



Green Gown
Awards 2016



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Finalist's case study

University of East Anglia Research and Development (Institution)

Our Starfish have fins!

About the project

Summary

The StarFin is the first combination of two specific commercially-available laboratory components, initiated by a lab technician independently from any core research programmes or central projects. With non-sector-specific replicability, it has a huge potential to enable water and energy saving internationally.

The Starfish is a multi-experiment energy saving chemistry workstation, and the Findenser is a waterless super air condenser. At the University of East Anglia (UEA) we have worked in collaboration with the manufacturers of these two established products, Radleys, to combine the two into the StarFin.

In comparison with the conventional single reflux setup predominantly found in chemistry laboratories, the StarFin represents a direct energy saving of 40% and eliminates the need for water. This can save up to 600 litres per hour. At UEA we currently save 118,080 litres per year in one lab after installing four StarFins, each saving just under 30,000 litres per year.

Leading on lab sustainability at UEA, the Chemistry and Pharmacy Teaching Laboratory received the University's only Gold Labs Award in the 2015-16 NUS Green Impact programme, with a special 'Innovation Award' presented for the StarFin project. The StarFins will be used by over 200 undergraduate students in the 2016-17 academic year. This project contributes to the 'Smart Condensing' initiative running in the Teaching Lab this year which aims to make the lab waste water-free for condensing applications throughout the academic year with savings of an estimated 236,670 litres.

Project partners

The project, led by Senior Technician Matthew Bennett, did not require internal or external funding due to the commercial potential for the manufacturer. The project utilised the teaching lab's current equipment and where additional equipment was required this was provided free of charge by Radleys.



University of East Anglia

Profile

- Higher Education
- 14,300 students (includes full and part time students)
- 3,300 staff
- Greenfield edge of city location

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The initiative developed a novel apparatus, combining two of Radleys' established energy and water saving products. Following a rigorous testing regime completed by teaching technicians the apparatus was piloted in Chemistry and Pharmacy practical sessions, giving 2nd-year students the exciting opportunity to use the first apparatus of its kind and to provide feedback on its design and potential.

The results

The problem

Water condensers are routinely used to perform the reflux technique in which the solvent is continually boiled, condensed and returned to the flask throughout an experiment providing a constant temperature and medium for the reaction. Water condensers are generally operated at a rate of 2 litres per minute for efficient condensing, and this water can commonly be emptied to drain on an ongoing basis.

The approach

The two devices used were the Radleys StarFish (monoblock for multiple flasks) and the Radleys Findenser. The former is an aluminium baseplate with 5 wells to hold 5 round-bottom flasks. The baseplate fits on top on one heater stirrer device, saving up to 40% of the energy required for heating 5 individual setups. The base plate saves space, equipment and energy.

With the Findenser, a Super Air condenser uses an internal high surface area glass column, surrounded by a sealed water thermofluid compartment and an aluminium-finned jacket to dissipate the heat efficiently to surrounding air. This eliminates the need for running or recirculated cold water for cooling, saving up to 2 litres per minute per reaction setup. By combining the two devices one apparatus can perform the same reactions, achieving a 40% energy saving and 10 litres of water per minute. These savings are evident in the teaching lab environment where 40 refluxes can be performed at the same time.

Our goals

- To create an innovative alternative to a classic synthetic chemistry apparatus
- To engage academics, technical staff and students in sustainable laboratory practices
- To explore ways to reduce energy and water consumption in chemistry laboratories.

Obstacles and solutions

Obstacles	Solutions
Need for equipment and support from supplier	Engage equipment manufacturer at early stage with idea
Proof of concept required before satisfaction that equipment suitable for research	Test different reactions to ensure suitability; engage manufacturer for case studies
Financial support required for components and products, and expansion of concept to more setups	Work within academic School structures to gain formal permissions to proceed.



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Performance and results

The equipment means zero waste water from key experiments, leading to a water saving of up to 600 litres per hour for each single StarFin setup along with a 40% direct energy saving through the use of a multi-flask base plate for heating.

The StarFish multiple flask base plates were already routinely used for reflux with traditional water condensers in the teaching laboratory. The drive to reduce waste water led to the idea of coupling the Radleys StarFish and Findenser; exploiting the benefits of both inventions. Senior Technician Matthew Bennett approached academics to incorporate the new apparatus into current undergraduate practical sessions starting with a pilot in a 2nd-year inorganic chemistry module. The benefits of introducing the innovation go beyond the immediate savings in the lab, engaging students to think about sustainability in an environment where it can be easily under-emphasised. The project has been commended by the Director of Learning and Teaching for Chemistry, Professor Simon Lancaster:

“Chemistry will always be a profoundly practical science and our students have begun their career with the perfect balance between education, sustainability and safety. The sense that our students have gained: that sustainability is an economic as well as a social imperative, will be invaluable. I believe that this is just the beginning of the influence upon our lab classes and technician team.”

The apparatus is of general application for any laboratory performing synthesis and is especially useful where parallel synthesis is required. We expect that any laboratory that currently uses a StarFish will be interested in the StarFin, and believe that the Findenser will replace the conventional water condenser on the Starfish exclusively in the future. Teaching labs are ideal areas for the use of this apparatus due to the high volume of replicate reactions being performed at the same time.

The future

Lessons learned

1. Commercial partnerships are ideal forums for sustainable innovations in a university environment.
2. Collaborative projects between the University's Sustainability Team, academic staff, technical staff and students can be extremely effective when addressing sustainability goals.
3. Engaging varied staff groups and students in sustainable laboratory projects catalyses activity, extending and creating sustainable initiatives.

Sharing your project

A case study was shared through a public newsletter, website and social media as part of the SustainableUEA communications strategy. Student use of social media has shared details and perspectives through Instagram, Twitter and others, and the lead technician on the project is keen to work with peers in other HE lab environments to continue to develop new innovative applications.

Work is ongoing with Radleys to release the commercial StarFin, and to develop their own online case study materials. Sustainable labs guidance materials and videos are being prepared for SustainableUEA YouTube channel, relevant to staff and HE peers.



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What has it meant to your institution to be a Green Gown Award finalist?

The national recognition for independent research into a common resource-efficiency issue has helped to raise the profile of sustainability across the University's laboratories. UEA's Vice-Chancellor, Professor David Richardson, has commented: "Laboratories can be heavy consumers of energy, but they're also hugely innovative places. They are the places where learning and education take place, and where research takes place. So it feels to me like they should also be places that endeavor to embrace new developments in technologies that help laboratories to be more sustainable. If a laboratory is actually a place of research that is producing sustainable technologies then that is very exciting." The Green Gown Awards are a great way to highlight developments as well as to inspire new projects, and we are excited about where the University will go from here.

Further information

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