RAMIRAN 2025
Book of abstracts

Wageningen, The Netherlands, 15-17 October 2025

99. Physico-chemical and biological characterization of sludge from Normandy dairy industries: combining agronomic value and regulatory compliance of contaminants

Velasco-Sánchez, Á[a,b,c], Castel, L.[a], Khalaf, N.[d], Gattin-Trinsoutrout, I.[a] and Bennegadi-Laurent, N.[a]*

Institut Polytechnique UniLaSalle, SFR NORVEGE FED 4277, AGHYLE UP 2018.C101, Mont-Saint-Aignan, France[a], Soil Biology Group, Wageningen University and Research, Droevendaalsesteeg 3, 6700 AA Wageningen, The Netherlands[b], Wetsus, European Centre of Excellence for Sustainable Water Technology, Oostergoweg 9, 8911 MA Leeuwarden, The Netherlands[c], Chemical and Environmental Science Department, University of Limerick, Limerick, V94 T9PX, Ireland[d], *Corresponding author: nadia.laurent@unilasalle.fr

Introduction

The region of Normandy is the leading French producer of fresh dairy products and cheeses from cow milk such as Camembert. These productions generate a large amount of sludge. This sludge has a high fertiliser potential and is usually applied to nearby agricultural soils. However, depending on the dairy product and the processing treatment plan, this waste may show large physicochemical differences and may contain organic and inorganic pollutants that could prevent it from being safely used in agriculture.

Methodology

To provide an overview of the diversity of dairy waste used on Normandy's agricultural soils, ten dairy industries agreed to our survey to characterize the sludge produced at their treatment plants. The sludge was collected at the beginning of the summer 2020 from the sludge holding tank or just before storage. The samples were freeze-dried and then milled to < 1 mm. A detailed analysis was carried out including: i) nutrient composition (organic C, total N, total P, soluble P, K, Al, Ca, Fe, Mg, Mn, Na, Zn), as well as heavy metals (Cd, Cr, Ni, Pb), ii) physical properties (particle size and shape) and thermal stability, and iii) pathogen presence in fresh samples (coliforms and salmonella). The levels of nutrients and pollutants were compared to the current European Union legislation for fertilisers (EU 2019/1009).

Results and discussion

Sludge from dairy processing in Normandy can be source of nutrients for agriculture, containing high concentrations of P (up to 78 g kg^{-1}), N (up to 82 g kg^{-1}) and K (7.65 g kg^{-1}). However, none of the samples complied with the current legislation, as many heavy metals (mainly Cr) and pathogens (*Salmonella spp.*) were found above the legal threshold established by the EU, hindering its application in soil.

Further work should identify the sources of this contamination and/or provide technologies to reduce the concentration of pollutants. Our work also showed a strong heterogeneity across the studied sludges, which did not depend on the type of dairy-end product. For example, 60% of dairy industries use iron chloride to precipitate phosphorus from effluents and 80% use polymers to coagulate sludge before storage. Sludge's pH is mainly basic, however limed sludges were found strongly basic. The sludge samples shown by the considerable heterogeneity in the size and shape of the particles or aggregates, which may impact the bioavailability of nutrients for the crops.

Conclusion

Dairy sludge contamination levels should be lowered by a more effective reduction of pollutants throughout the dairy production chain and by the use of cleaner chemical technologies and/or technologies to remove pollutants from the resulting dairy sludge. The treatments of dairy processing sludge should be homogenised to ease the recovery of nutrients and implementation of new technologies across the dairy sector.

Acknowledgements

This work was funded by the Horizon 2020 REFLOW project (grant number 814258). We would like to thank the technical staff of the AGHYLE and TA research units at UniLaSalle for their technical help. The heads of each of the 10 plants who helped us and allowed us to take our dairy sludge samples.

References

European Commission, 2019. Regulation (EC) No 765/2008 of the European Parliament and of the Council (4) lays down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.