Investigation of Intermittency in the Noise Exposure Pattern of Longwall Coal Miners

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Abstract

An analysis of the noise exposure of longwall coal miners was performed to quantify the intermittency aspect of their exposures. The study was based on the use of 58 full shifts of noise exposure data collected at 6 underground mines on 4 different miner occupations. It is concluded that the noise exposure pattern of these miners is complex and highly intermittent.

Introduction

It is generally recognized that intermittent exposures to noise are less hazardous than continuous exposures with the same energy. This effect has been accounted for in the USA with the use of a 5-dB exchange rate, instead of the 3-dB rate associated with the equal energy principle. Although the intermittency characteristics of mining noises have been observed and qualitatively reported,[1] the intermittency pattern associated with mining has never been described, or examined, quantitatively. The authors have previously reported the results of a worker noise exposure survey conducted at six longwall coal mines;[2] the time-resolved dosimeter data from that study were reanalyzed to determine if the noise exposure pattern of longwall miners can be categorized as intermittent. For this study effective quiet, which is defined as the level of quiet needed for recovery from temporary threshold shift (TTS), was chosen as 75 dBA. This level is consistent with the effective quiet levels identified by Melnick[3] for broadband noise. In the case of longwall mining noise, most of the energy content at this sound level, and below, is in the low frequencies. Kryter[4] has also suggested that a period of effective quiet must last for 10 seconds or longer; the rationale for this is that the process of recovery from TTS by the ear, 10 seconds after an exposure to any given level of noise, continues whether followed by a higher or lower sound level.

Method

Time resolved noise logging dosimeters were worn by miners for 8 hours during their work shifts. The dosimeters were configured to measure and store the equivalent integrated sound level (L_{eq}) every 10 seconds. The dosimeters were placed on miners representing 4 different occupations at the beginning of the shift, and 8 hours of noise data were recorded. At the end of the shift the dosimeter data were downloaded into a portable computer for later analysis. Thus, the noise exposure during each 8-hour shift was recorded in 10-second increments for a total of 2880 L_{eq} data points. Figure 1 shows a typical noise exposure scenario. A total of 58 full-shift exposure measurements was obtained. These data were subsequently analyzed to determine the number of times during each shift that a period of effective quiet was achieved.

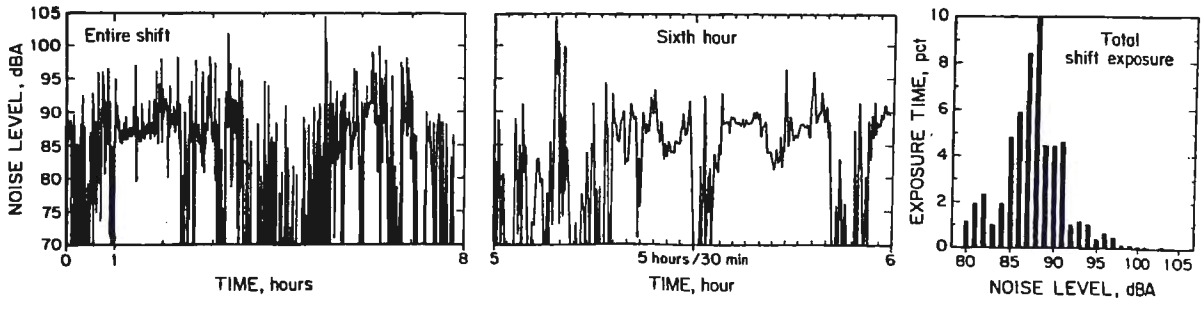

Figure 1. Full-shift noise exposure history for a headgate operator

Results and Discussion

Table 1 provides a summary of the results of the analysis based on an effective quiet level of 75 dBA. Intermittency for the different occupations is described quantitatively by the number of daily effective quiet periods, ranging in duration from 10 seconds to more than 30 minutes. Also, to demonstrate that this pattern of intermittency appears to be relatively stable, regardless of the actual choice of effective quiet level, similar data based on an effective quiet level of 70 dBA are shown in Table 2. It is found that the miners experience an average of 125 periods of effective quiet and an average total quiet time of 1.6 hours on a daily basis. However, these data reveal there are few quiet periods that exceed 30 minutes, or even 15 minutes. Although it is evident that the exposure pattern of longwall miners is highly intermittent and complex, no conclusions should be drawn about the application of these results to other mining occupations.

TABLE 1. Number of Daily Effective Quiet Periods (≤ 75 dBA)

	Duration of Effective Quiet Periods						
Miner Occupation	≥10 Sec	≥ 20 sec	≥30 Sec	≥1 Min	≥5 Min	≥15 Min	≥30 Min
Headgate Operator	131	79	54	24	3	.33	0
Shearer Tailgate Operator	124	81	58	27	3	.5	.1
Shield Setter Operator	122	73	50	24	6	.5	0
Shearer Headgate Operator	122	76	52	26	3	.33	0
Average	125	77	54	25	4	.4	.025

TABLE 2. Number of Daily Effective Quiet Periods (≤ 70 dBA)

	Duration of Effective Quiet Periods						
Miner Occupation	≥10 Sec	≥ 20 sec	≥30 Sec	≥1 Min	≥5 Min	≥15 Min	≥30 Min
Headgate Operator	113	61	40	16	2	.1	0
Shearer Tailgate Operator	121	70	47	21	2	.2	0
Shield Setter Operator	105	59	36	16	1	0	0
Shearer Headgate Operator	113	63	43	20	2	.2	0
Average	113	63	42	18	2	.125	0

REFERENCES

1. Sutter, A. H., *The relationship of the exchange rate to noise-induced hearing loss*, Final Report, Dec. 13, 1983, p. 45.

2. Bartholomae, R.C., and Burks, J.A., *Occupational noise exposures in underground longwall coal mines*, in Proceedings, Inter-Noise, July 10-12, 1995, pp. 833-836.

3. Melnick, W., *Human temporary threshold shift (TTS) and damage risk*, Acoustical Society of America J., 90 (1), July 1991, pp. 147-154.

4. Kryter, K., *The Effects of Noise on Man*, Academic Press, Inc., 1985, p. 273.

Burks JA, Bartholomae RC [1998]. Investigation of intermittency in the noise exposure pattern of longwall coal miners. In: Proceedings of the 16th International Congress on Acoustics and 135th Meeting of the Acoustical Society of America, pp. 1523–1524.