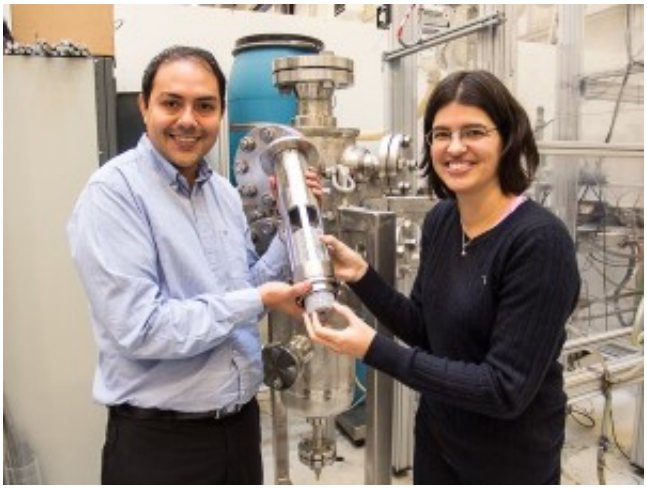
Cleaning up ship emissions with a steel sponge

August 31 2015



Carlos Dorao and Maria Fernandino with a model of their invention. Credit: Maren Agdestein/NTNU

The world shipbuilding industry is facing drastically stricter requirements for emissions starting this year, and by 2020 emissions will need to be cut even more. Currently, as many as 60 per cent of the world's ports have voluntarily joined forces and agreed that they will refuse access to ships that fail to comply with the emission standards. By 2020, this restriction will apply to all ports.

Given this outlook, many smaller and larger vessels are now on a desperate hunt to find new technology that will remove polluting particles from their exhaust emissions. A pilot project developed by

Norwegian University of Science and Technology (NTNU) researchers Carlos Dorao and Maria Fernandino shows great promise to help solve this problem.

Designed for the gas industry

The production of natural gas involves complicated processes to separate the gas and liquid from each other after being extracted from a well. Separators used in the industry today are expensive and bulky.

Dorao and Fernandino - in collaboration with others – came up with the simple but clever idea to use a steel sponge along with centrifugal force to remove the fluid from a gas stream, offering a brand new solution for the gas industry.

The hybrid solution is called the Lynx Separator. InnSep was created as a company in 2011 to further develop the researchers' original idea and to test a more scalable and flexible version of the gas/liquid separator. CEO Sondre K. Jacobsen was hired, and the company's local office is based at the Gløshaugen Innovation Centre in Trondheim, Norway.

In brief, the concept is as follows: Wet gas flows through the separator. A tubular metal sponge spins rapidly, separating the liquid from the gas and throwing it to the side and down, allowing dry gas to stream up to where it's needed.

Small is beautiful

Dorao and Fernandino were aware that the technology could have other uses, but at the time it seemed that the greatest need was in the oil and gas industry.

On offshore gas platforms, equipment is measured by weight and size, since their area and tonnage are limited. Less equipment is almost always better and more cost effective. With some small adaptations, the Lynx separator can be constructed with about half the diameter of today's existing separators.

The “steel sponge” in the Lynx separator is made up of a complex network of metal, not unlike a stiff metal scrubber that you might use for cleaning pots and pans. Credit: NTNU

Full-scale prototype very promising in tests

Thanks to funding from NTNU Discovery, a university fund that helps scientists commercialize their inventions, the researchers and InnSep were able to go from extensive laboratory testing at NTNU to full-scale testing of a prototype in the US in late 2012.

Testing was carried out in Colorado on a repurposed missile launch base from the Cold War, which has been converted into top-notch modern laboratories. Natural gas and liquid hydrocarbons at 60 bar pressure were

used in the tests.

"The results there were so good that we managed to convince Statoil, and so now we're part of DEMO 2000, which is a qualification program for new solutions in oil and gas technology," says Jacobsen.

Introducing new technology takes time

The aim of the DEMO 2000 project with Statoil is to create a separator that is only half as large as separators in use today. From there, the separator needs approval through 7 technology-readiness levels. After 5 years of development, the Lynx separator is now eligible for Level 3 of 7 in the group qualification stage for new technologies, which illustrates how long the process for innovations in the oil industry can take.

InnSep's CEO explains that if the Statoil qualification goes well, they will be able to proceed to the commercial phase with both retrofitted and new installations of their separators.

While the group qualification stage runs its course, InnSep and the researchers have begun to look at other uses for the technology.

Promising early results for ship emissions

The Research Council of Norway's MAROFF Innovation Programme (Maritime activities and offshore operations) funded a pilot project to examine the possibility of applying Dorao and Fernandino's separator technology to cleaning the exhaust emissions from ships. Venezuelan student Jesus Silva assisted in the project, and contributed valuable electrical engineering skills.

With so many ports refusing access to ships with excessive emissions,

many ships need ways to reduce and clean up their emissions, including sulphur particles in the exhaust. The InnSep pilot project irrigated simulated exhaust with saltwater, before being separated by the rotating metal foam cells in the Lynx technology. Jacobsen says that the theoretical calculations and testing show promising results for this cleaning treatment.

The pilot project has tested liquids at 20-30 degrees. Since ship exhaust typically ranges from 60-70 degrees, one of the goals is to incorporate heat exchangers into the developing technology.

Next, InnSep will take the pilot project results to market players and figure out the fastest and cheapest ways to integrate the technology. With the shipbuilding industry now facing such stringent emission standards, this field appears to be a very promising opportunity.

Continued testing for gas and oil

The shipbuilding industry opens up new and exciting opportunities for the Lynx technology while the qualification process with Statoil is underway. InnSep reports that a player in the oil and gas industry is interested in contracting for a commercial license for part of the Lynx technology in 2015, and with luck it may also expedite the qualification process at Statoil.

It may just be that Dorao and Fernandino's original oil and gas industry innovation will be put to work in ships on the high seas.

Provided by Norwegian University of Science and Technology