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Mineral and chemical composition of biomass ash

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Biomass is considered as important non-fossil renewable energy source and its combustion or co-combustion with hard coal in power plants in Poland increases systematically. Chemical and mineral composition of biomass ash differ significantly from coal ash. In case of co-combustion the composition and properties of fly ash and slag differ from the composition of ash and slag obtained during combustion of coal. Modified composition of fly ash produced in co-combustion influences possibilities of its application.
The composition of coal ash varies within broad range but silicates or aluminosilicates are dominant components. Variation of chemical composition of biomass ash is very high. This study is based on 8 samples of biomass used in power plants in Poland.
SiO_2 content is relatively high in the straw ash (>66 wt% in ash obtained at 475°C and >73 wt% in ash obtained at 800°C) or beech bark (ca. 56 wt% at 475°C and ca. 58 wt% at 800°C) and very low in sunflower husks ash (<2.4 wt% in ash obtained at 800°C) or corn bark (8.3 wt% at 475°C and 10.6 at 800°C). K_2O content in sunflower husks ash obtained at 800°C varies from 27.6 to 31.4 wt%; in corn barn ash is 24 wt% (475°C) and 26.7 wt% (800°C); in olive residue ash is 22.9 wt% (475°C) and 25.6 wt% (800°C). On the other hand beech bark ash is characterized by low K_2O content (<4 wt%). P_2O_5 content is very high in several types of biomass ashes. In corn barn ash P_2O_5 reaches >36 wt% (475°C) and >42 wt% (800°C); in palm kernel ash varies from 21.6 (475°C) to 32.6 (900°C). CaO content is relatively high in beech bark ash – 15.4 wt% (475°C) and 17.7 (800°C). In several biomass ash samples MgO content exceeds 10 wt% (corn barn, straw and palm kernel). It is worthy to add that chemical composition of biomass used as fuel can vary significantly because it is related not only to vegetation type but also to soil conditions influencing vegetation growth and composition of detrital components (derived from soil, atmospheric dust particles deposited during cultivation or storage).
Chemical composition of biomass ash results in its very variable mineral composition. Several samples are rich in K and Mg phosphates, other rich in carbonates (e.g. calcite, fairchildite, kutnahorite), sulphates (arcanite) and lime beside other components as quartz or cristobalite, and Fe oxides. Addition of these components to coal ash component results in high variability of composition and properties of ash obtained in co-combustion.
The real influence of biomass co-combustion with coal on fly ash composition is related not only to the chemical and mineral composition of biomass ash but also ash content in biomass. Ash content in saw dust biomass is often very low (<1 wt%) but in olive residue or palm kernel relatively high (10.5 and 9.3 wt% respectively). The obtained results indicate that blending of various types of biomass used in co-combustion with the intention of control of fly ash composition is very difficult because of high variability of biomass ash composition and content of ash in biomass.