

## Rapid Analysis of Cattle Manure used to Fuel the Bioethanol Industry

**Summary** Efforts to make bioethanol production as environmentally-friendly as possible are leading the bioethanol industry to consider not only the types of feedstocks employed but also the fuel used in the refinery. Cattle manure is a fuel resource planned for use in some ethanol refineries located in areas of high beef production. In this way, a biowaste is recycled, consumption of non-renewable fossil fuels is avoided, and greenhouse gas emissions associated with manure composting are reduced. Near-infrared spectroscopy is suggested as a method for ensuring that the manure entering refineries is of the proper composition.

**Storage and disposal** of livestock manure is a nutrient management, environmental, and health concern in many countries. Improperly handled, cattle manure can be a source of nutrient pollution to surface and groundwater, emissions of greenhouse gases including the most potent nitrous oxide, and a source of contamination from disease-producing microbial populations. Now a Texas-based bioethanol refinery will be fuelled by one billion pounds of manure from the concentrated cattle production in the area. This elegant solution to manure management and the dilemma of consuming fossil fuels to produce biofuels is not without challenges. “The problem with using manure as a fuel has always been its variability”. Fresh manure is too wet to burn correctly and must be allowed to dry. If incorrectly harvested from cattle pens, the manure may have too high a soil content.

**Field-based near infrared spectroscopy** (NIRS) may provide an analytical solution to ensure the manure entering the refinery is of appropriate

composition. Over the past 15 years, NIRS has been applied to quantify numerous constituents in raw manure, and manure that has been stockpiled (subject to anaerobic breakdown) or composted (subject to a controlled process of periodic aeration to allow aerobic decomposition).

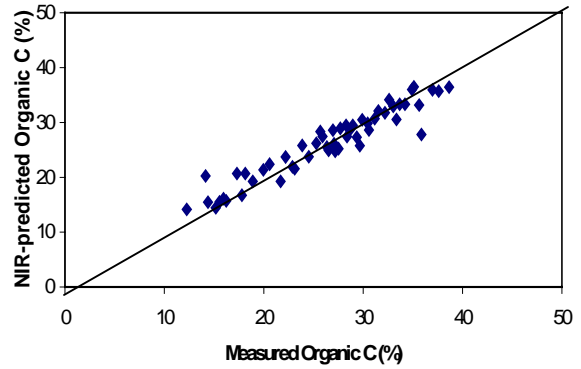


The constituents analyzed by NIRS include moisture, carbon, nutrients, calcium and magnesium, heavy metals, lipids, fibre and microbial content. In the context of using manure as fuel, the key constituents that can

be measured with NIRS include moisture, solids, crude ash, total carbon, and organic matter. While the BTU content of manure may not yet have been measured, this property has been predicted in natural gas by NIRS.

