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SEASONAL COMPARATIVE STUDY OF KANOI PAPER MILL EFFLUENT IN REFERENCE OF PHYSICO-CHEMICAL AND HEAVY METALS

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ABSTRACT: In order to ascertain the degree of various pollutants in Kanoi Paper mill effluent of Bilaspur district (C.G.) India. We have taken minor research project. For attained to this purpose, we have selected eight sampling sites; Four SW and four GW sources. Collected samples (Premonsoon, Monsoon and Postmonsoon 2012) were analyzed for physico-chemical special chloride and phenolic compounds and heavy metals viz: Fe, Zn, Cu and Mn. The observed results were seasonally compared and with standard value stipulated by water monitoring agency: WHO (2011) and BIS (2012). The phenol, Chloride and Fe were detected from above the excessive permissible level in all seasons; Premonsoon (Phenol; 75 ppb, Cl; 516 mgL^{-1}, Fe; 14.55 mgL^{-1}) Monsoon (Phenol; 69 ppb, Cl; 516 mgL^{-1}, Fe; 10.11 mgL^{-1}) Postmonsoon (Phenol; 71 ppb, Cl; 521 mgL^{-1}, Fe; 10.17 mgL^{-1}). The water sources surrounding the Konai paper mill are not suitable for agricultural and industrial purpose.

INTRODUCTION: Paper industry is a globally growing industry that consumes a significant amount of natural resources; bamboo and other woods, raw materials and energy[1]. The paper industry is one of the largest industries in India, consuming large amounts of water, nearly 75 to 95% of the water discharged as effluent in different water sources. In our country 300 paper mills are settle, among them 40 are large producing, more than 35 tons paper and rest are medium and small and fifth ranks amongst the industries contributing water pollution[2-3]. Paper mill effluents are characterized by the colour and the presence of suspended solids.

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In one hand the paper mill wastes contain toxic components such as tanin, NaOH, Na_2CO_3, Na_2S, bisulfites, chlorine, chlorine dioxide, CaO, HCl acid, Hg, Cr, Pb, Chlorinated phenol and hydrocarbon, but on the other hand paper mills wastes are associates with micronutrients, NPK and organic matter needed for maintaining fertility and increase the productivity level of the soil[4-10].

Study Area:

Bilaspur district head quarter is surrounded by the Mungeli, Korba, Durg and Janjgir-Champa district. The head-quarter is located in Bilaspur city. In this district only Kanoi paper mill is located, which is 12 km away from the district head-quarter on the bank of river Arpa, which is flown from the middle portion of the city.

The annual production of the paper mill is 50 tons. The raw materials are crushed straw, gunny, conc. HCl, caustic soda, conc. H_2SO_4 and alumn etc. Partial treated effluents are dumped in reservoir

and discharged in Arpa River. As a consequence, water sources are continually received various kind of contamination. So we have taken the minor research project in order to determine the degree of pollutants. In this paper we have discuss the comparative study of analytical results of premonsoon, monsoon and postmonsoon (2012) season of different water sources in and around of Kanoi paper mills effluents.

MATERIALS AND METHODS:

Four surface and Ground Water sources were selected in study field. From which water samples were collected in precleaned polythene bottles in the premonsoon (March - 2012), monsoon (Aug. - 2012) and postmonsoon (Nov. - 2012). The collected water samples were analyzed for physico-chemical and metallic element by using standard methods[11-13] the results were compared with the standard value stipulated by water quality standards[14-15].

RESULTS AND DISCUSSION:

Analytical results for physico-chemical quality of paper mill effluents for premonsoon, monsoon and postmonsoon (2012) are tabulated in **Table.1- 3** and Graphical representations are mentioned in **Fig.1-8**

