FACT SHEET: Nutrient Value of AD Digestate

Research evidence is accumulating that biogas production via anaerobic digestion (AD) of animal manures, agro-industrial waste and byproducts and nutrient-rich plant biomass (energy crops) provides for further environmental benefits if the AD digestate (spent liquor) is used as an alternative fertilizer for crops and pasture. The value of AD digestate as an agricultural fertilizer is measured both as the cost of replaced fertilizer and its several environmental benefits.

AD can open up currently underutilised or wasted nutrient resources for agricultural use, improve the usefulness of traditional alternative fertilizers (manures etc.) and minimise their detrimental side effects (odour, GHG emissions, handling issues etc.).

Biogas systems can facilitate a diversion of large volumes of agro-industrial waste and by-products from landfill disposal and manures from discharge to water. The nutrients contained in these reclaimed wastes can provide an alternative supply of fertilizer nutrients to farmers that can substitute for mineral fertilizers. This can realize energy and fossil fuel savings (e.g.1.2% of annual energy use by mankind is to synthesize N-fertilizers (Wood and Cowie 2004)). Digestate can improve New Zealand’s balance of trade since a large majority of mineral fertilizers (or their raw ingredients) are imported and can also substitute for some essential but finite P-fertilizers (‘peak phosphorus,’ the year after which the rate of P production can not be increased any further may have already occurred a decade ago). In addition AD digestate also provides large amounts of organic carbon to the soil which is beneficial for soil and crop health.

The nutrient profile and fertilizer value of AD digestate is dependent on the feed-stock composition. Energy crops, crop residues and industrial by- and waste products generally have greater DM content and more favourable nutrient composition than manure slurries, resulting in a more concentrated and valuable digestate (Mokry, 2008). During anaerobic digestion the feed-stock biomass is broken down to water and biogas consisting mainly of methane and carbon dioxide. While this reduces the DM concentration of most AD feed-stocks by 50% to 75% the nutrient content of most macro and micronutrients is preserved - apart from nitrogen and sulphur, where gaseous losses in the low single digit percent range have been recorded (Munzert and Hueffmeier 1998).

While total content of most nutrients is preserved, the form and availability of some of these is significantly changed by the AD process. As the organic structure of the feed-stock biomass is broken down, nutrients are released in simple, plant available forms such as ammonium and phosphate in the case of N and P respectively. The enhanced value of nutrients contained in plant available forms in AD digestate is well recognised. In Danish trials comparing digestate to manure slurry the percent of N in the source that was utilised by crops was 80% when applied by either trailing hoses or injection into soil. Manure slurry utilisation of the N was only 50-70%, varying with method and type of manure (Sommer and Birkmose, 2007).

Additional manure management benefits of digesting manure rather than using the slurry directly include lower DM, so it is easier to pump; a more uniform product, giving better prediction of nutrient use; starkly reduced odour emissions and less “burn” issues after topdressing (Chadwick 2007, Van der Meer 2007). Along with the benefits of a higher ammonia fraction in digestate comes the need for careful management when it is field applied. Loss of volatile ammonia can be quite high if digestate is applied under the wrong conditions. Optimal timing is late in the day, just before or during light rainfall.

The main culprit of odours produced during land application of raw manures or agro-industrial wastes are volatile organic compounds (VOC's). During AD these are broken down to biogas, hence much less odours are released during land application of AD digestate (Van der Meer 2007). Analogous to VOC's most of the readily bio-available carbon contained in AD feed-stock is broken down during digestion, and it has been speculated that this may lead to reduced N_2O (a potent GHG) emissions from anaerobically digested manures when land applied (Steinfeld et. al. 2006). With respect to greenhouse gas (GHG) emissions, of even greater importance are the replacement of open anaerobic systems with systems incorporating biogas capture and proper storage of digestate following AD. Leaked methane has been identified as the single largest potential GHG abatement option in manure management, but also the biggest risk factor regarding the GHG balance of biogas production, if digestate storage is facilitated in open storage structures (B. Amon, in Chadwick, 2007).

While the use of AD digestate as an alternative fertilizer is not widely practiced in NZ, the practice is well established, and highly valued in many overseas countries. Sweden is encouraging use of AD digestate and regulates its handling the same as organic fertilisers such as manure. For example digestate slurry must be stored covered and applied to minimise loss of GHG and odour. To protect water quality a maximum of 110kg P/ha is allowed in Sweden (Palm, 2008). With the use of good practices it is clear that the benefits of using AD digestate as an alternative fertilizer clearly exceed the risks – consequently use of nutrients from AD digestate should be integrated into good agricultural practice in NZ.

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