Understanding air pollution from biomass burners used for heating

4 February 2015

As many places in the U.S. and Europe increasingly turn to biomass rather than fossil fuels for power and heat, scientists are focusing on what this trend might mean for air quality—and people's health. One such study on wood-chip burners' particulate emissions, which can cause heart and lung problems, appears in the ACS journal *Energy & Fuels*. The scientists say the findings could help manufacturers reduce the negative impact of this fuel in the future.

Aki Kortelainen and colleagues note that in Europe, burning wood for heat is one of the biggest sources of fine particulate emissions, contributing about the same amount of these tiny bits of pollution to the air as vehicles on a busy street. All totaled, these emissions—which have been linked to irregular heartbeats, breathing problems and nonfatal heart attacks—are associated with 350,000 premature deaths every year across Europe. In the U.S., the Centers for Disease Control and Prevention estimates that a 10 percent reduction in these particles of dust, soot and smoke could save at least 13,000 lives annually. With the rise in wood chip burners, Kortelainen's team wanted to better understand the technology's potential impacts on pollution and health.

The researchers measured fine particulate emissions from a wood-chip burner and found that emissions varied as the fuel went through different stages of combustion. They conclude that emissions can be reduced if burning efficiency can be maintained at a high level. The finding, they say, could help the industry design units that are less polluting and less harmful to people.

More information: Real-Time Chemical Composition Analysis of Particulate Emissions from Woodchip Combustion, *Energy Fuels*, Article ASAP. DOI: 10.1021/ef5019548

Abstract

Residential wood combustion is one of the major sources of fine particles. The chemical composition of the particles plays a key role in both adverse health and environmental effects. It is important to understand how chemical composition of particulate emissions varies during different combustion processes and conditions. In this work, combustion of wood chips was studied in a moving step-grate burner in different combustion conditions (efficient, intermediate, and smoldering) in the laboratory. The particulate emissions were measured with an Aerodyne high-resolution time-of-flight aerosol mass spectrometer (HR-TOF-AMS). It was found that two phases were occurring frequently in the intermediate and smoldering combustion. Phase 1 took place when gaseous carbon monoxide (CO) was rapidly increasing after the new fuel addition. Phase 2 was a stable, burn-out period with low CO emissions until the new fuel addition and automatic removal of fuel leftovers from the grate. The analysis on the organic aerosol by positive matrix factorization (PMF) extracted out five factors: hydrocarbon-like organic aerosol (HOA), low-volatile-oxidized organic aerosol (LV-OOA), biomass burning organic aerosol (BBOA), and two additional factors of "polycyclic aromatic hydrocarbon (PAH) factor" and "aromatic factor". PAH and LV-OOA were found to be forming mainly during phase 1. HOA showed similar behavior as a PAH factor and LV-OOA in a time series. BBOA was consistent with levoglucosan formation during the combustion and became higher during phase 2. The aromatic factor was mainly composed of fragment ions of n-butyl benzenesulfonamide compound, which was observed in both phases. To our knowledge, this is the first work to report the particulate organics of combustion aerosols and PAH distinguished by PMF. The results prove that the particulate organic emissions can be reduced efficiently when keeping combustion efficiency high. This may help in targeting the efforts on emission reduction better in the future.

Provided by American Chemical Society