DETERMINATION AND MODELLING OF WATER QUALITY PARAMETER IN ABUJA METROPOLIS.

By

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ABSTRACT:
This research work involves the determination and modelling of water parameter such as pH, Temperature, Turbidity, Chloride, Hardness. The result of the analysis was used as important operating variables to generate a model equation of pH, Hardness, Temperature, Turbidity and Chloride. The values obtained from the model equation were compare with those from experiment. On an average bases the values were close. These parameters can be use to monitor the extent of pollution of pond water and to monitor stress and diseases of fish. The experimental data of pH was in the range of 6.7 to 6.9 while the modelled result was also between 6.7 to 7.0. The turbidity experimental value was close to the modelled value also. The chloride value for the experimental data was in the range of 25.32 to 35.0. The total hardness value ranges between 4.5 to 65.1 mg/l while the modelled result ranges between 11.025 to 68.402 mg/l. the result was within the acceptable limit of world health organization standard on water quality parameter.

INTRODCUTION

Water is one of the indispensable chain links of a national economy and has many uses for man other than that of human consumption. It is necessary for industrial uses, for irrigation in areas of limited or seasonal rainfall, and in the field of hydrology and aquaculture development.

Static water is more characteristic of semi-arid and arid regions, where rates of replenishment and flow components are slow or infrequent, as is fossil water deposit. The dynamic water resource consists of moving water flowing through surface water systems or ground water aquifers. Both of the above type of water resources is conventional (1969) Gadzama *et.al.* 1985).

Because of the essential role played by water in supporting human life, it also has, if contaminated the potential for transmitting a wide variety of disease and illness In the developed world water-related diseases is rare, due to essentially to the presence of efficient water supply and wastewater disposal system.

However, in the developing world perhaps as many as millions of aquatic organism are without safe water supply and adequate sanitation (Bipin, 1991).

As a result, the ball of water related disease in these is is frightening in its extent. A recent WHO Survey has highlighter the following fact (John *et. al.* 19890) each day some 30,000 people suffer from water related disease.

At anyone time there are likely to be 40 million people suffering from Gastroententis, 200 million with Selistosomosis, 160 million with malaria and 30 million with Onchoceriosis. All of these diseases can be water-related although other environmental factors may also be important.

In the developed world there is concern about the possible long-term health hazard which may arise from the presence of trace concentration of impunities in drinking water, particularly the health effect of carcinogenic compounds.

There are also several contaminate, which may be naturally occurring or man-made, having known effects on the health of consumers. It is therefore important that that relationship between water quality and health be fully appreciated by the Engineer and Scientist concerned with water quality control.

MATERIAL AND METHODS.

Material:

Conical flask, burette, pipette, retort stand with clamp, phenolpthaian, indicator methyl orange, disodium ethylenediamine acetic acid (Na_2EDTA), ltd

pH:

pH was determined with the acid of a pH meter using a Jan way electrode and ion selective electrode at a temperature of 25°C. Total hardness = 50ml of water sample each from Gwagawalada, Kuje and Kwali were collected and buffered with 3ml buffer solution to bring the to pH 10 this was followed by addition of Eriochrome black T indicator. The mixture was titrated with EDTA solution until the colour change.

Chloride:

25ml of the water sample was titrated with standard AgN03 solution using $K_2Cr_20_4$ as indicator.

$AgCl \longrightarrow Ag^+ + Cl^-$ In the presence of chloride K2 Cr04 $\rightleftharpoons 2K^+ Cr0_4^{2-}$

The pH of the medium was between 6-8 and the titravalue indicate the level of chloride, which is measured in mg/l.

The temperature was determined with the acid of clinical Thermometer by measuring 50ml of each for the water sample into a beaker and inserting the Thermometer.

The turbidity value

Was determined with the acid of AASS by measuring the light penetrating ability of each for the water samples.

RESULTS.

The experimental result of the water sample obtain from five different locations in F.C.T., namely Gwagwalada, Kuje, Kwali, are presented in the tables below:

Table 1: Experimental result of Gwagwalada water.

S/No.	Temp.(°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)	pH
1	28	14.1	32.7	0	6.8
2	27	4.5	35.5	0	6.8
3	26.5	21.3	31.24	0	6.9
4	26.67	20.2	34.27	0	6.7
5	26	12.93	33.9	0	6.7
6	26.75	12.4	32.9	0	6.8
7	26.88	7.14	32.7	0	6.8
8	27.14	12.93	40.2	0	6.8
9	28.67	12.00	30.96	1	6.8
10	28.25	11.24	28.35	0.8	6.9

Table 2: Experimental result of Kuje water.

