Feasibility of two MEMS-NIR spectrophotometers for characterizing different biofuel origin

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**Abstract.** The European Union effort to reduce fossil fuel consumption paves the way to enhancing interest towards renewable resources. Solid biofuel could play a key role, but its properties and origin are fundamental issues affecting energy conversion efficiency and supply chain sustainability. At the moment, laboratory conventional analysis require huge economic and timing efforts. Moreover, it is fundamental to obtain rapid and real-time quality information along all the supply chain. In this context, Near Infrared Spectroscopy (NIRS) is able to satisfy these requirements, minimizing the time delay of the lab analysis and promoting on site analysis along the whole process. The main aim of the present work is to evaluate the performance of two different portable MEMS (Micro Electro Mechanical System) NIR spectrophotometers for identifying the raw biomass of which pellet is made. Thus, samples of different categories have been collected and in detail: i) the most relevant Italian softwood and hardwood species, ii) different wood processing industry residues and iii) four bioenergy crops. Ten replicates for each sample have been performed and different spectral pretreatments have been tested to reduce noise and scattering effects. Principal Component Analysis (PCA) has been used to investigate the spectral variability and look for groupings among the different samples and categories. According to the spectral range, the C12 revealed a fair separation between virgin and treated wood than the C13 due to detection of chemical bonds related to glue presence. On the other hand, softwood and hardwood differences are better shown by the C13 because of C-H bonds related to wood components. A good separation between virgin and herbaceous samples has been achieved with both instruments, showing slight spectral differences in herbaceous. More interesting results could be obtained by widening the biomass samples in order to manage stronger dataset for chemiometric analysis. Nevertheless, the results of the research aimed at introducing NIR sensor, coupled with chemiometric, onboard pellet combustion devices to improve combustion efficiency and environmental performance.

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