

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



January 31, 2014

MATERIALS LABORATORY FACTUAL REPORT

Report No. 14-009

A. ACCIDENT INFORMATION

Place : Lake Ozark, Missouri
Date : June 28, 2013
Vehicle : Bell 47D
NTSB No. : CEN13LA396
Investigator : Mitchell Gallo

B. COMPONENTS EXAMINED

Debris found in carburetor bowl, carburetor screen and fuel sump.

C. DETAILS OF THE EXAMINATION

A container with the combined material found in the accident aircraft's carburetor bowl, carburetor screen and fuel sump was submitted to the Materials Laboratory to determine the identity of the debris. The material is shown in Figures 1 and 2.

The unknown materials was visually examined using a 5x to 50x stereo zoom microscope and a scanning electron microscope (SEM). Under magnification, the material in the container was a grey-colored crystalline powder with a clump of cloth-like fibers present. The particle size was not uniform. A micrograph of the material is shown in Figure 3.

The unknown material was examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory¹ in accordance to ASTM E1252-98 and ASTM E334-01². The spectrometer was used to

¹ An IR spectrum is created when a molecule converts infrared radiation into molecular vibrations. There are two types of molecular vibrations: stretching and bending. These vibrational movements create bands in a spectrum that occur at specific wavelengths (cm^{-1}). Each wavelength is dependent on a number of factors including the mass of the atoms present, the force constants of the bonds present, and the geometry of the molecule present. Infrared spectra can help in identifying the chemical composition and/or bonding present in an unknown molecule. The spectrometer emits a broad band of infrared light through the specimen. Depending on the bonding present, the light will be absorbed, transmitted, or reflected at various wavelengths. From the spectrum produced, information about the bonding present is obtained from the location of group frequency peaks. Most spectra contain additional "fingerprint" peaks that are unique to a particular molecular structure. All molecules have a unique spectrum in IR.

² American Society for Testing Materials E1252-98: Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis and American Society for Testing Materials E334-01: Standard Practice for General Techniques for Infrared Microanalysis.

collect and process infrared wavelength absorbance spectrum of the sample³. The spectra contained two strong peak patterns: a broad peak pattern from $\sim 1200\text{-}900\text{ cm}^{-1}$ which is often indicative of a silicon-oxygen bond asymmetrical stretching vibrations and a strong single peak around $\sim 775\text{ cm}^{-1}$ which is indicative of symmetrical stretching vibrations of a silicon-oxygen bond. The spectrum of the unknown material was processed through a spectral library search engine. The search found several matches to the unknown material. The matches were all silicon oxide/glass based materials.

The unknown material was then analyzed by scanning electron microscopy (SEM) and quantitative standardless energy dispersive x-ray spectroscopy (EDS) in accordance with ASTM E1508⁴. The EDS analysis showed the presence of aluminum, silicon, and oxygen. These constituents are consistent with silicon dioxide.

According to investigators, the accident aircraft had been recently painted and the use of glass blasting media for paint removal was suspected. The morphology and the FTIR and EDS spectra of the unknown material is consistent with used silicon glass blasting media. Due to the condition of the particles, grit size could not be determined.

Nancy B. McAtee
Chemist

³ The samples from this aircraft were analyzed using the reflective mode. In reflective mode, the infrared beam is passed through the sample and then reflected off of a reflective IR plate and passed back through the sample where it is detected and analyzed.

⁴ American Society for Testing Materials E1508 Standard Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy, 2008.

