

# OBTAINING BIO-STIMULANTS PRODUCTS FOR LAND APPLICATION FROM SEWAGE SLUDGE IN SMALL POPULATIONS

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## Abstract

Large amounts of sewage sludge are generated in wastewater treatment plants during the purification process. In small populations, with less than 2,000 p-e, sewage sludge is produced normally in anaerobic systems (like septic tanks, Imhoff tanks or anaerobic ponds) or in extended aeration systems. According to the European Directives 86/278/EEC and 2006/12/EC, sewage sludge must be treated before its final fate. Although there are different alternatives, land application of sewage sludge after its composting has been widely promoted because of its high nutrients content. In this paper a hydrolytic process is evaluated for obtaining an agricultural bio-stimulant from the sewage sludge generated in small wastewater treatment facilities.

Keywords: sewage sludge; land application; bio-stimulants products; small WWTP.

## Introduction

During sewage treatment a residual sludge is generated. The treatment and management of that solid waste result really important because it concentrates all the pollutants that are removed from wastewater. In order to regulate the management of these residues, the European Union has promulgated different Directives (Directive 2006/12/EC on Waste; Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture). In Spain, the National Plan on Sewage Sludge (2001-2006) was promulgated in this sense. The objectives of this plan were to improve the management of sewage sludge, and especially optimize the agricultural application, protecting the environment and, specially, the quality of the soil. That Plan considered that the recycling of nutrients and organic matter by agricultural land application was the most sustainable option for these residues. Recently, a Second National Plan on Sewage Sludge for the period 2007-2015 has been established as a part of the Integrated National Plan of Residues (PNIR).

Sewage sludge (SS) can be used as fertiliser because of their high N and P content and low C/N ratio (Boyd *et al.*, 1980; Iakimenko *et al.*, 1996). Sewage sludge also has a high content of organic matter which makes both a quantitative and qualitative contribution to the soil organic matter so that it acts as an organic amendment for both agricultural purposes and for the rehabilitation of degraded areas. Positive effects have been reported for soil physical, chemical, nutrient and biological properties (Navas *et al.*, 1998; Wong *et al.*, 1998). The direct use of these wastes may cause new problems derived from the presence of heavy metals, pathogenic microorganisms, bad odours or phytotoxicity. Composting is the main biological approach to stabilize the SS. However, the composting of sewage sludge has several problems: the long time of production, the low control of the process, the low value of the final products, the presence of large size solids that avoid some kind of agronomic applications and the slow assimilation by soil microorganisms and plants. In this study, a hydrolytic process has been applied for obtaining a bio-stimulant product from the sewage sludge generated in small wastewater treatment plants.

## Methods

Sewage sludge was collected from the Experimental Plant of the Foundation Centre for New Water Technologies (CENTA) at Carrión de los Céspedes (Seville), concretely from the waste sludge line of an extended aeration unit. The sewage sludge was then introduced in a bioreactor where the hydrolysis took place, according to the pH-stat test (Adler-Nissen, 1977). Finally, the hydrolysed mass was centrifuged obtaining two products: the hydrolysed sludge and an insoluble waste. Both the fresh sludge and the hydrolysed product were characterised (organic matter content, total nitrogen, total phosphorous and proteins). For analysing the potential use of the sewage and the hydrolysed sludge as an agricultural bio-stimulant, the dehydrogenase, phosphatase and  $\beta$ -glucosidase enzyme activity were measured in a pilot plot.

## Results and discussion

Table 1 shows the chemical properties of both the fresh and the hydrolysed sludge.

*Table 1. Results of the chemical characterisation of the sewage Sludge and the hydrolysed product*

Parameter	Sewage Sludge	Hydrolysed sludge
Organic matter	39.20	55.51
Total Nitrogen	2.70	2.93
Total Phosphorous	2.08	0.22
Proteins	170 g/kg	190 gr/kg

As observed in table 1, the hydrolysis of the sewage sludge increased the content of organic matter, total nitrogen and proteins but reduced the phosphorous concentration. It is supposed that phosphorous is removed with the insoluble waste during the centrifugation. The observed solubilisation of both the total nitrogen and proteins shall improve the bioavailability of them to plants and other organisms in the soil.

