

OPTIMISATION OF THE COMPOSTING PROCESS OF SLUDGE FROM WASTEWATER TREATMENT PLANTS

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ABSTRACT

The water resources and sustainable development group has extensive experience in the reuse of sludge from urban waste water for the amendment or subscriber soil , as currently a process of composting is required whose product has no detrimental effects on health and / or the environment. As a major innovation , monitoring highlights a whole series of parameters that are being studied with the working documents of the European Community, such as the limit value of the concentration of linear alkyl benzene sulfonate (LAS) , pathogens, respirometric measurements ,

**TECHNICAL DESCRIPTION****Environmental aspects**

The process of composting is defined as an acceleration of the natural biological processes of mineralization, supposing a biological transformation on the organic fraction that leads to an stabilization and a reduction, on weight and volume, of the final product, which is called compost; obtaining an stabilized organic material very similar to the humus.

It's an ecological process, dynamic and complex, in which the temperature and the assimilation of the nutrients are variable due to the microbial activity.

Not all the raw materials are suitable for the process; for example, it's better to use sludge from urban water-treatment plants, avoiding this way contents of heavy metals and other inappropriate products inadequate for the agricultural use. With this objective of an agricultural use, the sludge must be processed to reduce the humidity, increase the ratio C/N, change the physical structure and decrease the presence of pathogen micro organisms, all that during the composting process with some complementarily stuff.

Following the European Directive 91/271/CEE of the Council of wastewater treatment, before the year 2005 every town with more than 2000 inhabitants must have a water-treatment plant. In accordance with the National Plan of Water Purification, the sludge production in Spain will achieve even one million tones of dry material in the year 2005.

The National Plan of Sewage-Treatment Plants 2001-2006; published the 14 of June of 2001, of the General Secretaryship of Environment determines the adequate management of this kind of waste (excluded from the National Plan of Solid Waste), and establishes the right procedure for its valuation and recycling, following the European and Spanish legislations. This plan pretends to protect the environment, specially the quality of the soils due to the adequate management of the sludge; it follows the Law of Waste of 1998, that binds to recycle as much sludge as possible, this is, to make good use of the material rather than the energy that it can produce.

That means giving a clear priority to the composting process , in all its variants, and whenever this is not technically or economically suitable, resorting to the energetic valuation, including methods like methanization, biodigestion and so on.

The composting of wastewater plant sludge appears to be the best option against other ways of elimination; this way they wouldn't be such an economical and sanitary problem because they would be useful and valuable. Some techniques of recycling suppose a complex technological infrastructure, and a considerable energetic costs, but the agricultural reuse is justifiable by many and very important reasons; the cultivations nowadays and in this latitudes need a great amount of nutrients and they have

to be replaced periodically by fertilizing, without them the mechanical, physical and chemical properties of the soil would decrease, troubling the vegetal growth and affecting directly in the quality and quantity of the crops; fertilizing has become a main step in the agricultural activity and its use to be done with chemical fertilizers and with dung; because of that there is a good chance of using the sludge as a fertilizer and at the same time revalue this waste.

Nowadays the European normative requirements are based on the Directive about the use of water-treatment plant sludge in agriculture (96/278/CEE). At the same time new technologies in the treatment of sludge have been developed, pathogenic microorganisms and some organic compounds associated to the food chain have been identified which has motivated a change in the acceptable risks by the people about this agricultural practice.

There has to be in mind that the recycling of the water-treatment plant sludge in the agricultural soil is a very important outlet for this waste, but it must be controlled to obtain an agricultural benefit, safeguarding the human and animal health and the environment, now and in the future.

Application of the optimisation process.

The optimisation of the composting process used by our team consists on the follow up and the control of the operative parameters as temperature, pH, conductivity, apparent density, humidity, organic matter, C/N ratio, ammoniac nitrogen and organic nitrogen. The determination of the specific rate of oxygen consumption, the analysis of LAS (linear alkylbenzene sulphate), the bacterial recount of *Escherichia coli*, *Clostridium perfringens* and *Salmonella* spp. As well as the nematode eggs viability complete the characterization profile of the product and the behaviour of the composting process of the water-treatment plant sludge.

The temperature is monitored all along the composting process by means of temperature drills with electronic registration.

The chemical and physical methods are the official methods recommended by the Agriculture Fishing and Nourishment Minister for the analysis of inorganic fertilizers.

The specific rate of oxygen consumption is obtained by the continuous measurement of the dissolved oxygen concentration of an aqueous suspension of compost supplemented with various dissolved nutrients except carbon. The humidity and the total volatile solids of the moisture are previously determined.

The viability of the nematode eggs has been done according to the methodology proposed by WHO, method Bailenger modified by Bouchoum & Schwatzbroud.

LAS (Linear alkylbenzene sulphate), the determination and quantification of this compound is done through High Resolution Liquid Chromatography that allows an individual determination of the various homologue groups. The analytical method is based in the technique developed by Matthijs and De Henau but with some modifications during the purification of the extract.

ADVANTAGES AND INNOVATIVE ASPECTS

The most innovative aspects of the proposed optimisation process is the followup of various parameters that are still under consideration with the working documents by the European Community, such as the limit concentration value of some organic compounds in the sludge for its agricultural application, one of these organic compounds is the LAS (linear alkylbenzene sulphate) ("Working document; on sludge 3rd Draft, European Community, 2000); also pathogen as the viability of nematode eggs (" Evaluation of sludge treatments for pathogen reduction", European Community, 2001), and the incorporation of quick techniques to determine the stability of the compost like the respirometric determination (Working document; Biological treatment of Biowaste 2nd Draft, European Community, 2001).

The experience of the research team in the analysis of LAS in different environmental arrays is very wide, and the compost is one of the fields where the research has been focalised during the last years.

In spite of there isn't yet a European normative that controls the characteristics and the permitted uses and applications of the bio solid, every day it's more necessary the knowledge of the characteristics of this waste and the adaptation to the every time more exigent tendencies of the European Council. The optimisation of the composting process and the monitoring of the control parameters of the process that we propose follows the trend of the new requirements.

CURRENT STATE OF DEVELOPMENT

The monitoring of the composting process has been applied successfully to the intensive composting process of water-treatment plant sludge realized in composting tunnels that are working at present (Compost treatment plant of Aspe (Alicante)).

MARKET APPLICATIONS

The present technique could be applied to:

- The monitoring and control of intensive composting processes already functioning.
- The start up functioning of intensive composting processes.
- The verification of the quality of the compost obtained in relation to the prevailing Spanish normative.

- The verification of the European recommendations on the compost quality in relation to the elimination of pathogens (viability of nematode eggs) and LAS.

COLLABORATION SOUGHT

The institute would be interested in:

- Realize the development to customers who would like starting the intensive composting process of water-treatment plant sludge.
- The monitoring of the composting process on urban water-treatment plants already functioning that would like to optimise the process.
- The control and follow-up of xenobiotics (LAS) and pathogens in composting processes and composting products.

INTELLECTUAL PROPERTY RIGHTS

The University Institute of Water and Environmental Sciences has a wide experience and the monitoring and optimisation of the composting process on urban water-treatment plants. The protection by patent is not applicable.

MARKET APPLICATION (2)

Pollution and Environmental Impact
Chemical Technology