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Correlation Analysis of Surface and Subsurface Water in Balco Indstrial Area, District Korba (C.G.), India

KEYWORDS: Physicochemical parameters, Heavy meals, Surface and Ground water, Statistical Parameters, WQI, Correlation Coefficient, Korba, Balco

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ABSTRACT *Water is renewable and expensive natural resources. It is advantageous for all kinds of microbes to plant, animals and human being. 79% area of our planet is occupied by the water, but unfortunately only 2.6% water is safe. From last three decades due to over industrialization, explosive population and unscientifically application of chemicals and fertilizers in agriculture water sources became unfit for human development. We have taken major and broadly assessment of water sources of Balco industrial area. In this paper we have attempt to monsoon analysis of GW and SW for ten selected sampling site (BS1 to BS10) in period of July 2010 to Sep 2010. Collected water samples were subjected for physicochemical analysis and observed values were interpreted in terms of statistical parameters such as Correlation Coefficient and WQI. The ranging for Al was 0.220 – 3.820 mg/L for GW and 0.070 – 10.170 mg/L for SW. Iron was detected in ranging value 0.260 – 26.160 mg/L for GW and in SW the ranging value fluctuated between 0.260 – 4.50 mg/L. The max. values is higher than the limit value, which is threat for drinking water and prove it is high rank of WQI from 431.788 (BS4) to 7399.031 (BS5).*

Introduction:
Water has unique position in earth planet owing to its multi and broad uses for surviving and existence of various kinds of biosystem. Hence, water is called Liquid of Life (Yadav, Khan & Sharma, 2010). Pure water is free from visible suspended matter, chemicals and pathogen bacteria while potable for drinking water is fit for human consumption (Muthulakshmi, Ramu & Kannan, 2010). In nature, water occurs in surface and subsurface sources. Oceans, sea, canal, rivers, small and large ponds are type of surface but tube well, dug well and bore well are considered as ground water. Ground water is an invaluable commodity available in very limited quantity for man and other living beings (Srinivas, Piska, Venkateshwar, Satyanarayana Rao & Reddy, 2000). Ground water is purest form and much cleaner than surface water. Due to haphazardly disposal of wastes, population explosion, uncontrolled urbanization, industrial revolution, modern agriculture technique, there is immense threat to aquatic environment (Nair, Singh, Arumugam & Clorson, 2011). Metallic inorganic elements are also play vital role for creating imbalance in water ecosystem. Large quantities of metals are being added to aquatic system through directly and indirectly sources and leading to long term toxic effect.

Study Area : Korba and adjoining area is important place in world map in pollution point of view. The study field is 8 Km away in north – east direction from Korba district head quarter is spread in 38 Km^2. The investigation area is divided into ten sampling station as environmentally significantly point of view, which are shown in Figure 1. The input of Balco industrial unit is crude bauxite procured from Phutka hill, Mainpat hill and Kawardha district and output refined Aluminum. The production is 3 Lakh Tonnes per annum. Owing to unscientifically management the wastes are not properly dumped at approximate place therefore, different water bodies are gradually damaged. In continuation of our previous work(Sahu & Vaishanv, 2008, Dewangan, Vaishnav & Chandrakar, 2010, Vaishnav & Dewangan, 2011, Vaishnav & Dewangan, 2012), we have taken monthly monitoring of different aquatic system for change and determined the degree of various kinds of polluter. The present communication attempts to characterize the water quality of surface and subsurface water in Balco industrial area, with respect to physiochemical metallic elements and mathematical parameters.

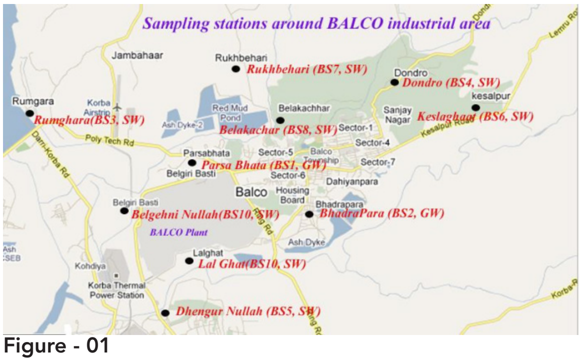

Figure - 01

Materials and Methods:
To order the assessment of water quality and selected elements, ten sampling stations were decided in study field as assigned as BS1 to BS10 (Fig. 1). The crude water samples were collected during Jul 2010 to Sep 2010 in a precleaned polyethylene bottle of 1L capacity without introduction of any air bubbles. The field parameters viz. Temp., EC, TDS, Turbidity were measured on the spot with the help of analyzer kit (E1 Model 132). The water was immediately brought in the laboratory for further analysis. Total Hardness, T. Alkalinity, T. Acidity and selected metallic elements were analyzed following the methods prescribed by APHA (1981), Trivedi & Goel (1986), and N. Manivaskam (1986) by volumetric and instrumental method (ICPAES). The statistical analysis has been performed using standard method (Gupta, 1999).

