RELIEVE AND REMOVE RADON-222 RESULTING THE DECAY OF THE DEPLETED URANIUM-238 FROM WELLS OF BABYLON INSTITUTE DRILLED BY KERBALA FOUNDATION OF GROUND WATER COMPANY

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ABSTRACT

Radon gas is unstable, it releases energy by emitting alpha particles, and is soluble in water and is often found in the ground water. Decays of radon emits alpha particles and beta particles. The energy released from these decay products results in damage to biological tissues which may lead to cancer. The health consequences of radon are well documented. Measurements of natural radioactivity in soil and ground water have been studied. Radionuclides present in soil include Ra^{226} , Th^{232} , and K^{40}. Gamma rays dose depends on the geological and geographical and appears in many levels in soils , the knowledge of gamma distribution in soils and well water play important role for protection against radiation. Drilling company drills 4 wells in Babylon Institute. Doses, statistical information's about these wells are studied, also contours between real and estimated values are drawn. Testes are done in Babylon Environmental Office

الخلاصة

غاز الرادون هو غاز غير مستقر حيث يحرر الطاقة على شكل دقائق الفا وهو يذوب فى الماء وكذلك يتواجد فى المياه الجوفية. ان انحلال غاز الرادون يؤدى الى انبعاث دقائق الفا وكذلك بيتا. ان منتج الطاقة المتحررة يعمل على تدمير بيولوجية الانسجة للكائن الحى وبالتالى يؤدى الى الاصابة بمرض السرطان. ان العواقب الصحية الخطيرة للرادون موثقة توثيقا جيدا. لقد تم دراسة النشاط الاشعاعى للرادون فى التربة والمياه الجوفية. النويدات المشعة الموجودة فى التربة هى (Ra^{226} , Th^{232} , and K^{4}). ان تركيز اشعة كاما يعتمد على مجموعة من العوامل الجيولوجية والجغرافية وممكن ان يظهر هذا التركيز فى مستويات الاعماق المختلفة للتربة. ان النظام المعرفى لتوزيع اشعة كاما فى التربة ومياه الابار يساعد على الحماية من مخاطر هذا الاشعاع. لقد تم حفر 4 ابار من قبل شركة حفر متخصصة فى المعهد التقنى بابل. لقد تم دراسة تراكيز اشعة كاما والبيانات الاحصائية لهذة الابار. لقد تم رسم ملامح هذة التراكيز والمقارنة بين القيم الحقيقية والمقدرة. لقد تم القياس والتحليل فى دائرة بيئة بابل باشراف فريق بيئى متخصص.

Key words: Wells, Statistical values, Radiation, Dose, Gamma ray

1. INTRODUCTION

Uranium and other underground miners were subject to elevated cancer risks, due to exposure to high concentrations in air of the radioactive decay products of the natural radioactive gas radon.

Radon is a naturally occurring radioactive noble gas which exists in several isotopic forms **[Nero.1989]**. Only two of these isotopes occur in significant concentration in the general environment; radon-222 a member of the radioactive decay chain of uranium-238, and radon-220 is a member of the decay chain of thorium-232 .Radon is the first and only gaseous and inert element of the radioactive chains, so that it can easily leave the place of production like ,soil, rock and building material which enter the indoor air. Contribution is made by thoron (half life is 55 seconds) which is small when compared with the radon (half life is 3.82 days). The main source of indoor radon is its immediate parent radium-226 in the ground of the site and in the building materials **[CastrBn, Winqist, and Miikelainen, 1985]**. In most situations it appears that elevated indoor radon levels originate from radon in the underlying rocks and soils. This radon may enter living spaces in dwellings by diffusion or pressure driven flow if suitable pathways between the soil and living spaces are present. It should be noted, however, that in a minority of cases elevated indoor radon levels may arise due to the use of building materials containing high levels of radium-226. For those who live close to the ground, the radium concentration in soil usually lies in the range 10 Bq/kg to 50 Bq/kg, but it can reach values of hundreds Bq/kg, with an estimated average of 40 Bq/kg. Typical radon concentrations in soil gas range from 10000 Bq/m^3 to 50000 Bq/m3 **[CastrBn, 1993]**. The potential for radon entry from the ground depends mainly on the activity level of radium-226 in the subsoil and its permeability with regard to air flow. The ground could also be contaminated with waste tailings from uranium or phosphate mining operations with enhanced activity levels. Under pressure occurs in most houses if either the adjustment of inlet and outlet of air in forced ventilation systems or the outdoor air supply for vented combustion appliances is inappropriate. The under pressure may be considerable for all types of ventilation systems when the inlet air is restricted too much **[CastrBn and Finnish1993]**. In wells drilled in rock the radon concentration of the water may be high, when such water is used in the household, radon will be partially released into the indoor air, causing an increase in the average radon concentration. Radon concentrations in tap-water from deep wells can range from 100 kBq/m3 to 100 MBq/m3. The indoor radon concentration in these regions may already be high due to high rates of radon entry from the ground. The world average radon concentration in all types of water supplies is assumed to be 10 kBq/m3. The main sources of indoor radon are; soil and water from deep wells. Experimental work carried out and show that radon from soil represents generally the most important source of indoor radon **[Asikainen and Kahlos 1980]**, **[Bruno1983]**, **[Damkjaer, and Korsbech1985]**, and **[Nazaroff 1987]**. The actions to reduce indoor radon concentration are mainly oriented to limit the ingress of radon from soil.

