Impact of VOC Composition and Reactor Conditions on the Aging of Biomass Cookstove Emissions in an Oxidation Flow Reactor

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Oxidation flow reactor (OFR) experiments in our lab have explored secondary organic aerosol (SOA) production during photochemical aging of emissions from cookstoves used by billions in developing countries. Previous experiments, conducted with red oak fuel under conditions of high OH reactivity (OHR) and/or low humidity (RH), were non-ideal due to the possibly large contribution of pathways (e.g. UV photolysis) of lower atmospheric significance than OH oxidation. Also, the contribution of speciated volatile organic compounds (VOCs) cookstove emissions to SOA formation has not been investigated in detail. Here, we investigate the impact of non-ideal OFR operation and VOC speciation on properties and quantity of SOA formed during OFR aging of stove emissions. Emissions from 'water boiling tests' of 3 stone fire, natural draft and forced draft gasifier stoves (in order of increasing efficiency) are collected in a smog chamber, aged under varying conditions and measured with an Aerosol Chemical Speciation Monitor and other instrumentation. The relative contribution of UV photolysis to OFR reactions is reduced via additional dilution of emissions (dilution factor of 1.2-4) with humidified air (RH = 20-65%). VOC measurements are taken before and after aging using online and offline gas chromatography. Preliminary results indicate that lower OHR /higher RH operation results in lower organic aerosol (OA) enhancement than in previous tests at similar OH exposures. Peak OA enhancement occurs at approximately 3 equivalent days of aging, consistent with previous tests. The range of OH exposures experienced in these tests are higher, but evolution of key organic mass fragments, like f44 (oxidized species) and f60 (biomass burning aerosol) is similar and plateaus at higher exposures. Further tests will focus on the properties of SOA formed from a soft wood (pine) and exposing the same batch of emissions to different reactor conditions – OH exposure, RH and OHR levels.