ReUseWaste News

November 2014

No. 12

Research Brief: ReUseWaste ESR 6.3

Drying of separated digestate solids: Effects of pH and temperature on ammonium contents

Athanasios Pantelopoulos[a], Jakob Magid[a], Lars Stoumann Jensen[a]

The residue from anaerobic digestion (AD) of waste for biogas production, commonly called digestate, is considered as a valuable source of plant nutrients. However, European and national legislation limits fertilizer application rates in agriculture and requires the surplus of nutrients to be transported outside the farm for the prevention of pollution risks. In the case of the digestate, its high water content is considered a main constraint for the transportation of large amounts of digestate to areas with nutrient shortage.

Solid-liquid separation technologies are often used as a first treatment for volume reduction and nutrient concentration of the digestate. Nevertheless, the solids have a high residual moisture content, even under the most efficient separation techniques, making them biologically instable, with potential for gaseous emissions. We therefore focus on exploiting further treatment practices of the solids as a means to obtain a more concentrated and stable organic fertilizer.

Thermal drying of manures has been proposed as an adequate treatment in order to facilitate transportation by volume reduction, nutrient concentration and sanitation of the final product; it is practised on a growing number of AD plants across Europe. However, thermal treatment of ammonium rich organic wastes, such as digestate solids, will cause relatively high volatilization of NH_3, thus causing a loss in the N fertilizing value of the final product as well as atmospheric pollution. Lowering the pH of the waste with the use of a strong acid can reduce the loss rate of nitrogen. The acidification technique has been widely used in Denmark during the storage and soil application stage of liquid manures, reducing the ammonia emissions by 90% and 75% respectively, but remains largely untested in combination with thermal evaporation of manure or digestate solids.

In our study, we used concentrated sulfuric acid to acidify the solid fiber fraction of digestate at two pH levels (pH 6,5 and pH 5,5) and tested the independent and combined effect of acidification and drying temperature on the ammonium nitrogen content of the final dried product.

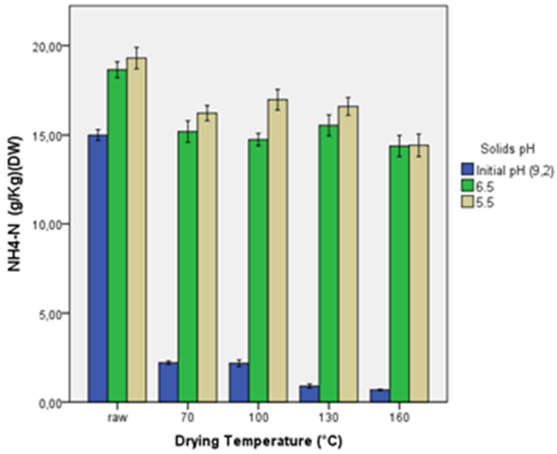

Figure 1. Ammonium nitrogen concentration of raw and dried solid digestate and their relative acidified solids after different drying temperatures

The results showed a strong mitigating effect of acidification on nitrogen losses across all operating temperatures (Fig. 1). Acidified samples were able to maintain more than 70% of their initial ammonium concentration. However, no significantly better effect on the ammonium content was observed from acidifying to pH 5.5 compared to 6.5 – the latter only requiring 68% of the amount of sulfuric acid required to reach the lower pH. Furthermore, in the case of acidified solids, increasing drying temperature appears to have no significant effect on the nitrogen losses.

The results obtained from this study could be further utilized by research and industry in cases where the solids management target is the retention of the inorganic and potentially plant-available nitrogen in the dried product. Currently we are investigating nitrogen release and plant uptake of these dried solids.

Contact Athanasios: thanos@life.ku.dk

[a] Department of Plant and Environmental Sciences, Faculty of Science, University of Copenhagen