When we use water radon is released into the air, we use a dishwasher, washing machine, or take a shower or bath the radon in the water raises the level of radon in the air. The two processes methods used to capture radon atoms are; Aeration and Gac tank processes.

2. EXPERIMENTAL WORK

Radon is responsible for most of the mean public exposure to ionizing radiation **[Wang, Setlow, Berwick, Polsky, Marghoob, and Kopf 2001]** and**[Toxological 1990]**. Its concentration is variable according to location and it is often the single biggest contributor to the amount of background radiation an individual receives. Radon gas from natural sources **[A Citizen's2007]** and **[Font2009]** can accumulate in buildings, especially in confined areas such as basements. No one can avoid the exposure to radon even though this may potentially cause damage. Breathing high concentrations of radon can cause lung cancer and could even be the second most frequent cause of lung cancer according to the United States Environmental Protection Agency **[A Citizen's2007]**. There are such techniques used to measure dose. Alpha guard technique is one of radon measurements. Radon detector is based on a design optimized pulse ionization chamber. The signals are transmitted to an electronic network for further digital processing. Radon monitor is a compact portable measuring system and can be completed by further external sensors for pressure and temperature. The systematic design to less the radon dose from groundwater out of wells to supply people with clean and pure water with no radioactive particles is shown in Figure 1. Figs (2-7) show processes of drilling wells (1-4).

3. RESULTS AND DISCUSSION

3.1 Chemical Testes for Wells of Babylon Institute Site

Results showed that wells 1, 3, and 4 had given the worst values for each chemical variables listed in **(Table 1)**, while we note through **(Figure 8)** that well No2 has given acceptance values for all variables. These variables are associated to assess the validity of well water for drinking or other purposes.

3.2 Testes of Radon for Soil and Water Wells of Babylon Institute Site

Iraq's future will see the adoption of the majority of the population of Iraq on groundwater for lack of water reaching the river, so we must maintained these waters from radioactive contamination and other pollutions like radon gas because the area in question are contaminated with depleted uranium-238. Foundation is digging a four wells up to a depth of 10 m. Conducting tests of soil has been done by using sensitive devices to gas where the screening process can take up to 45 minutes. After the end of each test data are stored and transferred to computer to analyze the results to compare them to get the perfect location to invest and continue work. There are different techniques for radon measurements, the liquid scintillation technique has been used to determine radon dose in groundwater. It is important that the reasons urged for this research is the proliferation of cancer diseases significantly in the areas of pollution that have been selected.

A number of wells are drilled in these sites to make sure that the groundwater is valid for drinking and irrigation operations and free from radioactive contamination. Wells are drilled to maximum depth of 10 m. From several tests, we see that the high dose is at the maximum depth as shown in **(Tables 2 to7)** and **(Figures 9 to 14)** , this means that the dose is proportional directly to the depth. We see that the humidity of air inside well is the most influential physical variable affected on the dose in the remote depths. We conclude that the dose is directly proportional to the humidity of air which increases the risk of this gas. This gas causes lung cancer which is the most common among the population, while the relationship between pressure inside well and depth, this relationship is reversible. Technical Institute site soil test results show that the critical time of maximum dose is at 15-19 minutes, while the less dose value is at 1-6 minutes. Figures **(15 to 20**) show that the standard deviation of well No2 is high enough in case of soil or water testes, this mean that this well is Ok to use, others show

according to real values, we can see for soil test that the contour of **(Figures 21 and 22)** show high error rate between real and estimated values of radon concentration in wells No 2 and 3. Also ground water test contour show there is high rate errors in wells No2 and 3. This error causes as a result of variation of depleted uranium concentration at the moment.

Outdoor air usually acts as a diluting factor, due to its normally low radon concentration, but in some cases, as in high rise apartments built with materials having very low radium content, it can act as a real source. The radon concentration in outdoor air is mainly related to atmospheric pressure.

Alpha guard radon monitor was used as an important technique to measure radon concentration in ground water, temperature, pressure, and humidity of Babylon Institute wells . Such short term measurements are commonly carried out to provide both cost and rapid results .It was found that the radon concentration with maximum value, while temperature with low limits. The humidity measure values with high levels .Each test need 35 minutes to collect data .The number of data taken during operation is 35 value for each variable studied.

