OCCUPATIONAL RADIATION EXPOSURE IN SOME EGYPTIAN PHOSPHATE MINES

A.Z. Hussein [1], Mohamed I. Hussein [1] and M.L.Abd-El-Hady[2]

1 National Center for Nuclear Safety and Radiation Control, Atomic Energy Authority, Nasr City, P.O. Box: 7551, Cairo, Egypt.

2 Physics Department, Faculty of Science, El-Minia University, Egypt.

ABSTRACT:

Radiation levels in some working phosphate mines in the Egyptian Eastern Desert have been investigated to estimate the occupational exposure to the workers in those sites. Such results may help in the preparation of the corrective actions as well as the improvement of the safety measures if needed in those working mines. Beta and gamma levels as well as radon gas concentration and its decay products have been measured. Active techniques are employed to fulfill the objectives of measuring radon gas and its daughters.

Some working conditions and environmental parameters such as the working time, type of available ventilation, temperature and humidity have been studied during the period of measurements. The maximum reported values for radon daughter concentration in units of working level are 1.28, in Safaga area south mine, 1.22 in Hamraween area B mine and 0.67 in El-Quser area Youns C mine. The maximum annual dose for the worker in all locations under investigation is about 100 mSv/y which is clearly much higher than the recommended international value. According to the above estimated values the question of ventilation economics in such mines is created. The classification of the miners in conventional mines as radiation workers should also be put into consideration.

INTRODUCTION

The main phosphate mines in Egypt are sited in the Eastern Desert. There are three regions Safaga, Hamraween and El-Quser which are considered as the producing mines. The three regions are separted by about 60 and 20 km from each other. The depth of the mines ranges from 10-50 meters.

It is well known that phosphate rocks contain the trace elements of uranium, thorium and their decay products in equilibrium. All technical processing leads to a high release of long and short half-life radionuclides from uranium mining and milling. (5) .

In this study a radiation monitoring programme was carried out in the mining areas, γ and β levels are measured as well as radon gas concentration and its decay products in units of working level.

EXPERIMENTAL

1. Monitoring External Beta and Gamma

An Eberline survey meter model L.B. 1200, was used.

2. Radon Gas Measurement

Alpha scintillation cells was used. Scintillations from Lucas cell were counted using a photomultiplier tube in a light-tight enclosure and a counting system made by EDA of Canada.

3. Air Sampling

Air samples were taken using air sampler having a flow rate of 1-10 l/min.

4. Rodon Daughters Measurement

Air was passed through high-efficiency filter paper (milipore) to trap radon daughters. Filter papers were counted using the same counting system by placing the filter paper on a scintillation tray coated with the same material as the Lucas cell.

5. Calculation of Radon Daughter Concentration

Rolle method was used to calculate radon daughter concentration in units of working level, (2,3).

RESULTS AND DISCUSSION

The results of radon and radon daughters concentrations, effective dose equivalent and annual dose for the workers are shown in table (1) for Safaga, Hamraween and El-Quser areas.

It is clear from table (1) that γ and β levels in the three mines are within the range (0.03-0.25 mR/h) which is higher than the natural background level.

The maximum radon daughters levels in units of WL were found 1.2 in south mine at Safaga, 1.2 in mine B at El-Hamraween and 0.6 in Youns C mine at El-Quser. These levels are higher than the ICRP recommended value for the workers (0.3), also the maximum values of radon gas concentration are found 90 pCi/l in south mine, pCi/l in mine B and 108 pCi/l in Youns C mine. (3)

The maximum values for the annual dose for the workers are found 121 mSv/y in south mine, 116 mSv / y in mine B and 65 mSv/y in Youns C mine. We notice that these levels are higher than the recommended value (20 mSv/y) (4).

It is clear from the results obtained for radon, radon daughters concentrations and gamma exposure rates that most values are higher than the recommended limits and require corrective actions. These higher levels are due to bad ventilation.

The following corrective actions are recommended :

1. An efficient mechanical ventilation system should be establised to decrease the annual dose equivalent to the accepted limit of 20 mSv/y.

2. Job rotation could be used as a helping action to decrease the exposure.

Table (1) : A Summary of Exposure Rates, Effective Dose and Annual Dose in Phosphate Mines.

LOCATION	POINT OF STUDY	GAMMA AND BETA LEVEL mR/h	RADON DECAY PRODUCTS WL	EFFECTIVE DOSE EQUIVALENT uSv/h	ANNUAL DOSE FOR THE WORKERS mSv/y	TEMPERATURE AND HUMIDITY C^{o}, %
SAFAGA AREA SOUTH MINE	1	0.03	1.283	83.19	121.46	26.85
	2	0.03	1.174	76.38	111.51	26.85
	3	0.03	0.959	62.94	91.89	24.80
	4	0.03	0.984	64.5	94.169	24.80
	5	0.03	0.939	61.69	90.067	24.80
	6	0.03	0.887	58.44	58.32	24.80
HAMRAW-EEN AREA MINE B	1	0.03	0.451	31.19	45.54	25.72
	2	0.03	0.708	47.25	68.98	26.75
	3	0.03	1.225	79.56	116.16	27.87
	4	0.03	1.009	66.06	96.45	27.87
	5	0.03	0.817	54.06	78.93	27.85
	6	0.03	0.624	42	61.32	26.80
EL-QUSER AREA YOUNS MINE C	1	0.25	0.034	4.625	6.75	26.82
	2	0.25	0.095	8.44	12.32	26.82
	3	0.25	0.157	12.31	17.97	26.82
	4	0.25	0.261	18.81	27.46	27.85
	5	0.03	0.476	32.75	47.46	27.85
	6	0.03	0.671	44.94	65.61	28.87

REFERENCES

1. EPA document No. OPA-86-004 (1986)
2. IAEA Safety Series No. 43, (1976)
3. ICRP Publication No. 32 (1980)
4. ICRP Publication No. 60 (1990)
5. I. Othman, Rad. Prot. Dosimetry 45, 197-201 (1992)
6. Ryan, Nucl. Saf. 22, 70-77 (1981)