



Beyond the Scent: Optical Characterization of Incense



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Introduction

- ‡ The World Health Organization estimates that air pollution causes approximately 2 million premature deaths worldwide per year³
- ‡ Mechanisms by which particulate matter (PM) causes mortality and morbidity are unknown
- ‡ PM2.5 (2.5 microns or smaller in diameter) identified as most harmful because it can penetrate deepest into the lungs³
- ‡ Incense is used in both indoor and outdoor settings for personal use as well as for ceremonies (especially in Eastern Asia)³
- ‡ Incense has been associated with health outcomes related to prolonged exposure
- ‡ Incense may be a confounder for optical measurements of Environmental Tobacco Smoke (ETS)

Methods

- ‡ Incense burned in combustion Chamber (shown to right)
- ‡ Collected filters with varying mass loadings
- ‡ Optical Analysis: integrated sphere, spectrometer, and balanced deuterium tungsten halogen light source with spectrum ranging from 250 to 1000 nm to measure absorption of light by particulate matter on filter
- ‡ Data analysis: end-member data plotted as Optical Density v. Mass loading and fit to Optical Density = (A)sinh(m/B)²
- ‡ Fitted Data used in data-reduction program which carries out linear combination of 3 different components (BC, ETS, INC)
- ‡ Tested data with reduction program using synthetic data
- ‡ Archived filters from NYC cohort study analyzed



Results

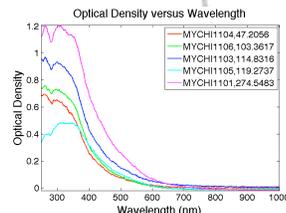


Figure 1: Optical Density v. Wavelength for "China Musk" incense (MYCHI)

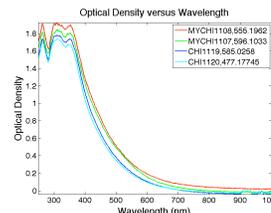


Figure 2: Optical Density v. Wavelength for "China Musk" incense (MYCHI) and "Joop Type" incense (CHI)

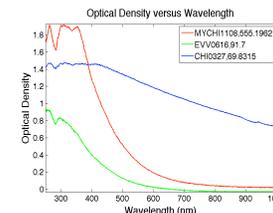


Figure 3: Optical Density v. Wavelength for "China Musk" incense (MYCHI), BC (CHI0327), and ETS (EVV)

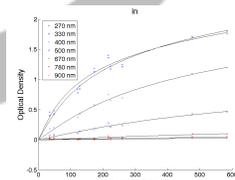


Figure 4: Standard Fitting for Incense

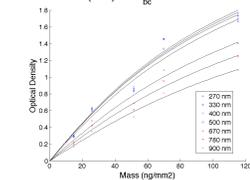


Figure 5: Standard Fitting for Black Carbon

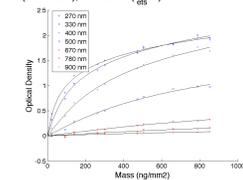


Figure 5: Standard Fitting for ETS

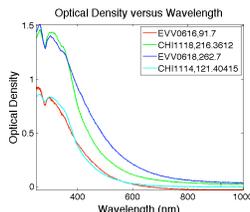


Figure 7: Incense (CHI) and ETS (EVV) at different loadings, note the similarity at loadings near 100 ng/mm²

	BC	ETS	INC
Lawless Wavel	Percent Error 0.05462635	3.573233333	8.193366613
Standard Devi	0.05642054	14.93548288	38.25490655
4 Wavelength	Percent Error 0.06252944	0.25226	0.29967036
Standard Devi	0.05674947	0.29761601	0.33023971
10 Wavelength	Percent Error 0.05733013	0.30136667	0.31410668
Standard Devi	0.05301987	0.320921252	0.334990668
12 Wavelength	Percent Error 0.06385221	0.279506667	0.30460444
Standard Devi	0.0585575	0.305508837	0.330468733

Figure 8: Percent error of data-reduction for synthetic data input at various wavelengths

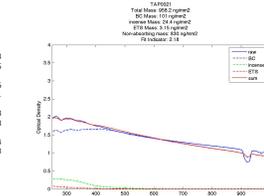


Figure 9: Result of data-reduction program run on filter loaded only with BC and ETS.

Conclusions

- ‡ Little difference between optical signatures of two different scents of Sandalwood incense
- ‡ Visually, optical signatures of INC and ETS are similar at light loadings and different as loadings increase
- ‡ Optimized wavelength set used in data-reduction program based on synthetic analysis
- ‡ Synthetic data experiments suggested the optical signature of incense is unique enough to differentiate it from ETS & BC without consideration of noise
- ‡ Analysis of field samples using data-reduction program has shown that incense is a confounder for ETS
- ‡ Further study must be done on the optical characterization of different types of incense (aloewood, sandalwood etc.) and other types of biomass materials

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References

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- ⁴World Health Organization, 2009. Air quality and health factsheet. <http://www.who.int/mediacentre/factsheets/fs313/en/index.html>