Results and Discussion: Correlation matrixes were represented in Table 1A and Table 1B for subsurface and surface water respectively. 105 correlations have been established between dependents and independent variables for GW and SW. 52 and 64 were calculated out as positive relations for GW and SW while 53 and 41 as negative r values for both sources of water. High value of +ive significant correlation was seen between Zn vs TH [+ 0.950(9.604)] in case of GW samples however for SW high degree relations was established between TDS vs TS [0.961 (13.862)]. In inverse relation high value of r was calculated out between total alkalin-

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ity and temp. in GW sample [-0.903(6.641)]. T. Aci. vs TDS showed [-0.930(19.851)] for SW. Total calculated relations were categorize in 0.1%, 1% and 5% significant level. For GW at 0.1 level (r > 0.780) were computed between T. Aci vs Temp. [+0.848(5.053)], Al vs Temp. [0.788(4.045)], TSS vs TS [0.890(6.181)], T. Alk. vs TS [0.858(5.276)], T. Alk. vs TS [0.858(5.276)], TH vs TS [0.797(9.174)], Zn vs TS [0.849(5.077)], T. Alk. vs TSS [0.904(6.701)], Zn vs TSS [0.889(5.972)], Al vs T. Aci.[0.840(4.897)], Zn vs TH [0.950(9.604)]. At 1% level (r = 0.684 – 0.780) high significant correlations were formed between Zn vs T. Alk. [0.714(3.228)] and Fe vs TH [0.733(3.407)] indicated zinc and iron compounds are imparting in total alkalinity and total hardness. At 5% level (r = 0.553 – 0.684) only a few relations were found between different parameters TS vs pH [0.593(2.331)], TDS vs pH [0.591(2.318)], T. Alk. vs pH [0.621(2.504)], Fe vs TS [0.559(2.133)], Fe vs Mn [0.671(2.815)]. In surface water only one high degree r value showed between T. Alk. vs TS [0.801(5.353)] it means the chemical constituents are same for T. Alk. and TS. At 1% level total alkalinity bear positive correlation with TDS [0.749(4.516)]. These relation help to predict the presence of $OH^-, CO_3^{2-}, HCO_3^{2-}, BO_3^{2-}$ and PO_4^{3-} ion which are cause for total alkalinity and TDS. At 5% level four relations were found by total alkalinity and temp. [0.602(3.014)], TDS and Turb. [0.610(3.080)], Zn and TH [0.559(2.669)], Fe and Al [0.670(3.609)]. So it may be concluded that TDS depended upon the turbidity. Zn compounds are also play vital role in enhancing TH. Iron and aluminum are occurring in the same region, therefore in water sample their concentrations are near about same.

WQI: Water quality index was calculated for all water samples collected from selected site BS1 to BS10 on the basis of some chosen physicochemical quality and metallic elements. The WQI range 431.788 (BS4) to 7399.031 (BS5), which are far beyond standard value. This high value of WQI for all water sources showed water was highly contaminated by the various kinds of pollutants which are origin from anthropogenic and natural sources.