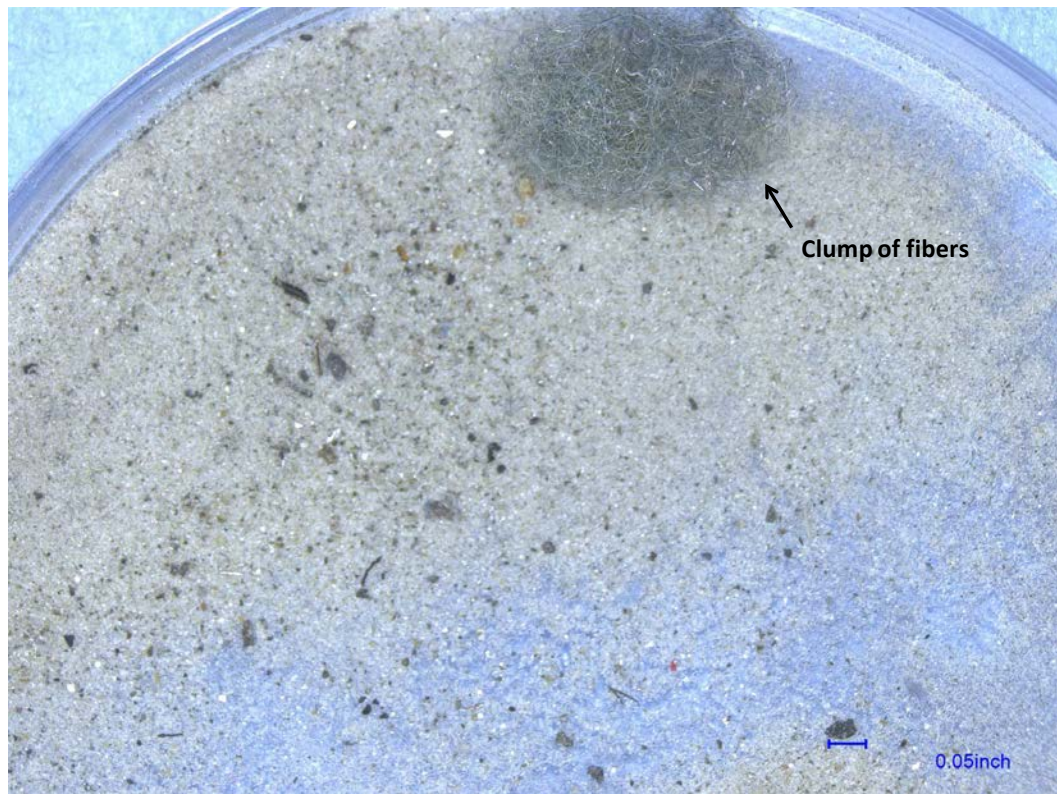


Figure 1. Overall photograph of submitted material.

