management practices for healthy ecosystems in the area.

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REFERENCES

[1] C. Sawyer, P. McCarty and G. Parkin, Chemistry for Environmental Engineering, Singapore: McGraw-Hill, Inc, 1994.

[2] M. El. Moujabber, B. B. Samra, T. Darwish and T. Atallah—Comparison of different indicators for groundwater contamination by seawater

intrusion on the Lebanese coast,‖Water Resour. Manag.20, 161–180, 2006.

[3] T. Y. Stigter, L. Ribeiro and A. M. M. C. Dill, ―Application of a groundwater quality index as an assessment and communication tool in agro-environmental policies - Two Portuguese case studies,‖ J. Hydrol. 327, pp. 578-591, 2006.

[4] J. C. Nonner,Introduction to Hydrogeology, London: CRC Press, Taylor and Francis Group, 2015.

[5] D. Han, C. Kohfahl, X. Song, G. Xiao and Yang J, ―Geochemical and isotopic evidence for palaeo-seawater intrusion into the south coast aquifer of Laizhou Bay, China,‖ Appl. Geochemistry, Vol. 26,pp. 863-883, 2011.

[6] P. N. Patil, D. V. Sawant, and R. N. Deshmukh, ―Physico-chemical parameters for testing of water – a review,‖ Int. J. Environ. Sci., Vol. 3 pp. 1194–1207, 2012.

[7] A. Marandi, M. Polikarpus and A. Jõeleht, ―A new approach for describing the relationship between electrical conductivity and major anion concentration in natural waters,‖ Appl. Geochemistry Vol. 38, pp. 103–109, 2013.

[8] W. L. Daniels, C. E. Zipper, Z. W. Orndorff, J. Skousen, C. D. Barton, L. M. McDonald and M. Beck, ‖Predicting total dissolved solids release from central Appalachian coal mine spoils,‖ Environ. Pollut., Vol. 216 pp. 371–379, 2016.

[9] M. Khaki, I. Yusoff and N. Ismalami, ―Application of the artificial neural network and neurofuzzy system for assessment of groundwater quality,‖ Clean - Soil, Air, Water , Vol. 43(4), pp. 551-560, 2015.

[10] D. Hem, Study and Interpretation the Chemical of Natural of Characteristics Natural Water rd edition USGS Water Supply Paper 2254 66-69 US Govt Printing Office Washington DC, 1985.

[11] E. Brown, M. Skougstad and M. Fishman, Methods for collection and analysis of water samples, USGS Water-Supply Pap. 1454, 1960.

[12] N. R. G. Walton, ―Electrical Conductivity and total dissolved solids—What is their precise relationship?,‖ Desalination, Vol. 72, pp. 275–292, 1989.

[13] Who guidelines for drinking-water quality 2018.

[14] S. agarwal, S. Pal, A. K. Gupta and Amardeep, ―A base line study physico-chemical parammeters and some trace metals in chhoyya nala of Hapur, District, Uttar Pradesh, India,‖Int. J. of Innovative. Res. & Studies , Vol. 3, No. 7, 127-138, 2014 (ISNN 2319-9725).

[15] P. M. Carreira, J. M. Marques and D. Nunes, ―Source of groundwater salinity in coastline aquifers based on environmental isotopes (Portugal): Natural vs. human interference. A review and reinterpretation,‖ Appl. Geochemistry, Vol. 41, pp. 163–175, 2014.

[16] A. F. Rusydi, W. Naily and H. Lestiana ―Pencemaran Limbah Domestik Dan Pertanian Terhadap Airtanah Bebas,‖ J. Ris. Geol. Tem Vol. 25, pp. 87-97, December 2015.

[17] WHO guidelines for drinking-water quality (Geneva: World Health Organization), 2011.

[18] D. K. Todd and L. W. Mays, Groundwater Hydrology ed B Zobrist (New Jersey: John Wiley & Sons, Inc.), 2005.

[19] J. Rhoades, A. Kandiah and A. Mashali, The use of saline waters for crop production (Rome: FAO United Nations), 1992.

[20] V. H. McNeil and M. E. Cox, ―Relationship between conductivity and analyzed composition in a large set of natural surface-water samples, Queensland, Australia,‖ Environ. Geol., Vol. 39, pp. 1325– 1333, 2000.

[21] S. Thirumalini and K. Joseph, ―Correlation between electrical conductivity and total dissolved solids in natural waters,‖ Malaysian J. Sci. Vol. 28, pp. 56-61, 2009.

[22] M. Siosemarde, F. Kave, E. Pazira, H. Sedghi and S. J. Ghaderi, ―Determine of constant coefficients to relate total dissolved solids to electrical conductivity,‖ Int. J. Environ. Chem. Ecol. Geol. Geophys. Eng. Vol. 4, pp. 457–459, 2010.

[23] A F Rusydi, ―Correlation between conductivity and total dissolved solid in various type of water: A review,‖ Global Colloquium on GeoSciences and Engineering,‖ IOP Conf. Ser.: EarthEnviron. Sci., doi :10.1088,1755- 1315,118,1,012019

[24] S. K. Yadav & G. C. Mishra, ― Analysis of water quality parameters of River Hindon entering in Saharanpur (UP, India),‖ International Journal of Environmental Research and Development, Vol 4, No. 3, pp. 269-274 (ISSN 2249-3131), 2014.

[25] S. Rani, G. Praveen and G. Kumar, ―Synthesis and characterization of copolymer film of acrylic

acid with acrylonitrile and hydroxylamine treatment of the acrylic copolymer,‖ VSRD International Journal of Technical & Non-Technical Research, Vol. IX (II), pp. 83-88, 2018.

[26] S. Rani, G. Praveen and G. Kumar, ―Synthesis, study and charactrization of amidoximatedacrylic copolymer,‖Int. Journal of Engineering Research and Application, ISSN : 2248-9622, Vol. 8, Issue3, (Part -IV), pp.54-60, march2018.

[27] S. Pal and S. agarwal, ―Physico-chemical characterstics of ground water samples of selected areas of Dheerkhera, Hapur, U.P., J. of Chemistry in Asia, Vol. 5, No. 1-4, pp. 31-38, 2014.

[28] S. agarwal, S. Pal and R. Tyagi, ―Humanr rights to consumed water, environment protection: present and future,‖ ESSENCE-Int. J. for Env. Rehl. and Cons. Vol. VI, No. 2, pp. 35-42, 2015.