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Data Article

Data on physicochemical properties of borehole water and surface water treated using reverse osmosis [RO] and ultra-violet [UV] radiation water treatment techniques

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ABSTRACT

This article present data on reverse osmosis (RO) and ultra-violet (UV) Radiation Water Treatment Techniques effects on the physiochemical properties of a treated surface water (SW) and borehole water (BHW). The water treatment study which was carried out in Omoku community in River State, lies with latitude 5°13¹N and 5°22¹N and longitude 6°33¹E and 6°42¹ North West of the Niger Delta region of Nigeria, an area with over Nine hundred oil wells with over thirteen active oil fields and playing host to three multinational companies, due to these activities the water is highly contaminated and causing serious health challenges to the water consumer. Therefore, this research work focus on RO and UV water techniques by applying the physicochemical characteristics method and total Coliform count, with the mechanism to check the influence of both techniques on the pH, temperature, Turbidity, conductivity, Total suspended solids Total dissolved solids of the water for three different samples within the Omoku community. The experiment shows that RO treatment technique produces potable water with reduced mineral content in comparison to the UV treatment.

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Specifications Table

Subject area	*Engineering, environmental Engineering, Chemical Engineering*
Compounds	*Water; Dihydrogen oxide*
Data category	*Absorbance data of Physicochemical Properties and the numerical data analyzed by ANOVA*
Data acquisition format	*Statistical data of absorbance monitoring from an Industrial 500 L/H Ss reverse osmosis system mineral water treatment machine and 60T–500T Ultraviolet Radiation System water treatment instrument.*
Data type	*Raw from experimental analysis*
Procedure	*A sterile sampling bottle was used to collect contaminated water samples from three boreholes at different locations of about 3 km apart and from Orashi flowing River at three (3) different points of at least 7 km apart, using the method of sweeping against the flowing river and all the samples were treated using reverse osmosis (RO) and Ultraviolet radiation (UV) techniques instrument. The treated samples were tested and analyzed for both RO and UV, using physicochemical characteristics method and total Coliform count.*
Data accessibility	*A complete dataset of Physicochemical Properties of the contaminated water after treatment using the physicochemical characteristics method and total Coliform count is provided in this article*

1. Rationale

Water is one of the most significant resources for animal, plant, power generation and also for human comfort [1,2]. Access to good and potable drinking water is a basic need. Water, due to its nature and source its often exposes to impurities, which makes such water unfit for human consumption [3,4]. Consumption of contaminated water can lead to loss of human life and animal [5,6]. To improve public health, especially in developing countries, there is need to provide communities with safe and clean water, in order to meet the United Nation Sustainable Developmental Goal of access to water [7–11]. Therefore, constant water treatment is needed.

However, this research data will assist the consumers and water production industry the opportunity to make used of any of the methods in treating water before consumption, such as reverse osmosis (RO) and Ultraviolet radiation (UV) treatment techniques, which will help improving the production output of water industries [12–16]. Table 1 shows some likely effects of chemical pollutant in water.

2. Procedure

The experimental analysis was carried out in Omoku community, River State which is one of the highest onshore oil and gas production communities of Niger Delta. It has over Nine hundred oil wells with over thirteen active oil fields and it host three multinational companies [19,20]. Fig. 1 shows the map of the study area. A sterile sampling bottle was used to collect the water samples from these boreholes. The boreholes were switched on and discharge pipes to the reservoir tank was disconnected to allow the water to flow out for minimum period of 5 min before the raw water was collected in a 4-liter jerry-can with laboratory sanitized standard, and the samples were collected before getting to reservoir tank (elevated plastic tank). Table 2, shows the samples collected from ground and Surface Water (River Orashi).

The water samples were treated using reverse osmosis (RO) and Ultraviolet radiation (UV) techniques and to determine the effect of the treatment technique The water samples were taken for laboratory analysis at Nigerian Agip Oil Company (NAOC) chemical industrial laboratory (located in Aya-Gologo, Port Harcourt, the distance between the sample location and the laboratory is 81.3 km and the lagging time between sample collection to the laboratory is 1 h 20 min. via Elele-Isokpo-Umueke Rd/A231 and Ikiri Airport Road from the Omoku community) for various physicochemical characteristics

Table 1
Health effects of selected chemical pollutants [17,18].