S/No.	Temp.(°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)	pH
1	26.5	31.4	35.5	0	6.9
2	26.7	37.5	34.45	0	6.8
3	26.2	43.3	28.03	0	6.9
4	26.5	41	32.16	0	6.8
5	26.5	44.5	34.82	0	6.8
6	25.9	32.4	32.26	1	6.8
7	26	50.4	35.5	0	6.7
8	25.3	50.3	39.67	1	6.8
9	24.8	52	28.72	1	6.8
10	25.5	49.3	27.46	2	6.9

Table 3: Experimental result of Kwali water.

S/No.	Temp.(°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)	pH
1	27.5	28.9	32.7	0	6.9
2	27.2	38.8	31.2	1	6.8
3	26.67	43.67	26.65	0	6.9
4	25.33	41	31.03	2	6.8
5	25.5	47.5	34.36	5	6.8
6	25.88	30.9	32.98	1	7
7	26.13	50.5	32.7	1.5	7
8	26.15	35.3	37.82	1.5	7
9	27.8	52.7	29.65	2.1	6.9
10	27.85	52.8	25.33	1.4	6.9

Table 4: Simulated result of Kwali water.

S/No.	Temp (°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)	pH
1	27.06724	12.75070	33.24517	0.47221	0.47221
2	27.09820	12.67204	35.22655	0.22117	0.22117
3	27.33104	14.72105	31.88539	0.17384	0.17384
4	26.52748	13.92418	35.28769	0.10247	0.10247
5	36.71175	26.61639	14.29137	-1.69277	-1.69277
6	27.64292	12.04257	32.52172	0.16749	0.16749
7	27.20829	14.16578	35.02748	0.30106	0.30106
8	34.13285	26.65275	10.24231	-4.84513	-4.84573
9	27.82280	11.02596	30.88693	0.71532	0.71532
10	28.19283	12.90449	30.16402	0.71169	0.71169

Table 5: Simulated result of Kuje water.

S/No.	Temp.(°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)
1	26.59743	30.88963	33.70734	0.26211
2	26.34387	38.74398	34.89219	-0.15541
3	26.51312	44.90651	29.85932	0.61172
4	33.82197	26.32062	43.36654	0.4863
5	26.21557	38.69718	32.64161	-0.11256
6	25.77417	42.70484	36.04331	0.71351
7	34.27943	25.93557	45.62415	0.01824
8	25.68713	31.50541	37.08197	0.98779
9	25.48868	52.23377	30.03907	1.481376
10	25.02507	43.42802	26.20251	1.14437

Table 6: Simulated result of Kwali water.

S/No.	Temp.(°C)	Hardness (mg/l)	Chloride (mg/l)	Turbidity (NTU)	pH
1	32.32495	26.62961	33.14475	-0.05561	6.91219
2	26.85901	36.55438	29.25912	1.621421	6.89638
3	27.46240	42.29316	27.8537	0.51135	6.90943
4	26.52522	39.08997	30.95647	2.51272	6.86973
5	25.42085	50.30545	35.05062	4.02248	6.79742
6	36.11588	26.09932	39.61532	0.06142	6.88991
7	26.78634	43.34983	30.96786	2.20564	6.98857
8	26.04942	34.38461	35.09247	1.88956	6.99368
9	26.87777	50.77989	29.13838	1.89217	6.89145
10	27.30044	54.55233	27.66152	0.83828	6.85123

Modelling for pH

$PH = aTbC+dF+et$ (1)

Where a, b, d, and e are constants, using linear regression analysis of least square method (Strand, 1981).

The variables are

T = Temperature

C = Hardness

F = chloride

T = turbidity

From equation (1)

$(pH-aT-bc-dF-et)^2 - 0$

$(pH)^2 - aTpH-bCpH-dFpH-etpH-aTpH+a^2+T^2+TC+ad\ FT+aeTt-bcpH\ +abCT+b^2C^2+bdCF+beCt-dF\ pH+adFT+bdCF+d2F2+deft-etpH+aeTt+beCt+deft+e2t2 = 0$

$(pH)^2-2aTpH-2bCpH-2dFpH-2etpH+2abCT+2adFT+2aeTt+ebdCF+2beCt^2deFt+a^2T^2+b^2C^2+d^2F^2+e^2 = 0$ – (2)

Differentiating the equation (2) partially with respect to the constant a

$$2pH\ \frac{\delta pH}{\delta a} - 2T\left(a\frac{\delta pH}{\delta a}+pH\right)-2bC\ \frac{\delta pH}{\delta a} - 2dFpH\ -$$

$$2et\frac{\delta pH}{\delta a}+2bcT+2dFT+2eTt+0+0+0+2aT^2+0+0+0 = 0$$

putting $\frac{\delta PH}{}$ = 0, we have

$$\frac{\delta a}{} - 2TpH+2bCT+2dFT+2eTt+2aT^2 = 0$$

$TpH-bCT-dFT-eTt-aT^2$

$\therefore \Sigma TpH-b\Sigma CT-d\Sigma FT-EeFt-e\Sigma Tt-a\Sigma T^2 = 0$ -(3)

