

Market dynamics as a driver towards the evolution of research needs: The case of up-flow anaerobic sludge blanket seeding granules

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Abstract

Market dynamics offer positive (incentive) or negative (disincentive) feedback loops that shape the research needs for, or certain aspects of, a particular technology. Our case study results illustrate how market dynamics have influenced the evolution of research needs in the wastewater treatment sector, with specific emphasis on research on the seeding granules used to start up-flow anaerobic sludge blanket (UASB) reactors. Because of insufficient data on the actual market demand for seeding granules for UASB plants, surrogate data, on the number of UASB plants installed internationally from 1970 to 2007, were used to predict the potential future demand for seeding granules. Secondly, we also determined whether or not such a demand would provide sufficient economic justification for the installation of one or more plants for manufacturing seeding granules in South Africa. The direct relationship between the demand for seeding granules and increased numbers of UASB plants was based on the premise that the start-up of each plant required a seeding inoculum before effluent could be treated. Three methods were used to obtain the data used in this study, namely: a literature survey, a questionnaire survey, and interviews with people having expert knowledge of wastewater treatment technologies. Our findings suggest that the UASB technology has largely been marginalised in the wastewater treatment market because of the introduction of competing technologies, and due to high initial capital costs. As a result, South African market demand for the seeding granules is likely to be very small or non-existent, because the number of new UASB plants installed per year is likely to decrease in future. Secondly, our research suggests that market dynamics, political contexts and technologies will continue to change, exerting an increasing downward influence on the UASB technology over time.

Keywords: market dynamics, UASB, EGSB, seeding granules, market demand, inoculum

Introduction

Historical context of UASB technology development

The up-flow anaerobic sludge blanket (UASB) technology was developed in the late 1960s by Bill Ross in South Africa (Ross, 1989). This was followed in the early 1970s by the work of Lettinga and co-workers (Lettinga et al., 1979), who solved the problem of how to ensure a long residence time of the seeding inoculum in a UASB reactor. Thereafter, the UASB process became among the most efficient treatment technologies for high strength effluents, and a stable anaerobic wastewater treatment technique.

Several reasons contributed to the relative success of the UASB technology up to the 1990s, when compared to other forms of effluent treatment technologies that were introduced during the same period. The most salient reasons include the following: First, the basic knowledge about anaerobic digestion (AD) and particularly the UASB reactor was freely accessible to companies that were interested in producing parts of the reactor. This cooperation between industry and research institutions led to several new firms entering the market. Unlike many other technological discoveries where the intellectual property was

protected through a variety of patent and licensing instruments – the UASB technology was never patented (Foresti, 2001). Both the Biothane Corporation and Paques Inc., the world leaders in this technology, only patented partial improvements to the reactor. Since then, the UASB reactor design has continued to be refined (Nederhorst et al., 1986) to cater for effluents derived from a variety of different industrial processes.

Secondly, political factors propelled the development and wide application of the UASB technology in Europe and North America. The underlying reason for this was the energy crisis of the early 1970s, which caused severe fuel shortages in Europe and North America, and particularly in the USA, which was heavily dependent on oil supplies from the Middle East (McBNeill, 2000). While the oil shortage only lasted for a few months, and supplies were ‘back to normal’ by March 1974, the price of crude oil had quadrupled during the crisis period. In Europe, the Netherlands was the country most adversely affected by the oil crisis and both the Netherlands Government and industry invested heavily in finding alternative energy sources. In this context, the UASB technology proved to be very effective at treating high strength effluent and also produced ‘free’ energy in form of biogas (Raven and Verbong, 2004).

On the other hand, the increased international attention directed towards waste minimisation and recycling that started in the 1960s forced companies to seek technology alternatives that could treat industrial effluents to acceptable standards before their release into the environment. In addition, governments started to exert increasing pressure on companies to meet their environmental-related obligations by enacting stringent

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