NREL's DMR process reinvents biomass pretreatment to yield larger quantities of cheap lignocellulosic sugars—choice ingredients for making low-carbon fuels, chemicals, and materials. *Photo from NREL, 16332*

Low-Cost Cellulosic Sugars Produced by NREL's Deacetylation and Mechanical Refining Process

Lignocellulosic biomass is a cheap, abundant feedstock for making low-carbon biofuels and bioproducts. But preparing or "pretreating" lignocellulosic biomass for enzymatic conversion has proven challenging. Pretreatment governs sugar yields and has a large impact on the economics and emissions from commercial biorefineries.

DMR Sidesteps Common Pretreatment Challenges

NREL has developed a deacetylation and mechanical refining (DMR) process that combines low-severity chemical pretreatment and mechanical refining to sidestep the expenses and challenges of traditional pretreatments, such as hydrothermal and dilute acid technologies:

1. Deacetylation—Acetate, lignin, and ash are removed from biomass using an alkaline extraction at atmospheric pressure. Acetate, lignin, and ash removal is key for the most efficient application of commercial cellulase and hemicellulase enzymes and optimal performance of ethanologens.

2. Mechanical Refining—Deacetylated feedstocks are processed using equipment and techniques borrowed from the pulp and paper industry to disrupt the plant tissue and cell walls, making the structural sugars more accessible to enzymes.

How They Stack Up: DMR vs. Dilute Acid or Hydrothermal (Conventional) Pretreatment

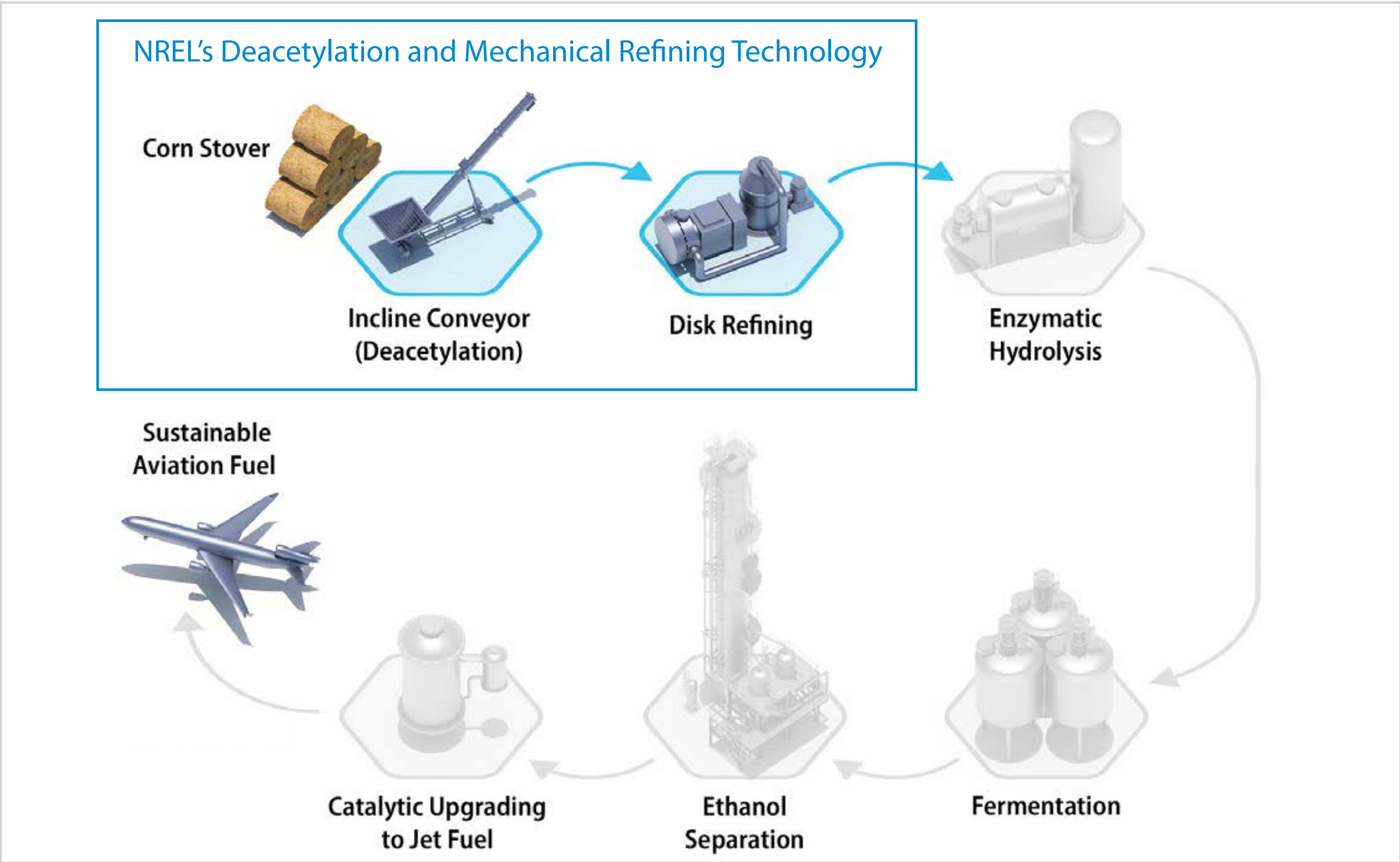
NREL's DMR uses different equipment and process conditions than conventional, dilute acid-based pretreatment systems. Using low pressures and cheaper equipment, NREL's DMR ultimately earns key advantages.