TABLE 1: ANALYTICAL RESULTS OF SELECTED PARAMETER IN PREMONSOON FOR GW AND SW SOURCES

	KA(SW)	KB(SW)	KC(SW)	KD(SW)	KE(GW)	KF(GW)	KG(GW)	KH(GW)
Temp.	25.7	25.7	25.1	25.3	24.1	24.7	23.8	23.7
pH	8.1	8.3	7.79	8.4	7.2	7.10	6.95	7.01
EC	1490	1680	1341	1881	1091	1121	1213	1014
Tub.	74	29	71	28	14	11	07	06
TDS	1641	1121	1530	1466	409	301	541	518
T. Alkalinity	329	651	429	451	298	339	346	334
T. Hardness	398	251	324	345	297	283	236	247
Cl	661	139	551	563	233	236	254	267
Phenol	75	3.74	18.37	14.50	15.37	13.47	18.39	12.33
Fe	14.55	0.92	1.88	1.77	1.61	1.01	1.12	1.98
Zn	0.31	0.26	0.29	0.20	0.11	0.03	0.14	0.13
Cu	0.05	0.03	0.03	0.05	0.01	0.04	0.05	0.15
Mn	0.47	0.04	0.22	0.12	0.03	0.05	0.08	0.18

Expecting p^H, EC (μscm^{-1}), Phenol (ppb), Turbidity (NTU) all parameters have been measure in mg/L

TABLE 2: RESULTS OF SELECTED PARAMETER IN MONSOON FOR GW AND SW SOURCES

	KA(SW)	KB(SW)	KC(SW)	KD(SW)	KE(GW)	KF(GW)	KG(GW)	KH(GW)
Temp.	21.7	20.8	21.1	22.1	21.4	23.1	22.4	22.8
pH	7.1	7.2	6.69	7.4	7.1	7.2	6.40	6.90
EC	1191	1501	1051	1607	998	1011	1041	975
Tub.	78	36	79	41	18	23	14	17
TDS	1440	878	1331	1106	414	319	511	471
T. Alkalinity	311	549	411	413	281	331	314	301
T. Hardness	374	241	313	306	291	296	241	231
Cl	516	149	515	502	236	216	251	260
Phenol	6.9	3.14	16.01	13.50	15.01	12.41	16.13	10.30
Fe	10.11	0.79	1.01	1.49	1.39	0.98	1.01	1.30
Zn	0.21	0.11	0.19	0.14	0.80	0.01	0.13	0.14
Cu	0.04	0.03	0.03	0.05	0.02	0.03	0.04	0.13
Mn	0.41	0.04	0.21	0.10	0.01	0.04	0.07	0.17

Expecting p^H, EC (μscm^{-1}), Phenol (ppb), Turbidity (NTU) all parameters have been measure in mg/L

Temperature: In the study field the premonsoon temperature was found from min 23.7°C (KH; GW) to max. 23.7°C. In monsoon the recorded temperature was low comparatively premonsoon was noted as min. 20.8°C (KB; SW) to max. 23.7°C (KF; GW). The decreasing in temperature was also maintained in postmonsoon and values were fluctuated from low 18.1°C (KB, SW) to high 22.3° C (KG, GW). Thus the ranges of temperature for SW and GW are influences by changing in seasons.

TABLE 3: RESULTS OF SELECTED PARAMETER IN POST-MONSOON FOR GW AND SW SOURCES

	KA(SW)	KB(SW)	KC(SW)	KD(SW)	KE(GW)	KF(GW)	KG(GW)	KH(GW)
Temp.	20.1	18.1	19.7	20.1	22.4	21.4	22.3	21.01
pH	7.8	7.4	6.71	7.1	6.50	7.1	6.40	6.19
EC	1221	1551	1091	1668	1011	1121	997	998
Tub.	81	40	82	43	19	27	13	16
TDS	1451	881	1326	1126	420	320	513	478
T. Alkalinity	317	556	414	418	289	336	316	313
T. Hardness	379	249	327	341	290	291	239	243
Cl	521	161	523	513	241	223	261	271
Phenol	7.1	3.10	17.01	14.57	16.16	13.45	17.14	11.31
Fe	10.17	0.89	1.02	1.89	1.51	1.01	1.02	1.36
Zn	0.28	0.13	0.18	0.17	0.81	0.03	0.17	0.18
Cu	0.05	0.04	0.04	0.07	0.03	0.04	0.05	0.17
Mn	0.43	0.67	0.31	0.13	0.02	0.05	0.07	0.21

