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Rapid communication

Microbial degradation of ignitable liquids on building materials

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ABSTRACT

Gasoline was added to moldy samples of unused building materials. The unused samples were allowed to sit at room temperature for 2, 4, 7, and 14 days. Each set of samples was extracted using passive headspace concentration and analyzed using gas chromatography–mass spectrometry. Microbial degradation of the gasoline pattern was observed in limited samples to an extent that could result in an inability to identify an ignitable liquid according to ASTM E1618. The degradation noted was largely consistent with the results of previous microbial studies involving soil.

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1. Introduction

When structure fires occur, an extensive amount of water is often used during suppression, resulting in the soaking of whatever building materials remain. Fire investigators, aware of the potential for the evaporation of ignitable liquids, will collect evidence and samples of the building material in vapor-tight packaging to prevent both loss of any ignitable liquid present and contamination by outside sources. Vapor-tight packaging also prevents the evaporation of water, which can lead to the development of mold and other microbial cultures over time. Extensive backlogs that prevent immediate analysis increase the probability that a microbial community will develop prior to analysis. The presence of these cultures in matrices other than soil has been suspected to alter chromatographic patterns of petroleum products, so much so that an ignitable liquid identification is not possible.

It is well known in the fire debris community that the presence of microbes in soil has the potential to cause the degradation of petroleum products with *n*-alkanes and monosubstituted aromatics preferentially degraded to a greater extent than other components [1–4]. To date, there is little information about the effect of the microbial strains found on building materials on ignitable liquid analysis. It has been established that building materials can contain a diversity of microbes including *Penicillium* sp. and *Aspergillus niger*, which can potentially degrade petroleum products [5–7]. These two microbes in particular can achieve approximately 90% degradation of *n*-alkanes and aromatics within 120 days, with noticeable changes within the first 60 days. These studies suggest that building materials may potentially serve as media for the microbial degradation of petroleum products. In addition to the evidence in the literature, suspected microbial degradation has been observed in casework in multiple laboratories where visible molding of the evidence was present.

In light of the potential for degradation, as well as the observations from casework, this research sought to determine what effect, if any, the formations of these types of cultures on common building materials have on the ability to identify ignitable liquids. Gasoline is one of the most commonly encountered ignitable liquids and as such was chosen as a representative ignitable liquid for this study. The two unused building materials chosen for the controlled study were wood, in the form of shims, and gypsum wallboard, as these materials are among the most common observed in casework.

2. Materials and methods

To initiate this study, mold was cultivated on unused building materials. Either one wood shim broken roughly in half (8-in. pine wood shims, Home Depot USA, Atlanta, GA) or two pieces of gypsum wallboard (½-in. × 3.5-in. × 2.5-in. Sheetrock, USG Corporation, Chicago, IL) were placed in clean, unused quart cans (Freund Container, Lisle, IL). A sufficient amount of tap water was added to fully moisten the substrate with minimal remaining liquid (see Table 1 for experimental conditions), and a watch glass was placed over the can opening to allow visual monitoring while preventing water evaporation. After 14 days, when visible mold growth was observed, any remaining water in each can was removed to prevent dilution and/or movement of the gasoline by diffusion, as well as to prevent potential sampling issues related to humidity during passive headspace concentration [9]. The cans were extracted by passive headspace concentration in accordance with ASTM

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Table 1
Experimental conditions for each sampling day. The quantity of water added was the volume determined to be sufficient to fully moisten the substrate with minimal remaining liquid.

Substrate	Water volume (mL)	Gasoline spike (μL)	Replicates per day sampled
Wallboard	70	7	3
Wood shim	40	7	3
Wallboard	0	7	1
Wood shim	0	7	1
Wallboard (control)	0	0	1
Wood shim (control)	0	0	1