	NREL's DMR	Dilute Acid/ Hydrothermal (Conventional)
Yields low-carbon fuels or chemicals	✔	✔
Uses hot alkali instead of acids at high temperature	✔	✖
Works at ambient pressures	✔	✖
Uses industry-proven, "off-the-shelf," and low-cost equipment (no problematic complex reactors)	✔	✖
Boosts sugar yields by eliminating degradation products and fermentation inhibitors	✔	✖

↑ ~14% Ethanol Yield	↑ ~4% Sugar Yield	↓ $0.33 Per Gallon of Ethanol

DMR in Action: Sustainable Aviation Fuel From [i] Renewable Ethanol Project (SAFFiRE)

NREL is already leveraging its DMR technology to help shift the aviation market further away from oil fields and closer to the farmlands. In partnership with D3MAX LLC, the U.S. Department of Energy Bioenergy Technologies Office, Southwest Airlines, LanzaJet, Novozymes, and others, NREL researchers are integrating DMR into a planned 10-ton-per-day pilot plant called SAFFiRE (https://www.saffirerenewables.com/). NREL scientists already proved the process is effective in the lab and at small pilot scale. Analysis shows that sustainable aviation fuel from SAFFiRE will be less expensive than petroleum-based jet fuel and reduce carbon intensity by up to 84% compared to conventional jet fuel.



With NREL's DMR technology, SAFFiRE will take advantage of the infrastructure of more than 200 existing corn ethanol plants and equipment already found in the pulp and paper industry. *Illustration by Besiki Kazaishvili, NREL*

Further Reading

X. Chen, et al. 2016. "DMR (Deacetylation and Mechanical Refining) Processing of Corn Stover Achieves High Monomeric Sugar Concentrations (230 g L−1) During Enzymatic Hydrolysis and High Ethanol Concentrations (>10% v/v) During Fermentation Without Hydrolysate Purification or Concentration." *Energy & Environmental Science*. DOI: 10.1039/C5EE03718B

X. Chen, et al. 2014. "A Highly Efficient Dilute Alkali Deacetylation and Mechanical (Disc) Refining Process for the Conversion of Renewable Biomass to Lower Cost Sugars." *Biotechnology for Biofuels and Bioproducts*. DOI: 10.1186/1754-6834-7-98

Find Out More

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