Varying proportion. **(Figures 21 to 26)** show the error in estimating radon concentration

4. Conclusion

Radium, radon and uranium are grouped together because they are radionuclides, unstable elements that emit ionizing radiation. Ionizing radiation can cause toxicity when the particles pass into or through the body at high speed. If a collision occurs with the molecules of living cells, they may be damaged. These particular radionuclides emit radioactivity primarily in the form of alpha particles. Alpha radiation cannot pass through the dead outer layers of the skin. Therefore, these substances are a health risk only if taken into the body by ingestion or inhalation. Radium has been used as a source of radiation to treat certain cancers. Radon gas can be found in the soil because of decay from the parent element uranium. Radon can also migrate from soil into groundwater, which can become another route of exposure if the groundwater is used as a water supply source. Radionuclides are undetectable by the human senses, so only analytical testing can determine if they are present in water. Because they are associated with rock, wells drilled into bedrock are more likely to contain elevated levels of radionuclides than shallow or dug wells**.**

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Table. 1: Chemical results of wells No (1-4) for Babylon Institute site-Hilla

Well No	PH	E.C	T.D.S	NO3	PO4	SO4
1	6.4	29530	23624	1.37	0.24	7700
2	6.7	20670	15502.5	1.58	0.22	5700
3	7.02	28500	22515	2.03	0.25	7350
4	6.8	28800	22752	1.46	0.20	7150

Time (min)	Rn222(kB/m3)	Rn222+error in Bq(bq/m3)	Temperature (C^o)	Air pressure (mbar)	Humidity %
1	0.00013	30.00	18.8	1018	**29.6**
2	0.00013	3.00	18.4	1018	**29.9**
3	0.02638	41.00	18.5	1018	**29.1**
4	0.00013	3.00	19.1	1018	**29.6**
5	0.02350	35.00	19.6	1018	**29.8**
6	0.02238	40.00	19.5	1018	**29.1**
7	0.11100	105.50	19.8	1018	**29.0**
8	0.21600	163.00	20.4	1018	**28.0**
9	0.34800	208.00	20.3	1018	**28.6**
10	0.05325	71.50	19.6	1018	**27.4**
11	0.29400	194.00	19.4	1018	**28.0**
12	0.24100	197.00	20.3	1018	**29.1**
13	0.37800	222.00	20.8	1018	**28.0**
14	0.50800	258.00	20.6	1018	**27.5**
15	0.52800	244.00	20.6	1018	**27.0**
16	0.58400	280.00	20.6	1018	**26.9**
17	0.86000	340.00	20.9	1018	**27.0**
18	1.08800	388.00	21.6	1018	**26.9**
19	0.91600	360.00	21.6	1018	**26.4**
20	0.89600	360.00	22.0	1018	**28.0**
21	**0.63600**	**310.00**	**21.8**	**1018**	**26.4**

Table. 3: Soil test of well No. 2 for Babylon Institute site

Time (min)	**Rn222(kB /m3)**	**Rn222+error in Bq(Bq/m3)**	**Temperature (C^o)**	**Air pressure (mbar)**	**Humidity %**
1	176.00	133.00	20.8	1018	**24.8**
2	7.06	180.00	21.4	1018	**25.9**
3	95.50	193.00	21.6	1018	**24.8**
4	134.00	222.00	21.3	1018	**25.3**
5	5.81	163.00	21.1	1018	**24.8**
6	2.19	71.00	21.6	1018	**24.1**
7	1.02	40.75	21.9	1018	**24.1**
8	120.50	208.00	22.0	1018	**24.1**
9	3.42	105.00	21.9	1018	**24.1**
10	5.84	163.00	21.6	1018	**24.3**
11	2.22	71.50	22.1	1018	**24.1**
12	62.25	169.00	22.6	1018	**23.8**
13	3.45	105.50	22.8	1018	**23.6**
14	49.50	179.00	22.4	1018	**23.6**
15	233.00	234.00	22.0	1018	**23.1**
16	42.00	179.00	21.9	1018	**23.1**
17	2.22	71.50	22.1	1018	**23.3**
18	7.03	163.00	22.6	1018	**23.8**
19	6.56	163.00	22.9	1017	**23.6**
20	4.66	142.00	22.9	1017	**23.6**
21	**3.42**	**105.00**	**22.9**	**1017**	**23.1**

Table. 4: Soil test of well No. for Babylon Institute site

Time (min)	Rn222(kB /m3)	Rn222+error in Bq(Bq/m3)	Temperature (C^o)	Air pressure (mbar)	Humidity %
1	0.01663	0.08100	21.1	1017	**24.1**
2	0.00227	0.07150	21.5	1017	**24.1**
3	27.39200	3.79200	22.0	1017	**23.1**
4	57.08800	2.73600	22.1	1017	**23.3**
5	60.41600	1.90400	22.1	1017	**23.0**
6	56.32000	1.81600	21.8	1017	**22.5**
7	49.40800	2.68800	21.5	1017	**22.6**
8	53.76000	1.81600	21.6	1017	**23.1**
9	55.29600	1.53600	21.8	1017	**23.1**
10	59.13600	2.04800	21.6	1017	**23.1**
11	63.48800	2.17600	21.5	1017	**23.1**
12	48.64000	2.49600	21.5	1017	**22.4**
13	33.79200	3.52000	21.4	1017	**22.0**
14	16.76800	3.48800	21.4	1017	**22.0**
15	7.55200	3.00800	21.3	1017	**22.5**
16	3.74400	2.27200	21.3	1017	**22.0**
17	2.32000	1.96800	21.1	1017	**22.5**
18	3.28000	1.86400	21.5	1017	**22.0**
19	3.24800	1.90400	21.9	1017	**21.8**
20	1.93600	1.36000	22.4	1017	**21.6**
21	**5.18400**	**1.93600**	**22.5**	**1017**	**21.4**

