The Hidden Danger of Noise

Shotcrete workers are subject to noise, much of which is at potentially dangerous decibel levels

By Derek and Amanda L. Pay

Hearing is one of the most important senses that we have, and one of the easiest to permanently damage. According to the Centers for Disease Control and Prevention, "Occupational hearing loss is one of the most common work-related illnesses in the United States. Approximately 22 million U.S. workers [are] exposed to hazardous noise levels at work….An estimated $242 million is spent annually on worker's compensation for hearing loss disability."[1] The use of hearing protection is one of the most overlooked pieces of personal protective equipment (PPE). Shotcrete workers working without effective hearing protection are exposed to potentially damaging noise levels.

How dangerous are these noise levels? Previous studies regarding worker exposure rates have been derived from common construction job site exposure. Pump operators, finishers, and especially nozzleman and blow pipe operators continuously use some of the loudest construction equipment in operation today. Over the last 2 years, research on shotcrete worker noise exposure rates was conducted by Derek Pay and his wife Amanda Pay, an audiologist specializing in hearing conservation.

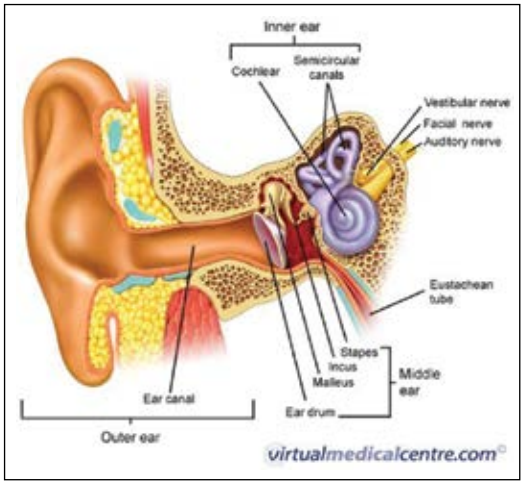

Fig. 1: Anatomy of the ear

They researched multiple environments designed to generate data on noise levels for various real-world jobsites. Data was collected using a noise dosimeter fitted to shotcrete workers over the span of their exposure time. The unexpected results of these tests clearly illustrate the acute need for hearing protection amongst shotcrete workers.

The Decibel

A unit of sound is measured by a decibel. A decibel measures the loudness or intensity of a sound. Once sound hits the ear, bones behind the eardrum begin to vibrate within the middle portion of the ear. The sound then travels to an area called the inner ear. Damage from noise exposure occurs in an area of the inner ear called the cochlea (refer to Fig. 1). The cochlea contains hairlike sensory receptor cells that transmit the acoustic message to the auditory nerve, which then sends it up to the brain. Damage occurring within the cochlea is permanent and is labeled sensorineural hearing loss. Unfortunately as of now, there is no known cure for sensorineural hearing loss.

For this experiment, we were interested to know at what point in the workplace, and for what period of time, could our ears be exposed to such sound levels before nerve damage may occur. Noise level and exposure time are key factors for possible permanent hearing loss.

The Occupational Safety and Health Administration (OSHA) provides us with a table (refer to Table 1) using A-weighted sound levels that calculate decibel levels (listed on left side of table) and length of time (listed on right side of table in hours going down to seconds) that an ear can be exposed to before nerve damage may occur. This chart illustrates, as the intensity level of sound increases, safe exposure time decreases.[2]

The Experiment

The experiment focused on three typical environments in which shotcrete workers may be

exposed. In each environment, the nozzleman was fitted to a Q-200 noise dosimeter device manufactured by Quest Technologies (refer to Fig. 2(a) and (b)). The probe was placed near his ear for the duration of his work day. The device is designed to measure and record data on the exact sound pressure levels and decibel levels reaching the worker's ear.

The first test environment was a jobsite including a soil nail tieback wall in an open area with a maximum height of 65 ft (20 m) while in a man basket. The device displayed data for the 8-hour work day. Collected data revealed that the nozzleman was subjected to an average of 93 decibels. According to Table 1, at 93 decibels constant noise, ears are safe for only 5.3 hours before permanent hearing loss can occur.

The second environment was an indoor seismic retrofit project. This project consisted of tight working conditions creating a less-than-ideal acoustic environment. The nozzleman was on the job for 10 hours and exposed to an average of 95 decibels. The device recorded an exposure level of more than double the allotted safe listening time of 4 hours.

The final environment involved an outdoor residential swimming pool. The nozzleman worked for 10 hours with an average exposure level of 92 decibels. Again, the device recorded levels that are considered safe for only 6.1 hours.

During the experiment, sound levels were also measured in the same manner for a pump operator. With all three environments, the same pump was used and the pump operator was subject to a shocking average of 104 decibels with occasional peaks of up to 110 decibels when standing at the controls. The operator was at an extremely high risk for hearing damage given the amount of time of his exposure. With his average of 104 decibel exposure, in only 1.1 hours permanent nerve damage may begin to occur.

