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Pierre Buffière, Renaud R. Escudie, Hassen Benbelkacem

ASSESSMENT OF SOLID MIXING CHARACTERISTICS THROUGH TRACER TESTS USING RADIO-FREQUENCY IDENTIFICATION (RFID)

P. BUFFIERE[1,*], R. ESCUDIE[2], and H. BENBELKACEM[1]
[1] Université de Lyon, INSA-Lyon, DEEP Laboratory, France.
[2] INRA, UR0050 Laboratoire de Biotechnologie de l'Environnement, F-11100 Narbonne, France
*Corresponding author: pierre.buffiere@insa-lyon.fr, +33 4 72 43 84 78, +33 4 72 43 87 17.

Abstract

The determination of residence time distribution (RTD) in reactors is a classical tool for engineers [1]. The objective is to assess the macro-mixing behavior of a given system. The selection of the tracer used for performing this test is quite easy for fluid systems (gases or liquids) and the tracer is usually detected automatically.

The objective of this study was to develop a tracer test technique for assessing the mixing characteristics of solid waste treatment reactors (high-solid anaerobic digesters). The specification was that this technique could be used at full scale (several cubic meters) and therefore that the selected tracers could be detected automatically.

The selected system is based on RFID technique (Radio Frequency IDentification). A RFID system is composed of transponders (tags, identities) and of one or several interrogators (couplers, base stations). RFID chips (Fig. 1) are small (2.5 cm) embedded active emitters of radiofrequencies. They contain specific information about their identity and an antenna is able to detect their presence in a given location. A large number of them can be injected at the inlet of the system. Their signals are detected and read by antennas at the outlet of the reactor. The interest of this technique is that RFID chips are considered as “individuals” and that the recorded signal, for instance, is associated to an identification number (that can be linked to a physical property: mass or density).

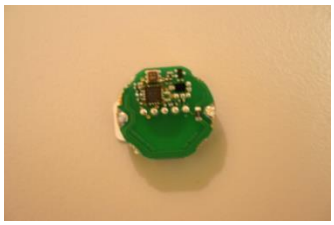

Figure 1: *RFID chips*

In the present study, RFID chips were embedded in sealed supporting systems with different densities. The objective was to investigate the mixing behavior and the residence time distribution of solids in anaerobic digesters treating Municipal Solid Waste or Biowaste according to their density. In a first test in a full scale plant, several hundreds of tags were injected, and 80% of them were detected after 3 retention times. The results can be analysed in terms of F function (cumulated fraction of solid that stays in the reactor) and was useful to estimate a segregation index [2] and an average residence time according to the density.

References

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