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INVESTIGATIVE REPORT

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Acoustical Field Investigation

Lexco, Inc.
I.T.M. Mine and Mill
(ID #42-02044)
Randlett, Utah

by

Paul T. Kinevy

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INTRODUCTION

In response to a request from the Metal/Nonmetal Mine Safety and Health (MNMS&H) Rocky Mountain District, an acoustical field investigation was conducted at Lexco, Inc.'s I.T.M. Mine and Mill (ID #42-02044) located outside of Randlett, Utah, on February 14, 2001. The investigation into the noise exposures of four underground miners was conducted by Messrs. Paul Kinevy, Anthony Argirakis[2] and David Zuchelli[3].

In November 2000, Noise Citations #6271711 and #6271712 had been issued to the mine operator for overexposure to noise. Two miners working on the fourth level had been exposed to noise doses of 309% and 269.3% and two miners working on the bottom level were exposed to noise doses of 274.3% and 322.5%. This overexposure to noise was determined using the 90 dBA threshold level.

This report summarizes investigative procedures, lists results of data obtained and gives a description of noise controls currently being utilized.

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DESCRIPTION OF OPERATION

Lexco, Inc. mines a mineral known as gilsonite at this operation. Gilsonite is a type of asphaltite found in vertical seams or veins. These veins lie nearly parallel to each other and extend many miles in length, some as deep as 1500 feet (457m). At the I.T.M. Mine, the vein was approximately 4 feet (1.2m) wide. On the date of the investigation, the miners were working on the second and seventh levels.

Gilsonite is mined with a hand-held pneumatic chipping hammer. The chipping hammer (also referred to as a moiler) used at the I.T.M. Mine is manufactured by Sullair (Model MCH-4) (see Figure 1).

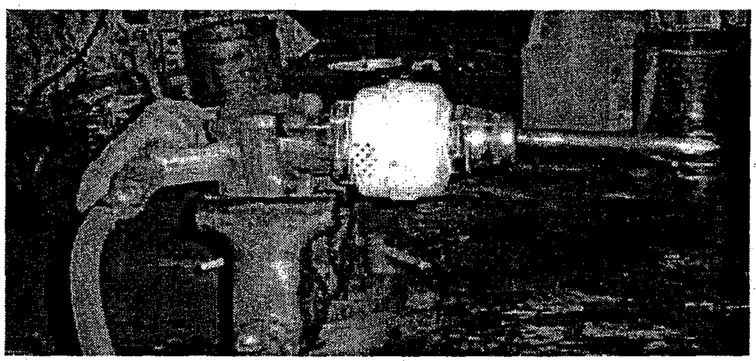

Figure 1 Sullair Chipping Hammer

The unique method of mining gilsonite requires one miner to penetrate the ore with the chipping hammer as he crawls up a 45 degree slope. Once this relatively soft, resinous hydrocarbon is freed from the vein, it falls to the lowest level and is captured by an air-lift (vacuum) system. The system is composed of sections of steel tubing 10 inches (25.4cm) in diameter. The tubing extends horizontally from the bottom of the slope to the shaft and then vertically to the surface. The system is powered by exhaust fans connected in series on the surface. A second miner (nipper) tends to the advancement and maintenance of the airlift system, as well as setting timbers horizontally between the walls. Once the first miner makes a complete cycle of mining up and then back down the slope, he exchanges duties with the second miner. This rotation of miners is an administrative control aimed at evenly distributing the actual mining time and, consequently, noise exposure time. This unique mining technique is illustrated in Figure 2.

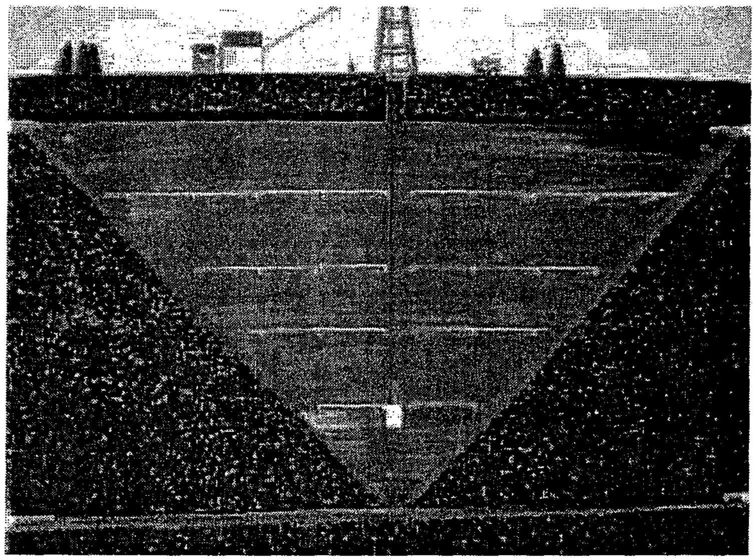

Figure 2 Model of Gilsonite Mine

INVESTIGATIVE PROCEDURES

All sound measuring and recording instrumentation were given a functional check and calibrated at the mine site prior to and after the investigation to ensure the integrity of the acoustical data collected.

