Plastic on the Beach

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Plastic is an organic polymer used for many different products and purposes in modern society. In 2009, 230 million tonnes were produced globally. Many of the additives used in plastic, such as heavy metals, bisphenol A, polybrominated and chlorinated biphenyls are toxic to the environment and also contribute to the persistency of the plastic products.

The governing degradation of plastic is a photochemical process, which is oppressed in the sea since the water shields the plastic from the UV-rays from the sun. This leads to an accumulation of plastic particles and fragments that may create mechanical problems for marine animals as well as induce the leakage of additives. Persistent organic pollutants (POPs) can also sorb to the particles and be released when ingested. So far 267 different species have been proven affected by the marine plastic pollution.

In this study we set out to quantify the amount of macro plastic fragments and microscopic plastic particles in a series of Danish beaches on the northern coast of Zealand. Three beaches (Charlottenlund Fort, Vedbæk Strand and Helsingør Strand) were examined for macro litter using guidelines standardized by UNEP. Sediment samples from six beaches (Dragør Strand, Charlottenlund Fort, Vedbæk Strand, Nivå Strand, Esbjerg Strand and Helsingør Strand) were examined for micro particles using density separation with a Sodium PolyTungstate solution and a microscope analysis.

In our study of macro litter we found a total of 368 fragments on 11,230 m² divided over the three beaches. Of these 86.8% were plastic litter fragments, whereas worldwide the percentage is between 60% and 80%. Most of the litter had been left in situ and not deposited by ocean currents. In our pilot study of microscopic plastic particles on the six beaches, we found an average of 6 particles per surface sample and 5 particles per core sample (each consisting of approximately 200 g of sediment).

Both of our studies showed a somewhat higher amount of plastic fragments/particles compared to international studies, which might be due to the season (for the macro investigation) and the use of Sodium PolyTungstate instead of a high saline solution (for the micro investigation).

Fermentation of Sugarcane Bagasse Hydrolysate by a widely used Brazilian Industrial Yeast Strain

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A considerable effort in research and development has been allocated worldwide in the bioethanol industry in order to convert lignocellulosic sugars from biomass into biofuels. In Brazil the main source of raw material comes from sugarcane plants and much research has been directed towards sugarcane bagasse utilization. Brazil is the world’s greatest exporter of fuel ethanol and together with USA (the biggest producer) detains 70% of the production worldwide. Utilization of bagasse-derived sugars would certainly result in a significant advance for this industry and would also bring many savings to the environment.

The sugarcane bagasse is rich in sugars, including pentoses, and is currently the focus of diverse research projects in major scientific poles, however industrially significant ethanol production based on the bagasse has not yet been achieved. As the sugar in the bagasse is mostly stored as cellulose and hemicellulose, many steps are necessary to process it down to fermentable sugars prior to fermentation, such as enzymatic hydrolysis.

Industrial ethanol fermentation is performed using robust S. cerevisiae strains, among others CAT-1 strain. This strain was recently sequenced and it has been proved to be very resistant to the harsh environment within the fermenter, where there is constant stress due to low pH, high osmotic pressure, high temperature, contamination and many others. Together with strain PE-2 they represent 70-80% of the commercialized industrial strains for fuel ethanol in Brazil.

In this project we have investigated the susceptibility of CAT-1 strain towards acetic acid, one of the most abundant growth inhibitors present in lignocellulosic hydrolysates. Shake flasks fermentations were performed with different concentrations of acetic acid in standard laboratory media (YPD) and cell viability, growth rate and product yields were analyzed. Fermentations of eight different sugarcane bagasse hydrolysates were also executed and the performance of CAT-1 was investigated with respect to cell viability, growth rate and product yields. The bagasse came from five different sources and received different pretreatments, and hydrolysis were performed using Novozymes enzymes prior to fermentation. We expect that the results obtained in this project might be useful to assess the decision making process on which hydrolysis conditions would be optimum to the following fermentation step in an industrial scenario.