

Ammonia Analysis by Gas Chromatography/Infrared Detector (GC/IRD)

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Methods are being developed at Marshall Space Flight Center's Toxicity Lab on a GC/IRD System that will be used to detect ammonia in low part per million (ppm) levels. These methods will allow analysis of gas samples by syringe injections. The GC is equipped with a unique cryogenic-cooled inlet system that will enable our lab to make large injections of a gas sample. Although the initial focus of the work will be analysis of ammonia, this instrument could identify other compounds on a molecular level. If proper methods can be developed, the IRD could work as a powerful addition to our offgassing capabilities.



Agilent 6890 Gas Chromatograph/Infrared System

Conditions for Analysis:

40 μ l injection of 100 ppm Ammonia Gas Standard
Oven Temp: -20°C for 4 min, Ramp $50^{\circ}\text{C}/\text{min}$ to 400°C
Carrier Gas: Helium 4.5 ml/min Constant Flow Rate
Column: Restek RT-Q-Plot, 30 m, 0.32 mm ID

Packed Quartz Liner

Specs of the Inlet Liner:

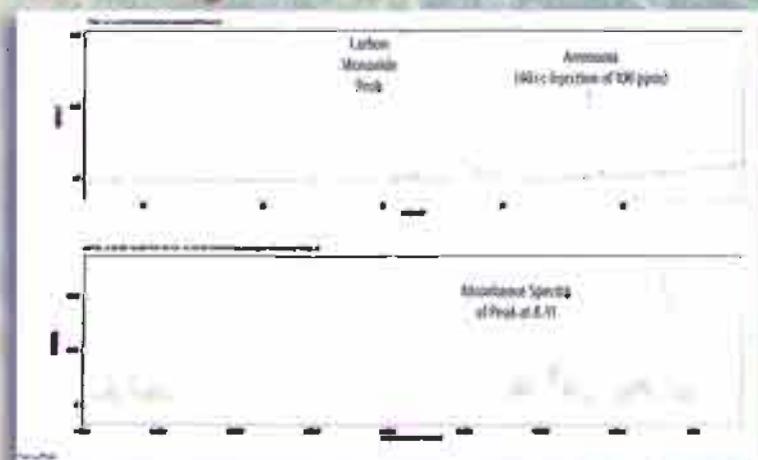
Joint Analytical Systems (JAS) UNIS 2000 Injection System

The inlet is cryogenically cooled using LN_2 to trap the gases on the packed liner.

Inlet Temp: -75°C for 2.5 min, Ramp $720^{\circ}\text{C}/\text{min}$ to 250°C



Chromatogram of the Ammonia Standard



Spectral Library Identification of the Ammonia Standard



Initial development of the testing performed included:

1. Injecting known amounts of a certified gas standard (100 ppm ammonia) by gas tight syringe.
2. Determining the proper temperatures and run times for the ammonia analysis.
3. Determining the elution time and verifying the identification of the ammonia.

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The research performed during this testing applies to standard NASA-STD-6001 Determination of Offgassed Products-Test 7.



Toxicity Lab: Marshall Space Flight Center performs all Materials and Flight Hardware Offgas testing in the Materials Combustion Research Facility's Toxic Offgassing Lab in Building 4623.



Toxicity Lab Oven Room: Materials and Flight Hardware Assemblies are loaded into these two ovens for testing. Chart recording devices and internal thermocouples continuously monitor the oven temperatures.



Experiment Hardware After Removal from Mounting Plate



Flight Hardware Positioned Over Test Chamber Using Lifting Bracket



Hardware Being Lowered Into Test Chamber

These pictures show the loading of the Optical Properties Monitoring experiment, slated for flight aboard the International Space Station (ISS), into the Toxicity test chamber.

The Determination of Offgassed Products Test is utilized to determine the identity and quantity of volatile organic offgassed products from materials and assembled articles. Test articles are measured, weighed, and loaded into various size clean chambers. The chamber is purged with high purity air, then sealed and loaded into an oven where it will be thermally conditioned at $49 \pm 3^\circ\text{C}$ for 72 hours. Subsequently, the chamber is removed from the oven and allowed to cool to ambient temperature. Gas samples are collected from the chamber by syringe and analyzed using Gas Chromatography/Mass Spectrometry (GC/MS) techniques. The data obtained from this analysis determines the quantity of the material that may be flown safely in the habitable areas of the spacecraft. This test also determines if flight hardware assemblies may be flown safely in the habitable areas of the spacecraft. This test is performed to ensure the safety of the crew aboard the Space Shuttle and the *International Space Station*.



Lid of Test Chamber Being Secured