Chemical	Source	Health effect
Inorganic salts e.g. Fluoride	Natural occurring	Yellowing of the teeth and damage to the spinal cord and other crippling diseases
Arsenic	Natural-occurring	Arsenic poisoning-cause liver and nervous system damage, vascular diseases and also skin cancers.
Lead	Pipes fittings solder, and the service connections of water pipes	Lead poisoning; damage, brain of children
Mercury	Gold mining from stream deposits	Mercury poisoning
Benzene	Underground petroleum storage tank	Direct toxicity; causes leukemia
Chlorinated Solvents	Laundry agents, e.g. bleaches and stain removers electronic plastic and aircraft manufacture	Direct toxicity; damages reproductive disorders, carcinogenic
Pesticides	Petrochemicals	Damage nervous system, causes
Nitrates	Internal combustion engines, Nitrate fertilizers	Restricts the amount of oxygen that reaches the brain causing the 'blue baby' syndrome. It is also linked to digestive tract cancers
Crude oil	Petroleum refinery	Toxic, some fractions are carcinogenic

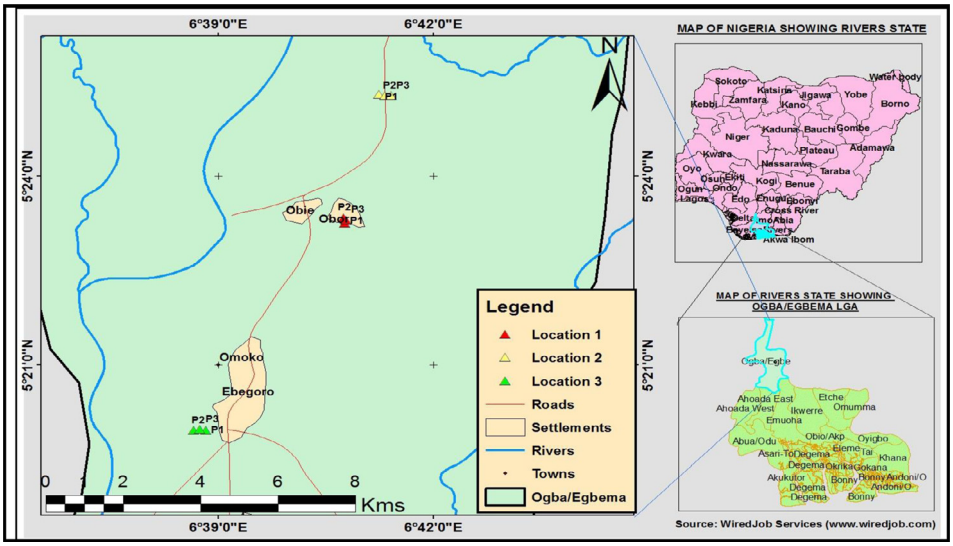

Fig. 1. Map of the study area: source [20].

Table 2
Borehole water and surface water sampling sites.

Borehole Sample	Depth of the borehole (m)	Volume (L)	Surface water sample (Orashi flowing River)
BH1	25	1	7 km apart from each sample
BH2	35	1	7 km apart from each sample
BH3	40	1	7 km apart from each sample

and Coliform count the water was analyzed to determine their physicochemical characteristics. The parameters characterized include pH, electrical conductivity, temperature, total hardness, turbidity, total dissolved solids, total suspended solids, Nutrients such as Nitrate, Sulphate and Chloride, mineral elements such as potassium, sodium and magnesium as well as heavy metals such as Iron, Lead, Chromium and Arsenic and the instrument used to carried out this various tests are ORION 1260, thermometric determination, electrometric method, 2100 T-metre, APHA 2540D, TDS and TDS metre, ASTM D512 titrimetric Method, APHA 4500-NO_3 B method respectively for the parameters. These parameters are indicators of purity levels of water.

3. Data, value and validation

The significance of the raw data acquired from the experiment analysis during the application of RO and UV techniques in water treatment, along with the physicochemical characteristics and Coliform count of the various samples, are stated as follows:

- The data set will give researchers and water production industry, and environmental engineers the optimum parameters to carry out water treatment with both the reverse osmosis (RO) and Ultraviolet radiation (UV) techniques in other to produce safe drinking water at lower cost.
- The data in this study focus on the physicochemical properties of water treated with reverse osmosis and ultraviolet radiation treatment process, to enable author and small scale industry analyse and understand the process of water treatment and make use of the data to eliminate water pollution from the community.
- The data given can be used to study the correlation between physicochemical parameters at different levels of concentrations.
- This data set can also be used in treating the water used to generate power via steam turbine power plant in other to avoid corrosion in the boiler feed drum and in other mechanical components.

The data obtained from all the experimental test analysis for RO and UV are shown in Tables 3–21. The data was subjected to descriptive and two-way analysis of variance (ANOVA) statistics to test the significant difference in the effectiveness of the RO and UV water treatment, in both borehole (BH) and surface water (SW) at 95% confidence limit on the physicochemical properties of the water, as shown in Tables 21–39 respectively. Fig. 2, shows the surface plot of Total Coliform (MPN/100 ml) in BH and SW treated samples with RO (T) and UV (T) and untreated water used as the control.

Table 3
Effect of RO and UV techniques on borehole and surface water to determine the pH.