Tape-recordings and sound-level-meter (SLM) measurements were made at various locations and conditions while the chipping hammer was operating. A noise dosimeter was also placed on each of the four miners during their entire shift. Photographs were taken in order to illustrate the hammer and muffler.

RESULTS

The tape-recorded data was processed by Mr. George Durkt[4]. A Bruël & Kjær (B&K) Model 2610 measuring amplifier and a B&K 2307 chart-level recorder were utilized to produce sound level (A-weighted) versus time strip charts. One-third-octave band spectra were then generated by analyzing tape samples on a B&K 2133 dual-channel real-time analyzer (RTA).

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Tape-recorded samples were taken at the operator's ear position except where otherwise noted. Table 1 provides a summary of the analysis of the tape-recorded data collected at various locations and conditions while mining on the slope (face).

TABLE 1. - Average Sound Levels While Mining

LOCATION / CONDITION	AVERAGE SOUND LEVELS	
	dBA*	Linear**
Level 7/Chipping gilsonite with eight hole add-on muffler .	94.5	96.9
Level 7/Chipping gilsonite with fourteen hole add-on muffler.	98.1	100.2
Level 7/Chipping gilsonite without a muffler.	106.4	111.2
Level 7/Intake of air slide.	97.5	103.5
Level 7/Along air slide, 3-feet (0.9m).	95.6	101.4
Level 7/Along air slide, 6-feet (1.8m).	96.8	102.2
Level 2/Next to miner chipping gilsonite with 14 hole add-on muffler (punching face).	98.1	99.8

*Sound level using an "A-weighted" network.
**Sound level using an unweighted network (flat response).

Table 2 lists the results of the noise dosimeter survey. The dosimeter's data includes approximately 30 minutes of travel time from the mill to the mine and 30 minutes of travel time on the return trip.

TABLE 2. - Dosimeter Survey Results

Occupation	90 dBA Threshold		80 dBA Threshold	
Miner	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 5 min 135.32 90.5 107.37	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 5 min 142.49 90.9 113.06
Miner	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 6 min 116.42 89.4 92.25	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 6 min 128.32 90.1 101.67
Miner	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 6 min 127.05 90.0 100.6	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 6 min 141.55 90.8 112.09
Miner	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 7 min 99.16 88.2 78.43	Run Time: % Dose: LAvg: Proj. Dose:	10 hrs: 7 min 116.02 89.4 91.76

DISCUSSION OF NOISE CONTROLS / RECOMMENDATIONS

Subsequent to the initial noise sampling, Lexco purchased and installed an off-the-shelf muffler (Ingersoll Rand, Part No. HHW1-A674). This muffler is illustrated in Figure 3.

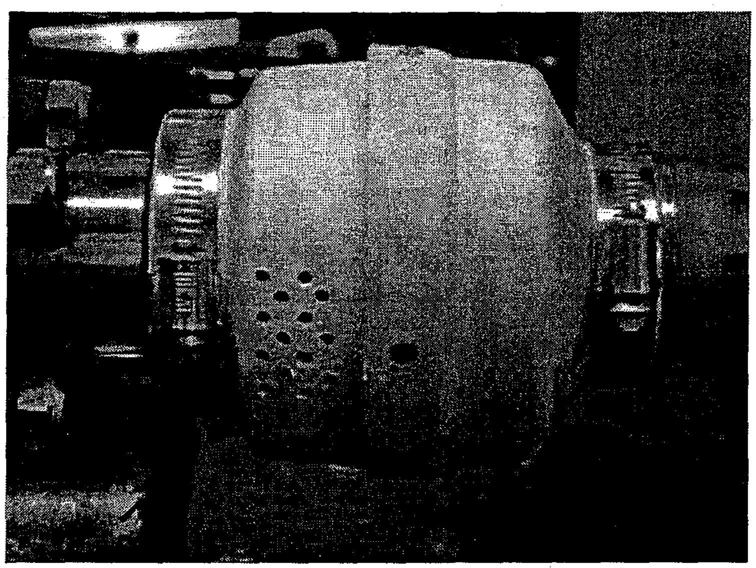

Figure 3 Add on Muffler for Sullair Chipping Hammer

The installation of the muffler resulted in an increase in back pressure, therefore, reducing the penetration rate of the chipping hammer. In an attempt to compensate for this loss of penetration, Lexco modified a few mufflers by drilling six additional holes in the muffler body. In order to evaluate the acoustical effectiveness of this modification, tape-recorded samples were made without the muffler and with both the eight and fourteen hole mufflers mounted on the chipping hammer.

