A Unique Idea in the World: BioGAS+

Applied Nanoparticles to Biogas Production

Barcelona, September 22, 2014. The spin-off Applied Nanoparticles SL presents in the Internet (http://www.appliednanoparticles.eu/ and https://twitter.com/biogasplu) their **innovative solution to multiply the current biogas production through nanotechnology advances**.

"Biogas *typically refers to a mixture of gases produced by the breakdown of organic matter in the absence of oxygen. It is a renewable energy source and in many cases exerts a very small carbon footprint. Biogas is produced by anaerobic digestion with anaerobic bacteria or fermentation of biodegradable materials such as manure, sewage, municipal waste, green waste, plant material, and crops.*" **Biogas converts the problem of organic waste and waterwaste in a solution that contributes to the Energy Transition, and to the mitigation of Climate Change**.

In 2013 and 2014 editions, Fundación Repsol's Entrepreneurs Fund **has selected BioGAS+ as an innovative energy efficiency project** to which it provide technical and financial support to enable it to become successful business.

The Repsol's Technological Innovation blog explains that BioGAS+ *"seeks to improve those processes in which cultures of bacteria degrade organic matter. For this they have* ***implemented a revolutionary idea that is "feed" the bacteria with iron nanoparticles to stimulate its activity. This is a unique idea in the world*** *and the benefits of this development are many: increased biogas production, reducing greenhouse gas emissions and the development of renewable energy, among others. In addition, as a result of increased biogas generation waste is most degraded and enriched with iron, which improves their properties and allows use as compost (fertilizer)*"

Biogas is a sustainable alternative source of energy but to date production methods have proven inefficient. Many attempts to increase biogas production are not suited to industrial scale-up. Iron has been shown to strongly enhance anaerobic digestion, but introducing the standard form of the metal ion in an anaerobic closed reactor is problematic. The new system is based on the use of slowly dissolving biodegradable nanoparticles, facilitating the production of iron ions in the reaction medium while avoiding many of the problems, such as bacteriostaticity.

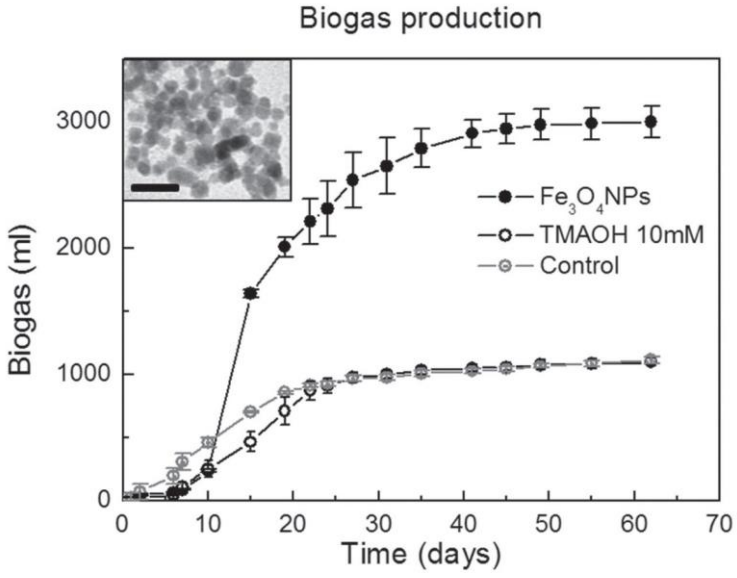

Figure Right) Biogas production of the anaerobic digestion processes using iron nanoparticles (Fe_3O_4). For this experiment three replicates were performed and each black line represents a different replicate. Grey line is control experiment (no nanoparticless). Top left) Image of the 7 nm Fe_3O_4 nanoparticles.

About Applied Nanoparticles

Applied Nanoparticles makes nanotechnology real. The main current objective of Applied Nanoparticles is the **commercial exploitation of the patent application "biogas production"**, in the U.S. and Europe, consisting of the use of iron oxide nanoparticles as additives to optimize the production of biogas.

Applied Nanoparticles SL also develops projects on the **production, characterization and commercialization of model nanoparticles**, as well as consulting work related to other possible industrial uses of inorganic nanoparticles. In this regard, Applied Nanoparticles explores the use of iron oxide nanoparticles or similar in other applications, such as catalysis, environmental remediation, energy storage, drug, imaging contrast agent, bacteriostatic and bactericide substance or hyperthermia.

Applied Nanoparticles business is **based on the principles of Responsible Research and Innovation**, focusing on the design processes of nanoparticles and low energy consumption, low toxicity, waste minimization and reduction of emissions.

Nowadays, innovation will not unfold unless companies cooperate and create partnerships to deliver their innovations. This means an in-depth knowledge of the value chain in order to discover synergies geared towards solving global challenges.

Applied Nanoparticles devotes **significant effort to education, public debate and public awareness of nanotechnology**, using virtual tools (such as NanoWiki, reference website and twitter account), but also by hosting Master and PhD students for specific technical training.

Documentation

Paper: Programmed Iron Oxide Nanoparticles Disintegration in Anaerobic Digesters Boosts Biogas Production (Small, April 2014). A novel concept of dosing iron ions using Fe3O4 engineered nanoparticles is used to improve biogas production in anaerobic digestion processes. Since small nanoparticles are unstable, they can be designed to provide ions in a controlled manner, and the highest ever reported improvement of biogas production is obtained. The nanoparticles evolution during operation is followed by an array of spectroscopic techniques.

Patent US 2014/0017753 A1, 16 de Enero 2014. "A process for the production of biogas from biodegradable material is disclosed."

Interview of Víctor Puntés, lead member of Applied Nanoparticles. From Journey to the nano world by Guillermo Orts-Gil, El Huffington Post (Spanish), June 10, 2014. "Tell us about any of the systems that you have developed in your lab: *Lately we have been entertained with the study of iron oxide nanoparticles, which are magnetic, but we do not want for their physical properties, but their biochemical properties. We use iron nanoparticles as ion dispensers. Nanoparticles are dissolved in a programmed manner in anaerobic environments and provide iron in a sustainable manner to the microbiotic organisms responsible for the degradation of organic matter. This fits them terribly well. This way you can increase biogas production up to 200%, thereby increasing degradation of organic waste. Indeed, when one havsa bacterial infection, the first thing the body does is to remove iron and nutrients from blood to starve the invaders. So the patient is anemic and lose their appetite. The funny thing is that some time ago, humans seeing infected people so pale and weakened, decided to give an iron supplement. Consequently the force of infection soared tremendously*."

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