Expecting p^H, EC (µscm^{-1}), Phenol (ppb), Turbidity (NTU) all parameters have been measure in mg/L

pH: In study field the pH was spread from 7.01 (KH; GW) to 8.4 (KD, SW) to 7.4 (K, SW) in season of premonsoon (2012). In postmonsoon season the low value of pH was recorded 6.40 (KG, GW) to high 7.8 (KA, SW). These variations of pH indicate the nature of water sources is slightly acidic to slightly alkaline. The pH value was high in summer season due to increase the conc. of basic ion compared the other reasons. The statistic of this parameter is under acceptable ranges as per (WHO, 2011; BIS, 2012)[14-15].

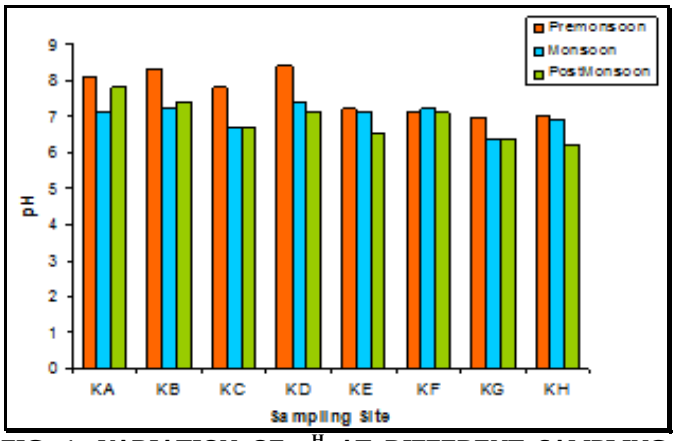

FIG. 1: VARIATION OF p^H AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

EC:

The magnitude Electrical conductivity is depends upon the conc. of dissolved ions. In study period, the min. conc. of EC was detected at the sampling site KH (GW); 1014 µscm^{-1} and max. conc. was noted at the site KD (SW); 1881 µscm^{-1} in premonsoon season of 2012.

In monsoon period the value of EC was low than premonsoon due dilution of water sources by rain water, the value noted from 975 µscm^{-1} (KH, GW) to 1607 µscm^{-1} (KD, SW). of water sources by rain water, the value noted from 975 µscm^{-1} (KH, GW) to 1607 µscm^{-1} (KD, SW). In postmonsoon season the value of EC was found between premonsoon and monsoon and conc. was covered from 997µscm^{-1} (KG, GW) to 1668 µscm^{-1} (KD, SW). In all seasons, the values of EC are not exceeded the excessive permissible limit set by (BIS, 2012)[15]; 750 to 1250 µscm^{-1}.

Turbidity:

Turbidity is caused by the presence of suspended particles[16]. In period of investigation, the ranges values was found from 16 NTU (KH, GW) to 74 NTU (KA, SW) for premonsoon season, but in monsoon season this parameter has increased owing to influxing of industrial effluents and values were found from 14 NTU (KG, GW) to 79 NTU (KC, SW), while postmonsoon season of 2012 the recorded value for turbidity was oscillate between 13 NTU (KG, GW) to 82 NTU (KC, SW). The observed results for NTU are just beyond from the acceptable ranges; 5 to 25 NTU as set by (WHO, 2011; BIS, 2012)[14-15].