Source	RO (T)	UV(T)	Control	WHO (pH)
BH_1	6.50	6.98	6.25	6.5–
BH_2	6.50	6.70	6.20	7.5
BH_3	6.55	6.60	6.00	
SW_1	7.00	6.98	6.98	
SW_2	5.99	6.00	6.00	
SW_3	6.00	6.25	6.85	

Table 4
Effect of RO and UV techniques on borehole and surface water to determine the temperature.

Source	R.O (T)	UV (T)	Control	WHO-limit
BH_1	32.00	320.00	31.00	No limit specified
BH_2	33.00	30.00	31.00	
BH_3	33.00	30.00	32.00	
SW_1	32.00	30.00	31.00	
SW_2	34.20	32.00	31.00	
SW_3	35.10	33.00	32.50	

Table 5
Effect of reverse osmosis (RO) and ultra-violet radiation (UV) techniques on borehole and surface water to determine water conductivity.

Source	RO(T)	UV(T)	Control	WHO-limit
BH_1	43.00	43.00	43.00	$<$1050.0 μs/mm
BH_2	38.00	42.00	42.20	
BH_3	40.00	40.00	42.00	
SW_1	405.00	428.10	525.00	
SW_2	750.00	900.00	1000.00	
SW_3	120.20	776.70	875.00	

Table 6
Effect of water treatment on turbidity of borehole and surface water.

Source	RO	UV	Control	WHO
BH_1	0.00001	0.00001	0.00001	$<$5.00
BH_2	0.00001	0.00001	0.00001	
BH_3	0.00001	0.00001	0.00001	
SW_1	7.00	23.38	23.00	
SW_2	15.00	33.50	33.50	
SW_3	14.00	25.34	25.34	

Table 7
Effect of water treatment on total suspended solid (TSS) of borehole and surface water total suspend solid (TSS).

Source	RO (T)	UV	Control	WHO
BH_1	0.00001	0.00001	0.00001	$<$5.00 ppm
BH_2	0.0001	0.00001	0.00001	
BH_3	0.0001	0.00001	0.00001	
SW_1	8.50	42.00	45.000	
SW_2	8.25	50.20	47.20	
SW_3	10.50	47.10	38.50	

Table 8
Effect of water treatment on total dissolved solid (TDS) of borehole and surface water.

Sources	RO	UV	Control	WHO
BH_1	0.50	15.00	17.00	00–999 ppm
BH_2	5.00	15.00	20.00	
BH_3	5.00	20.00	25.12	
SW_1	10.00	40.00	500.0	
SW_2	11.00	45.20	800.00	
SW_3	20.00	40.99	459.99	

Table 9
Effect of water treatment on salinity (chloride content) of the borehole and surface water.

Sources	RO	UV	Control	WHO
BH_1	10.00	20.20	39.99	<250 mg/l
BH_2	10.50	22.00	42.01	
BH_3	15.00	22.50	40.02	
SW_1	20.00	15.00	75	
SW_2	19.90	17.00	100	
SW_3	20.00	16.00	50	

Table 10
Effect of water treatment on total hardness of borehole and surface water.

Source	RO	UV	Control	WHO
BH_1	0.09	1.20	2.99	No
BH_2	1.00	1.22	2.89	limit
BH_3	0.98	1.25	2.01	
SW_1	1.00	97.00	207.00	
SW_2	0.01	100.20	220.20	
SW_3	0.05	120.87	198.87	

Table 11
Effect of water treatment on nutrients levels (Nitrate and Sulphate) of borehole and surface water.

Source	RO	UV	Control	WHO-limit
BH_1	0.10	0.11	0.11	<50 mg/l
BH_2	0.10	0.20	0.21	
BH_3	0.12	0.30	0.32	
SW_1	90.00	50.76	150.76	
SW_2	110.00	20.00	200.00	
SW_3	180.00	18.50	190.50	

Table 12
Concentration of sulphate ($SO4^{2-}$) (g/ml) in borehole and surface water samples treated with reverse osmosis (RO (T) and ultra-violet radiation (RO (T) and control.

Source	RO	UV	Control	WHO
BH_1	1.0	1.00	1.00	<500 mg/l
BH_2	1.10	1.10	1.10	
BH_3	2.00	2.12	2.12	
SW_1	50.00	101.01	20.01	
SW_2	45.00	100.00	15.00	
SW_3	22.10	180.90	17.90	

Table 13
Concentration of Sodium (Na^+) ion in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO
BH_1	0.01	0.07	0.07	<200 mg/l
BH_2	0.01	0.08	0.09	
BH_3	0.01	0.07	0.08	
SW_1	35.00	20.05	34.45	
SW_2	37.00	19.00	45.00	
SW_3	30.50	19.99	29.99	

Table 14
Concentration of Magnesium (Mg) (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO
BH_1	0.01	0.04	0.06	<0.5 mg/l
BH_2	0.01	0.45	0.04	
BH_3	0.01	0.50	0.09	
SW_1	24.00	20.09	45.09	
SW_2	35.00	21.15	79.00	
SW_3	40.00	21.55	78.79	

