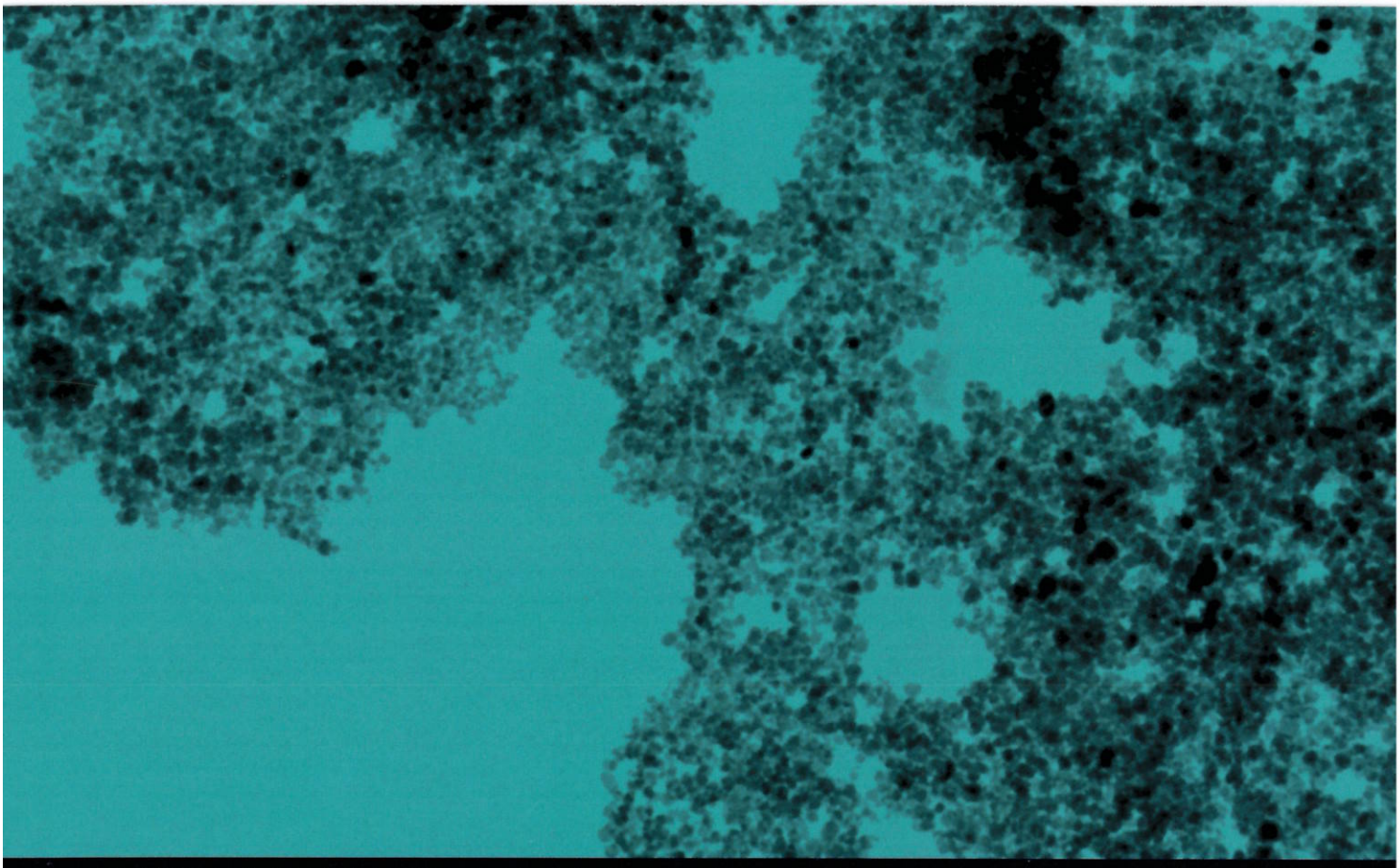

CREATING A **DIMENSION** OF INFINITE **POSSIBILITIES**

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COMMERCIAL APPLICATIONS

Enhancement of biogas production using iron Oxide nanoparticles

WASTE MANAGEMENT

- LANDFILL WASTE
- SEWAGE SLUDGE
- ANIMAL SLURRIES AND WASTES

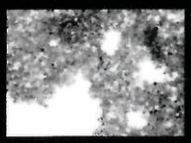
ENERGY PRODUCTION

Universitat Autònoma de Barcelona

Institut Català de Nanotecnologia

ENHANCEMENT OF BIOGAS PRODUCTION IN ANAEROBIC DIGESTORS USING IRON OXIDE NANOPARTICLES – EP11157784.7

ICN: Víctor Franco Puntes, Edgar Emir González, Eudald Casals Mercadal
UAB: Antonio Sánchez Ferrer, Xavier Font Segura, Lucía Delgado Ramisa, Ana García Mestre