Table. 5: Water test of well No. 1 for Babylon Institute site

Time (min)	Rn222(kB/m3)	Rn222+error in Bq(Bq/m3)	Temperature (C^o)	Air pressure (mbar)	Humidity %
1	9.50	30.00	17.3	1020	**27.5**
2	10.55	42.25	17.4	1020	**28.0**
3	262.00	208.00	17.5	1020	**26.9**
4	17.00	71.50	17.5	1020	**26.9**
5	9.50	41.00	17.5	1020	**26.5**
6	16.75	60.25	17.5	1020	**26.9**
7	42.00	105.50	17.5	1020	**26.9**
8	10.25	41.00	17.5	1020	**26.9**
9	21.50	72.00	17.5	1020	**26.9**
10	22.00	72.00	17.6	1020	**26.9**
11	80.50	142.00	17.6	1020	**26.9**
12	44.25	105.50	17.6	1020	**26.9**
13	124.50	163.00	17.6	1020	**26.9**
14	42.50	105.50	17.6	1020	**26.5**
15	167.00	179.00	17.8	1020	**26.4**

16	181.00	170.00	17.8	1020	**26.4**
17	38.50	105.50	17.8	1020	**26.9**
18	39.25	105.00	17.8	1020	**26.9**
19	258.00	208.00	17.9	1020	**26.9**
20	16.75	71.00	17.9	1020	**26.9**
21	**350.00**	**234.00**	**17.9**	**1020**	**27.5**
Time (min)	**Rn222(kB/m3)**	**Rn222+error in Bq(Bq/m3)**	**Temperature (C^o)**	**Air pressure (mbar)**	**Humidity %**

Table. 6: Water test of well No. 2 for Babylon Institute site

1	0.07050	0.41800	23.5	1017	**17.6**
2	0.08750	0.77600	23.5	1017	**17.6**
3	22.40000	3.45600	23.6	1017	**17.6**
4	37.63200	3.58400	23.6	1017	**17.6**
5	43.77600	3.15200	23.4	1017	**18.1**
6	42.24000	3.28000	22.9	1017	**18.1**
7	37.37600	3.24800	23.3	1017	**18.6**
8	41.72800	3.26400	23.8	1017	**18.9**
9	46.33600	2.43200	24.0	1017	**19.3**
10	37.12000	3.58400	23.9	1017	**19.8**
11	37.12000	3.29600	23.9	1017	**19.3**
12	38.65600	3.08800	24.1	1017	**18.6**
13	22.78400	3.53600	24.8	1017	**18.6**
14	13..05600	3.04000	25.1	1017	**18.6**
15	7.90400	2.84800	25.4	1017	**18.1**
16	7.77600	2.89600	25.3	1016	**17.6**
17	3.76000	2.41600	25.0	1016	**17.6**
18	4.16000	2.33600	24.8	1016	**17.0**
19	4.04800	2.09600	25.5	1016	**17.6**
20	5.08800	2.19200	25.5	1016	**17.6**
21	**4.51200**	**2.22400**	**26.0**	**1016**	**17.0**

Table. 7: Water test of well No. 3 for Babylon Institute site

Time (min)	Rn222(kB/m3)	Rn222+error in Bq(Bq/m3)	Temperature (C^o)	Air pressure (mbar)	Humidity %
1	38.75	66.00	19.6	1019	**28.5**
2	10.00	41.25	19.6	1019	**28.5**
3	21.38	72.00	19.8	1019	**28.0**
4	45.25	105.50	19.6	1019	**28.5**
5	80.00	142.00	19.6	1019	**28.5**
6	37.50	88.00	19.6	1019	**28.6**
7	11.00	41.00	19.6	1019	**28.5**
8	0.13	3.00	19.8	1019	**28.1**
9	51.25	105.50	19.6	1019	**28.3**
10	25.63	72.00	19.8	1019	**28.6**
11	0.13	3.00	19.6	1019	**28.6**
12	27.88	72.00	19.8	1019	**28.0**
13	13.13	41.00	19.8	1019	**28.0**
14	29.00	72.00	19.8	1019	**28.0**
15	48.25	88.00	19.8	1019	**28.0**
16	0.13	3.00	19.8	1019	**28.0**
17	30.38	72.00	19.8	1019	**28.0**
18	143.00	163.00	19.8	1019	**28.0**
19	28.63	72.00	19.8	1019	**27.5**
20	12.94	40.50	19.8	1019	**27.5**
21	**13.94**	**41.00**	**19.9**	**1019**	**28.0**