Table 15
Concentration of Potassium (K) ion (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.01	0.80	3.03	<50.0 mg/l
BH_2	0.01	1.00	2.98	
BH_3	0.02	2.00	2.67	
SW_1	29.50	30.00	50.00	
SW_2	30.11	35.00	75.00	
SW_3	32.00	40.00	45.00	

3.1. Effect of RO and UV techniques on concentration of heavy metals of borehole and surface water on Cadmium (Cd), Iron (Fe), Lead (Pb), Arsenic (As) and Chromium (Cr)

Table 16
Concentration of Cadmium (Cd^-) (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.00001	0.00001	0.00001	<0.003 mg/l
BH_2	0.00001	0.00001	0.00001	
BH_3	0.00001	0.00001	0.00001	
SW_1	0.00001	0.09	1.09	
SW_2	0.00001	0.02	12.12	
SW_3	0.00001	0.01	0.99	

Table 17
Concentration of iron (Fe) (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.00001	0.01	0.02	No limit specified
BH_2	0.00001	0.01	0.01	
BH_3	0.00001	0.01	0.02	
SW_1	0.00001	1.20	1.24	
SW_2	0.00001	1.50	1.55	
SW_3	0.00001	1.50	1.56	

Table 18
Concentration of Lead (Pb) (g/ml) in borehole and surface water samples treated with RO (T) and ultra- UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.0001	0.0001	0.0001	<0.01 mg/l
BH_2	0.0001	0.0001	0.0001	
BH_3	0.0001	0.0001	0.0001	
SW_1	1.10	4.20	5.00	
SW_2	1.50	5.10	7.10	
SW_3	0.50	5.40	6.40	

Table 19
Concentration of Arsenic (As) (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.0001	0.0001	0.0001	<0.01 mg/l
BH_2	0.0001	0.0001	0.0001	
BH_3	0.0001	0.0001	0.0001	
SW_1	0.02	0.09	0.9	
SW_2	0.99	1.32	1.32	
SW_3	0.02	0.08	0.08	

Table 20
Concentration of Chromium (Cr) (g/ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.0001	0.001	0.11	0.003 mg/l
BH_2	0.0001	0.001	0.12	
BH_3	0.0001	0.001	0.01	
SW_1	0.01	0.92	0.92	
SW_2	0.01	1.09	1.09	
SW_3	0.09	1.01	1.01	

Table 21
Total Coliform (MPN/100 ml) in borehole and surface water samples treated with RO (T) and UV (T) and CTRL.

Source	RO	UV	Control	WHO-limit
BH_1	0.0001	0.009	1.01	0.005 mg/l
BH_2	0.0001	0.008	0.09	
BH_3	0.0001	0.005	0.05	
SW_1	1.100	2.00	15.00	
SW_2	1.100	2.50	10.00	
SW_3	1.500	5.00	50.00	

3.2. Two-way analysis of variance for RO and UV techniques showing the significance in treating surface water and borehole water

Table 22
Anova of two-factor with replication (pH).

Summary	RO(T)	UV(T)	Control	Total
BH1				
Count	3	3	3	9
Sum	19.55	20.28	18.45	58.28
Average	**6.52**	**6.76**	**6.15**	**6.48**
Variance	0.000833	0.0388	0.0175	0.085003
SD	0.029	0.197	0.132	0.292
SW1				
Count	3	3	3	9
Sum	18.99	19.23	19.83	58.05
Average	6.33	6.41	6.61	6.45
Variance	0.3367	0.2593	0.2833	0.235425
SD	0.580	0.509	0.532	0.485
Total				
Count	6	6	6	
Sum	38.54	39.51	38.28	
Average	6.423333	6.585	6.38	
Variance	0.145467	0.15599	0.1838	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	0.002939	1	0.002939	0.01883	0.89313	4.747225
Trt	0.140078	2	0.070039	0.448759	0.64871	3.885294
Interaction	0.550478	2	0.275239	1.763535	0.213084	3.885294
Within	1.872867	12	0.156072			
Total	2.566361	17				

Table 23
Anova of two-factor with replication temperature.

Summary	RO(T)	UV(T)	Control	Total
BH1				
Count	3	3	3	9
Sum	98	92	94	284
Average	32.67	30.67	31.33	31.56
Variance	0.333333	1.333333	0.333333	1.277778
SD	0.577	1.155	0.577	1.130
SW1				
Count	3	3	3	9
Sum	101.3	95	94.5	290.8
Average	33.77	31.67	31.50	32.31
Variance	2.543333	2.333333	0.75	2.603611
SD	1.595	1.528	0.866	1.614
Total				
Count	6	6	6	
Sum	199.3	187	188.5	
Average	33.21667	31.16667	31.41667	
Variance	1.513667	1.766667	0.441667	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	2.568889	1	2.568889	2.020979	0.180605	4.747225
Trt	15.01	2	7.505	5.904283	0.016394	3.885294
Interaction	0.787778	2	0.393889	0.309878	0.739234	3.885294
Within	15.25333	12	1.271111			
Total	33.62	17				

*Sig at $p < 0.05$.

