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OAS

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Subject: ERA24LA388, Materials Laboratory Report - Oil Passage Debris

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An unknown material was removed from the engine case oil galley/passage and was submitted to the Materials Laboratory for examination and identification. The material on the swab was visually examined using a 5-50x stereo zoom microscope. The heterogeneous material consisted of reddish-brown particulates, yellow particulates, clear crystalline particulates and several black particulates.

A sample of the unknown material was examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory per ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis*). The spectrometer was used to collect and process infrared wavelength absorbance spectra of the unknown material(s).

The spectrum for the material had the following combination of spectral peaks corresponding to particular functional groups found within the molecular structure of the material. A set of sharp, distinct peaks at ~ 3693 , 3620 , 3528 , and 3442 cm^{-1} is characteristic of inorganic oxygen-hydrogen (O-H) stretching vibrations, found in silicate minerals like clays and micas. The presence of a strong shouldered peak $\sim 3375\text{ cm}^{-1}$ is indicative of a nitrogen-hydrogen stretching bond (N-H). The presence of a strong doublet peak between $\sim 2920\text{ cm}^{-1}$ and $\sim 2850\text{ cm}^{-1}$ is indicative of a carbon-hydrogen (C-H) single stretching bond. A peak at $\sim 1650\text{ cm}^{-1}$ is indicative of a nitrogen-hydrogen (N-H) bending bond. Peaks at approximately 1459 cm^{-1} and 1376 cm^{-1} are characteristic of C-H bending vibrations in alkanes. The simultaneous

presence of these two peaks is a strong indicator for the presence of methyl ($-CH_3$) and methylene ($-CH_2$) groups. Peaks at $\sim 1025\text{ cm}^{-1}$ and 1000 cm^{-1} are indicative of carbon-oxygen (C-O) and carbon-nitrogen (C-N) stretching bonds. A peak at $\sim 910\text{ cm}^{-1}$ is indicative of a silicon (Si-O) stretching bond. Peaks at 775 and 690 cm^{-1} are indicative carbon-hydrogen (C-H) rocking and stretching bonds. The spectrum was consistent with a mixture having an inorganic silicate, a carbohydrate and an aliphatic hydrocarbon.

A spectral library search was performed on the unknown spectrum. No single match was found. A mixture search was then performed. The mixture search found the unknown spectrum had spectral patterns in common with several polysaccharides including a known insect casing spectrum, several clays/minerals and lubricating oils.

The sample was also examined using an x-ray fluorescence (XRF) alloy analyzer. The elemental composition of the samples consisted largely of silicon (Si), and iron (Fe) Silicon and iron are consistent with soil.

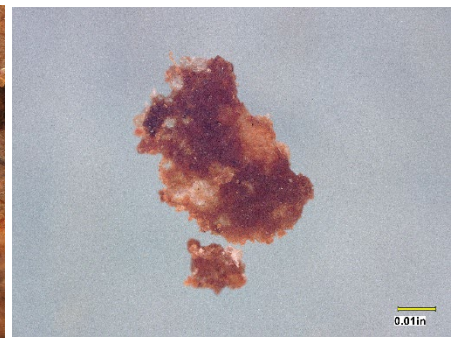
This combination is consistent with a mixture of insect-related debris, soil/clay/mud and lubricating oil within the engine case oil galley/passage.



Residue 20x



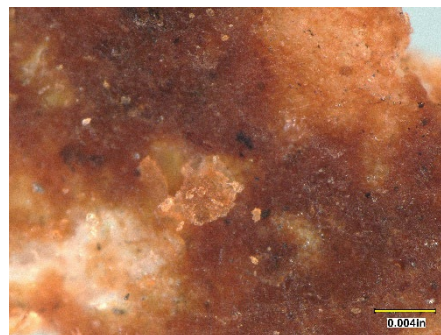
Residue 80x Composition



Residue 100x



Residue 400x Composition



Residue 400x