Performance evaluation of NIR prediction models of moisture content on industrial woodchip

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According to the current European climate actions, woodchip is considered a valuable renewable resource to energy production. Its qualitative assessment is required by the bioenergy sector to promote a high energy efficiency in the whole supply chain [1]. Moisture content (MC) represents the main discriminative parameter related to the energy conversion system. Thus, its steady control and management are deemed a viable and cost-effective approach to reduce economic and environment impacts. Besides, residual woodchip presents a very high heterogeneity, highlighting the need of a continuous quality characterization [2].Near Infrared (NIR) spectroscopy represents an affordable and rapid method to assess qualitative features.

The aim of this study is to investigate the possibility to use a portable NIR spectrophotometer for assessing the MC of industrial woodchip. Three regression models have been developed and tested using an external test set of around 800 industrial woodchip samples. A total of ten NIR replicates scans have been performed for each sample and the MC has been assessed according to ISO 18134. Statistical analysis has been used to compare the models and evaluate their prediction performance. The results demonstrated that it is possible to predict MC in real time and the errors are mainly associated to woodchip samples with extreme MC values. Tukey’s test has been used to investigate outliers in the 10 replicates scans. The results proved that, considering the high heterogeneity of the material, it could be necessary to perform a higher number of scans to describe the material variability and ensure reliable prediction models. As a consequence, a handheld NIR spectrophotometer for in-line system has been used to collect new samples increasing the number of scans. The results demonstrated the importance of deepening variability investigation when dealing with high heterogeneous material, in order to get reliable predictions.

**Keywords:** biofuel, energy content, handheld, PLS, spectroscopy, Tukey’s Test

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