Table 24
Anova of two-factor with replication for water conductivity.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	121	125	127.2	373.2
Average	**40.33**	**41.67**	**42.40**	**41.47**
Variance	6.3333333	2.3333333	0.28	3.06
SD	2.517	1.528	0.529	1.749
SW1				
Count	3	3	3	9
Sum	1275.2	2104.8	2400	5780
Average	**425.07**	**701.60**	**800.00**	**642.22**
Variance	99,464.013	59,902.41	60,625	83,338.9
SD	315.379	244.750	246.221	288.685
Total				
Count	6	6	6	
Sum	1396.2	2229.8	2527.2	
Average	232.7	371.63333	421.2	
Variance	84,194.06	154,615.5	196,437	

Anova

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Sample	1,624,082.6	1	1,624,083	44.2931	2.34E-05	4.74723
Columns	114,583.15	2	57,291.6	1.56249	0.249412	3.88529
Interaction	112,151.68	2	56,075.8	1.52934	0.256075	3.88529
Within	440,000.74	12	36,666.7			
Total	2,290,818.1	17				

Table 25
Anova: two-factor with replication for turbidity.

Summary	RO	UV	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.00003	0.00003	0.00003	0.00009
Average	**0.00001**	**0.00001**	**0.00001**	**0.00001**
Variance	0	0	0	0
SD	0.000	0.000	0.000	0.000
SW1				
Count	3	3	3	9
Sum	36	82.22	81.84	200.06
Average	**12**	**27.40667**	**27.28**	**22.2289**
Variance	19	28.8069333	30.3852	78.40551
SD	4.359	5.367	5.512	8.855
Total				
Count	6	6	6	
Sum	36.00003	82.22003	81.84003	
Average	6.000005	13.7033383	13.640005	
Variance	50.799928	236.860222	235.413436	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	2223.5538	1	2223.55375	170.6223	1.87E-08	4.747225
trtment	235.42991	2	117.714956	9.032747	0.004043	3.885294
Interaction	235.42991	2	117.714956	9.032747	0.004043	3.885294
Within	156.38427	12	13.0320222			
Total	2850.7978	17				

Table 26
Anova of two-factor with replication for TSS.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.00021	0.00003	0.00003	0.00027
Average	**0.00007**	**0.00001**	**0.00001**	**0.00003**
Variance	2.7E-09	0	0	1.575E-09
SD	0.000	0.000	0.000	0.000
SW1				
Count	3	3	3	9
Sum	27.25	139.3	130.7	297.25
Average	**9.08**	**46.43**	**43.57**	**33.03**
Variance	1.5208333	17.143333	20.4633333	333.82444
SD	1.233	4.140	4.524	18.271
Total				
Count	6	6	6	
Sum	27.25021	139.30003	130.70003	
Average	4.5417017	23.216672	21.7833383	
Variance	25.360035	653.67339	577.601405	

Anova

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Sample	4908.7446	1	4908.74455	752.73062	3.39E-12	4.747225
Columns	1296.166	2	648.082984	99.380178	3.41E-08	3.885294
Interaction	1296.1746	2	648.087294	99.380839	3.41E-08	3.885294
Within	78.255	12	6.52125			
Total	7579.3401	17				

Table 27
Anova of two-factor with replication TDS.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	10.5	50	62.12	122.62
Average	**3.50**	**16.67**	**20.71**	**13.62**
Variance	6.75	8.333333	16.85813	68.70438
SD	2.598	2.887	4.106	8.289
SW1				
Count	3	3	3	9
Sum	41	126.19	1759.99	1927.18
Average	**13.67**	**42.06**	**586.66**	**214.13**
Variance	30.33333	7.624033	34,534.6	86,858.23
SD	5.508	2.761	185.835	294.717
Total				
Count	6	6	6	
Sum	51.5	176.19	1822.11	
Average	8.583333	29.365	303.685	
Variance	45.84167	199.8802	109,912.7	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	180,913.2	1	180,913.2	31.36814	0.000116	4.747225
Columns	325,536.7	2	162,768.3	28.22205	2.9E-05	3.885294
Interaction	300,669.8	2	150,334.9	26.06625	4.29E-05	3.885294
Within	69,209	12	5767.416			
Total	876,328.6	17				