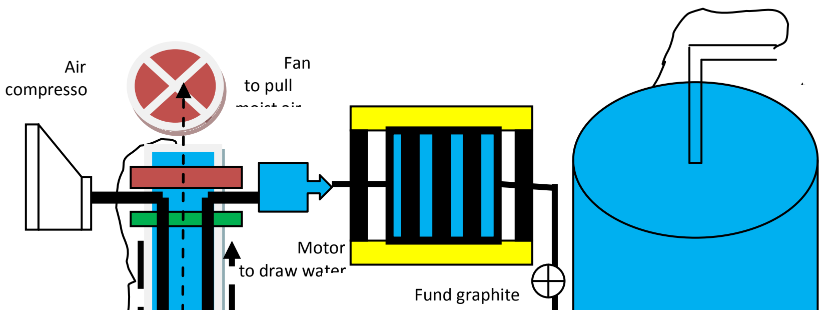


Figure. 1 Systematic design to less radon dose

Figure. 2 Soil and ground water radon test for well No 1.

Figure. 3 Soil and ground water radon test for well No 2.

Figure. 4 Soil and ground water radon test for well No 3.

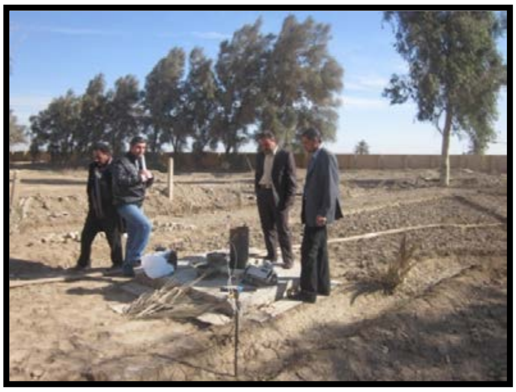


Figure. 5 Soil and ground water radon test for well No 4.

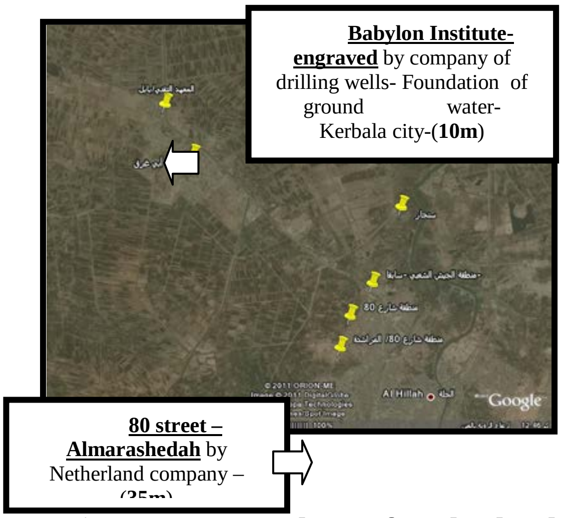
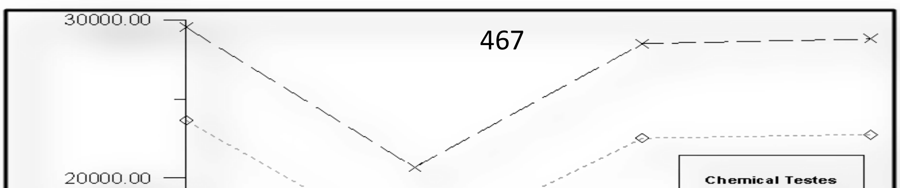


