



## System for Removing Pollutants From Incinerator Exhaust

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A system for removing pollutants — primarily sulfur dioxide and mixed oxides of nitrogen ( $\text{NO}_x$ ) — from incinerator exhaust has been demonstrated. The system is also designed secondarily to remove particles, hydrocarbons, and CO. The system is intended for use in an enclosed environment, for which a prior  $\text{NO}_x$ -and- $\text{SO}_2$ -removal system designed for industrial settings would not be suitable. The incinerator exhaust first encounters a cyclone separator, a primary heat exchanger, and a fabric filter that, together, remove particles and reduce the temperature to 500 °C. The exhaust then passes through a porous bed, main-

tained at  $\approx 450$  °C, that contains  $\text{Na}_2\text{CO}_3$ , which absorbs  $\text{SO}_2$ .

Next, a commercial catalyst maintained at 400 °C accelerates the oxidation of the carbon in hydrocarbons to CO and  $\text{CO}_2$ . A heat exchanger then cools the exhaust to  $\approx 300$  °C before passage over a catalyst that causes 95 percent of the NO to be oxidized to  $\text{NO}_2$ . The first of two water scrubbers removes most of the  $\text{NO}_2$ , which is converted to  $\text{KNO}_3$  and  $\text{KNO}_2$ . The second water scrubber contains sodium bisulfite, which, with an aminophenol catalyst, converts most of the remaining  $\text{NO}_2$  to  $\text{N}_2$ .

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*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

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*Refer to MSC-23440-1, volume and number of this NASA Tech Briefs issue, and the page number.*

## Sealing and External Sterilization of a Sample Container

This method would enable safe transport of a biologically hazardous sample.

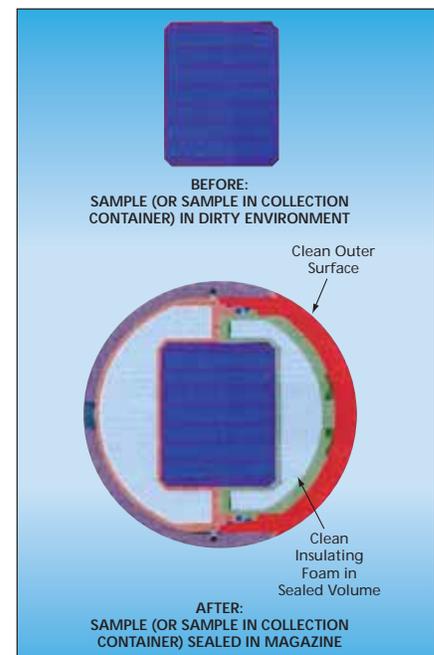
NASA's Jet Propulsion Laboratory, Pasadena, California

A method of (1) sealing a sample of material acquired in a possibly biologically contaminated (“dirty”) environment into a hermetic container, (2) sterilizing the outer surface of the container, then (3) delivering the sealed container to a clean environment has been proposed. This method incorporates the method reported in “Separation and Sealing of a Sample Container Using Brazing” (NPO-41024), *NASA Tech Briefs*, Vol. 31, No. 8 (August 2007), page 42. Like the previously reported method, the method now proposed was originally intended to be used to return samples from Mars to Earth, but could also be used on Earth to transport material samples acquired in environments that contain biological hazards and/or, in some cases, chemical hazards.

To recapitulate from the cited prior article: the process described therein is denoted “S<sup>3</sup>B” (separation, seaming, and sealing using brazing) because sealing of the sample into the hermetic container, separating the container from the dirty environment, and bringing the container with a clean outer surface into the clean environment are all accomplished simultaneously with an inductive-heating

brazing operation. At the beginning of the process, the sample container is the inner part of a double-wall container, and the inner and outer parts of the double-wall container are bonded together at a flange/braze joint at the top. By virtue of this configuration, the inside of the sample container is exposed to the dirty environment while the outer surface of the sample container is isolated from the dirty environment.

During the S<sup>3</sup>B process, a lid that is part of a barrier assembly between the dirty and clean environments becomes brazed onto the sample container, and the sample container with the lid attached becomes separated from the outer part of the double-wall container and is pushed into the clean environment. The brazing material is chosen to have a sufficiently high melting temperature (typically >500 °C) so that the brazing process sterilizes the outer surface of the lid/wall seam region of the newly created hermetic container. The outer surface of the inner container is covered with a layer of thermal-insulation material to prevent heat damage of the sample during brazing. Alternatively, in an application in which there is no concern about



A Sample Would Be Packaged in a magazine with redundant mechanical and brazed seals. Prior to sealing, the surfaces destined to become the outside surface of the magazine would be kept isolated from the dirty sample-collection environment. As an extra precaution, after sealing, the outside surface could be sterilized by ignition of pyrotechnic paint.