



Asbestos Pipe-Insulation Removal System



Developer: Carnegie Mellon University
Contract Number: DE-AR21-93MC30362
Crosscutting Area: Robotics

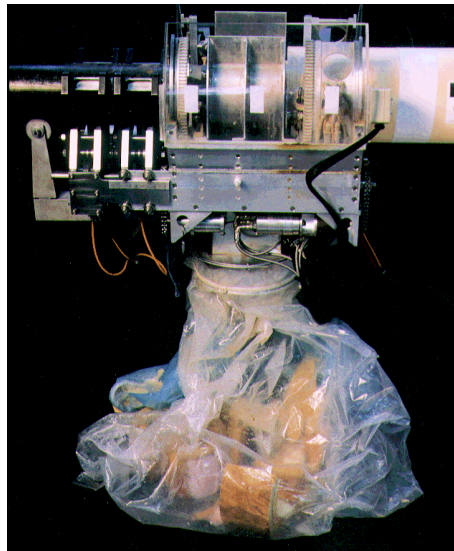
Deactivation & Decommissioning
FOCUS AREA

Problem:

Most of the steam and process piping in Department of Energy (DOE) facilities is clad and insulated with asbestos-containing materials (ACM), which must be removed before any deactivation and decommissioning (D&D) activity. Manual removal is expensive and time consuming because of the carcinogenic nature of asbestos fibers, radiological contamination, and abatement regulations from EPA and OSHA. Current manual methods require substantial infrastructure for scaffolding, containment areas, and air monitoring, which results in low asbestos-removal rates.

Solution:

Carnegie Mellon University (CMU) is developing a mechanical asbestos-removal system, dubbed BOA. BOA can be remotely placed on the outside of the pipe and can crawl along the pipe, wetting the ACM, encapsulating and stripped pipe, and bagging the removed insulation. Careful attention to vacuum and entrapment air flow ensures that the system can operate without a containment area while meeting local



and Federal standards for fiber-count.

Benefits:

- ▶ Asbestos removal from pipe sizes from 4 to 8 inches in diameter
- ▶ Increased asbestos-removal rates
- ▶ Reduction in number of abatement personnel
- ▶ Fully contained and sealed operations
- ▶ Continuous asbestos removal and packaging for easy processing and disposal

Technology:

The general configuration of the BOA system is that of an on-pipe self-locomoting removal head with an off-pipe control and handling system tethered to an off-board HEPA vacuum and liquids supply system. The removal head is manually placed with the assistance of a work-positioner, while the operator controls the robot via a touch-pendant. The removed insulation is vacuumed into a stationary HEPA vacuum system and manually bagged at the separator. The removal head can also be placed on pipes using a mobile boom-vehicle, allowing the system to work on pipes from 8 feet to 60 feet above ground. BOA can travel on pipe of 4 inches in diameter; crawls past hangers unassisted; is helped around obstacles such as valves; cuts through various types of insulation cladding, such as plaster-tape, aluminum lagging, wire-mesh, plastic boots and pipe-clamps; adapts to inconsistent insulation thickness; and reduces fiber emissions to allowable level while feeding removed ACM and lagging into a vacuum-fed bagging and waste water separator system.



Lagging and insulation are cut using a hybrid endmill and water-jet cutter, and diced into 2-inch cube sections of ACM. These are removed from the pipe using a set of blasting fan-spray nozzles, and vacuumed off through the vacuum hose.

Asbestos fibers are contained by drawing a vacuum on the entire removal module using the off-board HEPA vacuum. A separate fluid system provides sealant to spray the stripped pipe with an encapsulant material. Sensing on the removal head to detect and avoid obstacles consists of a hall-effect sensor, an infrared light-curtain and a set of bump switches.

The removed insulation sections are transported to the HEPA system where the waste and water are separated and the ACM is bagged using standard techniques. The water is recycled for continued use in the abatement. The bagged insulation can be taken to a disposal site for further treated.

All the integration of subcomponents has been completed. Tests at this CMU facility are being performed. The system will be tested at the Oak Ridge National Laboratory (ORNL) and K-25 facility.

The Field Robotics Center (FRC) at CMU's Robotics Institute has been developing field robot prototypes for remote and hazardous environments for over 10 years. The FRC is currently performing contract work for the DOE, NASA, ARPA, and the DOD among others. For information regarding this project, the contractor contact is:

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