THE ASSESSMENT OF RADIOACTIVE DOSE OF URANIUM MINERS

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1. Abstract

The main factors of radioactive hazard in uranium mines are radioactive ore dust, radon gas and tis daughters. These hazards often result in contracted sillicosis and lung cancer among miners, Howere, they can be fully avoided if some active radiation protection are taken up. According to the statistics (incomplete) over the past 30 years, average annual sillicosis rate in uranium mines of China was only 0.083%, far less than that of coal mines and metal mines. On the other hand, the average lung cancer rate was 108.3/million·men·annum, which is also very low.

2. Introduction

The first uranium mine was discovered in 1934 in Guangxi Chuang Autonomous Region of China, but recounaissance and exploration began in 1955, the mine construction was in 1958. After 1963, some uranium mines put into production and now there are more than twenty active uranium mines in China.

In the process of uranium exploration and mining, from the 30 years practice and experience, it is demonstrated that the main hazard factors are radioactive ore dust, radon gas and its daughters for uranium miners because of sillicosis and lung cancer intruced. In the initial period of the exploration and construction, some miners were found to be sillicosis by reason that the protection measures for the radioactive ore dust, radon gas and its daughters were insufficient.

3. The basic measures for controlling the radioactive harm of uranium mine

3.1 Adoption of dust-proof and radon-reduced measures

During the past 30 years, there are three periods for dust prevention and radon reduction in uranium mines of China.

The first period(1955-1963) included uranium exploration and initial construction. In this period, no mechanical ventilation system was adopted and the natural ventilation was the main way, the local stope and protection conditions were very poor. Some drilling were dry-type operating. The maximum dust concentration was up to 150 mg/m^3, and the average was 10 mg/m^3. The maximum radon gas concentration was 125 Bq/L, and the average

was 11.5 Bq/L.

The second period(1963-1975) indicated that overall dust prevention and radon reduction were developed comprehensively. After 1963, the uranium mine, one after another, was put into production. For prevention against occupational disease, some comprehensive measures of dust prevention and radon reduction were taken including "water supply at first and then ventilation" etc, and mechanical ventilation system was established and the approaches to dust-measuring, radon-monitoring and radiation monitoring were also set up. According to the statistics of the representative ten mines, averag ore dust concentration was 2.5 mg/m^3, and qualified rate was 65%, average radon gas concentration was 4.81 Bq/L, and qualified rate was 66% from 1963 to 1975 in the stopes of underground uranium mines. the incidence of sillicosis in a uranium mine of Hunan was dropped from 1.28% in 1964 to 0.17% in 1974.

In the third period(1976-1986), scientific research and development were strengthened and the experiences were summarized and promoted and applied. Since 1978, the ventilation system was adjusted in accordance with the different kind of uranium mines, the research for dust prevention and radon reduction was developed widely, the standard of dust prevention by ventilation and the technique of radon reduction were raised. From statistics of 13 mines, it shows that the average dust concentration was dropped to 1.19 mg/m^3 and qualified rate was raised to 74.1% from 65%; average radon concentration was dropped to 4.85 Bq/L; and qualified rate was 73.8%; radon daughters concentration was 2.27 WL, and qualified rate was 76.5% from 1976 to 1986 in the underground working faces.

3.2 Adoption of comprehensive measures for dust prevention and radon reduction

At the present ventilation is the main way for dust prevention and radon reduction and its daughters concentration radioactive hazard in uranium mines of China. In order to eliminate radon and its daughters timely and rapidly, mechanical ventilation is adopted day and night in uranium mines. The amount of ventilation is calculated in accordance with the National Standard for eliminating radon gas and its daughters. It is 4-6 times greater than that of non-uranium mines under the condition that there are the maximum workers in the underground or the amount of dynamite is equal.