The comparison of the acoustic attenuation (3.6 dBA) provided by the eight hole muffler to the fourteen hole muffler is illustrated in Figure 4, a composite graph showing the one-third-octave band frequency distribution of sound for the respective tape-recorded samples with each muffler.

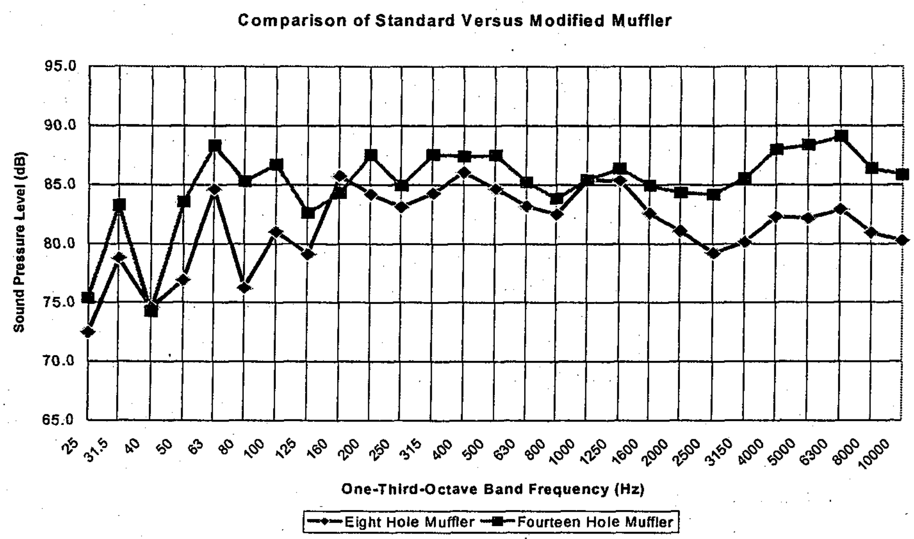

Figure 4 Frequency Distribution of Sound

The comparison of the acoustic attenuation (11.9 dBA) provided by the eight hole muffler to the chipping hammer without a muffler is illustrated in Figure 5, a composite graph showing the one-third-octave band frequency distribution of sound for the respective tape-recorded samples.

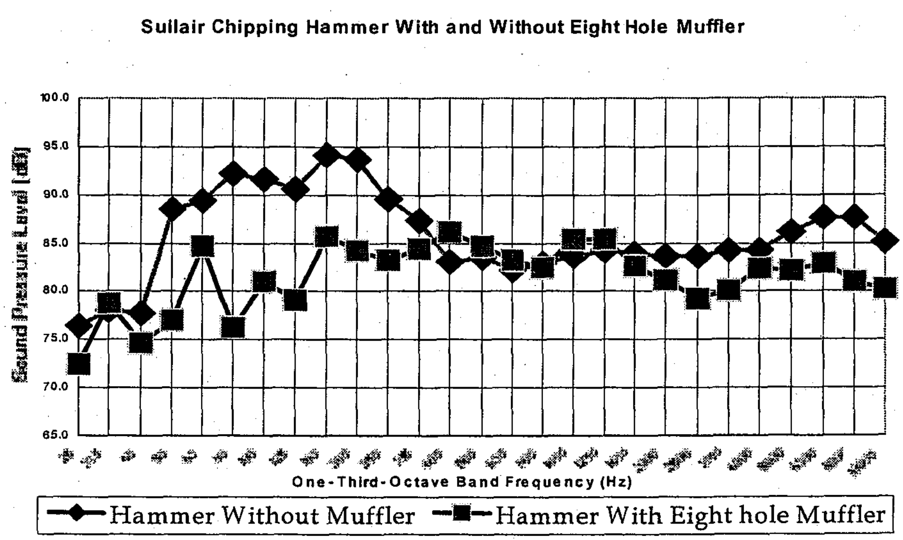

Figure 5 Frequency Distribution of Sound

The comparison of the acoustic attenuation (8.3 dBA) provided by the fourteen hole muffler to the chipping hammer without a muffler is illustrated in Figure 6, a composite graph showing the one-third-octave band frequency distribution of sound for the respective tape-recorded samples.

