

The phenomenon of sludge pelletisation in the anaerobic treatment of a maize processing waste

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Abstract

The anaerobic treatment of certain soluble organic wastes in upflow sludge bed reactors has resulted in the formation of granular or pellet sludges which have excellent settling and thickening properties. These properties hold considerable promise for optimisation of industrial waste anaerobic treatment systems in terms of improved biomass retention and loading rates.

This paper describes digester operational conditions which resulted in the formation of sludge pellets and illustrates certain physical, chemical and microbiological characteristics of such sludge types. The possible role of feed and extracellular polymers in the mechanisms underlying the pelletisation process is discussed.

Introduction

Biomass concentration and retention are considered important factors for the successful operation of a high-rate anaerobic process when treating a soluble/colloidal type of organic waste. Various anaerobic designs are being advocated in order to achieve both a high solids concentration and subsequent effective phase separation of the digester liquor. Of particular interest and significance is the reported sludge pelletisation or granulation phenomenon which has been achieved in full-scale upflow anaerobic sludge blanket (UASB) digesters in Holland treating sugar beet and potato starch processing wastes (Lettinga *et al.*, 1979; Lettinga *et al.*, 1980; Pette *et al.*, 1980; Pette and Versprille, 1981).

Based on the excellent results achieved in the Dutch plants, it would appear that the pelletisation phenomenon holds considerable promise in terms of improved sludge settling and retention, higher organic and hydraulic load rates and costs of digester design. Rabson and Rogers (1981) in reviewing future biomass technologies, considered the study of the mechanisms of aggregate formation and operation of microconsortia pellets as a priority area for the development of new types of methane generators of the future.

A dense pellet sludge with excellent settling and thickening properties has also been developed in a full-scale upflow clarigester plant in South Africa, treating a glucose/starch waste (Ross and Smollen, 1981). This paper describes the full-scale and pilot-scale digester operational conditions which resulted in the formation of sludge pellets and illustrates certain of their physical, chemical and microbiological characteristics. A possible mechanism for the formation of such sludge types is discussed.

Anaerobic treatment of a maize processing waste

History of the full-scale clarigester plant

An industrial waste arising from the manufacture of glucose and starch from maize has been successfully treated for some 22 years in a full-scale upflow clarigester plant situated at the Bellville sewage works (Hemens *et al.*, 1962). The plant consists of three identical unheated clarigesters, each with a digester and clarifier capacity of 623 m³ and 374 m³, respectively (Figure 1).

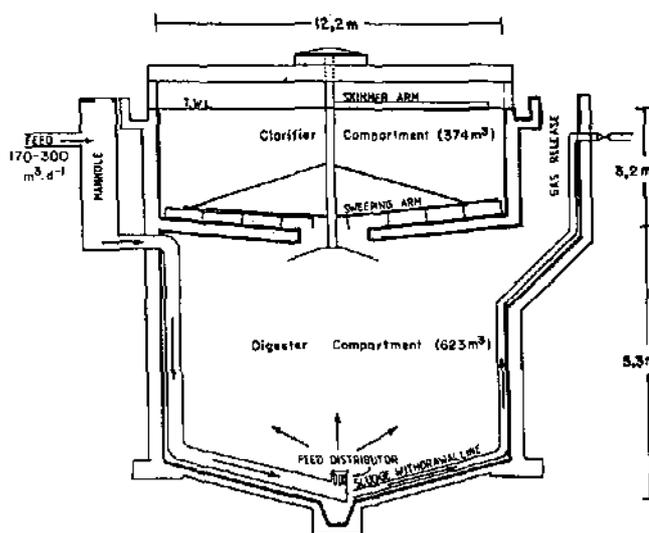


Figure 1
Full-scale upflow clarigester. Plant consists of three such units with a combined total capacity of 3000 m³

The degree of COD reduction is 93 per cent, based on an initial mean substrate concentration of 7200 mg l⁻¹. A feature of this plant was the well settling pelletised sludge that had developed over the years (Ross, 1980). This allowed suspended solids concentration of some 45 g l⁻¹ to be maintained in the digester compartment with a minimum loss of solids in the final effluent. In 1981/82, all the sludge had to be wasted to effect necessary repairs to the plant. This afforded an opportunity to study the pelletisation process from start-up. The clarigesters were thereafter recommissioned using primary sewage sludge as inoculum. Bacterial pellets once again formed a significant portion of the sludge at the bottom of the clarigesters some six mon-