

## Influence of Physico-Chemical Surface Characteristics on the Adhesion of *Alcaligenes denitrificans* to Polymeric Supports

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One way to avoid the washout limitation in continuous biological systems and to increase productivity is to retain the cells inside the reactor via immobilisation onto a supporting material. From a physical-chemical point of view, adhesion of cells to solid surfaces is determined by the interplay of electrostatic and hydrophobic interactions. Thus, the nature of the surface of the microorganisms and supports are deciding factors. The two characteristics of relevance are electrokinetic potential and hydrophobicity. Studies were performed to determine which type of material promotes a stronger adhesion of *Alcaligenes denitrificans* and the development of the most stable biofilm, to be used as biomass carrier in denitrifying inverse fluidised bed reactors. The supports are: high-density polyethylene (HDPE), polypropylene (PP), polyvinylchloride (PVC) and polymethyl-methacrylate (PMMA). This study also aims at determining if in the initial adhesion process prevails the electrostatic interaction or hydrophobicity. The zeta potential of the cells and supports was calculated by electrophoretic mobility measurements and the hydrophobicity was determined by contact angle measurements, using the concept that a material is hydrophobic when the interfacial free energy of interaction of its particles immersed in water is negative, and is hydrophilic when that energy is positive [1]. Initial adhesion tests were performed with four slides of each type of support horizontally placed in a sterile small container and 100 ml of bacterial suspension were added. After 2 hours of incubation at 27°C and 90 r.p.m., the slides were rinsed with sterilised water. They were then covered with a 0.1% acridine orange solution and observed under an epifluorescence microscope. The images were acquired by microscope photography and then digitised. The number of bacteria per square mm was enumerated by image analysis.

In the pH range 6-9 all the above mentioned materials to be used as carriers were found to be negatively charged as well as the bacterial cells, causing a potential energy barrier which difficults the adhesion process. All the supports studied are hydrophobic. PP is the most hydrophobic material, PMMA is the less hydrophobic whereas HDPE and PVC presents an intermediate behaviour. As bacteria cells are hydrophilic, adhesion is favoured to polypropylene. This is confirmed with the results of adhesion tests (Figure 1). In this way, adhesion seems to be dominated by hydrophobic interactions.

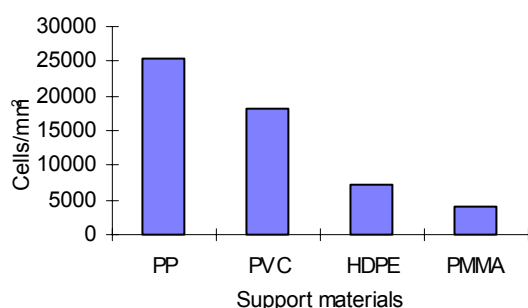


Fig.1 - Results of adhesion tests performed, expressed by the number of bacteria per square mm of the polymer surface.

[1] van Oss, C.J., *Interfacial Forces in Aqueous Media*, Marcel Dekker, 1994.