Utilizing 3D-Printed Engineered Living Materials To Break Down Environmental Pollutants

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Textile dyes have been a leading environmental pollutant for decades, causing mass degradation of ecosystems and wildlife. Although methods have been derived to break down these dyes, none are sustainable, renewable or easily controlled. Given that strains of cyanobacteria have been known to secrete an enzyme that breaks down these dyes, the purpose of this experiment was to determine if this property of cyanobacterial cells could be harnessed by confining a concentrated cell solution in a hydrogel matrix to break down environmental pollutants in a controlled, renewable manner. The procedure for this experiment was to create a semi-permeable, biocompatible polymer material by experimenting with different polymers and chemicals to create a gel, 3D-print a matrix/grid polymer capable of confining cyanobacteria cells using the biocompatible gel described above, combine the cyanobacteria cells with the printing gel and 3D-print matrices containing cyanobacteria and observe cell viability, run experiments on these matrices to confirm that the enzyme secreted by the cyanobacteria was able to permeate the polymer membrane, and finally to place these matrices in small samples of industrial textile dyes and observe their ability to degrade them. The biocompatible 3D-printed polymer matrix was successfully created, inside of which cyanobacteria strains were able to flourish and reproduce, the presence of the desired enzyme was confirmed, as was the matrix’s ability to degrade certain industrial pollutants. The tests run on other industrial pollutants were inconclusive, however proof of concept has been established and a clear application of engineered living materials has been established.

Awards Won:

Fondazione Bruno Kessler: Award to participate in summer school "Web Valley"

Arizona State University: Arizona State University ISEF Scholarship (valued at up to $52,000 each)

Second Award of $2,000