

CONTAMINATION OF PERSONS OCCUPATIONALLY EXPOSED TO NATURAL RADIOACTIVITY IN A COAL FIRED POWER PLANT

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INTRODUCTION

On the premise that a study of a work population in a coal fired power plant with a higher than average radioactivity and sulphur content can be of value, this paper is presented to stimulate investigations of practical means of assessing general exposure levels of employees in basically nonradioactive industries.

Air samples were taken, surface contamination surveys of the work areas were made, and urine specimens and blood specimens were analyzed for radioactive contamination and mutagenic analysis.

METHODS AND EQUIPMENT

The personnel in the original study group were sixty employees assigned to operations and maintenance activities in the coal fired power plant. The operation was a continuous one employing three shifts of operational personnel. During the study period the men worked rotating eight-hour shifts, with a duty cycle of seven days and a rest cycle from 24 to 48 hours. The environmental exposure involved uranium, dust particles, ^{226}Ra , ^{210}Pb , ^{210}Po , mixed with fly ash bottom ash and slag, with additional contamination from ^{222}Rn in ambient air.(1,2) After coal combustion the concentration of these radionuclides was increased tenfold(3.)

The possibility of chemical synergisms was not taken into consideration. The major route into the body had to be by inhalation, so ^{210}Pb in urine was expected to be present. ^{210}Pb was sampled in 24 h urine. It was radiochemically separated (4). ^{210}Pb concentration in urine of a control group was taken as "blank level".

The chromosome analysis was performed in 48 lymphocytes cultures. Two hundred cells were analyzed for each subject (5). A control group was investigated at the same time with the test group. The test group was chosen on the ground of good health and none previous mining experience.

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RESULTS

The results are presented in the following tables:

TABLE 1. CONTAMINATION OF WORKPLACES

WORKPLACE	$\mu\text{g U/m}^2/24 \text{ h}$
1. Automatic control operator	360.0
2. Conveyer belt operator	23.0
3. Steam turbine machinist	7.1
4. Turbine operator	7.1
5. Mechanical engineer	7.1
6. Water controller	7.1
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The ground 10 km ² distant from the coal fired power plant	0.07

Around the place of the automatic control operator the radiation at the time of sampling and measurement was 0.240 mR/h. The highest radioactivity ever registered at the ach hopper was 0.5 mR/h. On the average the level of radioactivity was lower - 0.05 0.05 mR/h. The surveys have shown that the contamination at the workplaces corresponded with the frequency of chromosome aberrations in persons working in these same places as indicated in tb 1. in numerical order. The same is valid for automatic control operator with ²¹⁰Pb in urine. 14,47 pCi ²¹⁰Pb/l urine and the turbine operator 7,15 pCi/l. All the workers had a higher amount of ²¹⁰Pb in urine than the control group.

DISCUSSION

It is evident from the tables that the contamination with low levels of radioactivity in the coal fired power plant can be detected and that the the threshold is very low. This may be due to synergism with chemical contaminants. The contamination of workplaces correlates with urine and chromosome results.

TABLE 2. FREQUENCY OF CHROMOSOME ABERRATIONS IN PERSONS OCCUPATIONALLY EXPOSED TO NATURAL RADIOACTIVITY AND IN CONTROL SUBJECTS

occup.exp. persons	Age years	Years of exposure	Structural aberrations			Numerical aberrations		Total %
			Dicentric	Ring	Invers. Break Gap	Polyploid.	Hypodiploid	
Automatic control	39	3	3	1	1 7 3	-	-	7.5
Conveyer belt operator	35	7	0	0	1 6 5	-	-	6
Steam turb. machinist	52	24	2	1	0 6 3	-	-	6
Turbine operator	39	20	3	0	1 8 6	2	-	10
Mechanical engineer	26	3	1	0	0 5 5	1	2	7
Water controller	33	2	2	1	0 8 4	1	-	8
No Control								
1.	48		-	-	2 1	-	-	1.5
2.	35		-	-	3 4	-	1	4
3.	35		-	-	2 4	-	-	3
4.	39		-	-	4 4	-	1	4.5
5.	24		-	-	2 5	-	-	3.5
6.	28		-	-	3 2	-	-	2.5

TABLE 3. FREQUENCY OF ELEVATED ^{210}Pb LEVELS IN THE URINE OF PERSONS OCCUPATIONALLY EXPOSED TO NATURAL RADIOACTIVITY

occupationally exposed persons	Age years	Years of exposure in CFP plant	pCi $^{210}\text{Pb}/1$ urine
Automatic control operator	39	3	14.47
Conveyer belt operator	35	3	1.89
Steam turbine machinist	52	24	5.80
Turbine operator	39	20	7.15
Mechanical engineer (shift supervisor)	26	3	4.31
Water controller	33	2	2.29
No Control: 1.	48	-	1.06
2.	35	-	1.24
3.	35	-	1.10
4.	39	-	1.07
5.	24	-	0.70
6.	28	-	0.86

The mean concentration of all control samples was used as blank level = 1.05 pCi $^{210}\text{Pb}/24$ h urine, and it was deducted from all test samples.

LITERATURE

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