Engineering to the rescue: Fighting kidney disease in rural Sri Lanka

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NJIT students Patrick Delong, Shaini Hewage and Mark De Jesus are fabricating and testing low-cost water filters for deployment in rural areas such as Sri Lanka's farming region. Credit: NJIT

Backed by a grant from the U.S. Environmental Protection Agency (EPA), an interdisciplinary, student-led team from New Jersey Institute of Technology is building a low-cost water filter for villagers in the north central farming region of Sri Lanka who are suffering from high rates of chronic kidney disease. The heavy metal-laden fertilizer they apply to their fields is considered a likely cause, and their drinking water a possible vehicle for the contamination.

Nearly 40 students - from biologists to engineers - are working on various aspects of the project, from the design of the clay pot filters individual families would use to purify their water each day, to the development of prototype tests that will simulate local conditions, to research into government policies that encourage the use of fertilizers that contain toxic levels of cadmium and arsenic. Their goal is to produce a prototype by the end of August.

"We're developing a filter that will absorb both heavy metals and disease-causing pathogens," said Janitha Hewa Batagoda, a doctoral student and Sri Lankan native who is leading the team of undergraduates, primarily from NJIT's chapter of Engineers Without Borders (EWB). "The idea is to make it easy and inexpensive to manufacture, using locally available materials, and also ensure it is simple to use. Each system would cost the equivalent of about $5 and enable families to filter 10 gallons of water a day."

The filter, which will sit inside a five-pound bucket, will be made of locally available clay mixed with hematite, a mineral containing iron oxide that binds with heavy metals. Colloidal silver, a suspension containing silver particles that captures biological pathogens such as e-coli and cholera, will be added to the filter.

The NJIT team won $15,000 to develop the idea through the EPA's P3 - People, Prosperity and the Planet—Program, an annual competition intended to inspire college students to "design solutions for a sustainable future." In April, the team will display its project at the USA Science and Engineering Festival in Washington, D.C., where it will compete against other Phase 1 winners for the P3 Award and a grant of $75,000 to develop it as a real world application.

Earlier this week, members of the team were tinkering with the ratio of sawdust and kaolinite clay used in the filter - mashing different

combinations together in a vessel resembling a French coffee press - in order to determine the right balance of permeability and absorption. They then heated them in a laboratory kiln to 850 degrees Celsius.

"We want to see how quickly water flows through the filter, which will determine if we can get 10 gallons of water a day. The more sawdust we add, the more pores the filter has after it's baked and the faster the water will flow through," said Patrick Delong '17, of East Brunswick, the president of the EWB chapter at NJIT. "But we need to achieve the right balance: the amount of time the water remains in the filter will determine how much of the contaminants are absorbed by it. Today, we're testing ratios of 70 percent clay versus 30 percent sawdust by mass."

While the current prototype is being developed for Sri Lankan farming villages, the technology is designed to be extremely adaptable in order to suit a range of rural areas that lack modern water infrastructure. Each version of the clay pot would be constructed of locally available materials such as clay, sawdust, bio-char, charcoal and hematite. The manufacturing process is both generic and simple.

"The proposed filter is a fully sustainable design with the ability to purify water at affordable costs. The production is a low energy process where agricultural waste will be combusted in the kiln to heat the air-dried filters," the team noted in its grant application. "The filtering system will have the capability to operate under adverse economic, social, and environmental conditions."

"Sri Lankans make cooking pots in kilns that are located close to the clay deposits they use, and we would use these same kilns to make the filters," said Jay Meegoda, a civil engineering professor and the group's advisor.

The project builds on the EWB chapter's ongoing work on the development of a portable water filter for the residents of Milot, Haiti, a sprawling commune in the island's north, where water-borne diseases are the principal concern.

"Adapting the filter to screen heavy metals as well definitely raises the level of complexity," said Delong, who joined the organization his freshman year and said he embraced the opportunity to "jump into the arena of international development." He plans to travel to Sri Lanka's farming region this summer with a filter prototype in hand.

Mark De Jesus '17, of Woodbridge, said he was looking for hands-on experience in environmental engineering and was particularly drawn to the filter project as it offered the chance to redress longstanding, often devastating problems.

He noted, "There are a lot of water-borne diseases and children are the ones primarily affected, so providing an adequate water supply is a challenge that really needs to be addressed."

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