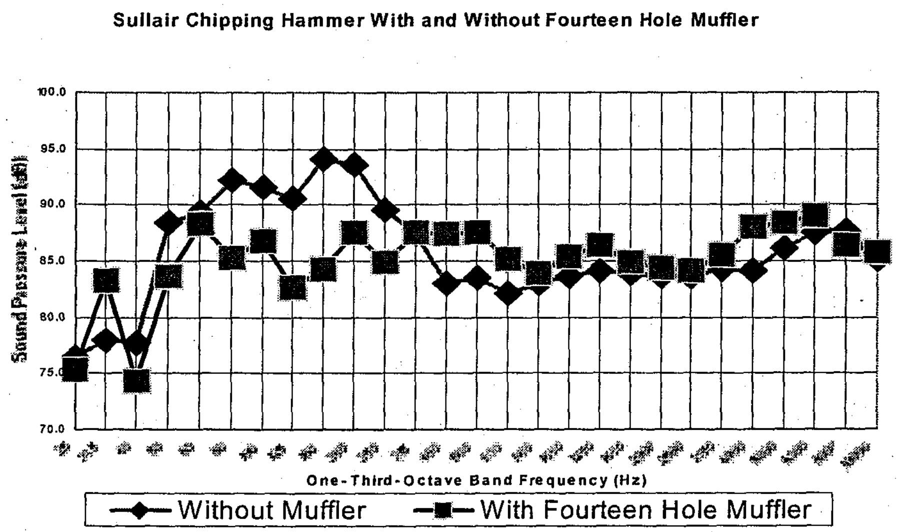

Figure 6 Frequency Distribution of Sound

It is evident from the data contained in Table 1, and graphically illustrated in Figures 4, 5 and 6, that the installation of the muffler significantly reduces the operational sound level of the chipping hammer by as much as 11.9 dBA. This significant reduction, coupled with the administrative control of evenly distributing the amount of actual mining time, manifested itself in the reduction of the individual noise doses contained in Table 2.

During the course of this investigation, it was noted that the lip inside the coupler, which connects the chipping hammer to the moiler bit, experienced considerable wear due to metal-to-metal contact (1700 blows per minute). A new coupler is illustrated on the right side of Figure 7 and a worn coupler is on the left side. Consideration should also be given to testing the effectiveness of a vibration isolation washer in the base of the coupler. This would eliminate the metal-to-metal contact of the bit against the coupler.

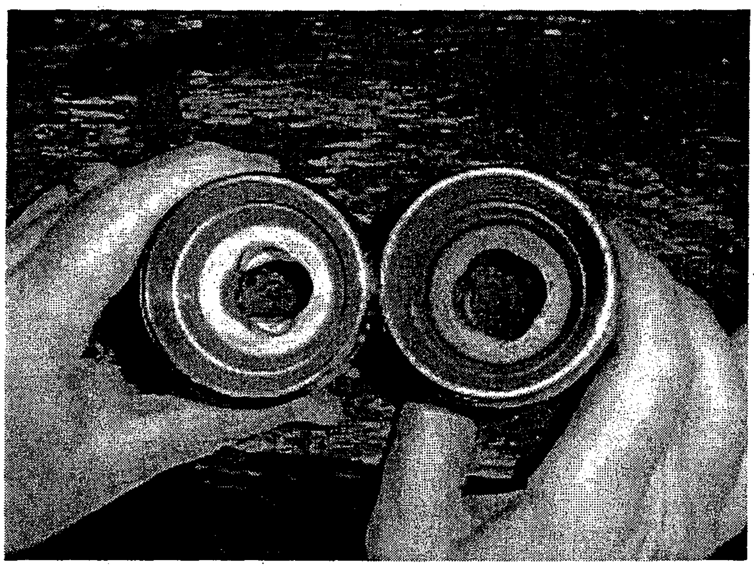

Figure 7 Coupler for Sullair Model MCH-4 Chipping Hammer

Currently, the only proven, effective engineering control for the Sullair chipping hammer is the installation of the add-on muffler. Some additional reduction in the sound level may be achieved by placing sound absorption material inside the muffler cavity. Another option is to fabricate a slightly larger muffler. Care should be taken when installing the muffler so that the exhaust holes are positioned on the side opposite the exhaust port on the hammer. The effective administrative control of worker rotation should be continued, as well as the use of personal hearing protection.

Paul T. Kinevy Date

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