Figure. 6 Space photo of Netherland and foundation of ground water companies

Figure. 7 Soil and ground water radon test for 80 street-Almarashedah



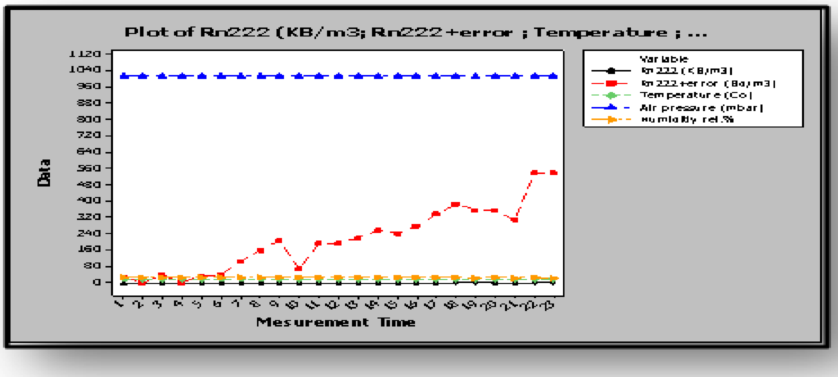


Figure. 9 Plot of well soil No1

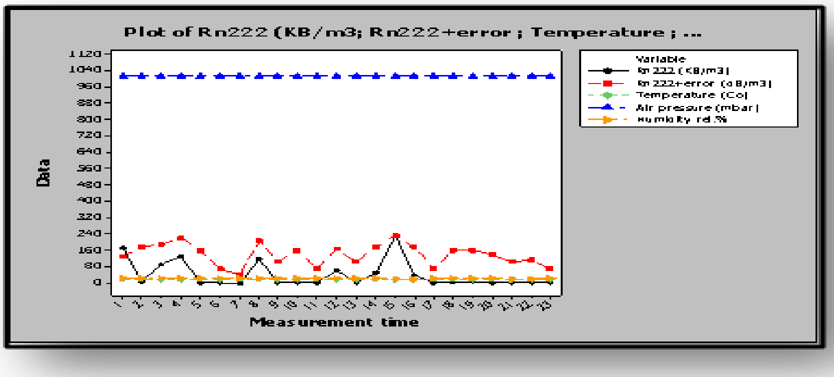


Figure. 10 Plot of well soil
No2

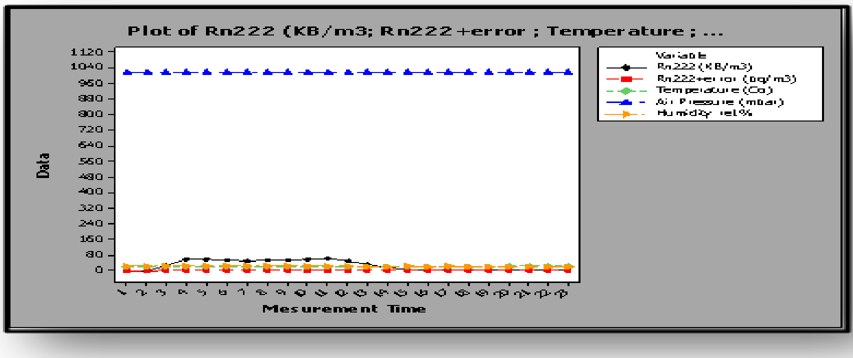


