

New method makes bioethanol from waste in existing plants

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Ramkumar Nair in the lab. Credit: University of Borås

It is possible to produce bioethanol from agricultural and industrial waste in existing plants in a socioeconomically sustainable way. A research project has been carried out by doctoral student Ramkumar Nair at the University of Borås, Sweden, in which he verified a new process model.

"I have been verifying a process that we hope will work in an industrial scale, when it comes to using existing ethanol factories," he says.

"Thanks to that process, the industry can become more sustainable and use agricultural or [industrial waste](#) for the production of bioethanol."

Bioethanol is used for fuel for ethanol cars, among other things. Usually, wheat, sugar canes, or corn are used for [ethanol production](#). In Sweden, wheat is the most common.

"But these are crops that could be used as human nutrition," Ramkumar Nair says. "It is more sustainable if we could use waste to create fuel, and this is something we have been working on in several projects here at the University of Borås.

Ramkumar Nair tells us that these research and pilots project where waste is used are called the second generation ethanol processes, whereas the current industrial production is called the first generation ethanol process. Ramkumar has now verified a process that integrates the first and the second generation ethanol processes.

No need for major investments

"This means that agricultural residues, such as straw, bran, or the like could be used for making ethanol without making any major investments in the factories. All we need is already there. You can use the factories existing reactors. This also eliminates the burden of using foodstuff to produce vehicle fuel."

In his research, Ramkumar has analysed the structure of the first generation ethanol processes and found out where the focus should be. The biggest challenge was not to add chemicals to break down the waste material for the ethanol process, as the residues from the ethanol factories among other things will be used for animal feed.

"What we added should not stop the fermentation," says Ramkumar Nair. "After several tests, the choice was to add phosphoric acid. It is good for the animals that eat the leftovers and it gives good results in the ethanol fermentation process."

The entire method was first tested in a small scale in the lab at the University of Borås, later in a larger facility at Borås Energi och Miljö, and finally on an even larger scale at SEKAB in Örnsköldsvik.

Fungus used for integration

In order to succeed with the integration, an edible filamentous fungus, *Neurospora intermedia*, was used. The fungus has a good ability to produce ethanol and is also a good ingredient in animal feed due to its high protein content. This fungus is easy to grow in a lab environment.

"One difficulty when using the fungus is that it has a tendency to clump, which creates challenges in the industrial process. But I have managed to form small balls or pellets instead of lumps. There are other fungi that form pellets, but I am the first to have make them from *Neurospora intermedia*. Pellets do not get stuck; they roll off, and are better for the fermentation process in some instances."

It was complicated to develop a method, but once found, it was quite simple.

Now the project will continue to develop and fine tune the process at a larger scale. "Now there is a research-based verification for the process, so the industry can carry on and continue to develop it," says Nair. "I hope that in a few years, I will see a large-scale, first-generation [ethanol](#) factory that produces bioethanol from agricultural [waste](#) using this integration model."

Provided by University of Borås

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