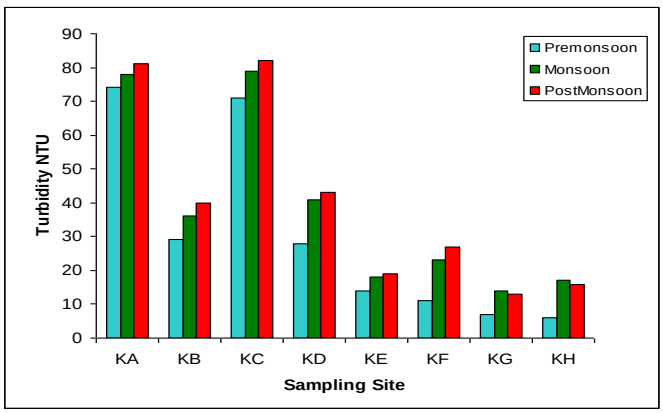

FIG. 2: TURBIDITY AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

TDS: The TDS value was recorded in premonsoon period (2012), the min. value was found on the sampling site KF, GW 301 mgL^{-1}, while max value was recorded at the site KA,SW, 1641 mgL^{-1}. In monsoon period the conc. of TDS was recorded from 414 mgL^{-1} on the site KE (GW) to 1440 mgL^{-1} on the site KA (SW). The conc. of TDS in postmonsoon season has been recorded between pre-monsoon and monsoon from 320mgL^{-1} (KF, GW) to 1451 mgL^{-1} (KA, SW). The maximum conc. of TDS was under below the excessive permissible level as per (WHO, 2011)[14]; 1500 mgL^{-1} excepting premonsoon of 2012.

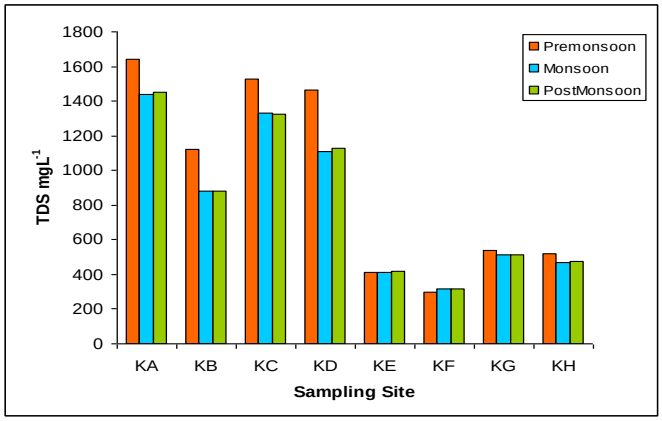

FIG. 3: TDS AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

Total alkalinity:

In study field the lower value for total alkalinity 298 mgL^{-1} (KE, GW) and higher value 651 mgL^{-1} (KD, SW) was noted in premonsoon (2012), however in monsoon period the value of total alkalinity was declined owing to intrusion of rain water in effluent reservoir and river, the value of total alkalinity was covered from 281 mgL^{-1} (KE, GW) to 549 mgL^{-1} (KB, SW).

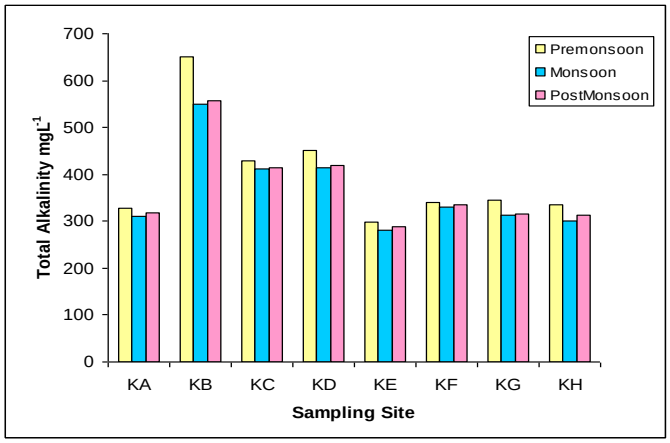

FIG. 4: TOTAL ALKALINITY AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

In postmonsoon season the min. conc. 289 mgL^{-1} (KE, GW) was recorded and max. conc. was found 556 mgL^{-1} (KB, SW) which was higher than monsoon but lower than premonsoon. The higher conc. of total alkalinity in all seasons are slightly less than max. permissible level as set by (WHO, 2011; BIS, 2012)[14-15]; 600 mgL^{-1}.

