Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover

NRRI Now

Monthly Edition August 2020 Issue 8, Volume 5

NRRI Mission:
Deliver research solutions to balance our economy, resources and environment for resilient communities.

www.nrri.umn.edu

From the Editor:

Innovation at NRRI is often messy business -- especially when you're working with charred wood. (Note photo below.)

Whether it's discovering the potential in biochar or developing another tool to address sulfate pollution, NRRI researchers have their hands in it.

But we understand that to prepare Minnesota for what's ahead, we have to get our hands dirty. Applied research is like that. And that's exactly what the state legislature wanted when they formed NRRI back in 1983 — applied research to address specific challenges and inform decisions.

NRRI research goes to work.

June Breneman
Manager, External Affairs

Duluth Labs & Administration
5013 Miller Trunk Highway
Duluth, Minn., 55811
218-788-2694

Coleraine Labs
One Gayley Avenue
Coleraine, Minn., 55722
218-667-4201

MN a leader in biochar research and demonstration

There's a material that can be made from forest resources – like, ash trees killed by beetles or excess wood residuals – that can address a lot of challenges. This material filters harmful chemicals from stormwater runoff, enhances soil microbial health, increases soil drought resistance and stores carbon in soils to mitigate climate change.

The material is biochar and people around the world are looking into its benefits. NRRI is helping Minnesota take a leading role in studying, developing and demonstrating biochar's potential, especially as a new market for the struggling forest products industry.

But there's a challenge with biochar. On the surface, it seems so simple – heating wood to greater than 650°F with limited oxygen (a process called pyrolysis) produces a black, charred material that looks like coffee.

It's not that simple. Just because biochars all look the same, doesn't mean they behave the same. Different biomass inputs – varying tree species, agricultural waste, invasive plants – combined with varying pyrolysis temperatures and times results in biochars with a variety of attributes. There's a lot of work to be done to understand what attributes are needed for which application.

That's why Jim Doten, City of Minneapolis Environmental Services and Health, is grateful that NRRI is working to apply some science and engineering to biochar development.

Bridget Ulrich, NRRI geochemist, inspects biochar in a lab at NRRI Duluth.

Doten has made Minneapolis a leader in biochar demonstration projects, garnering attention from other cities looking to incorporate it into environmental remediation and urban agriculture projects.

"We've seen biochar restore boulevard trees that are stressed from road salt, improve soils impacted by pesticide and herbicide use, filter *E. coli* and PFAS contaminants," said Doten. "You first hear about it and think, maybe its snake oil, but it works."

Finding new markets for Minnesota's wood resources is a keen focus as paper manufacturing is in a steep decline, following decades of decline in other forest products. Carbon storage is also a major goal to reduce greenhouse gases. Effective filtering of pollutants from roads and industrial processes is another urban issue to address. And these are just the obvious potential applications for biochar.

"But you really have to understand the char and how to use it so you don't have the wrong char for the wrong application. That's what NRRI is doing," Doten said.

Patent moves business toward green, low-cost sulfate treatment

Minnesota just got one step closer to having another tool to address sulfate in water bodies. NRRI and American Peat Technologies in Aitkin, Minn., were issued a joint patent on a new, environmentally safe anion exchange material to remove sulfate with peat.

Ion exchange for water treatment isn't new; it's commonly used in soft water treatment systems. But manufacturing the ion exchange resins uses chemical solvents which are an environmental disposal problem. These resins are largely manufactured in China.

But American Peat Technology – employing the chemistry expertise of NRRI's Igor Kolomitsyn and his chemistry team – set out to develop a peat-based anion exchange for sulfate removal that doesn't use chemical solvents. Even better, they aimed for a low-cost, marketable solution. The patent is the first step in developing a regenerable weak acid anion exchanger that targets removal of sulfate, selenite, arsenic, phosphate and other contaminants.

"Formulation work is not quite complete at this point," said Doug Green, American Peat Technology CEO. "But we are increasingly confident that the last of the hurdles will be cleared in the next few months."

To develop this material, Kolomitsyn looked at the natural structural characteristics of peat at the molecular level. He was able to follow the inherent pathways of peat so that "green chemistry" principles could be used to develop novel material. Green Chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Today, chemists commonly use a set of 12 design principles developed as metrics to develop new chemical technologies. This new peat-based material utilizes water as the only solvent and prevents harmful waste.

Archive Photo: Doug Green, CEO of APT and NRRI Chemist Igor Kolomitsyn

"Sulfate is a common problem across the globe," said Kolomitsyn. "I have been working on this first milestone for five years, but now we need to improve capacity and achieve better stability.