Producing water from air

TONI AXFORD

Airdrop, a device that extracts water from even the driest air for delivery direct to plant roots, has won Melbourne design student Edward Linnacre the 2011 James Dyson Award.

This international award, which is open to student design engineers from 18 countries, carries a cash prize of $15,400 for the winner and an equal amount for his or her university department.

The award is run by the James Dyson Foundation to encourage the next generation of design engineers to be 'creative, challenge and invent'. The brief for the award is 'Design something that solves a problem'.

The recent 12-year drought in much of south eastern Australia, including the Murray Darling basin, prompted Edward, who studies at Melbourne's Swinburne University of Technology, to turn his mind to finding a low-tech method of providing water for agriculture in arid environments.

The result is the Airdrop 'water harvester', a simple, low-tech device driven by wind power and solar panels and and designed so it could be installed and maintained by farmers.

Rather than tapping into underground water sources or using complex, energy-intensive methods such as desalination, Airdrop sources water from the air.

The design means it can be used anywhere in the world.

Airdrop was created to be used by anybody, anywhere, Edward explains. "A low-tech solution is perfect for remote areas and rural farmers; something they can install and maintain themselves."

With global temperatures continuing to rise and droughts set to become more severe, a device capable of literally pulling water out of thin air is likely to have significant global applications. Its potential is increased by projections that humidity is forecast to increase as part of the climate changes driven by global warming.

Edward is keen for his invention to be developed in Australia and, after building a large-scale working prototype, plans to seek support from local investors.

Concept

Even in the driest regions of Australia, water is present in the form of moisture in the air. The challenge has been finding a robust, low-tech and cost-effective way to extract it.

Most established atmospheric water harvesting technologies are high-tech and expensive; not ideal for the rural farmer market.

Airdrop uses a turbine to push hot air into an underground network of tubing filled with copper wool to maximise surface area. The air rapidly cools to the temperature of the surrounding soil, causing moisture it contains to condense in the piping, from where it gravitates into a tank.

Water from the tank is supplied to plants via a sub-surface drip irrigation system, which makes the system very efficient because there is no evaporation loss between the tank and the crop.

After passing through the condenser, which was developed based on investigations into the principles of air flow, the dry air returns to the atmosphere.

The latest version of the Airdrop system includes an LCD screen that displays tank water levels, pressure within the system, solar battery life and general system health.

The wind-powered turbine that drives the system is designed to maximise air intake and to switch to electricity from a battery when there is not enough wind to drive it.

The battery, which is charged by a small solar panel, also powers the low-pressure submersible pump that supplies the irrigation system with water from the condensate tank. The pump is fitted with a float switch to cut power to the pump when water levels are low.

Edward Linnacre says his Airdrop device can harvest 11.5 mL of water for each cubic metre of air that passes through it; even in the driest deserts such as the Negev in Israel, where the average relative humidity is 64%.

The initial prototype, which was much smaller than the current unit, was able to produce a litre of water a day, but increasing the scale and further development and refinement of the design are expected to increase the yield substantially.

ABOVE LEFT: A SCHEMATIC DIAGRAM OF A SELF-CONTAINED AIRDROP SYSTEM. HOT AIR DRIVEN INTO THE VERTICAL TUBES BY THE TURBINE ON THE STEM IS COOLED AND RELEASES MOISTURE, WHICH DROPS INTO THE RESERVOIR BELOW, FROM WHERE IT IS PUMPED TO NEARBY PLANTS.
ABOVE RIGHT: AN IMAGE OF THE ABOVE-GROUND SECTION OF AN AIRDROP CONDENSER IN A CROP PADDOCK.

Although the initial concept for Airdrop was to provide a secondary source of water for conventional cropping systems there are many other potential applications.

These include provision of:

- drinking water for human consumption
- water for remote stock troughs, opening the way for more intensive livestock production in such areas
- diversification or expansion of viticulture, horticulture and aqua-ponics into previously unsuitable regions
- water for plant nurseries and domestic gardens and animals.

The Airdrop irrigation system was bred of comprehensive investigations into rural agricultural environments, developed in consultation with irrigation manufacturers and local farmers and refined through extensive prototyping, Edward says.

Based on his research for the project he believes it fills a gap in Australian water-harvesting technology by providing an efficient, cost-effective means of harvesting atmospheric water for irrigation.