Total Hardness:

Hard water also play a vital role of heart disease[17]. In this comparative study the min. conc. of total hardness was observed as 236 mgL^{-1} on the site KG (GW) and max. value was note down 393 mgL^{-1} in the spot KA(SW) in premonsoon season of 2012. In monsoon period the conc. of total hardness was slightly decreased and covered from 231 mgL^{-1} (KH, GW) to 374 mgL^{-1} (KA, GW). In postmonsoon season the value of total hardness was found in between premonsoon and monsoon (2012) and spread from 239 mgL^{-1} (KG, GW) to 379 mgL^{-1} (KA, SW). The max. value for all seasons; premonsoon and post monsoon were recorded above the desirable limit but less than max. allowable conc. as set by (WHO, 2011; BIS, 2012)[14-15]; 300 mgL^{-1}.

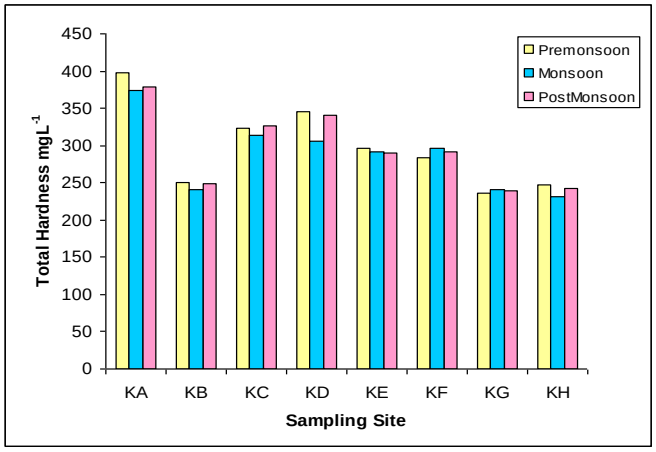

FIG. 5: TOTAL HARDNESS AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

Chloride:

Human and animal excretory waste containing 3.15 grams of NaCl[18]. In period of premonsoon assessment (2012) the max. value was calculated out 661 mgL^{-1} in spot KA(SW) and min. conc. was seen 139 mgL^{-1} (KA, SW) comparatively in monsoon season the conc. of chloride ion was found low conc. as min. 216 mgL^{-1} (KF, GM) to max. 516 mgL^{-1}(KF, SW). Owing to mixing up rain water in water sources, like the other parameters,

the conc. of chlorine was fluctuated in between premonsoon (2012) and monsoon (2012) and ranges were found as low conc. 161 mgL^{-1} (KB, SW) to 523 mgL^{-1} (KC, SW). Excepting the max. Conc. of Chloride in monsoon and postmonsoon, the recorded values are under acceptable ranges as prescribed by (WHO, 2011; BIS, 2012)[14-15].

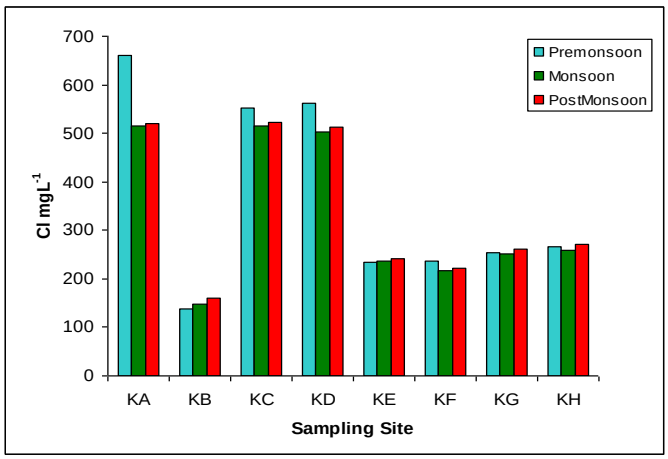

FIG. 6: CHLORIDE AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

Phenol:

Phenol is aromatic compounds and chief side product of paper mill effluent. It is acting as the disinfectant. In the study period of premonsoon, the conc. of phenol was high than monsoon and postmonsoon. The conc. of phenol was found from 3.74 ppb (KB, SW) to 75 ppb (KA, SW), while in monsoon the ranges values covered the conc. of phenol was fluctuated between 3.10 ppb; (KB, SW) to 71 ppb (KA, SW). In postmonsoon the ranges value was 3.10 ppb (KB, SW) to 17.14 ppb (KG, SW). These observed data's are not covered the standard ranges stipulated by (WHO, 2011; BIS, 2012)[14-15].

