BURNING CONTAMINATED WOOD RELEASES DANGEROUS TOXINS

Wasson, S. J., W. P. Linak, et al. (2005). "Emissions of chromium, copper, arsenic, and PCDDs/Fs from open burning of CCA-treated wood." Environ Sci Technol **39**(22): 8865-76.

Aged and weathered chromated copper arsenate (CCA) treated wood was burned in an open burn research facility to characterize the air emissions and residual ash. The objectives were to simulate, to the extent possible, the combustion of such waste wood as might occur in an open field or someone's backyard; to characterize the composition and particle size distribution (PSD) of the emitted fly ash; to determine the partitioning of arsenic, chromium, and copper between the fly ash and residual ash; and to examine the speciation of the CCA elements. This work reports preliminary air emission concentrations and estimated emission factors for total particulate matter, arsenic (As), chromium (Cr), copper (Cu), and polychlorinated dibenzodioxins/dibenzofurans (PCDD/F) totals and toxic equivalents (TEQs). The partitioning of As, Cr, and Cu between the emitted fly ash and residual ash is examined and thermochemical predictions from the literature are used to explain the observed behavior. Results indicate a unimodal fly ash PSD between 0.1 and 1.0 microm diameter. In addition to a large carbonaceous component, between 11 and 14% of the As present in the burned CCA treated wood was emitted with the air emissions, with the remainder present in the residual ash. In contrast, less than 1% of both the Cr and Cu present in the wood was emitted with the air emissions. PCDD/F levels were unremarkable, averaging 1.7 ng TEQ/kg of treated wood burned, a value typical for wood combustion. Scanning electron microscopy (SEM) was unable to resolve inorganic particles consisting of Cu, Cr, or As in the wood samples, but X-ray absorption fine structure (XAFS) spectroscopy confirmed that the oxidation states of the CCA elements in the wood were Cu2+, Cr3+, and As5+. SEM examination of the fly ash samples revealed some inorganic microcrystals within the mostly carbonaceous fly ash, while XAFS spectroscopy of the same samples showed that the oxidation states after combustion were mixed Cu+ and Cu2+, Cr3+, and mixed As3+ and As5+. Estimates of the ratios of the mixed oxidation states based on the XAFS spectra were As3+/(total As) = 0.8-0.9 and Cu+/(total Cu) = 0.65-0.7. The Cu and Cr present in the fly ash were determined to coexist predominantly in the two oxide phases CuCrO2 and CuCr2O4. These results indicate that the open burning of CCA-treated wood can lead to significant air emissions of the more toxic trivalent form of As in particle sizes that are most respirable.

Gullett, B. K., A. Touati, et al. (2003). "PCDD/F, PCB, HxCBz, PAH, and PM emission factors for fireplace and woodstove combustion in the San Francisco Bay region." Environ Sci Technol **37**(9): 1758-65.

Emissions from residential fireplace and woodstove appliances burning fuels available from the San Francisco Bay area were sampled for polychlorinated dibenzodioxins and dibenzofurans (PCDDs/Fs), polychlorinated biphenyls (PCBs), hexachlorobenzene (HxCBz), particulate matter (PM), polycyclic aromatic hydrocarbons (PAHs), oxygenated PAHs, and the monosaccharide levoglucosan. Emission factors for these pollutants were determined, the first known characterization of this extent. Common California natural firewoods and manufactured artificial logs were tested under operating conditions intended to reflect domestic use patterns in the Bay area, which are primarily episodic burning for aesthetic reasons. Emission factors were determined by fuel type, fuel weight, mass emission rates, and energy output, highlighting differences between fuel and

combustion facility type. Average PCDD/F emissions factors ranged from 0.25 to 1.4 ng toxic equivalency (TEQ)/kg of wood burned for natural wood fuels and 2.4 ng TEQ/kg for artificial logs. The natural wood emission factors are slightly lower than those which had been estimated for the U.S. inventory. Background-corrected PCBs emitted from woodstove/oak combustion (8370 ng/kg) are 3 orders of magnitude higher in mass than total PCDDs/Fs; however, their toxicity (0.014 ng TEQ/kg) is significantly lower. HxCBz emission factors varied from 13 to 990 ng/kg and were likely fuel- and appliance-specific. Relative PAH concentrations of particle-phase compounds and emission factors were consistent with others' findings. A total of 32 PAH compounds, ranging in concentration from 0.06 to 7 mg/kg, amounted to between 0.12 and 0.38% of the PM mass, depending on the wood and facility type. Preliminary analyses suggest relationships between wood combustion markers and PCDD/F levels.

Eriksson, O., G. Finnveden, et al. (2007). "Life cycle assessment of fuels for district heating: A comparison of waste incineration, biomass- and natural gas combustion." Energy Policy **35**(2): 1346-1362.

The aim of this consequential life cycle assessment (LCA) is to compare district heating based on waste incineration with combustion of biomass or natural gas. The study comprises two options for energy recovery (combined heat and power (CHP) or heat only), two alternatives for external, marginal electricity generation (fossil lean or intense), and two alternatives for the alternative waste management (landfill disposal or material recovery). A secondary objective was to test a combination of dynamic energy system modelling and LCA by combining the concept of complex marginal electricity production in a static, environmental systems analysis. Furthermore, we wanted to increase the methodological knowledge about how waste can be environmentally compared to other fuels in district-heat production. The results indicate that combustion of biofuel in a CHP is environmentally favourable and robust with respect to the avoided type of electricity and waste management. Waste incineration is often (but not always) the preferable choice when incineration substitutes landfill disposal of waste. It is however, never the best choice (and often the worst) when incineration substitutes recycling. A natural gas fired CHP is an alternative of interest if marginal electricity has a high fossil content. However, if the marginal electricity is mainly based on non-fossil sources, natural gas is in general worse than biofuels.