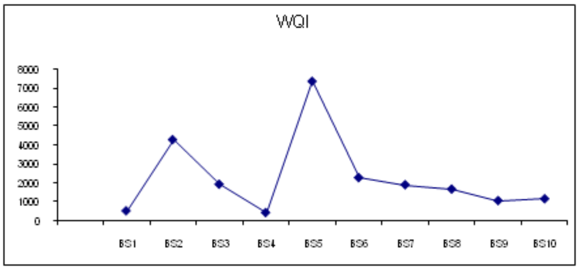

Table 1A Correlation Matrix GW Monsoon 2010

	Temperature	pH	EC	Turbidity	TS	TDS	TSS	T.Aci	T.Alk	TH	Mn	As	Zn	Al	Fe
Temperature															
pH	-0.483(1.747)														
EC	-0.476(1.711)	0.550(2.081)													
Turbidity	-0.192(0.618)	-0.160(0.514)	0.185(0.595)												
TS	-0.724(3.318)	0.593(2.331)	0.110(0.350)	-0.079(0.249)											
TDS	-0.004(0.014)	0.591(2.318)	-0.119(0.378)	-0.730(3.375)	0.493(1.793)										
TSS	-0.829(4.689)	0.372(1.267)	0.188(0.606)	0.292(0.965)	0.890(6.181)	0.043(0.136)									
T.Aci	0.848(5.053)	-0.667(2.831)	-0.636(2.607)	-0.122(0.389)	-0.736(3.440)	-0.105(0.335)	-0.790(4.078)								
T.Alk	-0.903(6.641)	0.621(2.504)	0.479(1.727)	0.233(0.757)	0.858(5.276)	0.154(0.494)	0.904(6.701)	-0.848(5.057)							
TH	-0.454(1.611)	0.117(0.374)	-0.458(1.631)	-0.022(0.070)	0.797(4.174)	0.315(1.049)	0.751(3.593)	-0.305(1.012)	0.544(2.051)						
Mn	-0.207(0.668)	-0.362(1.228)	-0.211(0.681)	0.175(0.561)	0.261(0.856)	-0.053(0.168)	0.328(1.097)	0.116(0.368)	0.243(0.791)	0.408(1.414)					
As	0.011(0.034)	0.187(0.601)	0.059(0.187)	-0.545(2.058)	0.018(0.057)	0.208(0.671)	-0.088(0.280)	-0.176(0.565)	-0.131(0.416)	-0.121(0.385)	-0.466(1.668)				
Zn	-0.615(2.467)	0.240(0.781)	-0.235(0.764)	0.214(0.693)	0.849(5.077)	0.174(0.559)	0.884(5.972)	-0.487(1.763)	0.714(3.228)	0.950(9.604)	0.381(1.302)	-0.193(0.623)			
Al	0.788(4.045)	-0.685(2.977)	-0.704(3.138)	-0.081(0.258)	-0.577(2.234)	-0.197(0.636)	-0.560(2.135)	0.840(4.897)	-0.733(3.412)	-0.083(0.264)	0.020(0.064)	-0.087(0.276)	-0.257(0.839)		
Fe	-0.413(1.432)	-0.293(0.970)	-0.311(1.036)	-0.035(0.110)	0.559(2.133)	0.003(0.011)	0.640(2.636)	-0.239(0.780)	0.389(1.335)	0.733(3.407)	0.671(2.865)	-0.130(0.415)	0.668(2.842)	-0.009(0.029)	

Table 1B Correlation Matrix SW Monsoon 2010

	Temperature	pH	EC	Turbidity	TS	TDS	TSS	T.Aci	T.Alk	TH	Mn	As	Zn	Al	Fe
Temperature															
pH	0.377(1.628)														
EC	-0.022(0.086)	0.381(1.650)													
Turbidity	-0.291(1.217)	0.145(0.585)	0.388(1.686)												
TS	0.337(1.434)	0.411(1.803)	0.386(1.674)	0.492(2.263)											
TDS	0.312(1.312)	0.289(1.207)	0.362(1.553)	0.610(3.080)	0.961(13.862)										
TSS	0.106(0.425)	0.450(2.017)	0.101(0.406)	-0.397(1.729)	0.181(0.734)	-0.099(0.399)									
T.Aci	-0.303(1.273)	-0.301(1.264)	-0.366(1.571)	-0.578(2.833)	-0.962(14.043)	-0.980(19.851)	0.026(0.104)								
T.Alk	0.602(3.014)	0.245(1.012)	0.135(0.547)	0.039(0.158)	0.801(5.353)	0.749(4.516)	0.219(0.900)	-0.750(4.533)							
TH	-0.042(0.167)	-0.118(0.477)	0.280(1.165)	0.444(1.983)	0.144(0.583)	0.305(1.282)	-0.565(2.738)	-0.279(1.164)	-0.020(0.079)						
Mn	0.090(0.361)	-0.539(2.560)	-0.139(0.562)	-0.314(1.321)	-0.187(0.759)	-0.136(0.549)	-0.187(0.762)	0.086(0.345)	0.122(0.492)	0.014(0.056)					

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As	-0.193(0.786)	0.300(1.259)	0.186(0.757)	0.547(2.611)	0.352(1.503)	0.389(1.687)	-0.116(0.468)	-0.322(1.360)	0.071(0.284)	0.003(0.010)	-0.524(2.462)					
Zn	-0.075(0.301)	-0.306(1.284)	0.082(0.328)	-0.260(1.076)	-0.431(1.911)	-0.324(1.369)	-0.398(1.738)	0.323(1.365)	-0.195(0.797)	0.559(2.699)	0.483(2.204)	-0.404(1.769)				
Al	0.245(1.010)	0.389(1.692)	0.437(1.941)	-0.110(0.444)	0.216(0.883)	0.134(0.540)	0.300(1.256)	-0.184(0.747)	0.286(1.194)	0.071(0.286)	-0.130(0.526)	0.039(0.156)	0.096(0.385)			
Fe	0.342(1.458)	0.186(0.757)	0.215(0.882)	-0.160(0.649)	0.151(0.610)	0.110(0.443)	0.151(0.611)	-0.110(0.442)	0.219(0.897)	0.262(1.086)	-0.394(1.716)	-0.081(0.325)	0.042(0.170)	0.670(3.609)		

Conclusion:

We have taken scientifically study in monsoon season (July 2010 to Sep 2010) of GW and SW of Balco industrial area. From observation values for different water quality parameters it is inferred that the SW are more polluted than GW owing to discharging of industrial effluents, agricultural and surface runoff in monsoon season. High degree of r values were found between Zn vs TH and TDS vs TS for GW and SW. WQI again support the water quality of the Balco region is high contaminated in terms of physical and chemical constituents. Before using prior purification is necessary and we have also suggested some indigenous technique by which different pollutants can be minimize.

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