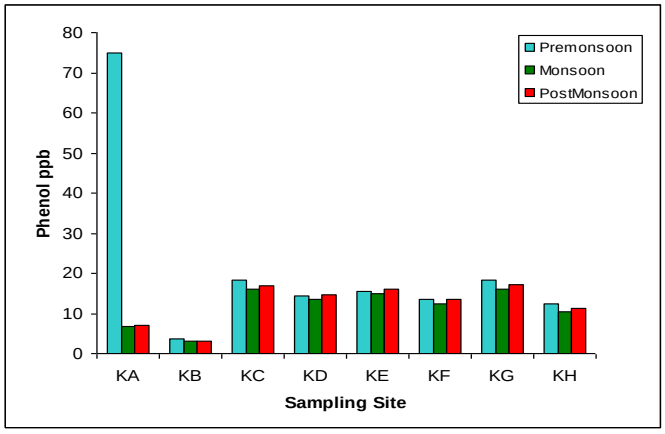

FIG. 7: CONCENTRATION OF PHENOL AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

Metallic elements:

Among all the pollutants, heavy metals are highly significant for bio-systems due to their large scale impact on human health. Earlier authors have been reported the Fe, Zn, Cu and Mn are main heavy metals in paper mills effluents[19-23]. In study field the Fe was reported upto 14.55 mgL^{-1} on sampling site (KA, SW) as high value to 0.92 mgL^{-1} as low conc. on sampling point (KB, SW) in the season of premonsoon of 2012.

In other season of 2012; monsoon and postmonsoon, the conc. of iron was decline; 0.98 mgL^{-1} (KA, SW) to 10.11 mgL^{-1} (KA, SW) in monsoon while in postmonsoon slightly higher than monsoon; 10.17 mgL^{-1} (KA, SW) to 1.01 mgL^{-1} (KF, GW). The reported high values are not not higher than the excessive permissible level; 1.00 mg/L as by (WHO, 2011; BIS, 2012)[14-15]. Other selected heavy metals such as Zn, Cu and Mn were detected under desirable level in all seasons; premonsoon, monsoon and postmonsoon monitoring session 2012.

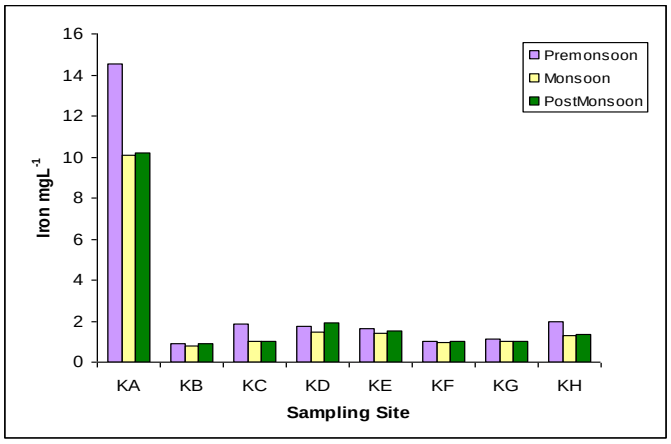

FIG. 8: CONCENTRATION OF IRON AT DIFFERENT SAMPLING SITES IN DIFFERENT SEASONS

CONCLUSIONS: From the above experimental results, the conclusion has come, the water sources, in which effluents are continuously discharge are associated with high degree contaminates in all seasons. Especially the conc. of EC, TDS, turbidity, phenol, chloride and iron have been reported in high amounts. After the seasonally assessment, the water sources in and around the Konai paper mill are not fit for agricultural and industrial purpose. We have suggested to plant management to maintain the level of pollutants in water sources by indigenous technique.