3.3 Ventilation

Over the 30 years, a few of practical experiences in uranium mine ventilation have been integrated including ventilation method, air amount of calculation, administration, etc, at the same time, some technicologies were adopted, such as the application of positive pressure ventilation for controlling the emanation rate and the usage of air-guided plate, etc. Blowing ventilation is an effective method for the control of radon emanation and the decreasement of radon concentration. Forced and exhaust overlap auxiliary ventilation was adopted in the

local area and descentional forced ventilation was adopted in shrinkage and filling stopes, both of them were also effective for decreasing stope radon gas and its daughters concentration.

Sectional ventilation system and exhaust ventilation method are adopted widely in uranium mines and surfacial coating and isolation techniques are applied to reduce radon emanation and migration. The practice shows that coating on the surface of ore bodies with organic coating material may reduce 75% of radon emanation.

3.4 Ore dust prevention and radon reduction

The main measures in uranium mining are to restrain dust source and to prevent ore dust as well as to collect ore dust, and the wet operating, sprinkling water and waterseal explosion will be all effect to restrain dust source and quicken dust condensation.

The method mechanical ventilation is used directly for high dust concentration and air return ways radon pollutant, and dry-type dust catcher with superfine fabric cloth and the method of dust removol by super high-pressure electrostatics are adopted in some uranium mines with the result of depressing 99% Of dust and 89% radon daughters from air.

3.5 Personal health and protection

In order to safeguard the health of uranium miners, they must be inspected before their employment, and after that, the inspection must be carried out at regular intervals, on the other hand, a more subsidies for health, a better health foods and personal-protective equipments are free supplied. For any miner, personal dose monitoring should be carried out. And now protable and fast-speed air-ball radon detectors are used widely in uranium mines.

4. The evaluation of radioactive dose in uranium mines

China has a history of more than 30 years in uranium exploration mining. Over 30 years, in order to understand and control the hazard of radioactive ore dust, radon gas and its daughters in uranium mines, a great deal of inverstigation has been carried out so as to study the characteristics of sillicosis and lung cancer of uranium miners. It was reported that, from 1962 to 1985, the average annual sillicosis rate is only 0.083% in uranium miners of China, which was far less than that of miners in coal mines and metal mines.

According to census from 1955 to 1985 in uranium miners, average death rate of lung cancer was 19.5/million·men·year. A uranium mine of Hunan was the highest in uranium mines of China in which twelve patients of lung cancer was found from 1976 to 1983, among them eleven was dead. Average death rate was 357/million·men·year. The accumulated exposure of workers who worked in the underground for 2-19 years was equal to 130-450 WLM. The

age of miners who had lung cancer was from 40 to 62 years, average age of death was 46 years, which was 11 years lower than that of the civilian, death rate was 30 times higher than that of the vesident.

Meanwhile, 402718 employees in five uranium mines were investigated in epidemiology from 1958 to 1982, amoung which the death rate of lung cancer was 108.3/million·men·annum. in checking of the dead bodies, it was found that the radioactive composition in the lung organization indicated uranium concent was less than that of the ordinary resident and that the sillicosis for uranium miners would be caused mainly by the pathological changes of lung organ leading to the obstructive of lung function because radioactive ore dust could make the sillicosis originate and develop. Lung cancer from that uranium miner suffered was caused mainly by potential of radon daughters as a result of its internal exposure in lung organ. The result of reseach shows that the incidence of uranium miners is linear effect of uranium ore dust and radon daughters may promote the obstructive of lung function.

5. Conclusion

5.1 In uranium exploration and mining, the main radioactive harmful factors are uranium ore dust, radon gas and its daughters, resulting in that uranium miners will suffer from sillicosis and lung cancer.

5.2 Incidence of uranium miner is linear with the radon gas and its daughters concentration. The complex effect of radioactive ore dust and radon daughters will promote the obstructive of lung function.

5.3 The basic measures for protecting miners from radioactive hazard are to adopt mechanical ventilation, wet-type operating, sprinkling water so as to decrease the exposure surface of bodies and ore amount stored in underground and to apply surfacial coating and isolation of bodies, and to seal the mined-out area and abandonment tunnels.

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