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Occupational Asbestos Exposure Monitoring of Brake Replacement Activities on All-Terrain Vehicles (ATVs)

AUTHORS

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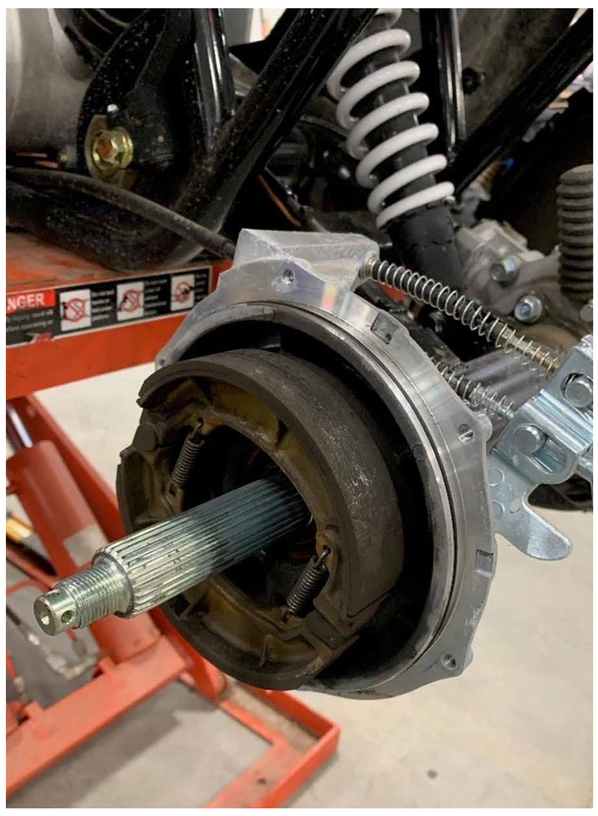
INTRODUCTION

Asbestos-containing brakes were discovered upon importation of all-terrain vehicles (ATVs) into a country with a ban on the use of asbestos-containing products. The authors of this study were involved with the bulk characterization of asbestos in the brakes along with the assessment of a mechanic during the replacement of brakes on several ATVs.

Asbestos was historically used in automotive friction products such as brakes and clutches, however, the known use of asbestos in brakes in the US is currently limited. In 2010, California and Washington prohibited the sale of asbestos-containing brakes (USEPA 2017, Washington State Legislature Chapter 70.285, Division 4.5 California Code of Regulations Title 22, Chapter 30). California evaluated the use of asbestos for light-, medium- and heavy-duty onroad vehicles and reported that 3% of the light- and medium-duty vehicles sampled contained asbestos, whereas none of the heavy-duty vehicles had asbestos-containing brakes (De Vita, Wall et al. 2012). Asbestos-containing brakes are still commonly found in certain countries, while other countries have bans on the use of asbestos as a constituent ingredient, which includes friction products. Asbestos has not been wholly banned as a constituent ingredient in products in the US. In 2016, asbestos was identified for evaluation of health risks by USEPA under the purview of the 2016 amendments to TSCA. The amendment requires USEPA to determine whether identified substances – in this case, asbestos – pose an unreasonable risk to human health or the environment.

USEPA is currently evaluating the risk associated with the handling of asbestos-containing brakes on automotive and utility vehicles (UTVs) in its Draft Risk Evaluation for Asbestos, which has not been finalized as of May 2020 (USEPA 2020).



METHODS

Prior to the commencement of brake replacement, 4 background air samples were collected in the work area to determine the background level of fibers and asbestos fibers on the day prior to the start of brake replacement activities. The samples were collected over a period of 1 hour at a flow rate of approximately 15 liters per minute (lpm).

An exposure assessment was conducted during the replacement of brakes from affected models of ATVs. All brakes used were from lots of products previously identified to contain asbestos and were previously worn in prior to replacement. The mechanic performed brake replacements on 8 ATVs during a single day following a removal procedure consistent with OSHA's "wet method" for automobile brake removal.

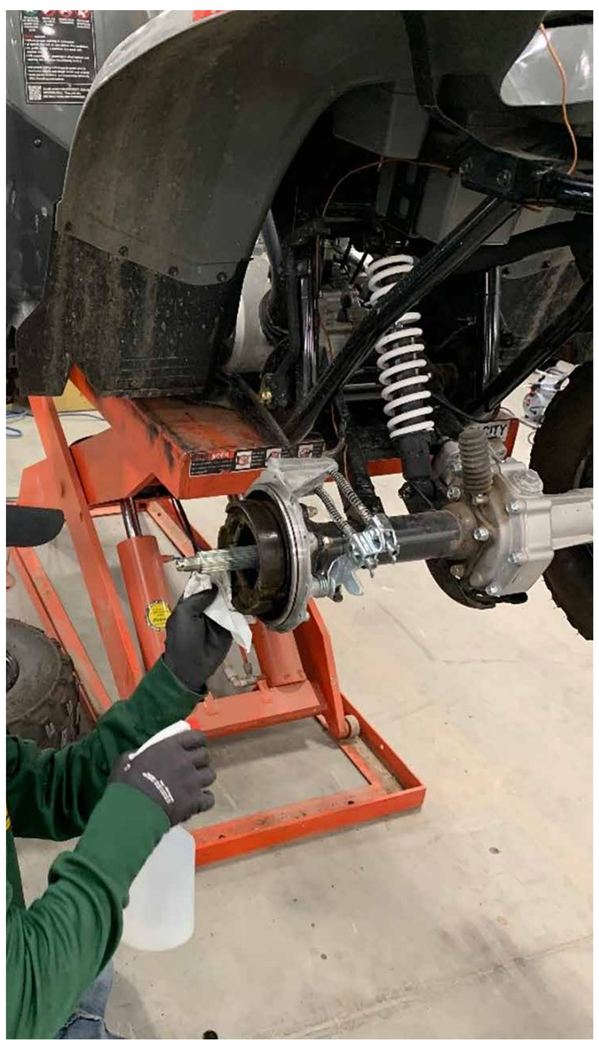
Three personal air samples were collected in the mechanic's breathing zone throughout the entire process of replacing the asbestos-containing brakes on an ATV. The personal air samples were collected by attaching a stationary high-flow pump to an employee with sufficient slack Tygon tubing to minimize interference with the mechanics movements. Stationary pumps were used to achieve a flow rate of approximately 15 lpm as compared to the flow rate of 4 to 5 lpm achievable by traditional personal sampling pumps, allowing for reduction of the detection limit by a factor of 3. Detection limits ranging from 0.008 to 0.016 fibers per cubic centimeter (f/cc) were achieved for personal samples.

