

Electron microscope study of silica phytoliths and other Si-rich bodies in rice straw and husks

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A classification of energy crops on the basis of their inorganic constituents (e.g., alkali elements, metalloids, heavy metals) is needed to evaluate the critical role these components play during combustion and, later, when the ashes are used as fertilizer or secondary raw material, or when they are released into the environment. The aim of our study was to characterize and compare the silica-containing portion of rice straw and rice husks after dry extraction as well as subsequent to combustion under controlled conditions in a REKA boiler. Using Field-Emission Environmental Scanning Electron Microscopy combined with Energy-Dispersive X-Ray (EDX) spectroscopy, we collected for each sample 10 EDX spectra on different areas of interest, and compared the chemical composition by sample and by morphology.

The Si content is similar in all studied samples, with all variations within the 1 σ -standard deviation range. The main difference between straw and husks is the morphology of the Si-rich parts: in the case of straw, bilobate phytoliths are clearly distinguishable, whereas in the rice husks, the Si-rich material appears as flat objects with poorly defined morphology, which cannot be classified as phytoliths and more closely resemble structures reported as “silica sand” in other monocot plants.

Combustion of rice straw and husks, and the consequent release of Si-rich particles into the environment, emitted along with the flue gases, can contribute to the total suspended particles (TSP) in the atmosphere, with potential impacts on air quality and health.