Table 28
Anova of two-factor with replication for the water salinity.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	35.5	64.7	122.02	222.22
Average	11.83	21.57	40.67	24.69
Variance	7.5833333	1.4633333	1.3402333	164.04024
SD	2.754	1.210	1.158	12.808
SW1				
Count	3	3	3	9
Sum	59.9	48	225	332.9
Average	19.97	16.00	75.00	36.99
Variance	0.0033333	1	625	972.17611
SD	0.058	1.000	25.000	31.180
Total				
Count	6	6	6	
Sum	95.4	112.7	347.02	
Average	15.9	18.783333	57.836667	
Variance	22.88	10.281667	604.03211	

Anova

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Sample	680.55902	1	680.55902	6.4164312	0.026271	4.747225
Columns	6584.3209	2	3292.1605	31.039073	1.81E-05	3.885294
Interaction	1232.6294	2	616.31469	5.8107242	0.017189	3.885294
Within	1272.7805	12	106.06504			
Total	9770.2898	17				

Table 29
Anova of two-factor with replication for total hardness.

Summary	RO(T)	UV(T)	Control	Total
BH1				
Count	3	3	3	9
Sum	2.07	3.67	7.89	13.63
Average	0.69	1.22	2.63	1.51
Variance	0.2701	0.0006333	0.2908	0.8937278
SD	0.520	0.025	0.539	0.945
SW1				
Count	3	3	3	9
Sum	1.06	318.07	626.07	945.2
Average	0.35	106.02	208.69	105.02
Variance	0.314033	167.87763	115.8843	8209.864
SD	0.560	12.957	10.765	90.608
Total				
Count	6	6	6	
Sum	3.13	321.74	633.96	
Average	0.521667	53.623333	105.66	
Variance	0.267657	3362.0633	12,784.687	

Anova

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Sample	48,212.37	1	48,212.37	1016.2899	5.73E-13	4.747225
Columns	33,163.34	2	16,581.671	349.53239	2.31E-11	3.885294
Interaction	31,953.45	2	15,976.723	336.78042	2.88E-11	3.885294
Within	569.275	12	47.439583			
Total	113,898.4	17				

Table 30
Anova of two-factor with replication for Nitrate.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.32	0.61	0.64	1.57
Average	**0.11**	**0.20**	**0.21**	**0.17**
Variance	0.0001333	0.009	0.011033	0.00765
SD	0.012	0.095	0.105	0.087
SW1				
Count	3	3	3	9
Sum	380	89.26	541.26	1010.52
Average	**126.67**	**29.75**	**180.42**	**112.28**
Variance	2233.3333	331.5	682.3492	5184.56
SD	47.258	18.208	26.122	72.004
Total				
Count	6	6	6	
Sum	380.32	89.87	541.9	
Average	63.386667	14.98	90.31667	
Variance	5698.5635	394.6	10,015.28	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	56,554.45	1	56,554.45	104.497	2.82E-07	4.747
Columns	17,488.912	2	8744.456	16.1574	0.000394	3.885
Interaction	17,493.168	2	8746.584	16.1613	0.000394	3.885
Within	6494.4505	12	541.2042			
Total	98,030.981	17				

Table 31
Anova of two-factor with replication for Sulphate.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	4.1	4.22	4.22	12.54
Average	1.37	1.41	1.41	1.39
Variance	0.303333	0.3841	0.38413	0.2683
SD	0.551	0.620	0.620	0.518
SW1				
Count	3	3	3	9
Sum	117.1	381.91	52.91	551.92
Average	39.03	127.30	17.64	61.32
Variance	221.3033	2154.7	6.32703	3130.108
SD	14.876	46.419	2.515	55.947
Total				
Count	6	6	6	
Sum	121.2	386.13	57.13	
Average	20.2	64.355	9.52167	
Variance	514.276	5617	81.7083	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	16,162.82	1	16,162.8	40.68833	3.51E-05	4.747225
Columns	10,140.77	2	5070.39	12.7642	0.001069	3.885294
Interaction	10,135.42	2	5067.71	12.75747	0.001071	3.885294
Within	4766.818	12	397.235			
Total	41,205.83	17				

Table 32
Anova of two-factor with replication for Sodium.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.03	0.22	0.24	0.49
Average	0.010	0.073	0.080	0.054
Variance	0	3.33E-05	0.0001	0.001153
SD	0.000	0.006	0.010	0.034
SW1				
Count	3	3	3	9
Sum	102.5	59.04	109.44	270.98
Average	34.167	19.680	36.480	30.109
Variance	11.08333	0.3477	59.4157	79.89356
SD	3.329	0.590	7.708	8.938
Total				
Count	6	6	6	
Sum	102.53	59.26	109.68	
Average	17.08833	9.876667	18.28	
Variance	354.4367	115.4655	421.2543	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	4064.713	1	4064.713	344.2394	3.34E-10	4.747225
Columns	248.0884	2	124.0442	10.50527	0.002308	3.885294
Interaction	249.3755	2	124.6878	10.55977	0.002262	3.885294
Within	141.6937	12	11.80781			
Total	4703.871	17				