Four area samples were collected from the corners of the work area during the brake replacement activity. The area samples were placed at a height of approximately 5 ft to be representative of the breathing zone of a bystander in the work area and the dispersion of fibers into the workplace. Area samples were collected at a flow rate of approximately 15 lpm, achieving detection limits ranging from 0.008 to 0.016 f/cc for area samples.

During each brake replacement activity, detailed field notes were recorded documenting the overall timing of the process, the timing of sub activities, the work methods and tools used during the process, and any deviations from OSHA's wet method for brake replacement. Background area samples over a period of 30 minutes from the stationary pumps used for area samples between each brake replacement. Area background samples were collected at a flow rate of approximately 15 lpm and achieving detection limits ranging from 0.005 to 0.006 f/cc for area background samples.

All air samples were transmitted under proper chain of custody to EMSL Analytical (EMSL) for analysis by NIOSH Method 7400 – Fibers by Phase Contrast Microscopy (PCM). For any samples where fibers were detected above the limit of detection by NIOSH Method 7400, EMSL further analyzed the samples by NIOSH Method 7402 – Asbestos by TEM to determine what percentage of the fibers detected were asbestos and obtain a PCM equivalent (PCME) asbestos concentration.

Each removed brake was placed in a sealed and labeled sample bag and transmitted under proper chain of custody to EMSL for analysis. EMSL tested all removed brakes by polarized light microscopy (PLM) and transmission electron microscopy (TEM) with non-friable organically bound material (NOB) preparation in accordance with USEPA Method 600/R-93/116.



RESULTS

Exposures were compared to the relevant occupational exposure limits, specifically, OSHA permissible exposure limits (PELs) and excursion limits (EL) for asbestos. The OSHA PEL is 0.1 f/cc as an 8-hour time-weighted average (TWA); the EL is 1.0 f/cc over a 30-minute period.

The exposure assessment did not identify any detectable levels of asbestos fibers during the exposure simulations. EMSL identified 1 area sample with detectable fibers at a level of 0.01 f/cc during analysis by PCM, which detects all fibers; no fibers were detected in personal or background samples. EMSL determined that the fibers detected in the single sample were not asbestos by TEM methodology and asbestos exposure for this sample was reported to be less than 0.0099 f/cc. The maximum detection limit in any sample was 0.016 f/cc, and the average detection limit for personal samples was 0.012 f/cc. A summary of the brake replacement times can be found in Table 1. A summary of exposure results for each ATV can be found in Table 2.

All brakes that were removed and replaced in the study were analyzed by the bulk analysis methods previously described to confirm their asbestos content. Brakes removed during the work were sent for analysis for verification that they were asbestos-containing. The brakes contained actinolite and/or chrysotile and tremolite ranging from 6% to 44.3% total asbestos by TEM.

Table 1. Brake replacement times

Vehicle	Time start	Time end	Total time
ATV 1	08:48	9:08	20
ATV 2	09:55	10:07	12
ATV 3	10:52	11:04	12
ATV 4	11:46	11:57	11
ATV 5	12:56	13:17	21
ATV 6	14:01	14:16	15
ATV 7	15:00	15:18	18
ATV 8	15:59	16:12	13

Table 2. Brake replacement exposure summary

	Vehicle	Minimum (f/cc)	Maximum (f/cc)	Average[a] (f/cc)
Personal	ATV 1	<0.009	<0.009	0.005
	ATV 2	<0.014	<0.015	0.007
	ATV 3	<0.014	<0.015	0.007
	ATV 4	<0.016	<0.016	0.008
	ATV 5	<0.008	<0.009	0.004
	ATV 6	<0.012	<0.012	0.006
	ATV 7	<0.01	<0.01	0.005
	ATV 8	<0.013	<0.014	0.007
Area	ATV 1	<0.008	<0.009	0.004
	ATV 2	<0.014	<0.015	0.007
	ATV 3	<0.014	<0.015	0.007
	ATV 4	<0.015	<0.016	0.008
	ATV 5	<0.008	<0.009	0.005
	ATV 6	<0.011	<0.012	0.005
	ATV 7	<0.009	<0.01	0.007
	ATV 8	<0.013	<0.014	0.006

[a] Average calculated using 1/2 of the limit of detection as value for non-detect results

CONCLUSION

The results of this study indicate that relying on OSHA's wet method guidance for automobile brake removal when removing asbestos-containing brakes on ATVs – consistent with the conditions of this assessment – would lead to controlled exposures; that is, the asbestos exposures during ATV brake replacements would be well below the OSHA PEL or EL for asbestos.

The presence and amount of tremolite and actinolite asbestos identified in bulk samples was particularly notable as these forms of asbestos have not been historically added as a constituent in brakes.

References available upon request.