Bull. Environ. Contam. Toxicol. (1988) 40:703–706

Bulletin of Environmental Contamination and Toxicology

Absence of Asbestos in Municipal Sewage Sludge Ashes

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In earlier studies (Bishop et al. 1985; Patel-Mandlik et al. 1987), asbestos was found in sewage sludges in several cities in the United States using x-ray diffraction, high power light optical microscopy, polarized light microscopy or electron microscopy. In a number of cities in the United States, sewage sludge is incinerated at temperatures up to 1,000°C. Temperatures of 550°C or higher dehydroxylate the asbestos lattice resulting in alteration or even destruction of the mineral (EPA 1982). Since refractive index and other key parameters used to identify asbestos minerals change above 550°C, it was of interest to analyze for the presence of asbestos in typically produced municipal sludge ashes. In the work reported here, sewage sludge ashes from 10 American cities were obtained and analyzed for the presence of asbestos.

MATERIALS AND METHODS

The sludge ashes obtained and details pertaining to their treatment during incineration are given in Table 1. All of the sludges were dewatered by vacuum filtration and the final ash remaining after incineration was disposed by landfilling. The process may include addition of ferric chloride or aluminum sulfate to precipitate phosphates and addition of polymers as a settling agent for suspended solids and phosphate floc during primary sedimentation. Addition of lime may also be used to precipitate heavy metals and other solids. The resulting solids are largely dewatered by vacuum filtration or centrifugation. The solids may then be fed into the top of the incinerator where they are further dried, incinerated and cooled as they progress toward the bottom where the ash collects and is removed by trucking or sluicing. Exhaust scrubbers remove the fly ash which may then be conveyed back and added (as a filtering aid) to incoming sewage prior to its primary sedimentation. In some cities the sludge that is incinerated is a mixture of dewatered primary and excess activated sludge.

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Table 1. Data pertaining to municipal sewage sludge incinerator ashes studied.

City	Sewage treatment plant	Ratio (%) industrial: domestic contribution	Combustion unit	Combustion temp. °C	Feed rate tons/h[a]	Additives
Dunkirk, NY	Dunkirk Wastewater Treatment Plant	60:40	Multiple (5) hearth	870	3	Ferric chloride, lime
Grand Rapids, MI	Grand Rapids Wastewater Treatment Plant	30:70	Multiple (7) hearth	up to 980	4	Ferric chloride, lime
Greensboro, NC	North Buffalo Sewage Treatment Plant	30:70	Multiple (5) hearth	870	2.5	Polymer
Hilton, NY	Northwest Quadrant Treatment Plant	2:98	Multiple (6) hearth	775-870	4	Aluminum sulfate
Indianapolis, IN	Dept. of Public Works	70:30	Multiple (8) hearth	800-1000	5	Dry sludge ash
Kalamazoo, MI	City of Kalamazoo Treatment Plant	50:50	Multiple (7) hearth	775	7	None
Lorton, VA	Lower Potomac Treatment Plant	10:90	Multiple (6) hearth	775-870	5	Ferric chloride, lime
Naugatuck, CT	Borough Naugatuck Wastewater Treatment Plant	50:50	Multiple (7) hearth	775-870	6	Ferric chloride lime, aluminum sulfate, polymer
Saginaw, MI	Saginaw Wastewater Treatment Plant	Heavily industrial	Multiple (6) hearth	870-925	5	Ferric chloride, lime
Youngstown, OH	Youngstown Wastewater Treatment Plant	25:75	Multiple (7) hearth	800	6	Ferric chloride, lime

[a]Moist sludge cake.

The sludge ashes received were air dried, pulverized in a hammermill containing a 3-mm sieve, mixed by tumbling and subsampled for analysis of asbestos. Each sample was thoroughly examined under a stereo binocular microscope and the fibrous material was removed and mounted for polarized light microscopy.

RESULTS AND DISCUSSION

The results of analysis of the sludge ash samples are given in Table 2. Whereas glass fibers were detected in three of the ash samples (Indianapolis, Naugatuck and Saginaw) asbestos fibers were not detected in any of them.

Table 2. Results of analysis of the sewage sludge ashes for asbestos fibers.

City	Color of ash	Asbestos present	Comments
Dunkirk, NY	Rust	Negative	
Grand Rapids, MI	Beige	"	
Greensboro, NC	Rust	"	
Hilton, NY	Tan	"	
Indianapolis, IN	Rust	"	Glass fibers present
Kalamazoo, MI	Light grey	"	
Lorton, VA	Brown	"	
Nangatuck, CT	Light rust	"	Blue glass fibers present
Saginaw, MI	Tan	"	Glass fibers present
Youngstown, OH	Beige	"	

The absence of detectable asbestos fibers in sewage sludges is not unexpected. The high temperatures of incineration are sufficient to alter the mineral form. The high organic matter content of sewage sludges may also contribute to the destruction of silicate minerals. Reducing reactions, brought about by carbon particles formed during coal combustion, have been reported (France et al. 1984). Carbon radicals, formed during incineration of the highly organic sewage sludges, may abstract oxygen from the asbestos structure, thus altering it. The toxicology associated with such altered asbestos structures is unknown. One might conclude that the absence of asbestos fibers in the sludge ashes could have been due to their absence in the original sludges before incineration. This is possible but asbestos fibers were found in 10 of 20 municipal sewage sludges analyzed earlier (Bishop et al. 1985; Patel-Mandlik et al. 1987). Asbestos in sewage sludge could result from fibers present in wastewater from the use of the many asbestos-containing products (tiles, gaskets, shingles, packings, friction products or textiles). The corrosive effects of wastewater on asbestos-cement pipes may also contribute to asbestos in sewage sludge. However, a study of the effects of drinking water on asbestos-cement pipes did not show a significant

difference in the asbestos levels of "before pipe" and "after pipe" samples (Hallenbeck et al. 1978).

One of the major problems in proper solid waste disposal or utilization is the unpredictable variability of its composition with time. Considering sludge ashes, this problem complicates their disposal in landfills or utilization, for instance, as an additive to cement. It may also necessitate individualized engineering techniques when such sludges are incinerated. The fact that incineration of sludges may indeed destroy asbestos is important since destruction of solid wastes by combustion methods is receiving major attention by federal and state regulatory agencies presently.

REFERENCES

Bishop K, Ring SJ, Zoltai T, Manos CG, Ahrens VD, Lisk DJ (1985) Identification of asbestos and glass fibers in municipal sewage sludges. Bull Environ Contam Toxicol 34:301-308

Environmental Protection Agency (1982) Interim method for the determination of asbestos in bulk insulation samples. EPA-600/M4-82-020, Environmental Monitoring Systems Laborarory, Research Triangle Park, NC 27711

France JE, Grimm U, Anderson RJ, Kovack JJ (1984) Deposition and corrosion in gas turbines utilizing coal or coal-derived fuel. US Department of Energy Publication, DOE/METC/84-17, Morgantown, WV

Hallenbeck WH, Chen EH, Hesse CS, Patel-Mandlik KJ, Wolff AH (1978) Is chrysotile asbestos released from asbestos-cement pipe into drinking water? J Amer Water Works Assn 70:97-102

Patel-Mandlik KJ, Manos CG, Lisk DJ (1987) Identification of asbestos and glass fibers in sewage sludges in small New York State cities. Chemosphere (accepted for publication)

Received October 16, 1987; accepted December 26, 1987.