

Abstract

Fast prediction of methane potential of municipal solid wastes by near infrared spectroscopy

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Introduction

Biochemical methane potential (BMP) is one of the most important criteria measured on solid waste before treating it in an anaerobic digester to produce biogas (methane and carbon dioxide). The BMP value gives information on the capability of the waste to produce methane in anaerobic conditions as an indicator of its anaerobic biodegradability. However, this measurement consisting of fermentation of the waste by micro-organism is time consuming (about 30 days). There is a close link between BMP value and the type and quantity of organic matter (e.g. carbohydrates, proteins, fibers). NIR spectra present the advantage to provide this information. In this study, a predictive model based on NIR measurement was built in order to reduce the analysis time from several days to two days (including sample preparation).

Materials and Methods

Seventy-six municipal solid waste samples were freeze-dried and ground to 1 mm. The composition and quantity of gas produced was analysed every two days with a micro-Gas Chromatography Varian CP-4900. BMP value is the cumulative quantity of methane produced at 30 days. NIR measurement was performed with the NIRFlex N-500 solids, with the Petri dish add-on, by reflectance (R) in the NIR wavelength region (1000–2500 nm). A calibration data set (47 samples) and a validation data set (29 samples) were built. Pretreatments were tested by leave-one-out cross-validation. PLS was used to predict the BMP value. Data analysis were carried out by Matlab software using the PLS toolbox.

Results and Discussion

The best model was obtained with SNV and Savitzky and Golay first derivative pretreatments applied on absorbance, $\log(1/R)$. Standard error of cross-validation (SECV) of the model was 32 ml CH₄.g⁻¹ of volatile solids ($r^2 = 0.69$), with 5 latent variables. The RMSEP_{val} was 28.6 ml CH₄.g⁻¹ of VS ($r^2 = 0.72$).

Conclusion

Taking into account the variability that occurred in the BMP test (e.g. the initial inoculum activity and the complexity of the matrix of solid waste) these results are considered acceptable from a practical point-of-view.