Figure. 11 Plot of well soil No3

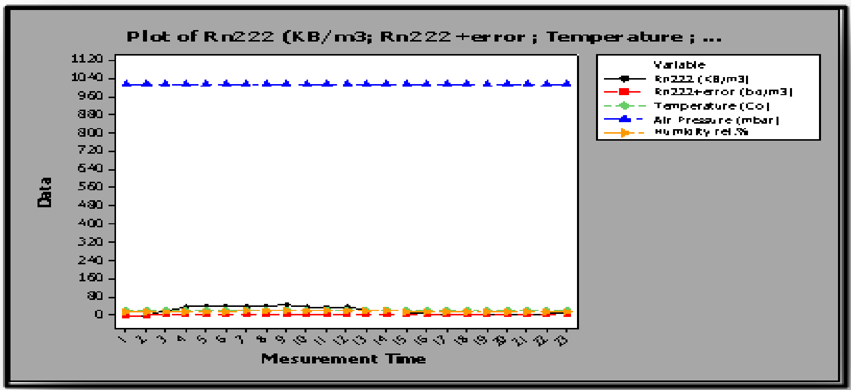


Figure. 12 Plot of well water

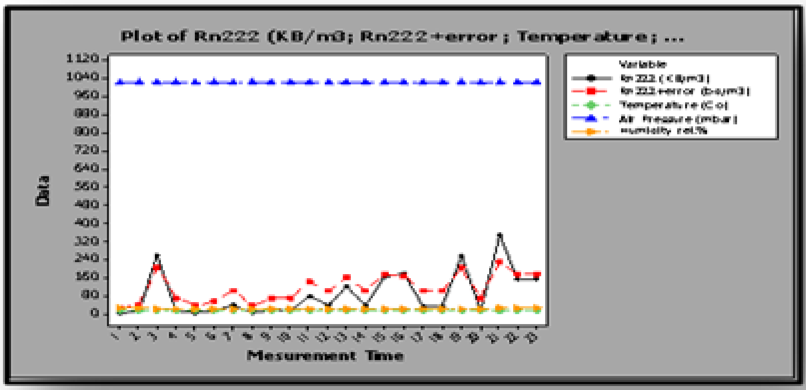


Figure. 13 Plot of well water No2

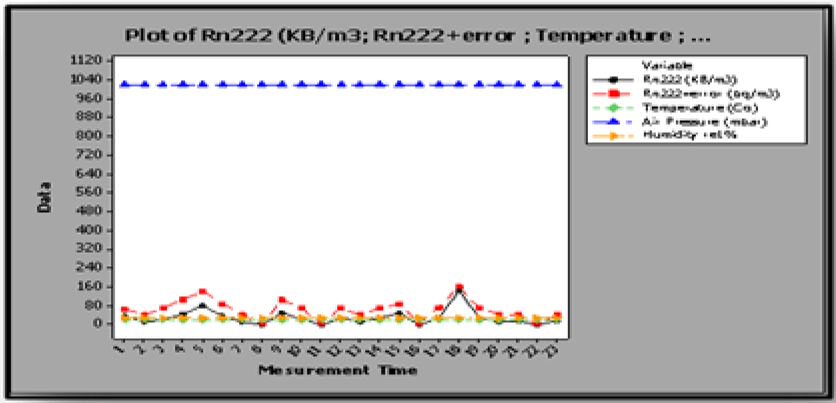


Figure. 14 Plot of well water No3

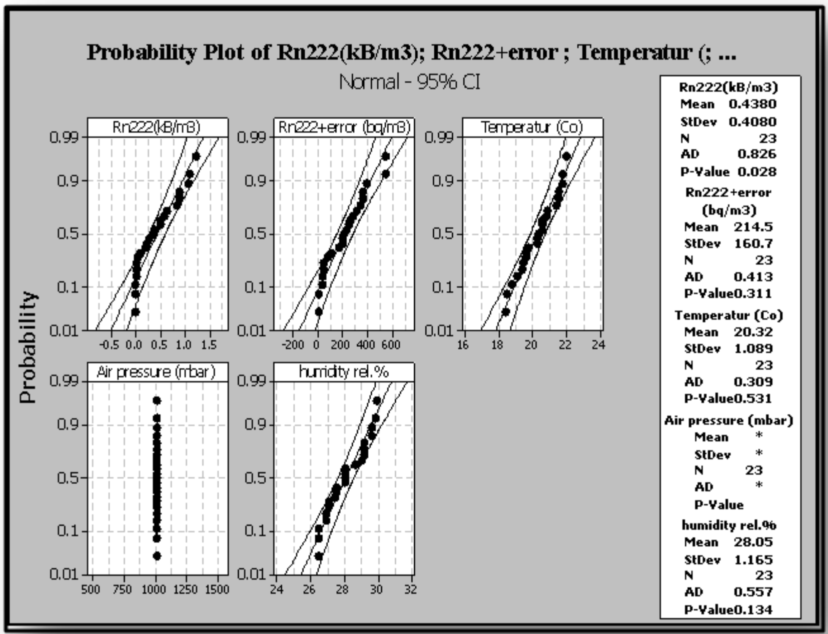
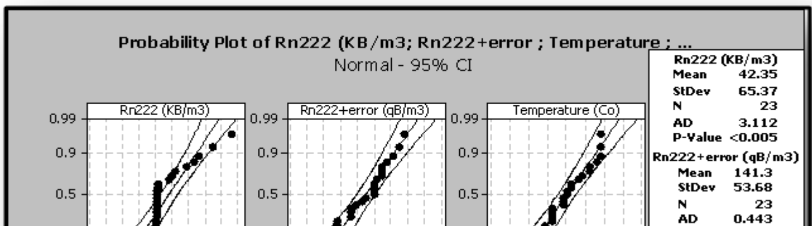


