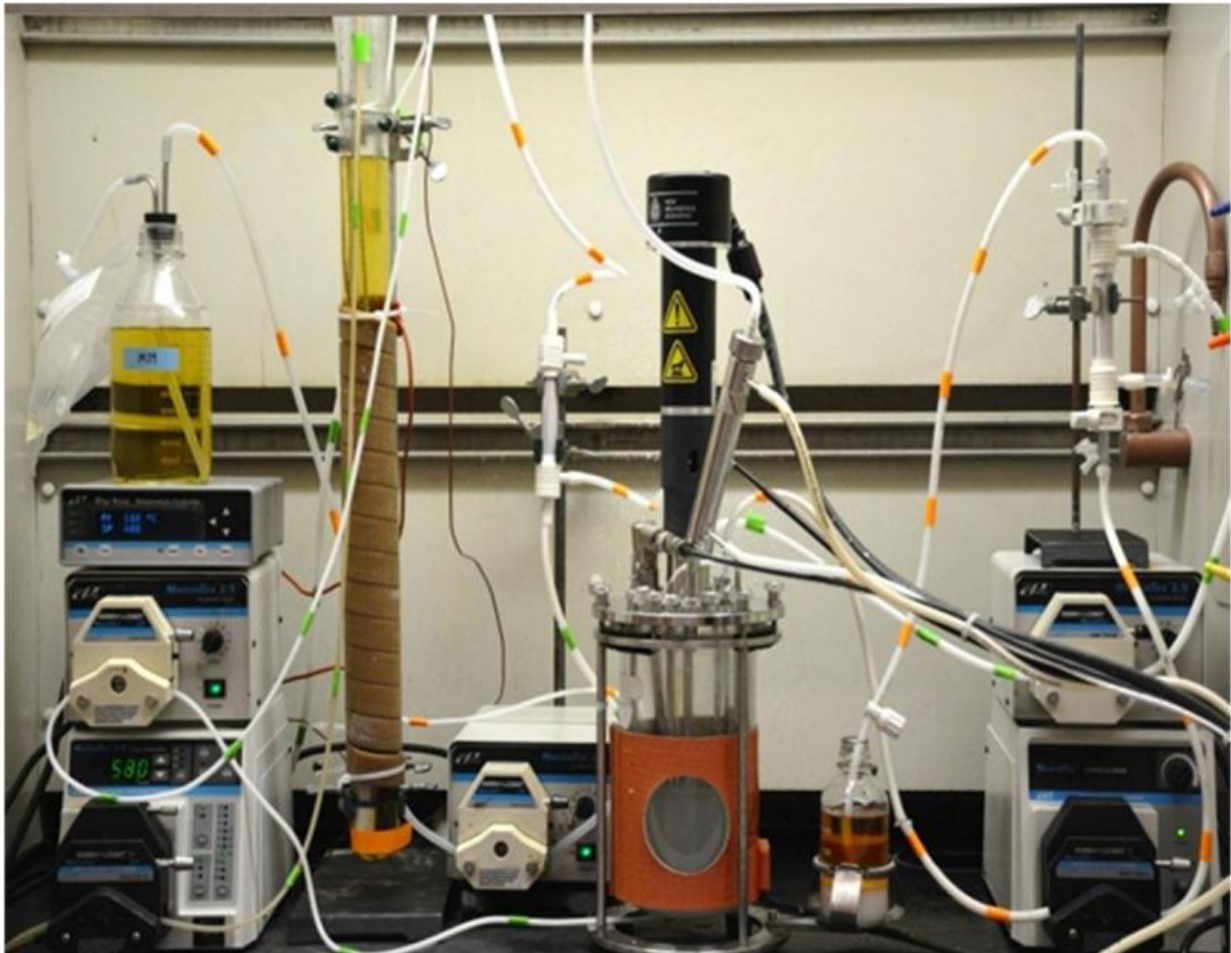


A bioprocess for converting gaseous waste substrates to liquid fuels

March 8 2016, by Bob Yirka



Two-stage process uses bacteria and yeast to convert syngas into lipids suitable for biodiesel production. Credit: Gregory Stephanopoulos

(Tech Xplore)—A team of researchers with MIT has developed a two-step process for converting waste gas into a liquid fuel suitable for use in transport vehicles. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes their technique and their plans for further testing to see how well it scales to larger applications.

As most people are aware, waste gases from human applications are making their way into the atmosphere leading to adverse climate changes; this has led to efforts across the globe to find ways to either capture and hold waste gases or use them in another productive way. In this new effort, the research team looked to see if it might be possible to capture waste gases that are normally expelled from applications such as steel making facilities or coal fired power plants and convert them into a type of fuel that could be used by transport trucks as a replacement for diesel fuel.

To find out, the team came up with a two-stage [process](#). The first stage involved building a bioreactor that converted a mixture of carbon dioxide, dihydrogen, or carbon monoxide gasses to acetic acid (the acid that makes vinegar taste sharp). The bioreactor did its job using anaerobic acetogen *Moorella thermoacetica*. In the second stage, the [acetic acid](#) was fed as a substrate to a secondary bioreactor where it was converted into a lipid—the second bioreactor worked aerobically by making use of an engineered yeast, *Yarrowia lipolytica*. The lipid produced, the team reports, was in the form of an oil that could be used as a replacement for [diesel fuel](#) in transport trucks—they also note that the process is relatively inexpensive.

The team at MIT has been working on the project for the past five years, which they have now patented and licensed to GTL Biofuel Inc., a company that has been testing the process at a pilot plant in China since last fall. The project has been successful to the extent that a much larger plant has been planned with construction to start very soon.

The researchers are confident their process will scale well, and if they are right, they envision plants being built to capture and convert gases from a variety of applications, including farm waste and garbage dumps.

More information: Peng Hu et al. Integrated bioprocess for conversion of gaseous substrates to liquids, *Proceedings of the National Academy of Sciences* (2016). [DOI: 10.1073/pnas.1516867113](https://doi.org/10.1073/pnas.1516867113)

Abstract

In the quest for inexpensive feedstocks for the cost-effective production of liquid fuels, we have examined gaseous substrates that could be made available at low cost and sufficiently large scale for industrial fuel production. Here we introduce a new bioconversion scheme that effectively converts syngas, generated from gasification of coal, natural gas, or biomass, into lipids that can be used for biodiesel production. We present an integrated conversion method comprising a two-stage system. In the first stage, an anaerobic bioreactor converts mixtures of gases of CO₂ and CO or H₂ to acetic acid, using the anaerobic acetogen *Moorella thermoacetica*. The acetic acid product is fed as a substrate to a second bioreactor, where it is converted aerobically into lipids by an engineered oleaginous yeast, *Yarrowia lipolytica*. We first describe the process carried out in each reactor and then present an integrated system that produces microbial oil, using synthesis gas as input. The integrated continuous bench-scale reactor system produced 18 g/L of C16-C18 triacylglycerides directly from synthesis gas, with an overall productivity of 0.19 g·L⁻¹·h⁻¹ and a lipid content of 36%. Although suboptimal relative to the performance of the individual reactor components, the presented integrated system demonstrates the feasibility of substantial net fixation of carbon dioxide and conversion of gaseous feedstocks to lipids for biodiesel production. The system can be further optimized to approach the performance of its individual units so that it can be used for the economical conversion of waste gases from steel mills to valuable liquid fuels for transportation.

© 2016 Tech Xplore

Citation: A bioprocess for converting gaseous waste substrates to liquid fuels (2016, March 8)
retrieved 10 April 2024 from

<https://techxplore.com/news/2016-03-bioprocess-gaseous-substrates-liquid-fuels.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--