The application of the hydrolysed sludge in the pilot plot produced an increase of the dehydrogenase activity (up to 78 times greater than the control) (see Figure 1) and  $\beta$ -glucosidase (2-4 times greater). The fresh sewage sludge also produced an increase of both enzymatic activities but not as noticeable as the ones obtained for the hydrolysed one. However, the phosphatase activity was larger promoted when the fresh sludge was applied.

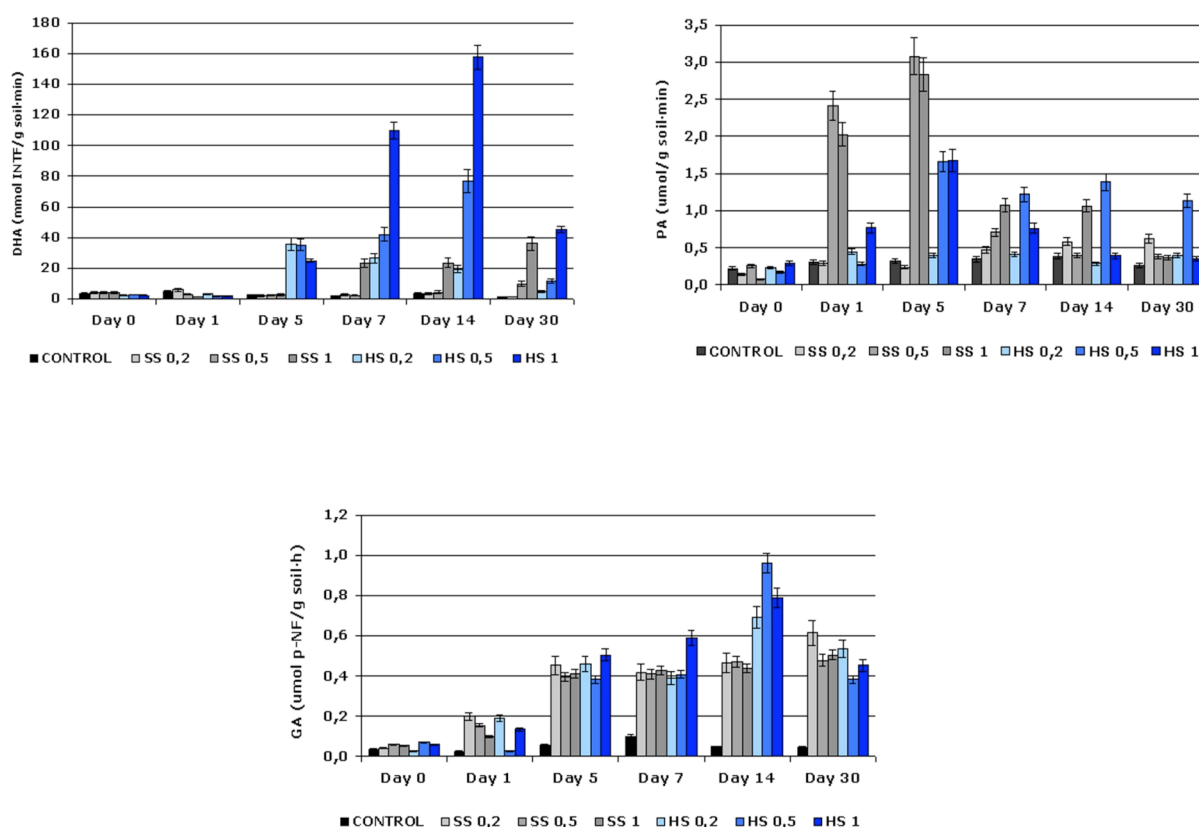


Figure 1. Enzymatic activities measured in the pilot soil after the sewage sludge and hydrolysed product

## Conclusions

The hydrolysis of sewage sludge generated in small WWTP is an alternative process to composting for land application of those wastes. The hydrolysed product obtained presents a high stability and bioavailability thus enhancing the enzymatic activities of the soil's microbial community.

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