Nanoparticles of Iron Oxide (Magnetite)

A new method to significantly enhance biogas production using iron nanoparticles has been developed. These new iron oxide nanoparticles have been successfully tested in anaerobic digestion processes with sludge from real wastewater treatment plants, demonstrating significant improvement of biogas production (up to 70% increase in methane production) at a low cost, making it a very market-friendly technology with applications in other areas such as industrial residues, urban solid residues (USR) or even agricultural wastes.
We are seeking a company partner to further develop the technology through a co-development and license agreement.

BACKGROUND

There are currently three major biogas production channels: direct recovery from landfills, urban waste and industrial effluent treatment facilities and methanisation plants. Organic waste is treated in anaerobic digestors in the presence of microorganisms to obtain a gas mixture mainly composed of methane and carbon dioxide, which can be used for industrial and/or domestic purposes, especially for waste management and energy production.

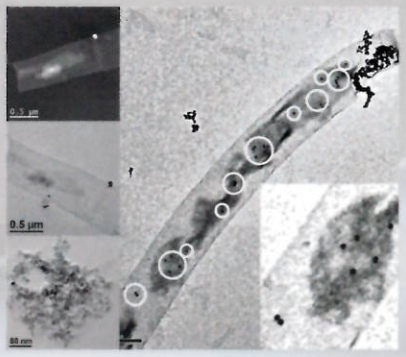
However, biogas production methods to date have proven to be inefficient, and most attempts to increase production via thermal or ultrasound pretreatment of the organic waste are difficult to scale-up. Iron has been shown in the laboratory to strongly increase anaerobic digestion, but problems result in practise as the standard form of the metal ion is ineffective when used in a closed anaerobic reactor.

RESEARCH RESULTS

The new delivery system based on Fe_3O_4 (magnetite) nanoparticles leads to enhanced anaerobic digestion, and consequently to higher methane production and organic matter processing. The improved performance is due to the presence of Fe^{+2}/Fe^{+3} ions, introduced into the reactor in the form of nanoparticles in a similar way to controlled drug delivery systems.

The use of soluble/biodegradable iron oxide nanoparticles facilitates the production of iron ions in the reaction medium while avoiding toxicity and other problems commonly associated with iron supplemented digestion processes. Fe_3O_4 nanoparticles ensure an even distribution of iron ions in solution, with corrosion of the nanoparticles maintaining a sustained supply of iron ions in the reactor. Tests have shown an increase in methane production of up to 70% and a 300% increase of organic matter processing using optimised forms of this iron oxide additive.

An additional benefit is that these nanoparticles can be easily recovered after the anaerobic digestion process using the intrinsic magnetic properties of material.



TEM images of Iron oxide nanoparticles and microorganisms in the sludge.
Encircled: Iron oxide NPs modified by microbiota metabolism.
Right: Detail.
Left Up and Middle: Iron oxide NPs associated to microorganisms.
Left Down: The iron oxide NPs of 7 nm mean diameter as synthesised

COMMERCIAL APPLICATIONS

This Iron Oxide Nanoparticle system represents a totally innovative approach as it is the first application reported of nanoparticles for enhancing biogas production and organic waste treatment, and it affords a significant increase in organic waste degradation in comparison with existing technologies.

The technology has already been successfully applied to sludges, but may also be used in different applications of anaerobic digestion, such as agricultural wastes, industrial residues and urban solid residues treatment.

CONTACTS: SCIENCE - VÍCTOR FRANCO PUNTES - VICTOR.PUNTES@ICN.CAT | ANTONIO SÁNCHEZ FERRER - ANTONI.SANCHEZ@UAB.CAT |
COMMERCIAL DEVELOPMENT - JORDI REVERTER - JORDI.REVERTER@ICN.CAT
INSTITUT CATALÀ DE NANOTECNOLOGIA. CAMPUS DE LA UAB, EDIFICI CM7, 08193 BELLATERRA, ESPAÑA | TEL: +34 935814408 | WWW.ICN.CAT
UNIVERSITAT AUTÒNOMA DE BARCELONA. CAMPUS DE LA UAB, EDIFICI EUREKA, 08193 BELLATERRA, ESPAÑA | TEL: +34 935812810 | WWW.UAB.CAT/PARC-RECERCA

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