A RESERCH IN THE CLEANER FOR REMOVAL OF DUST AND RADON DAUGHTERS

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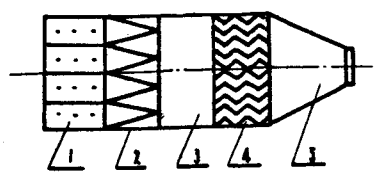
ABSTRACT. In polluted mines by radon and its daughters, the purification of mine air can be accomplished by the removal of dust particles and radon daughters using filters. A multi-stage filter cleaner was developed in Northeast University of Technology in People's Republic of China. Experimental data have indicated that removal efficiency is greater than 99% for dust and greater than 98% for radon daughters. Especially, it is able to withstand high humidity in mines. Its effectiveness has been proved by the data in-situ application in underground workings.

For the purpose of occupational radiation protection at uranium mines and other mines polluted by radon daughters, many researchers and engineers have been paying great attention to looking for a kind of high efficient cleaner. Because radon daughters are infinitesimal and positively charged particulates and can rapidly attach to dust, especially to submicron-dust, suppression of radon daughters is just as suppresion of dust in size of submicron. Obviously, it is impossible to collect such fine particulates by means of the program of common industrial collection dust. As well known, the glass fibre paper filter has a higher efficiency in the cleaning and has been used to protect radon radiation, but it is so difficult, even impossible to use it in underground because of high humidity in mines and low strength of glass-fiber paper. It is necessary that the cleaner has such an ability to withstand high humidity in underground, by all means, also high efficiency and economic cost are taken into account.

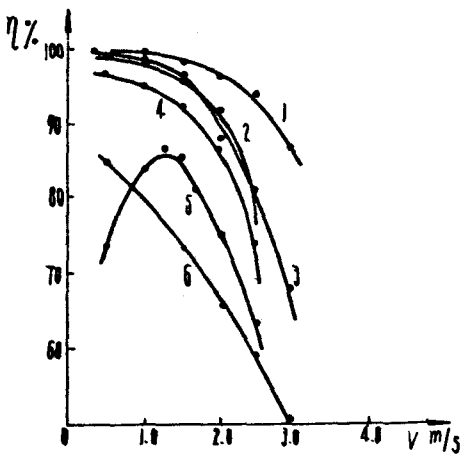
A multi-stage filter developed by Northeast University of Technology is composed of three parts: an electrostatic precharger (ESP), a fiber filter unit and a high efficient filter unit. Its structural scheme is shown in Fig.1. It owns such advantages as high collection efficiency, low noise level with 78db(A) and 75db(A) at the inlet and the outlet of cleaner respectively, high dust loading capacity (1500 g/m^2), long cleaning period of dust. The filter can be reused after being washed dust cake by water spray in assembly state. Its pressure drop is 60-100mmW.G at flow rate 3500-5400m^3/hr.



1. Electrostatic precharger
2. Fibre filter
3. Fan
4. High efficient filter unit
5. Collecting wind device

Fig.1 The structural scheme of multi-stage filter cleaner

Whether the last stage high efficient filter can be used successfully, it deponds on the effectiveness of the prefiltration for the particles in size of submicrons. Because a bit little dust loading will sharp increase the resistance of the high efficient filter, in order to prolong the filter's life, the prefilter should be designed as large dust loading capacity, high filtration efficiency, strong moisture resistance, simple maintenance and long period of dust cleaning. The PW fiberous filter medium is of advantages for the purpose of collecting dust in underground. It has been developed by Ventilation and Safety Engineering Division of NEUT and has been used effectively in industrial dust collection. Its efficiency is always more than 97%. The comparison of six kinds of filters are shown in Fig.2.



1. The filter with electrostatic precharger
2. The thick filter material
3. The series ESP
4. Common ESP
5. The ESP with cross collective plates
6. The thin filter material

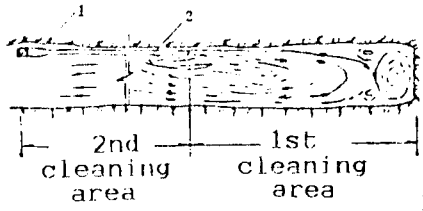
Fig.2 The comparison of the collection efficiency of six kind of filters.

As mentioned above, the PW fiberous filter medium are chosen as a prefilter and assembled in the cleaner to protect the last stage filter from excessive dust loading.

The compound filter's filtration effectiveness only acheived 80-90% because the efficiency of fiberous filter paper is 95% for particles larger than 0.3microns. It is neccessary for acheivement high efficiency that the submicron particles should be condensated as large as possible. As mentioned by Mr.R.L.Rock, the scholar of Denver Technical Support Center U.S.in 1972, "the most interesting aspect of ESP is that it appears that a bonus in air benefication is achieved by removal of condensation nuclei from mine air." So an electrostatic precharger have been assembled for condensation of particle in front of fiberous filter. Experimental data showed that the filtration efficiency for radon daughters was raised to 98%.

The test of the cleaner was carried out in the Heading 1730 at Malage Mine Yunnan Province China. Fig.3 shows the position of test site at the working face. The stope 1730 had an excessive concentration of dust and Radon daughters. Before the test, Radon daughters radioactive potential energy reached 6.4×10^{-5} JM^{-3}. It is 10times more than the National Health Standard Level. The experimental data are summarized in the following Table, which shows the concentration of Radon daughters and dust decrease quickly as long as the cleaner turns on 10 minutes later, the concentration can drop to the Nation-

al Health Standards. The cleaning efficiency in the working space achieved 89.6% and the total collection efficiency of the cleaner for Radon daughters reached 98.85%.



1. The cleaner
2. Ventilating tube

Fig. 3. The position of test site at working face.

sampling location	date time	process	concentration	
			Radon(JM^{-3}) daughters	dust mgm^{-3}
8.5m from face	Aug.7 8:55	loading	$5.6x10^{-5}$ (Initial)	2.28
	9:00		$0.42x10^{-5}$	2.23
	10:35	drilling (two drilling)	$0.37x10^{-5}$	0.75
	Aug.8 16:00		$0.25x10^{-5}$	0.72
15.5m from face	Aug.7 9:00	loading	$1.03x10^{-5}$	1.64
	Aug.8 8:30		$0.26x10^{-5}$	1.2
20m from face	Aug.8 16:00	drilling (two drillers)	$0.33x10^{-5}$	
cleaner inlet outlet	10:35		$1.97x10^{-5}$ $0.024x10^{-5}$	

The concentration of Radon daughters and dust in cleaning process . The outlet of ventilating tube was kept 15m from drilling face in-situ test.

CONCLUSION

Experimental results show that the method of local cleaning is available and reasonable technically for removal of dust and Radon daughters from the contaminated air in mines for the purpose of Alpha radiation protection. The cleaner can remove dust and Radon daughters effectively and make excessive concentrations of dust and Radon daughters decreasing to the National Standards during 3 to 10 minutes in underground atmosphere.Even though double drillers work at the same time, the cleaner can also make the concentration of dust decreasing to The National Standard, 2mg/m, at the working face. When the cleaner is connected with a duct of 90 meters long and the flow rate at the outlet drops to 0.8 m^3/s,the concentrations of both pollutants can still be drained off effectively. The cleaner can be run continuously. Because of its low noise, workers can talk each other freely.