High-strength Anticlogging Permeable Concrete Pavement

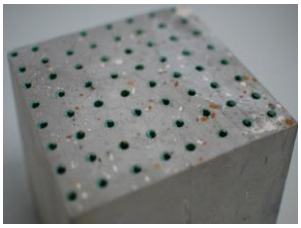
Background and problem addressed

As societies become increasingly urbanised, there is a vulnerability to flooding because impermeable infrastructure are wholly incapable of absorbing rainfall. Flooding has enormous impact on lives, commerce and society, costing billions of pounds of damage per year in the UK alone. Sustainable Urban Drainage Systems (SUDS), such as permeable pavements, have been developed to mitigate flooding risks.

Permeable pavements are highly porous materials that rapidly drain surface water, enabling rain or storm water to pass through impermeable infrastructure. However, they are extremely prone to premature clogging that degrades their performance and service life. The problem is exacerbated by the tortuous pore network of variable cross-section and connectivity, which increases particulate trapping and accumulating at pore constrictions. As a result, conventional permeable pavements require regular maintenance using expensive, time consuming and not fully effective methods, such as vacuum cleaning or pressure washing. In addition, conventional permeable pavements have low strength and are limited to light applications e.g. pedestrian traffic.

Technology overview

A high-strength clogging resistant permeable pavement (CRP) has been developed at Imperial College London. This novel permeable pavement is not only resistant to clogging, but also has high permeability and strength. This is achieved by introducing straight pore channels of varying size and number in self-compacting cementitious material, to engineer a uniform pore structure of low tortuosity. Rigorous lab testing supported by modelling confirmed its superior performance. The new material has high strength (> 50 MPa) and high permeability (> 2 cm/s) yet does not clog despite extensive cyclic exposure to sand and clay. It is at least twice as strong and ten times more permeable than conventional systems of equal porosity, which completely clogged after just a few cycles of sediment exposure. Therefore, this novel material can be used in a wider range of settings. It is more durable, requires less maintenance and its superior performance will deliver material and cost savings, making it commercially viable.



A novel interlocking tile system has also been developed to show that the concept can be deployed at scale as cast in-situ slab or pre-cast pavers. The tiles are lightweight for ease of transportation and installation. These are placed on an aggregate sub-base and self-compacting cementitious material applied to the required thickness. The process is quick, simple and versatile, resulting in a controllable surface finish.

Benefits

- Flood mitigation-prospects properties.
- Sustainable urban drainage system-contributes to groundwater recharge.
- Prevents aquaplaning and stormwater runoff.
- Superior performance will deliver material and cost savings.
- Commercially viable.

Advantages

Comparing to conventional permeable concrete:

- CRP is twice as strong and ten times more permeable.
- It is clogging resistant-requires less maintenance.
- More durable.
- Specialist contractors are not needed, and it can be installed easily.
- It can be deployed at scale as cast *in situ* slab or pre-cast pavers.

Dr Laura Cabo-Fernandez

Industry Partnerships and Commercialisation Officer

Faculty of Engineering

e: l.cabo-fernandez@imperial.ac.uk

t: +44 (0) 7590 250 597

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Imperial College London

Intellectual property information

An international patent application is filed (PCT/GB2019/053217) to protect the method to produce these high-strength anticlogging materials and the method for on-site delivery.

Link to published paper(s)

A. Kia, H.S. Wong, C.R. Cheeseman, 'High-Strength clogging resistant permeable pavement', *International Journal of Pavement Engineering*, ISSN:1029-8436.

A. Kia, H.S. Wong, C.R. Cheeseman, 'Defining clogging potential for permeable concrete' *Journal of Environmental Management*, 2018, **220**, 44-53.

A. Kia, H.S. Wong, C.R. Cheeseman, 'Clogging in permeable in permeable concrete: A review' *Journal of Environmental Management*, 2017, **193**, 221-233.

Inventor information

This invention has been developed by Prof. Christopher Cheeseman and his team in the Department of Civil and Environmental Engineering at Imperial College.