

Siemens Competition

Math : Science : Technology

Regional Finalist

Names: Charles Pei

High School: Upper Arlington High School

Mentor: Jie Dong

Project Title: An Industrial Method of Biofuel Production from Chitin: Moving Towards Profitability (Bioengineering; Environmental Science & Engineering)

Chitin, the long chain biopolymer of N-acetyl-D-glucosamine (GlcNAc), is the most abundant biopolymer found in nature, after cellulose. However, chitin has largely been ignored as a potential carbon source in biofuel production. We developed a complete input-to-output industrial process of converting chitin to useful fuels and solvents, namely acetone, butanol and ethanol (ABE). We developed procedures for the three steps of biofuel production: pretreatment, hydrolysis and fermentation. For fermentation of GlcN, we developed an ABE process using bacteria of the *Clostridium* genus with empirically optimized bacteria species and strain, sterilization procedure and fermentation length. Butanol production reached an average of 8.578 g/L when using *Clostridium acetobutylicum* ATCC 55025, which is competitive with glucose fermentation. All results were compounded into the process modeling program SuperPro Designer for economic analysis. Using this model, we found that a large-scale chitinous biofuel plant using our method would be near profitable with a gross profit margin of -6.82%. Our approach indicates that chitin is a new and valuable potential source of biofuel deserving of further research.