CELLULOSE BIOAVAILABILITY IN WASTE

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Microbial activity in landfills is possible because favourable conditions to its development are combined. The presence of substrates and sufficient moisture content are two of these conditions.

Municipal solid waste (MSW) may be considered like lignocellulosic substrates undergoing biological degradation processes. Jointly with the bioconversion process of cellulose into biogas, a mechanism of organic matter stabilisation takes place, *i.e.* the humification process.
Cellulose is the most important carbon source for methanogenesis in landfills, however it is not an easily biodegradable material. In fact, cellulose and hemicellulose whose half-lives are about 15 years would contribute to 90 % of the total methane produced (Barlaz *et al*., 1989; Gendebien *et al*., 1992). Therefore, the cellulose degradation should be considered as a limiting factor for the biological activity. On that basis, several works have estimated the biodegradability of solid waste components, like cellulose, using a biochemical methane potential assay (BMP) (Shelton and Tiedje, 1984; Bogner, 1990; Wang *et al*., 1994; Stinson and Ham, 1995; Eleaser *et al*., 1997). Other authors have also developed methods describing the biological reactivity and the chemical state of pre-treated wastes (Binner *et al*., 1999; Pichler and Kögel-Knabner, 1999).

In our work, the problem of cellulose biodegradability has been investigated at the first stage of the organic fraction decomposition process, *i.e.* the enzymatic hydrolysis step. From this point of view, a new original lab test based on cellulases and hemicellulases-mediated hydrolysis has been developed to evaluate the potential of evolution of a sample by measuring the quantity of sugars released during the enzymatic degradation (Rodriuez *et al*, 2001). This method allows the assessment of the cellulose biological reactivity in landfills. Moreover, the quantity of sugars liberated can express the cellulose bioavailability when it is transformed as the percentage of cellulose hydrolysed.
From this point of view, enzymatic hydrolysis has been performed on refuse samples originating from different layers of an old landfill. This enzymatic test has been compared to a BMP test. In fact, the quantity of sugars liberated by the enzymatic degradation has been compared to the methane produced by the BMP assay. The results showed a very good correlation between the two methods.

Furthermore, the relationships between cellulose enzymatic bioavailability and cellulose or lignin contents of solid waste have been studied. In the same way, the impact of humic acids on the cellulose bioavailability has been tested with the aim to explain the lack of biological reactivity of old MSW as a protection effect of humic acids.
These experiments have pointed out the fact that the cellulose bioavailability does not depend on the degree of lignification, however, it seems to depend weakly on the cellulose content for the studied case. They have also shown that humic acids do not hamper the accessibility of cellulose. On the contrary, the results have suggested that for high humic acids contents, the cellulose degradation had been increased.

On the other hand, moisture content in landfills is considered as one of the most important factors that favours the mineralization of organic matter. In this respect, the influence of moisture content on the 3 main steps (hydrolytic, acidogenic and methanogenic steps) of the biochemical processes has been investigated in order to assess the limiting effect of the hydrolytic stage. Indeed, enzymatic kinetics of cellulose hydrolysis have been investigated on refuse samples at different water contents. In the same way, BMP tests have also been carried out at different water contents in order to follow the patterns of fatty acids and biogas production.
The results showed the strong dependance of the enzymatic degradation step for the water content. Moreover, an important decrease has been noticed in the rates of fatty acids and biogaz production when the moisture content decreases.

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