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REFERENCES:

1. Negi R K and Rajput Anjana: Impact of pulp and paper mill effluents on the diversity of micro-invertebrate fauna of Ganga River at Bijnor, U.P., India. International Journal of Applied and Natural Science, 2013; 2(5): 91-96.
2. Springer AM: Industrial Environmental control- Pulp and Paper Industry. Atlanta, GA: Tappi Press, 3rd ed, 2000: 238-239.
3. Kuzhali Surumbar S, Manikandan N and Kumuthakalavalli: Physco-chemical and biological parameters of paper industry effluent. Journal of Natural Product and Plant Resourse, 2012; 2(3): 445-448.
4. Sumathi S and Hung Y T: Treatment of pulp and paper mill wastes, in waste treatment in the process industries. Taylor and Francis, USA, Eds : Wang LK, Hung YT, Lo HH, Yapijakis C, 2006: 453-497.
5. Pradhan S C and Behera Prashanti Behera: Changes in some physical properties of siol amended with effluent of Emami paper mills located at Balgopalpur, Balasore, Orissa. The Bioscan, 2011; 6(1): 153-155.
6. Liss S N, Bicho P A, McFarlane P N and Saddler J N: Microbiology and degradation of resin acids in pulp will effluents- a mini review. Can J Microbiol, 1997; 75: 599-611.
7. Maheshwari Raaz, Rani Bina, Saxena Archana Prasad Magan and Singh Upma: Analysis of Effluents released from recycled Paper Industry. Journal Advance Scientific Research, 2012; 3(1): 82-85.
8. Pokhrel D and Viraragharan T: Treatment of pulp and paper mill waste water- a review. Sci Tot Environ, 2004; 333: 37-58.
9. Choudhary S, Sahoo N, Manthan M and Rohella R S: Fungal treatment of PWP and paper mill effluents for pollution control. Journal Industrial Pollution Control, 1998; 14(4): 1-13.
10. Bhatia H S: A textbook on Environmental pollution and control. Galgotia Publications Pvt. Ltd, New-Delhi, 2003.
11. APHA: Standard methods for examination of water and waste water. American public Health Association Inc. AWWA, WPCF Washington, 21th edition, 2005.
12. Trivedi R K and Goel P K: Chemical and Biological methods for water pollution studies. Environmental Publication, Karad, 1986.
13. N Manivaskam: Physico-chemical examination of water sewage and industrial effluent. Pragati Prakashan, Meerut, 2008: 34 – 57.
14. WHO: Guidelines for Drinking-Water Quality, World Health Organization, Geneva, Switzerland, 4th edition, 2011: 224-334.
15. Bureau of Indian Standards (BIS): Indian Standard Drinking Water Specification. Manak Bhawan, New Delhi, India, Second revision of IS: 10500, 2012.
16. Duggal K N: Element of Public Health Engineering, S. Chand and Company Ltd., New Delhi, 1996.
17. Masood A and Anwar A: Water quality in and around industrialized of Delhi east and Sahibabad. Ind J Environ Prot; 2002; 22(08): 900-904.
18. Meenambal M, Pugazhendy K, Vasantharaja C and Venkatesan S: Effect of paper mill effluent on the ground water quality in and around Adhikaripatti area of salem, Tamilnadu. Golden Research Thoughts, 2011; 1(3): 1-4.
19. Kesavan K G and Parameswari R: Evaluation of G-W quality in Kancheepuram, Ind J Environ Prot; 2005; 25(03): 235-239.
20. Thippeswamy B, Shivakumar C K and Krishnappa M : Accumulation potency of heavy metals by saccharomyces sp. Indigenous to paper mill effluent. Journal of Environmental Research and Development, 2012; 6(3): 439-445.
21. Medhi U J, Talukdar A K and Deka S: Impact of Paper mill effluent on growth and development of certain agricultural crops. J Environ Biol, 2011; 32: 185-188.
22. Kumar Vinod and Chopra A K: Alterations in Physico-chemical characteristics of soil after irrigation with paper mill effluent. J Chem Pharm Res, 2011; 3(6): 153-155.
23. Hakeem Arti Suri and Bhatnagar Smita: Heavy metal reduction of pulp and paper mill Effluent by Indigenous Microbes. Asian J Exp Biol Sci, 2010; 1(1): 201-203.

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