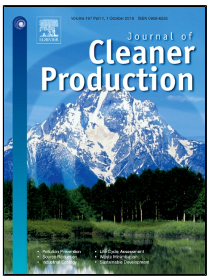
Accepted Manuscript



A new water-retaining paver block for reducing runoff and cooling pavement

Yinghong Qin, Yuhui He, Jacob E. Hiller, Guoxiong Mei

PII:	S0959-6526(18)32239-X
DOI:	10.1016/j.jclepro.2018.07.250
Reference:	JCLP 13704
To appear in:	*Journal of Cleaner Production*
Received Date:	21 November 2017
Accepted Date:	25 July 2018

Please cite this article as: Yinghong Qin, Yuhui He, Jacob E. Hiller, Guoxiong Mei, A new water-retaining paver block for reducing runoff and cooling pavement, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.07.250

A new water-retaining paver block for reducing runoff and cooling pavement

Yinghong Qin[1,2]; Yuhui He[1,2]; Jacob E. Hiller[3]; Guoxiong Mei[1,2*]

1. College of Civil Engineering and Architecture, Guangxi University, 100 University Road, Nanning, Guangxi 530004, China
2. The Key Laboratory of Disaster Prevention and Structural Safety of Ministry of Education, Guangxi University, Nanning 530004, China
3. Department of Civil and Environmental Engineering, Michigan Technological University, 1400 Townsend Dr., Houghton, MI 49931, USA

Nomenclature for critical parameters

Symbols		subscript	
T	Temperature, (^{o}C)	s	Pavement surface
z	Coordinate origins at pavement surface	a	The air above the pavement
ρ	Albedo of the blocks	1	Measurement with the target under the detector
ρ	Albedo of the known-albedo mask	2	Measurement with the mask under the detector
I	Downwelling solar radiation, (W/m^2)		
J	Upwelling reflected radiation, (W/m^2)		
F	View factor, (-)		
H	Instantaneous sensible heat flux (W/m^2)		
h	Convective heat coefficient(W/m^2·^{o}C)		
v	Wind speed measured at height of 9.0m		

Abstract: In cities, urbanization tends to replace open soils that were naturally used for water storage with impermeable roofs and roads. These impervious surfaces have led to the development of urban heat island effects and to the occurrence of urban flooding during high intensity rainfalls. This phenomenon can be alleviated through the use of water-retaining (WR) pavements to hold rainwater for the subsequent evaporative cooling. These WR pavements are typically constructed as a porous pavement with water-holding media, which occupy the cavity of the matrix and decrease the amount of stored water for evaporation cooling. In this paper, a novel WR paver block is utilized to enhance the water storage capacity of the pavement system by retaining the water in the paver block without the need of water-holding layers. The new block retains the water in the block's matrix by sealing the bottom and sides of the block with impervious media. The albedo, temperature, and WR capacities of this new paver block were measured and compared with conventional dense and pervious pavement options. It is found that even though the albedo of a new paver block is 0.10-0.15 lower than a conventional or pervious block, the new block can be 2-10^{o}C cooler. For 6cm-thick paver blocks, the WR paver block can retain about 9.5L/m^2 water, which can be removed during a hot sunny day through evaporation. Pavements made of interlocking WR paver blocks can be used as a strategy to mitigate urban heat island and reduce urban runoff simultaneously.

Keywords: Water-retaining pavement; urban heat island, urban runoff; pervious concrete; albedo and temperature

1 Introduction

Urbanization has replaced grasslands, natural ground, and other natural surfaces by creating impermeable seals (roofs, roads, parking lots and sidewalks) in cities. These surfaces tend to absorb 70-95% of sunlight that falls on them; a great amount of solar absorption releases via sensible heat (heat that can be felt). These impervious surfaces have been shown to contribute to the development of urban heat island,