Pavements: a new source of water and energy?

Climate change means storm runoff is becoming an increasing problem in urban areas, and yet so is water supply. A novel permeable pavement design that combines water-harvesting with a heat-exchange system could help solve everything. **Piotr Grabowiecki** and **Miklas Scholz** of The University of Edinburgh report.

Urban water runoff has become an increasing concern for civil engineers. Climate change appears to be causing more intense and frequent storms, which in turn lead to more frequent discharge of untreated sewage from combined sewer overflows into natural watercourses as well as increased risk of local flooding.

One way to reduce surface runoff volumes, and consequently environmental and property damage, is to use permeable pavement systems as part of an integrated sustainable urban drainage system (SUDS). Permeable pavement systems are a well-established technique for reducing standing water and urban runoff, and can be combined with recognised SUDS techniques such as swales, infiltration trenches, ponds and constructed wetlands to avoid surcharging sewage systems, which often operate under conditions of full capacity.

However, the Urban Water Research Group at The University of Edinburgh is currently working with the manufacturer Formpave Ltd and others to take permeable pavement systems well beyond their conventional drainage role.

Harvesting of treated runoff

Formpave's existing Aquaflow permeable paving range and storm water source control system is currently widely used in the UK and elsewhere, particularly in car parks and pedestrian areas. The runoff passes through pavement slots and is cleaned by filtration and microbial action before being released into sewers or watercourses, or infiltrated directly into the sub-grade.

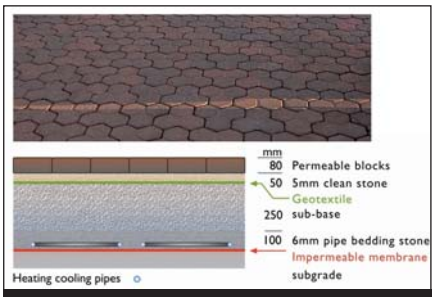
However, by adding an impermeable membrane, the cleaned runoff can also be harvested for typical non-potable 'grey water' recycling purposes such as watering plants and flushing toilets. This is particularly relevant for warm countries where evaporation losses are significant—but increasingly relevant in the UK, where water shortages are also becoming more frequent.

A major part of the work being carried out at Edinburgh is to study the physical, biochemical and microbiological processes that take place within various permeable pavement systems in more detail in order to assess their suitability for water harvesting.

Heating or cooling function

Taking things a step further, the researchers have teamed up with Formpave, Water Furnace (Europe) Plc and others to develop a geothermal heat-exchange system that can be installed just above the impermeable Inbitex composite membrane within the permeable pavement sub-base. Depending on the temperature of the harvested water, the below-ground heat pump and its associated equipment could then also be used for heating or cooling adjacent buildings—potentially reducing carbon dioxide emissions from burning fossil fuels, which in turn are linked to climate change.

Ground-source heat pumps are already widely used for geothermal heating such that the mechanical technology is tried and tested. However, temperature reductions in the permeable pavement are likely to impact negatively on the treatment performance of the active biomass in reducing hydrocarbons, nutrients and other pollutants in the runoff. The main focus of the research has thus been on improving the growth of useful bacteria and other micro-organisms during the temperature fluctuations induced by the heat pump.



The novel permeable pavement system will both treat and harvest storm water runoff as well as using it to heat or cool nearby buildings

A series of outside experiments is being conducted in parallel with laboratory-controlled experiments to gain statistically sound data sets. The physical and biochemical processes will then be statistically analysed and modelled. Different types of wastewater including storm runoff contaminated with dog faeces are being used for the experiments and different sub-base configurations are being examined. The presence of dog faeces on permeable pavements is currently preventing the recycling of runoff treated by the Formpave system in Australia, for example.

Ongoing research

The system is being made commercially available from spring 2006. However, research in Edinburgh on the system will continue until 2008 and guidance documents based on latest research findings will be available in 2007.

The invention will also be incorporated into a revised version of the sustainable urban drainage system decision support model, which is freely available at www.see.ed.ac.uk/research/IIE/research/environ/uw12.html.

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