Ash reduction strategies to provide on-spec feedstocks for biofuel conversion processes

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Biomass contains introduced soil ash and endogenous physiological ash comprised of metals and heteroatoms that may be damaging to equipment, destructive to conversion products, fouling agents for conversion catalysts, and sources of pollutants – which increases processing costs and/or reduces product yields. We describe ongoing work at the Idaho National Laboratory utilizing chemical and mechanical separations together with feedstock formulation approaches to provide low-cost, on-spec feedstocks for conversion processes. Mechanical fractionation of corn stover by tissue and by particle size reduced the physiological ash content by as much as 45% through removal of select high-ash fractions representing only 20% of the total biomass. Chemical treatment of corn stover via water, dilute acid and dilute alkali leaching at 25-90°C, 2-10 % (w/v) solids and catalyst loadings of 0-1 wt% resulted in a maximum achievable ash reduction of 50.3% at 60°C, 1 wt% NaOH, and 2% solids, including a 50.7% reduction in silica. Conversely, dilute-acid leaching more effectively removed alkali metals, with 97.9% of the potassium removed at 90°C, 1 wt% H_2SO_4, and 2% solids. In addition, municipal solid waste was assessed as a potential lower-cost blend stock for a formulated feedstock based on corn stover. It was demonstrated that an 80:20 corn stover: paper waste blend could meet an ash specification of 5.5% after taking into account the paper waste ash content of 20%. These studies and their implications for an integrated approach to corn stover and woody feedstock ash reduction in the feedstock supply chain will be discussed.