Manufacturing & Prototyping

System for Removing Pollutants From Incinerator Exhaust

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A system for removing pollutants — primarily sulfur dioxide and mixed oxides of nitrogen (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 NO_x-and-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, maintained at ≈ 450 °C, that contains Na_2CO_3, which absorbs SO_2.

Next, a commercial catalyst maintained at 400 °C accelerates the oxidation of the carbon in hydrocarbons to CO and CO_2. A heat exchanger then cools the exhaust to ≈ 300 °C before passage over a catalyst that causes 95 percent of the NO to be oxidized to NO_2. The first of two water scrubbers removes most of the NO_2, which is converted to KNO_3 and KNO_2. The second water scrubber contains sodium bisulfite, which, with an aminophenol catalyst, converts most of the remaining NO_2 to N_2.

This work was done by David T. Wickham, James Bahr, Rita Dubovik, Steven C. Gebhard, and Jeffrey Lind of TDA Research, Inc. for Johnson Space Center. For further information, contact the JSC Innovative Partnerships Office at (281) 483-3809.

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.

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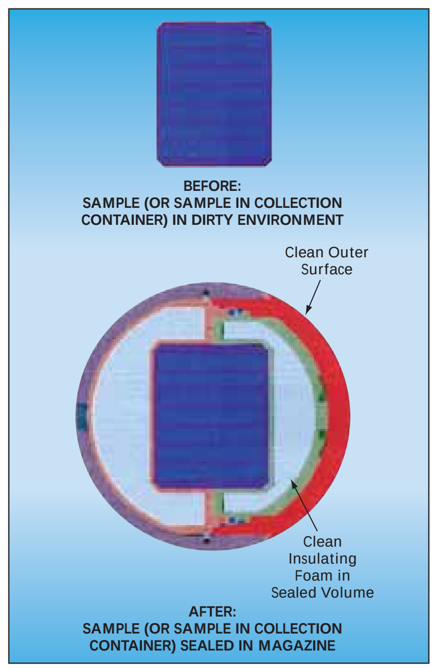
A method of (1) sealing a sample of material acquired in a possibly biologically contaminated ("dirty") environment into a hermetic container, (2) sterilizing the outer surface of the container, then (3) delivering the sealed container to a clean environment has been proposed. This method incorporates 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^3B" (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^3B 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.

biological contamination, it could be feasible to substitute a lower-melting-temperature solder for the brazing material.

The method now proposed goes beyond what was reported previously by providing for container-design modifications and additional process steps to ensure cleanliness and delivery of a hermetically enclosed dirty sample to a clean environment. Implementation of the proposed method in the original intended Mars-to-Earth application would entail the use of dedicated machinery in a multistep augmented version of the previously reported S^3B process that would result in sealing of the sample in a magazine and (see figure) and placement of the magazine in the nose cone of a spacecraft. Modified versions of the machinery and process, without provision for placement in a nose cone, could be devised for terrestrial applications. One feature of the outer-space process that might be useful in some terrestrial applications would be coating the outer surface of the magazine with a pyrotechnic paint, which would be ignited to insure sterilization before releasing the magazine into the clean environment.

The method as now proposed also provides additional options to choose materials and process conditions to suit specific applications. These options include the following:

- The sample container and the lid could be made of a nonmetallic material, in which case a mixture of plastic and metallic particles could serve as an appropriate lower-melting-temperature alternative to a brazing material. The metallic particles would render the mixture amenable to inductive heating, so that the plastic component could be melted to make or break a seal.
- During brazing or during the cooldown after brazing, expansion or contraction, respectively, of the gas inside the sample container could push the brazing material away from the desired braze joint. One way to limit expansion and contraction to a harmlessly low level would be to line the inside of the sample container with a thermally insulating material.
- Instead of trying to limit the aforementioned expansion and contraction, one could fabricate the sample container with a small breathing hole to accommodate the expansion and contraction. The hole would be sealed in a small, localized brazing operation after the main S^3B brazing operation.

This work was done by Yoseph Bar-Cohen, Mircea Badescu, Xiaoqi Bao, Stewart Sherrit, and Ayoola Olorunsola of Caltech for NASA's Jet Propulsion Laboratory.

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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