Table 33
Anova of two-factor with replication for Magnesium.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.03	0.99	0.19	1.21
Average	0.01	0.33	0.06	0.13
Variance	0	0.0637	0.000633	0.038128
SD	0.000	0.252	0.025	0.195
SW1				
Count	3	3	3	9
Sum	99	62.79	202.88	364.67
Average	33.00	20.93	67.63	40.52
Variance	67	0.5692	380.937	552.7853
SD	8.185	0.754	19.518	23.511
Total				
Count	6	6	6	
Sum	99.03	63.78	203.07	
Average	16.505	10.63	33.845	
Variance	353.302	127.5612	1521.816	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	7339.065	1	7339.065	98.16603	3.96E-07	4.747225
Columns	1748.255	2	874.1275	11.69217	0.001521	3.885294
Interaction	1777.191	2	888.5955	11.8857	0.001425	3.885294
Within	897.1411	12	74.76176			
Total	11,761.65	17				

Table 34
Anova of two-factor with replication for Potassium.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.04	3.8	8.68	12.52
Average	**0.01**	**1.27**	**2.89**	**1.39**
Variance	3.333E-05	0.4133333	0.0380333	1.6767611
SD	0.006	0.643	0.195	1.295
SW1				
Count	3	3	3	9
Sum	91.61	105	170	366.61
Average	**30.54**	**35.00**	**56.67**	**40.73**
Variance	1.6990333	25	258.33333	217.77593
SD	1.303	5.000	16.073	14.757
Total				
Count	6	6	6	
Sum	91.65	108.8	178.68	
Average	15.275	18.133333	29.78	
Variance	280.18179	351.54667	970.81996	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	6965.5405	1	6965.5405	146.39446	4.41E-08	4.747225
Columns	708.41988	2	354.20994	7.444415	0.007901	3.885294
Interaction	476.2341	2	238.11705	5.0044958	0.026272	3.885294
Within	570.96753	12	47.580628			
Total	8721.162	17				

Table 35
Anova of two-factor with replication for Cadmium.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.00003	0.00003	0.00003	0.00009
Average	0.00001	0.00001	0.00001	0.00001
Variance	0	0	0	0
SD	0.000	0.000	0.000	0.000
SW1				
Count	3	3	3	9
Sum	0.00003	0.12	14.2	14.32003
Average	0.00001	0.04000	4.73333	1.59111
Variance	0	0.0019	40.924633	15.785799
SD	0.000	0.044	6.397	3.973
Total				
Count	6	6	6	
Sum	0.00006	0.12003	14.20003	
Average	0.00001	0.020005	2.3666717	
Variance	0	0.0012398	23.091158	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	11.39226	1	11.39226	1.6701527	0.22057	4.747225
Columns	22.216663	2	11.108332	1.6285276	0.236735	3.885294
Interaction	22.216663	2	11.108332	1.6285276	0.236735	3.885294
Within	81.853067	12	6.8210889			
Total	137.67865	17				

Table 36
Anova of two-factor with replication for Iron.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.00003	0.03	0.05	0.08003
Average	0.00001	0.01000	0.01667	0.00889
Variance	0	0	3.333E-05	6.104E-05
SD	0.000	0.000	0.006	0.008
SW1				
Count	3	3	3	9
Sum	0.00003	4.2	4.35	8.55003
Average	0.00001	1.40000	1.45000	0.95000
Variance	0	0.03	0.0331	0.5238929
SD	0.000	0.173	0.182	0.724
Total				
Count	6	6	6	
Sum	0.00006	4.23	4.4	
Average	0.00001	0.705	0.7333333	
Variance	0	0.59163	0.6295867	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	3.98560556	1	3.9856056	378.77983	1.92E-10	4.747225
Columns	2.07115358	2	1.0355768	98.418069	3.6E-08	3.885294
Interaction	1.99421111	2	0.9971056	94.76188	4.46E-08	3.885294
Within	0.12626667	12	0.0105222			
Total	8.17723691	17				

Table 37
Anova of two-factor with replication for Lead.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.0003	0.0003	0.0003	0.0009
Average	0.0001	0.0001	0.0001	0.0001
Variance	0	0	0	2.066E-40
SD	0.000	0.000	0.000	0.000
SW1				
Count	3	3	3	9
Sum	3.1	14.7	18.5	36.3
Average	1.0333	4.9000	6.1667	4.0333
Variance	0.2533333	0.39	1.1433333	5.81
SD	0.503	0.624	1.069	2.410
Total				
Count	6	6	6	
Sum	3.1003	14.7003	18.5003	
Average	0.5167167	2.45005	3.0833833	
Variance	0.4216047	7.358706	11.865297	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	73.20137	1	73.20137	245.8255	2.34E-09	4.747225
Columns	21.453333	2	10.726667	36.022388	8.47E-06	3.885294
Interaction	21.453333	2	10.726667	36.022388	8.47E-06	3.885294
Within	3.5733333	12	0.2977778			
Total	119.68137	17				