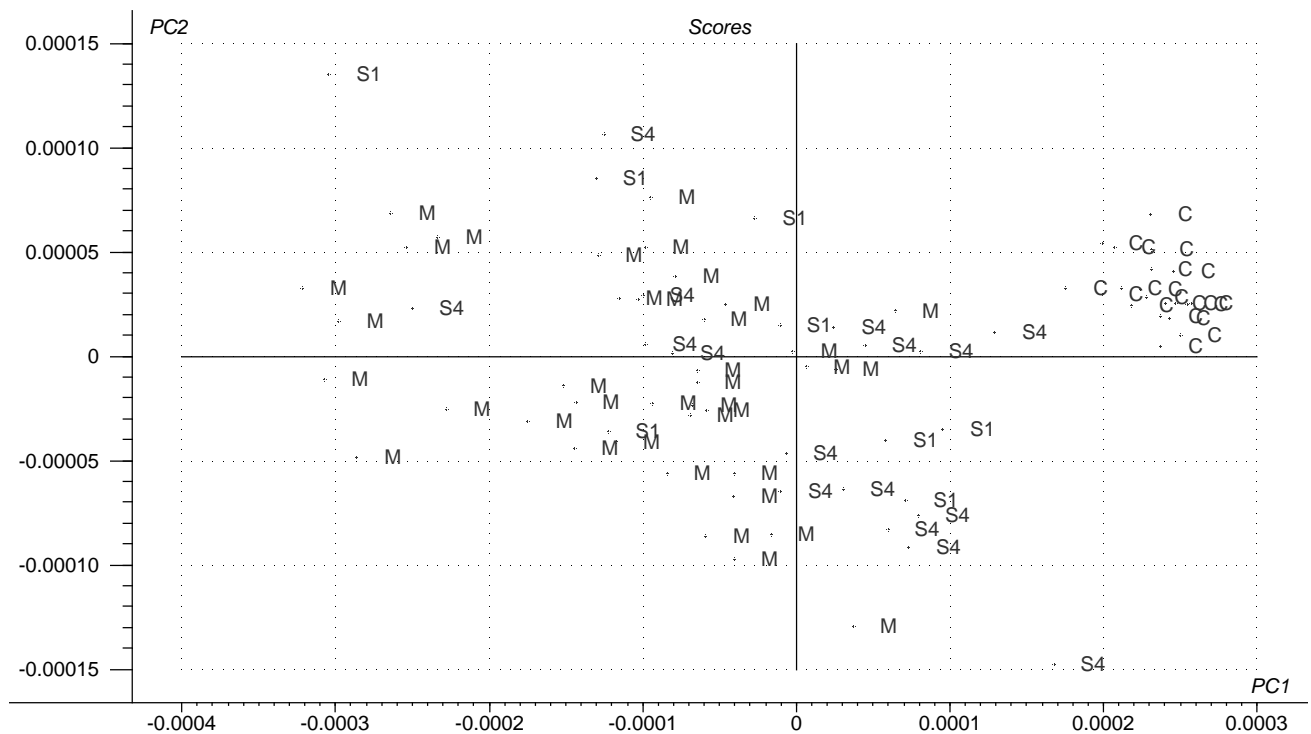
Near-infrared technology is being applied at various stages in bioethanol production for analysis of feedstocks and product and co-products. Now a number of field-portable instruments are available that can allow rapid analysis to be extended to the cattle feed pen or the manure windrows.

**A laboratory study** of 179 samples of raw cattle manure, stockpiled manure, and compost collected over two years demonstrated that % organic carbon can be predicted in dried, ground samples over a 30% range in organic carbon content.



NIR-predicted % organic carbon values agree 91% with the chemically-measured values

Moreover, the NIR spectra of samples alone provide rapid information on samples. The figure below shows that composted samples (C) are distinguishable from the raw manure (M) and the stockpiled (S) samples.



Each spectrum from a sample is reduced to a single point in this Score plot and represented by a letter. Raw manure samples are “M”, stockpiled samples are “S” and composted samples, “C”.

**In conclusion**, the prospect of using cattle manure as a renewable fuel in the production of bioethanol is a novel application. The use of rapid, flexible NIRS can help ensure that refineries receive manure of the appropriate composition.

## References

- Brown C.W. and S. -C. Lo. 1993. Feasibility of on-line monitoring of the BTU content of natural gas with a near-infrared fiber optic system. *Applied Spectroscopy* 47: 812-815.
- Ledbetter, K. 2007. Cleaner manure burns hotter in ethanol processing. *Manure Manager* Vol. 5, No. 5: 24. September/October.

Malley, D.F., C. McClure, P.D. Martin, K. Buckley and W.P. McCaughey. 2005. Compositional analysis of cattle manure during composting using a field-portable near-infrared spectrometer. *Communications in Soil Science and Plant Analysis* 36: 455-475.

Mettler, D. 2007. Burning a billion pounds of manure. *Manure Manager* Vol. 5, No. 5: 19-22. September/October.

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