Recycling plastics using enzymes from bacteria

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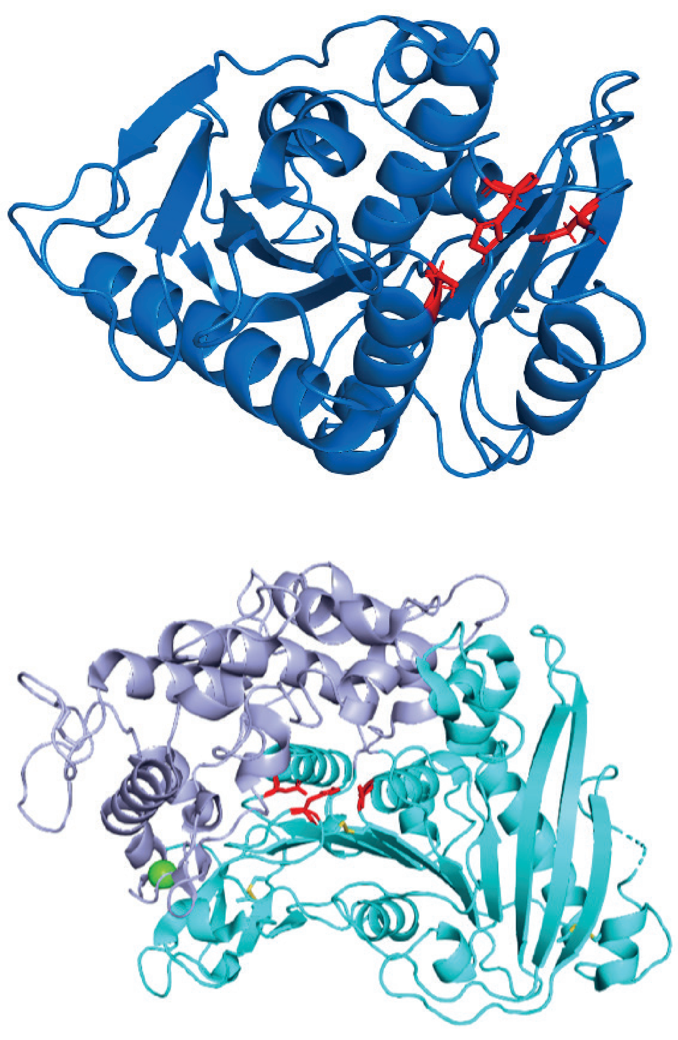
Which SDG does your project relate to?

Contributing to SDG's 9, 11, 12 and 13 calls for revisiting the use, disposal and recycling of plastic.

What is the concrete problem you have worked with?

Since 1950, the production of plastic has increased by 8.4% every year, leading to a production of 268 million tons in 2019 alone. The large production leads to a significant amount of plastic waste, and as of now, processes for recycling the plastic are largely inefficient. They often lead to a decrease in the quality of the plastic, which, in turn, reduces the field of use. This is coupled with relatively low recycling rates. In Europe only 32% of plastic was recycled in 2018. Many different types of plastic are produced for many different industries. The largest use of plastic is within the packaging industry, and with an average of only six months between production and disposal of the plastic, there is a large accumulation of plastic waste.

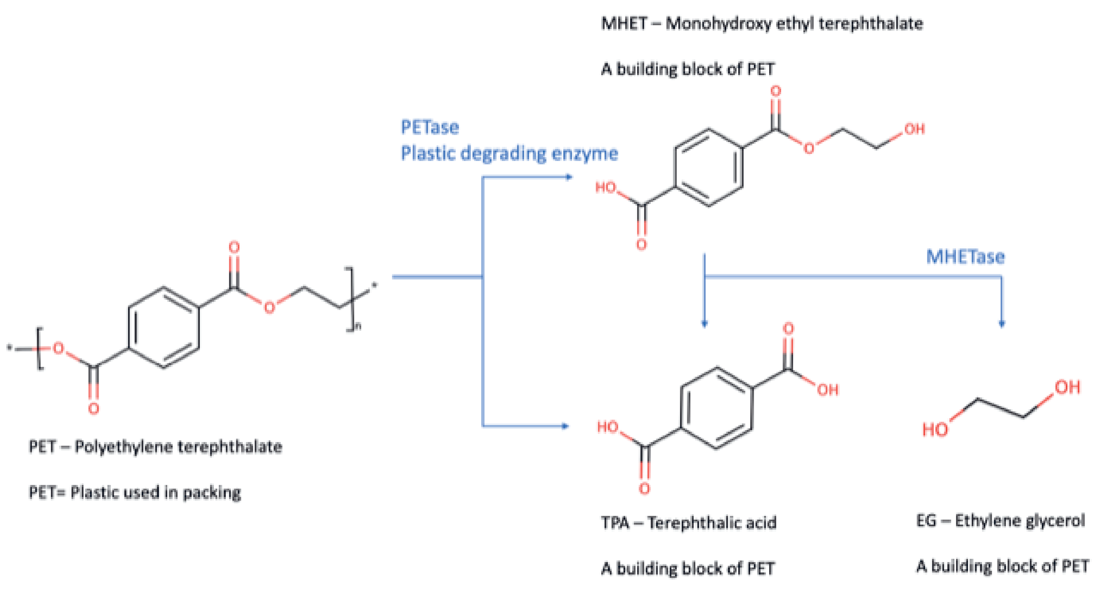


What is your conclusion and/or solution that can be applied in the 'real' world?

PET is a specific type of plastic used for packaging, such as soda bottles. In Japan, a group of researchers found a new bacterium that was able to use PET as a source of nutrition. After further analysis, the researchers discovered and isolated two enzymes, which enables the bacteria to degrade PET into molecules, and afterwards, use them as a carbon-source. The first enzyme, PETase, degrades the PET into the molecules, MHET and TPA. The second enzyme further degrades MHET into TPA and EG, which are the two molecules PET consists of. Researchers have tried to optimise the degradation of PET using PETase and MHETase by linking them covalently together, like pearls on a string. The small amount that was produced showed better degradation of PET, however, it also led to the generation of a very large enzyme that is difficult to produce as a functioning enzyme.

In this project, we continued to work on increasing the efficiency of the enzymes by linking them together using communication mediating (COM) domains, which was added to the ends of the enzymes by enzyme modification.

After production of the enzymes with the COM-domains, the COM-domains will bind to their partner, where specific COM-donor and -acceptor will link to each other, like a magnet-key, ensuring that the right enzymes are linked. By holding the enzymes separate, they become easier to produce, while still obtaining the advantage of being able to link them later in the process, obtaining higher activity.



The end goal of the project and the research of PETase and MHETase is to maintain the properties of the plastic during recycling. This would lead to a decrease in the need for new PET, leading to a lower oil demand and lower waste accumulation. The products of the recycling can be PET, but also other new plastic types consisting of the same molecules as PET. Furthermore, recycling using enzymes and bacteria leads to less toxic waste and lower cost compared to existing methods once established. Recycling plastic using bacteria and enzymes is an area of intense research, and a part of the future if we are to combat the accumulation of plastic waste and support fulfilment of the SDGs.