Table 38
Anova of two-factor with replication for Arsenic.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.0003	0.0003	0.0003	0.0009
Average	0.0001	0.0001	0.0001	0.0001
Variance	0	0	0	2.07E-40
SD	0.000	0.000	0.000	0.000
SW1				
Count	3	3	3	9
Sum	1.03	1.49	2.3	4.82
Average	0.3433	0.4967	0.7667	0.5356
Variance	0.313633	0.508433	0.397733	0.339403
SD	0.560	0.713	0.631	0.583
Total				
Count	6	6	6	
Sum	1.0303	1.4903	2.3003	
Average	0.171717	0.248383	0.383383	
Variance	0.160796	0.277347	0.335381	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	1.290207	1	1.290207	6.34632	0.026949	4.747225
Columns	0.137811	2	0.068906	0.338935	0.719134	3.885294
Interaction	0.137811	2	0.068906	0.338935	0.719134	3.885294
Within	2.4396	12	0.2033			
Total	4.005429	17				

Table 39
Anova of two-factor with replication for Chromium.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.0003	0.003	0.24	0.2433
Average	0.0001	0.0010	0.0800	0.0270
Variance	0	0	0.0037	0.002503
SD	0.000	0.000	0.061	0.050
SW1				
Count	3	3	3	9
Sum	0.11	3.02	3.02	6.15
Average	0.0367	1.0067	1.0067	0.6833
Variance	0.002133	0.007233	0.007233	0.239375
SD	0.046	0.085	0.085	0.489
Total				
Count	6	6	6	
Sum	0.1103	3.023	3.26	
Average	0.018383	0.503833	0.543333	
Varia,nce	0.001254	0.306303	0.261987	

Anova

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	1.938284	1	1.938284	572.8917	1.7E-11	4.747225
Columns	1.025589	2	0.512794	151.5649	3.05E-09	3.885294
Interaction	0.868837	2	0.434418	128.3995	7.92E-09	3.885294
Within	0.0406	12	0.003383			
Total	3.873309	17				

Table 40
Anova of two-factor with replication for Coliform.

Summary	RO(T)	UV(T)	CTRL	Total
BH1				
Count	3	3	3	9
Sum	0.0003	0.022	1.15	1.1723
Average	0.0001	0.0073	0.3833	0.1303
Variance	0	4.333E-06	0.29493333	0.1097714
SD	0.000	0.002	0.543	0.331
SW1				
Count	3	3	3	9
Sum	3.7	9.5	75	88.2
Average	1.2333	3.1667	25.0000	9.8000
Variance	0.0533333	2.5833333	475	250.07
SD	0.231	1.607	21.794	15.814
Total				
Count	6	6	6	
Sum	3.7003	9.522	76.15	
Average	0.6167167	1.587	12.6916667	
Variance	0.4775927	4.0277512	371.912057	

Anova

Source of variation	SS	df	MS	*F*	*P*-value	*F* crit
Sample	420.76781	1	420.767809	5.2823601	0.040319	4.747225
Columns	540.11898	2	270.059489	3.3903532	0.068048	3.885294
Interaction	505.45598	2	252.727992	3.1727719	0.078326	3.885294
Within	955.86321	12	79.6552674			
Total	2422.206	17				

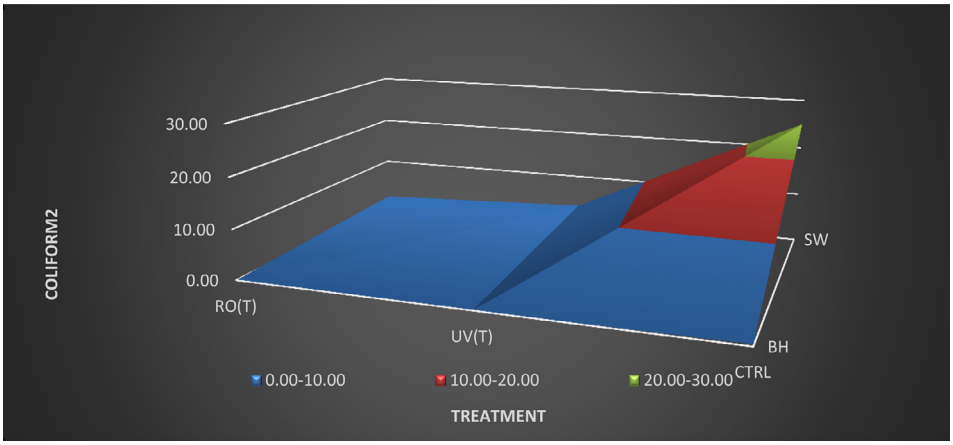

Fig. 2. The surface plot of Total Coliform (MPN/100 ml) in borehole and surface water samples treated with RO (T) and UV (T) and untreated water CTRL.

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