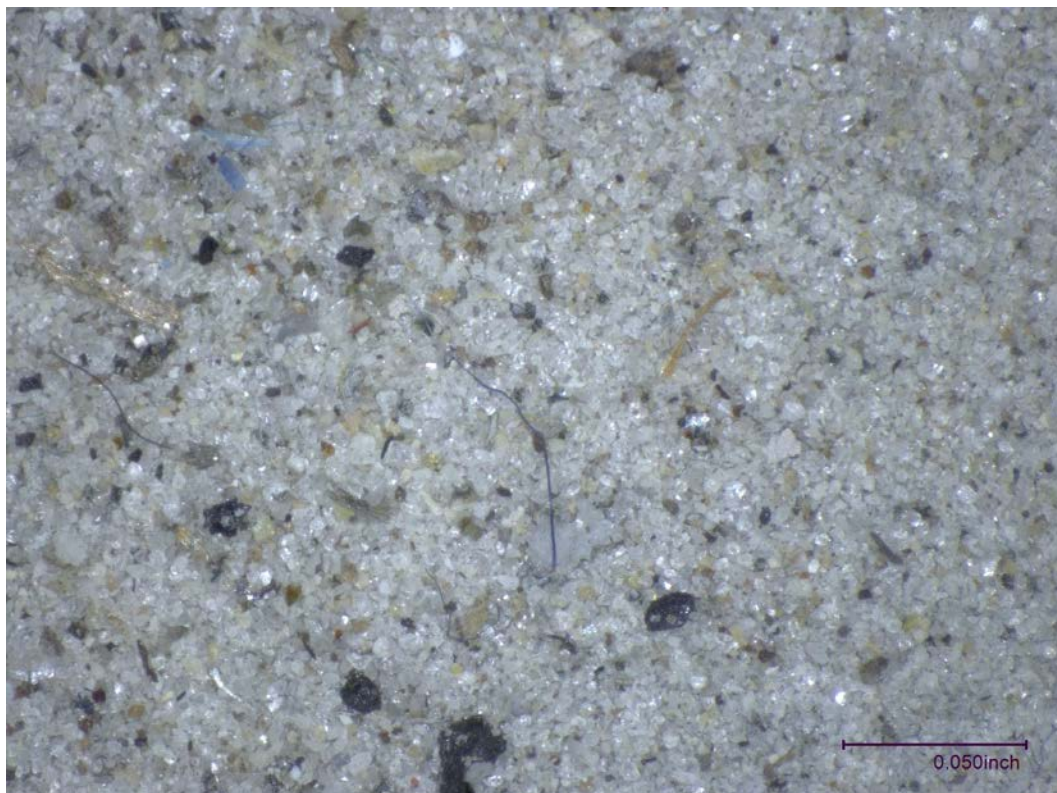


Figure 2. Close-up photograph of grey crystalline powder.

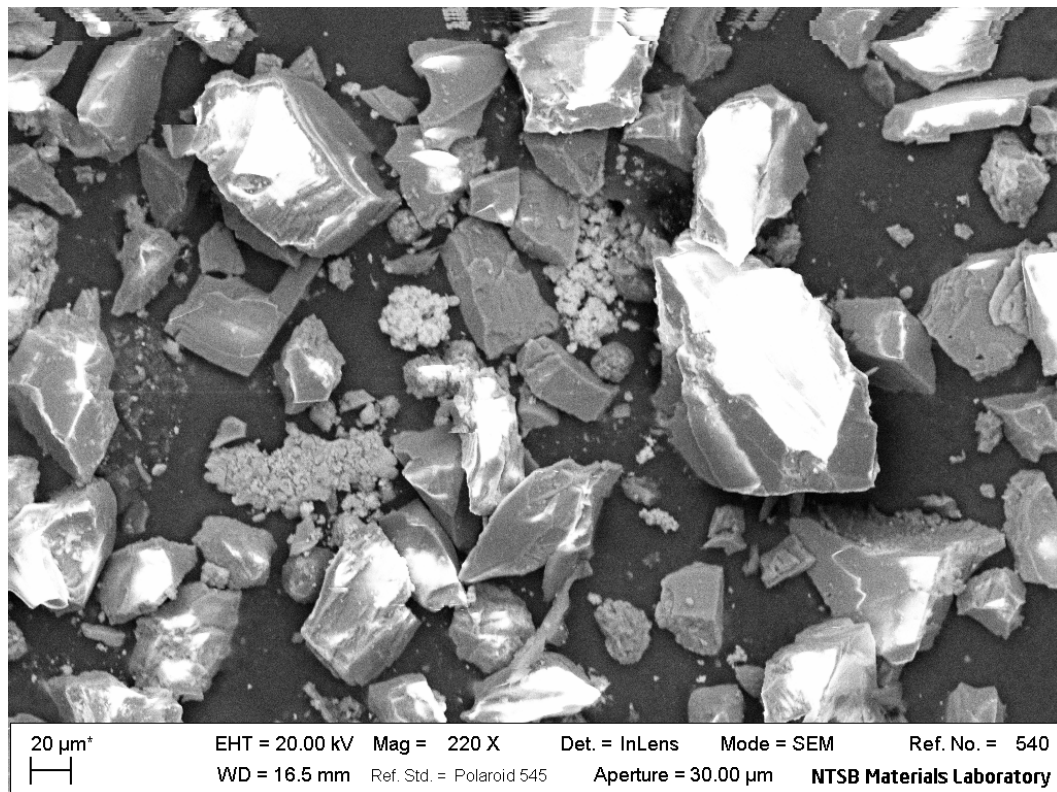


Figure 3. SEM micrograph of grey crystalline.