Chemical Preprocessing

Low-severity treatments to improve feedstock quality and handling

INL's Chemical Preprocessing System has robust alloys on all wetted surfaces and seals that are resistant to aqueous treatments and organic solvents, allowing for dilute acid, dilute alkali, ammonia, polar and nonpolar solvents at a range of conditions.

Researchers at the Department of Energy's Biomass Feedstock National User Facility (BFNUF) work to overcome technological barriers facing the bioenergy industry. Such challenges include biomass variability, low bulk and energy density, storage stability, and feed handling.

By addressing these challenges, BFNUF researchers help reduce the cost and supply risk of bioenergy feedstocks delivered at various steps along the supply chain and at the conversion facility.

The use of chemical preprocessing using thermal, chemical or biological treatments can produce value-added bioenergy feedstocks. The treated feedstocks are often easier to grind, densify, store, handle and transport than untreated biomass. As a result, they offer the potential to reduce the biorefinery supply risks associated with feedstock variability. Chemical preprocessing can also remove contaminants, inhibitors and toxins from biomass, so feedstocks perform better during conversion.

BFNUF researchers have developed a unique chemical preprocessing system designed to help advance these technologies. Together with BFNUF researchers' expertise in process development, characterization and bioenergy feedstock variability, the system allows industry to perform detailed assessments of the energy and cost trade-offs involved with chemical preprocessing.

VERSATILITY

BFNUF's chemical preprocessing system is among the most versatile of its kind, which allows for a wide variety of preprocessing chemistries. The continuous reactor is relatively large — an 8-inch inside diameter with a 12-foot-long reaction zone. Three 10-liter batch reactors are also available for process development.

Engineers designed INL's chemical preprocessing system with robust alloys on all wetted surfaces and seals that are resistant to aqueous treatments and organic solvents. These

Idaho National Laboratory

BFNUF's chemical preprocessing system is among the most versatile of its kind, allowing for the use of a wide variety of preprocessing chemistries.

design specifications allow for dilute acid, dilute alkali, ammonia, polar and nonpolar solvents at a wide range of conditions, feedstock sizes and processing rates:

pH: from 0.5 to 13.5

Pressure: from atmospheric to 200 psig

Temperature: from ambient to 200 C

Particle size: up to 2 inches for herbaceous materials and up to 1-by-1-by-0.25 inches for wood chips

Processing rate: 5 to 70 dry kilograms per hour

Material densities: 2 to 14 pounds per cubic foot

Example materials include but are not limited to:

- Ground corn stover
- Ground miscanthus
- Ground Arundo Donax
- Pine chips
- Hybrid poplar chips
- Eucalyptus chips
- Pinion pine chips

TREATMENT CHEMISTRIES

Although chemical preprocessing and chemical pretreatments employ the same chemistries, chemical preprocessing is less severe than typical chemical pretreatments at the biorefinery. These lower severity reactions result in less extensive modifications to the biomass structure, but still disrupt the structure sufficiently to improve grinding, densification and composition. Treatment chemistries supported by INL's chemical preprocessing system include, but are not limited to: grinding, densification and composition. Treatment chemistries supported by INL's chemical preprocessing system include, but are not limited to:

- Steam
- Aqueous mineral acids (e.g., sulfuric, hydrochloric)
- Aqueous organic acids (e.g., acetate, propionate)
- Aqueous alkali (e.g., sodium hydroxide, potassium hydroxide)
- Hydrogen peroxide (with and without alkali)
- Pressurized gases
- Liquid ammonia

BIOREFINERY PRETREATMENT CHEMISTRIES

BFNUF's chemical preprocessing system is capable of performing most pretreatment chemistries at small pilot scale, allowing industry to explore process development options prior to costly capital outlays at the biorefinery.

FOR MORE INFORMATION

Technical contact
Neal Yancey
208-526-1931
neal.yancey@inl.gov

General contact
Abby Todd
Communications Liaison
208-526-6166
abby.toddbloxham@inl.gov

bfnuf.inl.gov

A U.S. Department of Energy National Laboratory

20-50443-024-R2 (Updated: 2021)