Figure. 15 Probability plot for well soil No1



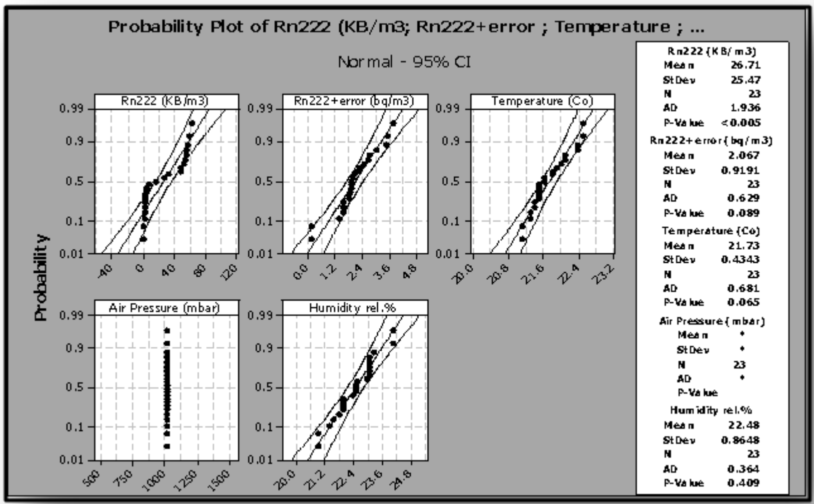


Figure. 17 Probability plot for well soil No3

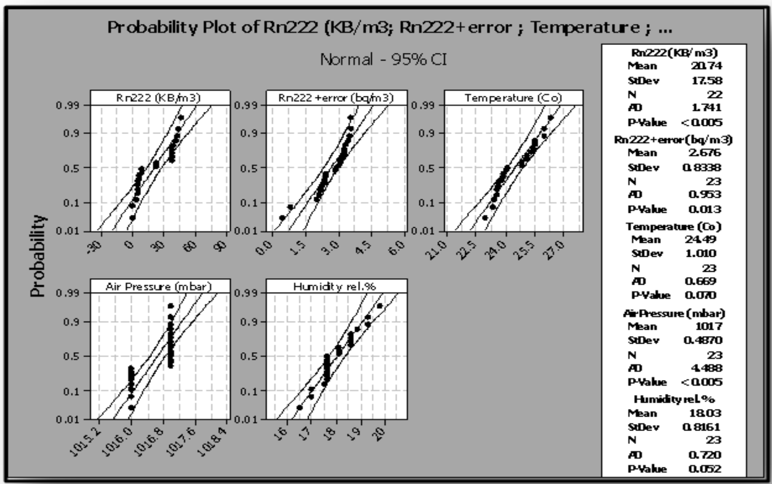


Figure. 18 Probability plot for well water No1

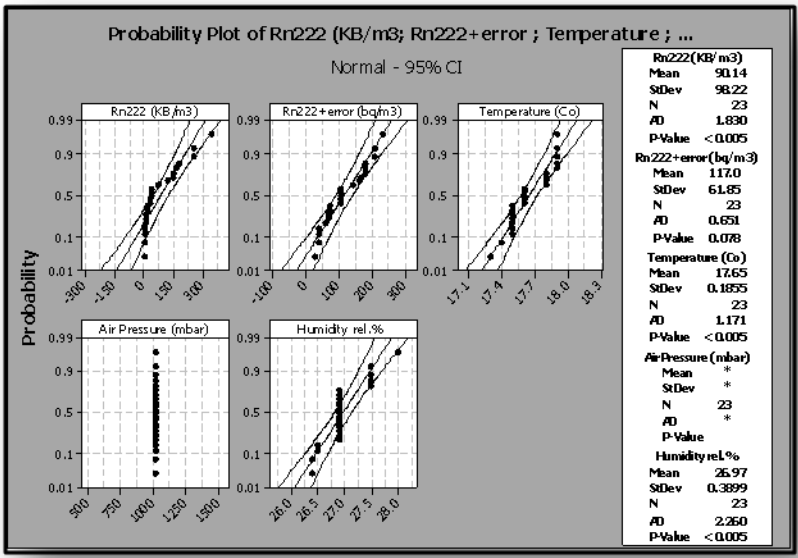


Figure. 19 Probability plot for well water No2

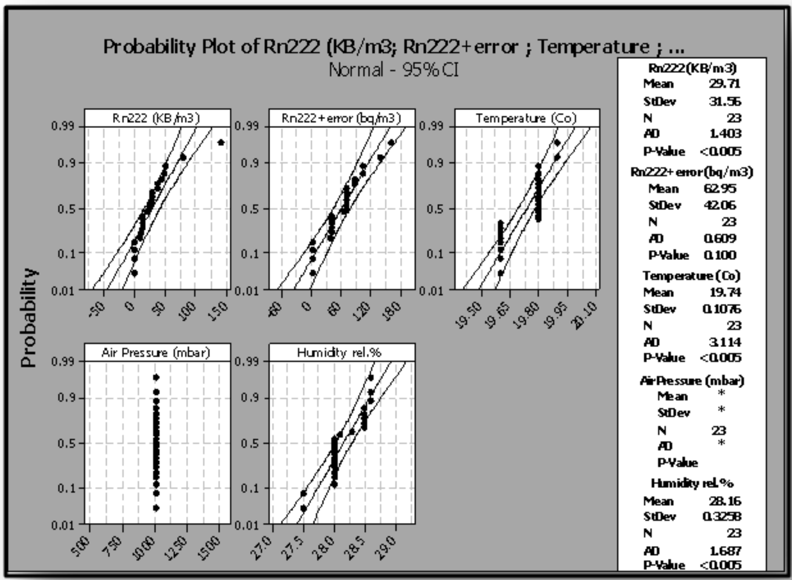


Figure. 20 Probability plot for well water No3

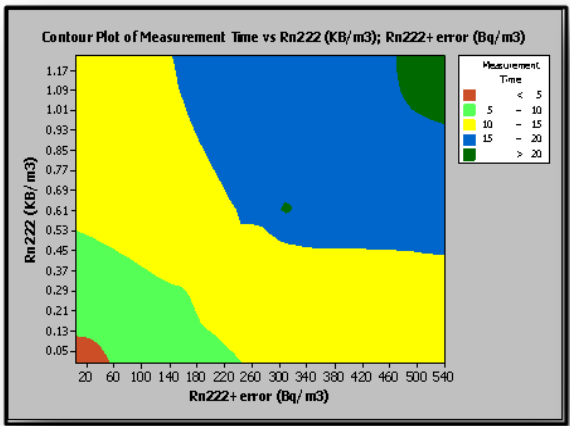


Figure. 21 Soil well No 1 contour plot

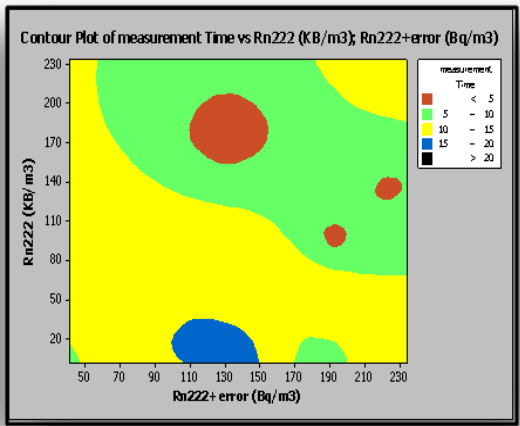


Figure. 22 Soil well No 2 contour plot