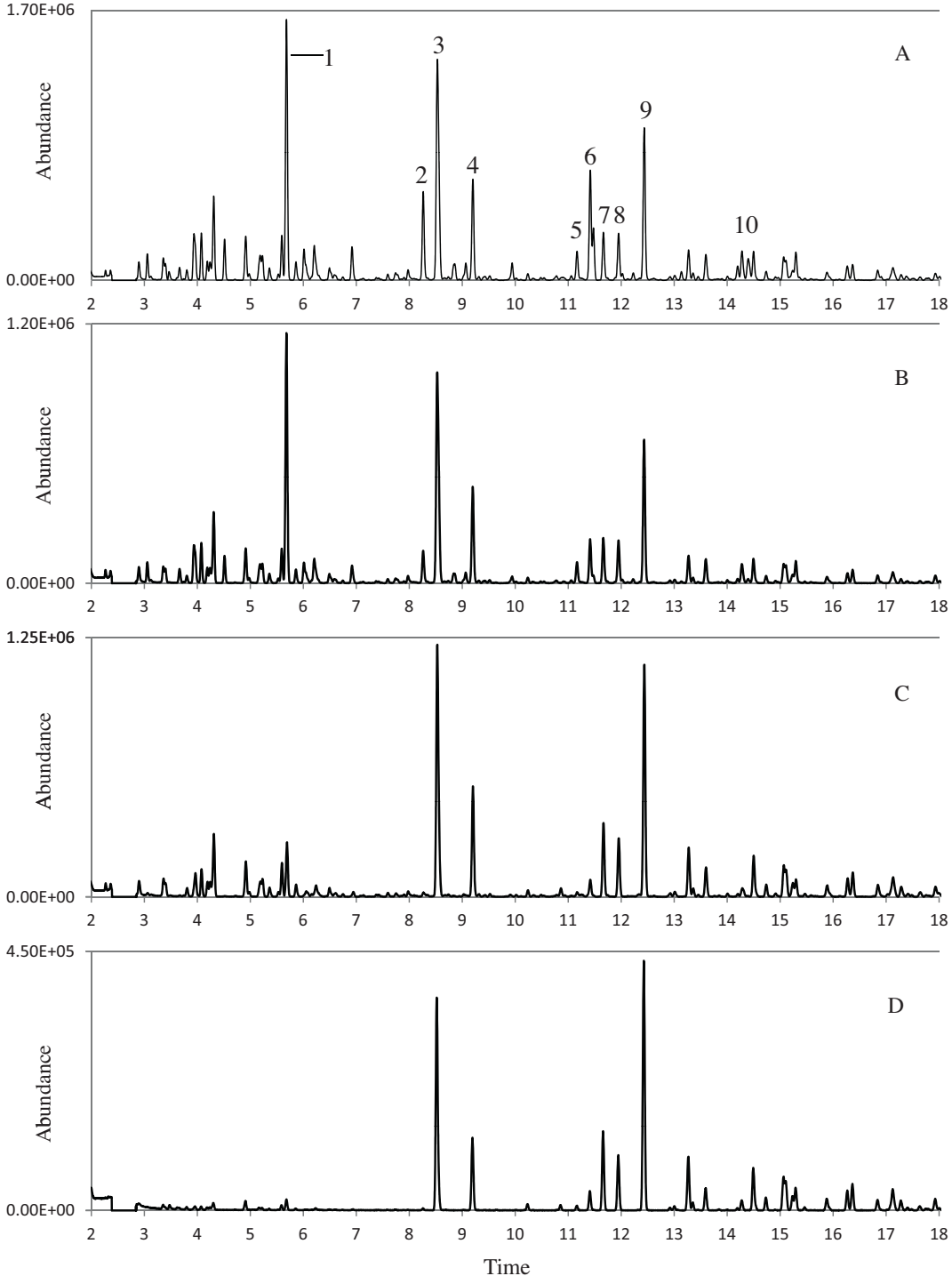

Fig. 1. TICs of moldy wood spiked gasoline after (A) 0 days, (B) 2 days, (C) 7 days, and (D) 14 days. Peak identities: 1 – toluene, 2 – ethylbenzene, 3 – *m*- and *p*-xylene, 4 – *o*-xylene, 5 – propylbenzene, 6 – 3-ethyltoluene, 7 – 1,3,5-trimethylbenzene, 8 – 2-ethyltoluene, 9 – 1,2,4-trimethylbenzene, 10 – C_4-alkylbenzene group.