NRRI News

Incorporate circles, there’s a lot of buzz about the “social license.” What is it? A powerful but informal permission that society grants to companies, allowing them to do business without widespread public opposition, resistance and disruption.

Industry must earn the social license by building trust—going beyond what’s required, engaging with stakeholders and addressing concerns. Companies must be responsive and responsible as projects are planned and operated.

NRRI helps industry identify factors that define a social license to operate in Minnesota. Our multi-disciplinary expertise facilitates engagement between those who use and those who manage our natural resources with a vision for the future.

What are we working on? Read about some of our innovations in this issue.

June Breneman NRRI Now Editor

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

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In February 2017, NRRI received $2.6 million from the Minnesota legislature for a Mining Innovation Initiative. Five projects have been identified to address challenges in responsible and efficient mining opportunities. A better way to get more iron ore? Shaping the iron ore from the range traditionally done with low intensity magnets. It works great for the magnetite ore—it’s magnetic, after all. But magnetite ores are expected to be tapped out of Minnesota’s Iron Range in the next 10 – 15 years. What then?

NRRI is developing a new process we’re calling “NatFlot,” a natural flotation process that recovers two other valuable iron oxide minerals—hematite and goethite. Bench scale testing shows that the NatFlot process is more effective, with potentially lower cost and less environmental impact.

“We had higher recovery, we can make a higher grade concentrate with half of the reagent costs and in a natural pH solution,” explained NRRI Researcher Tom Peterson. “It’s just a better process.”

NRRI is testing the reaction of the different Minnesota ores in response to the NatFlot process at the bench scale and then will run pilot tests of 10 tons or more.

Microbial sulfate removal

Using bacteria to remove sulfate in water systems has the potential to be very cost effective and versatile. First, the sulfate is converted to sulfide with naturally-occurring bacteria, and then it must be transformed into a solid (elemental sulfur or metal sulfide) for removal.

But there’s a hurdle to jump. Neutral pH mine or industrial water cannot carry a high metal concentration, making sulfide capture methods elusive.

The first step of using bacteria to convert the sulfate to sulfide is well understood. The next step requires the sulfide to bond to specific metals so that it can precipitate in the water column for removal. Reactive iron is often added to precipitate sulfide as solid iron sulfide. NRRI Researcher Chunlan Chan is working with colleagues Nate Johnson and R. Lee Penn on this project. They are testing a variety of mining waste materials including magnetite-rich ore, iron-carbonate-rich waste rock, hematite-rich waste rock, taconite tailings and more for their reaction with sulfide. Then, they’ll enhance the process using bacteria and low electrical voltage to make water reactive iron ore.

“We hope to use the natural process in a controlled way,” explained Chun. “Basically, we free the iron so that it can react with the sulfide using readily available taconite tailings.” It’s basic research with a specific goal—to improve the natural, biological sulfate removal process. Once perfected at the lab bench scale, Chan will scale up the experiments to larger water columns. The lab research is expected to be completed in two years.

Innovative Filter Technology

The goal of limiting sulfate to 10 parts per million in Minnesota water bodies was set in 1973. NRRI isn’t here to debate that standard, but we are here to help. New technologies are being developed to address sulfate, mercury and other pollutants that are a problem from Albert Lea to Ely. One such technology is showing promise in the lab and NRRI wants to scale it up to a pilot demonstration.

Collaborating with industry partner Process Research Ortech, Inc., NRRI scientists will experiment with a unique filtration technology to see if it can be adapted to Minnesota water issues. If other remediation methods can reduce pollutants from thousands of parts per million, the hope is that this technology can take water from levels of 100 parts per million to 10 and meet the standard. NRRI will be testing a variety of media in the filter system.

Iron Reduction Simulator

NRRI is preparing for the Iron Range’s future by designing and building an iron reduction simulator. This test-size technology will help the iron ore and steel industry transition from taconite pellets to direct-reduct grade pellets and making direct reduced iron.

“Blast furnaces have served the industry well but the taconite industry in northern Minnesota must adapt to the electric arc furnace market which demands higher purity iron,” said NRRI Coleraine Site Manager Kevin Kangas. The simulator will provide a new, larger scale test that more closely simulates the dynamic operating conditions found in today’s commercial direct reduced iron furnaces. With this additional capability, NRRI will be the only research facility in the world with a facility to test iron ore and iron product research capabilities, from iron ore crushing all the way to making direct reduced iron and pig iron.

Natural Resources Atlas

Vast amounts of data on Minnesota’s natural resources are collected and archived by a variety of organizations. That’s a good thing. But the information isn’t necessarily easy to access or easy to understand. That’s a problem NRRI is solving with an online Natural Resource Atlas for Northeast Minnesota.

It is being designed so both citizens and resource management agencies can pull information on minerals, forests, water quality, land use, infrastructure and much more. This web-based tool and database will translate data into user-friendly, comprehensive information that can inform a range of land management issues.

“The Atlas levels the playing field for people who have to make important decisions about our state’s natural resources,” explained George Host, NRRI Initiative Director. “Not just for agencies, but everyone interested in our natural resources, including the general public as well.”

Currently, NRRI is collaborating with state agencies such as the Department of Natural Resources, Minnesota Pollution Control Agency, and the Board of Water and Soil Resources to gain insight on what should be included in the Atlas.

Innovative Research: Raising the value of Minnesota’s wood supply

NRRI Wood Scientist Matt Aro thought he finally came across a project that he just couldn’t pull off. It was that darn pine (pronounced “ee-pay”), a tropical wood species that is very dense and durable. It was cracking when processed in NRRI’s test-scale thermal modification kiln.

Aro has spent the past four years testing Minnesota’s tree species in the kiln to upgrade their durability and expand markets for their use in high value products. But this tropical pine just wouldn’t cooperate.

A company in Montana had asked Aro if thermal modification could alter the color of this durable wood to almost black, but without chemicals or paint. “After the first two tests, the quality of the wood was very poor with cracking,” said Aro. “And we still didn’t have the right color.”

For Minnesota species, the kiln cooking process improved the wood quality by making it more dimensionally stable, warp-free and water-resistant.

“Our main customers are fire arms manufacturers for the gun stocks, but modified wood for musical instruments and pool cues is a growing market.”

With encouragement from Perkins, Aro and his team kept at it until they finally figured out a unique scheduling process that produced the desired color and quality. The success also encouraged Hot-Woods to acquire its own thermal modification kiln and Aro was able to advise them in the purchase.

The thermally modified wood industry is very small and “nichey” in the United States producing around 40 million board feet annually. “That’s just a blip on the radar right now, but it’s growing,” said Aro.

One of the challenges is the lack of publicly available technical information about the altered material’s specifications — gaps in knowledge that NRRI is working to fill. There’s also inconsistency in messaging around thermally modified wood, making it a harder sell. Aro is working with a team to develop a marketing plan targeted at the professional sector.