Results of this study conclusively prove that shotcrete workers are in very real danger of serious and permanent hearing loss. The solution to keeping our ears safe and conserving our hearing can be as simple as wearing effective protection designed for the expected exposure rate. The importance of wearing effective hearing protection during working hours cannot be overemphasized. The National Institute for Occupational Safety and Health (NIOSH) recommends using hearing protectors in all situations where dangerous noise exposure cannot be controlled or eliminated.

Table 1: OSHA Noise Exposure Computation, Table G-16A

A-weighted sound level, L (decibel)	Reference duration, T (hour)	A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32	106	0.87
81	27.9	107	0.76
82	24.3	108	0.66
83	21.1	109	0.57
84	18.4	110	0.5
85	16	111	0.44
86	13.9	112	0.38
87	12.1	113	0.33
88	10.6	114	0.29
89	9.2	115	0.25
90	8	116	0.22
91	7.0	117	0.19
92	6.1	118	0.16
93	5.3	119	0.14
94	4.6	120	0.125
95	4	121	0.11
96	3.5	122	0.095
97	3.0	123	0.082
98	2.6	124	0.072
99	2.3	125	0.063
100	2	126	0.054
101	1.7	127	0.047
102	1.5	128	0.041
103	1.3	129	0.036
104	1.1	130	0.031
105	1	—	—

Fig. 2(a): Dosimeter ear probe

Fig. 2(b): Dosimeter

"Of all of the regrettable things of working as a shotcrete nozzleman for more than 25 years, it is the perceived lack of importance I have given to basic personal protective devices (PPDs). Continuous, preventable exposure to our very loud work environment has caused irreversible damage that I must live with daily.

We all share the belief that we are somehow insulated from many common work hazards. Please consider how we take hearing for granted in our daily lives. Permanent hearing damage is preventable by the use of inexpensive ear protection."

—Oscar Duckworth (regular *Shotcrete* magazine contributor)

There are many different types of hearing protection: foam earplugs, custom earplugs, hard hat mounted over ear covers, and circum-aural headsets. Manufacturers of these products include a noise reduction rating (NRR) number that tells us to define how much sound attenuation the product provides (refer to Fig. 3(a) and (b)). For example, a common manufacturer of foam inserted earplugs have an NRR rating of 32, meaning when worn properly it will block out 32 decibels of overall loudness. Attenuating that much noise would bring our nozzleman and pump operator into a much safer noise exposure level, dramatically lowering their risk of permanent hearing damage.

Protecting our hearing is vitally important to our quality of life. Shotcrete workers are exposed to high-intensity levels of sound for long periods of time. It is essential we make hearing protection a high priority while on the job.

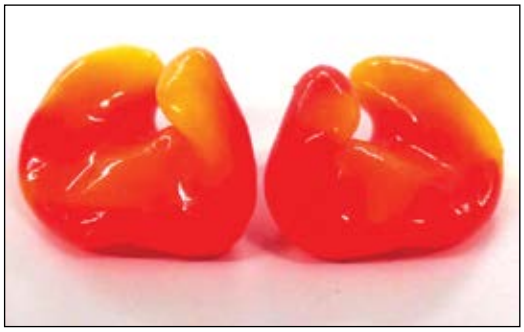

Fig. 3(a): Custom-molded earplugs

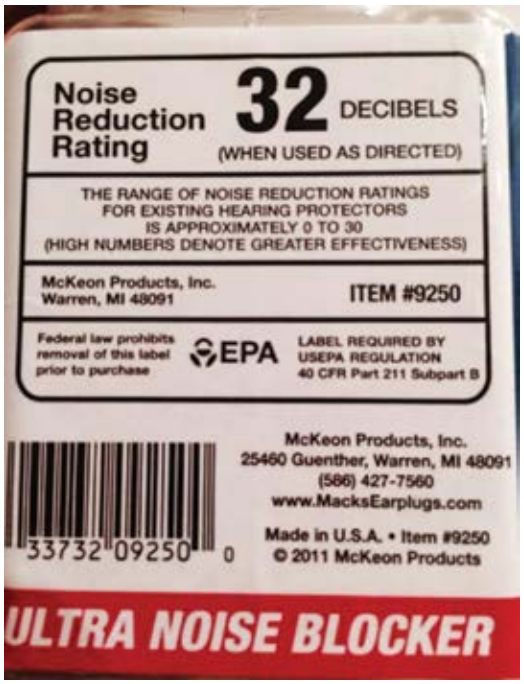

Fig. 3(b): Manufacturer's details on foam earplugs

References

1. "Workplace Safety & Health Topics—Noise and Hearing Loss Prevention," Centers for Disease Control and Prevention, Atlanta, GA, 2014, http://www.cdc.gov/niosh/topics/noise/. (last accessed March 30, 2015)

2. "Noise Exposure Computation," Occupational Safety & Health Administration, Washington, DC, 2015, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9736. (last accessed March 30, 2015)

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