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Use of near infrared spectroscopy for the rapid low-cost analysis of a wide variety of lignocellulosic feed stocks

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It is important to know the lignocellulosic composition of a feedstock in order to ascertain its potential value for biorefining. The standard laboratory methods of analysis are costly and time consuming. Celignis personnel have worked on the development of rapid, low cost methods of analysis using near infrared spectroscopy (NIR). Over 1000 biomass samples have been collected and processed for conventional analysis with the NIR spectra of each sample collected at several stages of sample preparation. The dried samples were then analysed via reference methods for a number of lignocellulosic constituents, ash, extractives, and elemental composition. Following this NIR models were developed for a large number of constituents (including glucan, arabinan, galactan, xylan, mannan, rhamnan, total sugars, Klason lignin, acid soluble lignin, extractives, ash, and nitrogen) using a calibration set and the predictive abilities of the models were tested on an independent set. Separate models were developed on specific sample groups (Miscanthus, pre-treated biomass, peat, straws, waste paper/cardboard, sugarcane bagasse and others). In addition a global model was developed incorporating all those samples as well as many other sample types including: trees, energy crops, agricultural residues, animal excreta, biorefinery residues, grasses, municipal wastes, composts etc. The models developed were highly accurate and robust for important lignocellulosic constituents. For example, the rootmean square errors of prediction (RMSEP) [and R2 in prediction] for the global dataset were 1.84% [0.976], 0.75% [0.989], and 1.73% [0.983] for glucan, xylan, and Klason lignin, respectively. This work is significant since it is the first demonstration of the utility of NIR in the commercial analysis of such a wide variety of biomass samples for all these lignocellulosic constituents.

Biography

Daniel Hayes has extensive experience in the analysis of biomass and in the evaluation and development of biomass conversion technology. He received his PhD from the University of Limerick in 2012 and played an important role in the development of UL's Carbolea Biomass Research Group. He has been successful in securing project funding for the group from industrial, national, and European sources. One of these projects, funded by the EU's 7th Framework Programme and entitled DIBANET, involved 13 partners from a number of European and Latin American countries. Within DIBANET he was responsible for the development of a series of mathematical models that allow for many of the important properties of biomass (for production of second generation biofuels) to be predicted from their near infrared (NIR) spectra. This allows for analysis to be carried out much more quickly and at a lower cost than through conventional wet-chemical techniques.

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