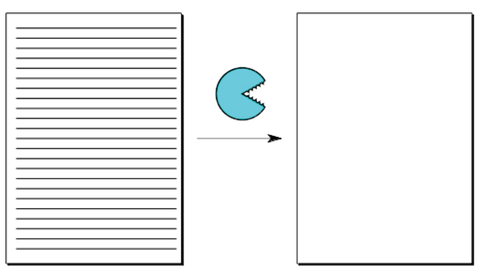
iGEM Bonn 2016

PAPER RECYCLING
An Enzymatic Approach

universitätbonn | LIMES Life & Medical Sciences Institute | Hochschule Bonn-Rhein-Sieg University of Applied Sciences

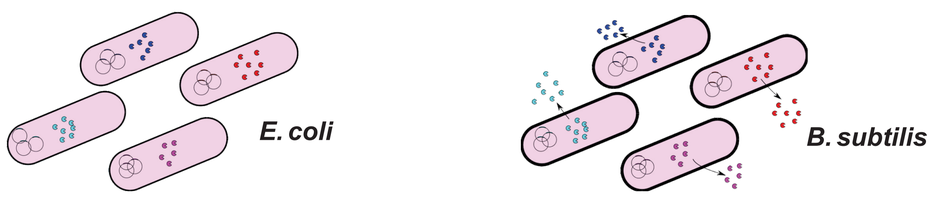
Our Idea



- **Paper recycling** is becoming increasingly large-scale. More than 70 million tons of paper are used in the US alone every year, and 66% of this amount is recycled.
- Current recycling methods use vast amounts of energy and release toxic byproducts, most of which come from a process called "**deinking**" - the removal of ink from paper fibers.
- Research has pointed to several classes of **enzymes that can deink paper**. If we can somehow produce these enzymes en masse to replace chemicals, deinking can be much cheaper and cleaner.
- But knowledge on the feasibility of this approach is still poor, so we decided to investigate!

Scientific background

- Enzymes can be produced by bacteria, if the genes coding for them are put into the organisms. The soil bacteria *Bacillus subtilis* is chosen for this project, since they secrete enzymes into the environment, unlike *Escherischia coli*, which keep the enzymes inside their cells.



- We want enzymes which either digest paper fibers to free ink particles, or attack the ink particles themselves: cellulase, esterase...
- Industrially, deinking is done by "froth flotation," which collects ink into foam. In the lab, however, a small scale method must be developed.

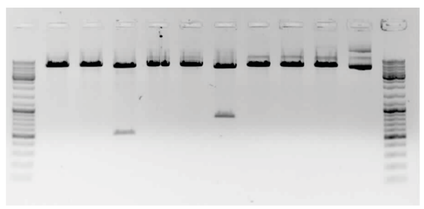
Achievements

- New parts to the iGEM registry! 7 enzyme-coding genes, 3 gene constructs for use in *B. subtilis*, and one new plasmid backbone compatible for both *B. subtilis* and *E. coli.*

  Parts: from BBa_K2029000 to BBa_K2029015

  New backbone: pSBbs1AK1

  All sequence-validated



- Together with **iGEM Freiburg**, we built a transformation protocol for *B. subtilis.* Accessible on our wiki site.
- Establishment of lab scale deinking system and grayscale scanning of dried paper samples as a method to measure deinking efficiency.

We are...

A team of Biology and Chemistry students from the **University of Bonn** (Rheinische Friedrich-Wilhelms-Universität Bonn) and the **Bonn-Rhein-Sieg University of Applied Sciences** (Hochschule Bonn-Rhein-Sieg.)

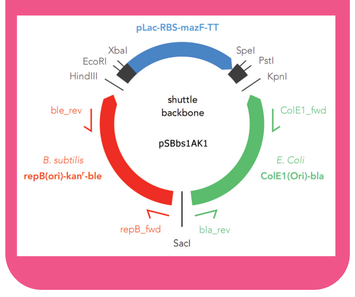
We receive funding and support from the **Life & Medical Sciences Institute (LIMES)**, our institutions and our sponsors.

Methodology

The project is split into 4 sub-areas, each addresses a different aspect.

Cloning

Constructing plasmids which give bacteria the ability to secrete enzymes



plasmid

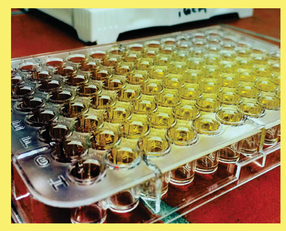
B. subtilis

- Developing a protocol to transform *B. subtilis* with our constructed plasmid
- Expressing enzymes
- Establishing a protein purification system with His-tag

enzymes

Enzyme assay

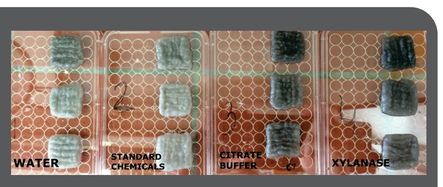
Determining the optimal working conditions for our enzymes



working conditions for enzymes

DEINKING

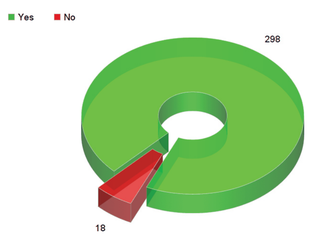
- Establishing a small scale deinking system for use in the lab: filtration or flotation?



- Finding a method for measuring paper brightness (deinking efficiency) with consistent results: flowthrough analysis or grayscale measurement?

Public Engagement and Human Practice

- How do the public feel about using paper recycled with the help of synthetic biology? A **survey** was conducted.
- We also penned an **essay** on biosafety and society.
- In collaboration with the Centre for Advanced European Science and Reseach (ceasar), we organised **Science Slam**, a stage for scientists to present their researches to the non-scientific public in a quick, easily understandable and humorous manner!



Reach us at: **http://2016.igembonn.com**

Wiki page: **http://2016.igem.org/Team:UBonn_HBRS**

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