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ELSEVIER

Vibrational Spectroscopy

Volume 106, January 2020, 103008

Installation design of on-line near infrared spectroscopy for the production of compound fertilizer

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https://doi.org/10.1016/j.vibspec.2019.103008

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Abstract

Low-analysis fertilizer composition highly poses risk to soil infertility, crop yield and farmer livelihood. Fertilizer testing via traditional laboratory methods is a tool for quality control but with the significantly high cost of investment and maintenance in the long run. Physiochemical data from vibrational spectra obtained from the near-infrared reflectance (NIR) analyzer shows successful installation design for real-time quality monitoring of compound fertilizer production in this study overcoming exhaustive laboratory methods offering competitive advantages to the fertilizer industry becoming a great tool for product development and lower the risk of farmers buying the low-analysis fertilizer. The NIR analyzer was designed for on-line analysis of nutrient contents of the fertilizer before bagging. Total nitrogen (TN%), available phosphorus (available P_2O_5%), water-soluble potassium (water-soluble K_2O%), total organic matter (TOM%), moisture content (TMC%) including pH were required to be monitored to ensure final product release being within limits legislatively established. Spectral variations across different times of measurement over a day of the production was investigated in the condition of on-line system instead of a controlled condition to confirm the measurement will be reliable and in good reproducibility. Calibration models were developed using Partial Least Squares (PLS) regression with a series of data pretreatments on individual model per nutrient. Precision and accuracy figures of NIR results were obtained considerably good enough to the manufacturing practice. NIR prediction results were later designed for threshold and feed-back to the process control.

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SpringerLink

Research Article | Published: 01 December 2018

Utilization of Lignin Extracts from Sugarcane Bagasse as Bio-based Antimicrobial Fabrics

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Sugar Tech **21**, 355–363 (2019) | Cite this article

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Abstract

A lignin-coated fabric made from sugarcane bagasse exhibits antimicrobial characteristics. The bacterial strain *Staphylococcus epidermidis* (DMST 15505), a cause of skin infection commonly found in medical facilities, was used in this study. At specific coating concentration, in vitro study suggested this bacterium can be inhibited to prevent further propagation within 6 h of contact with lignin-coated fabric. The price for lignin extraction at the laboratory scale (500 ml) was approximately USD 974.60/kg and USD 15.22/kg at the pre-pilot scale (50 l). The minimum inhibitory concentration (MIC) for lignin extracts was 4096 µg/ml. A price-performance index (PPI) was proposed and calculated from the material price and the amount required to inhibit bacterial propagation based on the MIC according to the antimicrobial performance of the coated fabric. This index provides swift cost estimation of a product's antimicrobial properties to inhibit specific bacterial propagation. A smaller value of PPI is preferred when comparing multiple antimicrobial agents. The PPI for lignin was USD 0.0080 at the laboratory scale and USD 0.0002 at the pre-pilot scale. The PPI for commercial silver nanoparticles was USD 0.6084 (20 nm) and USD 0.3498 (200 nm). The PPI index supported the utilization of lignin extracts from sugarcane bagasse as a bio-based antimicrobial agent on fabric for antimicrobial textile application.