Second with respect to constant b:

$$2pH\frac{\delta pH}{\delta b} - 2aT\frac{\delta pH}{\delta b} - 2c(b\frac{\delta pH}{\delta b}+pH) - 2dF\frac{\delta pH}{\delta P} - 2et$$

$$-\frac{\delta pH}{\delta b} = 2aCT+0+0+2dCF+2ect+0+02bc^2+0+0+ = 0$$

putting $\frac{\delta pH}{\delta b} = 0$, we have,

$-2 cpH+2aCT+2dCF+2ect+2bc^2 = 0$

$CpH - aCT -dCT-dCF-ect-bc^2 = 0$

$\therefore \Sigma CpH-a\Sigma CT-d\Sigma CF-e\Sigma Ct-b\Sigma C^2 = 0$ --- (4)

Third with respect to constant d:

$$2pH\frac{\delta pH}{\delta d} - 2aT\frac{\delta pH}{\delta d} - 2bC\frac{\delta pH}{\delta d} - 2F(d\frac{\delta pH}{\delta d}+pH)$$

$$-2et\frac{\delta pH}{\delta d} + 0 + 2a FT+0+2bCF+02eFt+0+2dF^2+0$$

putting $\frac{\delta pH}{\delta d} = 0$, we have

$-2FpH+2aFT+2bcFt2eFt+2dF^2 = 0$

$Fph-aFT-bcF-eFt-dF^2 = 0$

$\Sigma FpH-a\Sigma FT-b\Sigma cF-e\Sigma Ft-d\Sigma F^2 = 0$ --- (5)

Fourth with respect to constant e:

$$2pH-\frac{\delta pH}{\delta e} - 2aT\frac{\delta pH}{\delta e} - 2bc\frac{\delta pH}{\delta e} - 2dF\delta pH - 2t(e\frac{\delta pH}{\delta e}+pH)+0$$

$+0+2aTt+0+2bct+2dFt+0+0+0+2et^2 = 0$

$0+0+0+02et^2 = 0$

putting $\frac{\delta pH}{\delta e} = 0$, we have

$-2tpH+2aTt+2bct+2dFt+2et^2 = 0$

$tpH-aTt-bct-dFt-et^2 = 0$

$\Sigma tpH-a\Sigma Tt-b\Sigma Ct-d\Sigma Ft-e\Sigma t^2 = 0$ --- (6) (Lugben 1985).

Using polymath software package, the equation was resolved into matrix form so as to obtain the model result for each of the parameter.

DISCUSSION

From table 1 the values of pH for Experiment. Value was in the range of 6.7 to 6.9, the simulated and experimental data is close. The turbidity value of Gwagwalada water from experimental data is also very close to that of the modelled result, the second and fifth value for the modelled result is negative which indicates that the turbidity value is negligible.

The chloride value of Gwagwalada water in the experimental result and modelled result were also reasonably close except for the seventh data which gives 45.62415 the large difference in this value might be due to operational error in the determination. The experimental and modelled result for the temperature data was also reasonably close and variance between modelled and experimental data ranges between 30.3 to 52.0 while the modelled data ranges between 25.93557 to 52.23377. The large difference between the both value for the

experimental and simulated result for chloride was as a result of variation in the concentration of residual chlorine in the water (Bipin 1991).

From Table 2 and table 6 the value of pH for the experimental and simulated data for Kuje town was reasonably close. For the experimental data the pH ranges between 6.8 to 7.0 while for modelled result it ranges between 6.85 to 6.99367. The difference in the value is in minimal range. The turbidity value for the experimental data was 0 while simulated value gave a negative value, which indicates that the turbidity is negligible in the modelled result. The chloride value for the experimental data and modelled result are also very close except for the both data, which gives 39.61535, this value might be as a result of error in the determination of the chloride concentration this might be cause by the presence of free chlorine in the water (Metcalf, 1975).

The temperature for the experimental data from table 3 of Kwali town and modelled result was also very close with little variation. The variation is in the range of 0.02 to 0.04; this gives a reasonable result for the model. The value of hardness from the experiential data also correlate with that of modelled result except for the slight variation in the eight and tenth data, fluctuation in the concentration of mg^{2+} and Ca^{2+} is likely to be responsible for this (Metcalf 1975).

CONCLUSION

This research work which is based on the determination and modelling of water quality parameter i.e. pH, Chloride, Turbidity, Hardness, and Temperature, gives an insight into the relationship between experimental data and the equation used in verifying the performance of the data.

It can be concluded that the modelled equation can serve as a good tool in determination of pH, Chloride, Turbidity, Hardness and Temperature of the water in a given period of time.

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