Using Permeable Concrete as a Solution for Urban Runoff and Flooding

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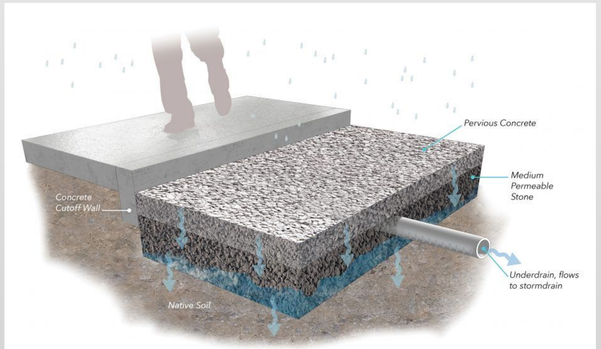
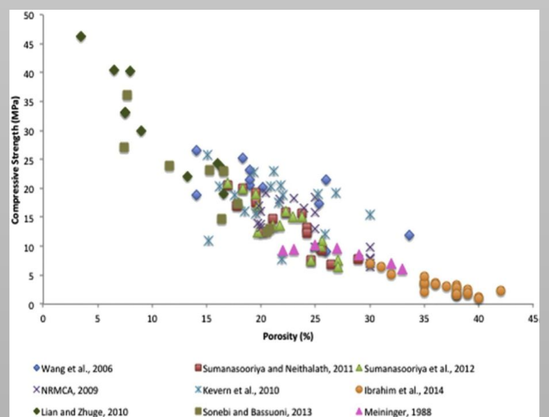
Introduction

Our goal is to create the most viable and cost efficient permeable concrete. We want to further investigate permeable concrete as a solution for combatting flash floods and other natural disasters. The functionality behind permeable concrete is its capability of letting water flow through its pores. We hypothesized that we would be able to make this concrete, and that it would eventually be able to take the place of the common concrete in today's world.



Methods

- High strength concrete mix was mixed with bulk gravel and pea gravel.
- Two mixtures were made with varying levels of bulk gravel and pea size gravel to test different levels of permeability.
- The concrete mix and gravel were mixed in a plastic bin with water.
- The final mixture was transferred into a clear plastic container to set.



Results

Two pieces of permeable concrete were created in the MakersSpace from following a YouTube instructional video. The two pieces did permit water to flow through, so the method in which we created them proved to be effective. The two pieces came out deformed and less togehter, so we probably would have attempted to make a larger more efficiently made piece had we the chance to.

Novel Applications

Photocatalysis Fe_2O_3 Nanoparticles

- A layer of photocatalytic Fe_2O_3 nanoparticles was coated onto the permeable concrete.
- The decontamination performance of the Fe_2O_3 Nanoparticles was significant in removing microbiological and physicochemical pollutants.

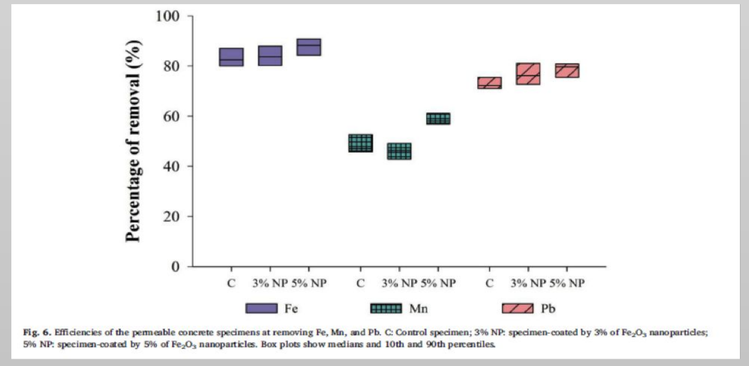


Fig. 6. Efficiencies of the permeable concrete specimens at removing Fe, Mn, and Pb. C: Control specimen; 3% NP: specimen-coated by 3% of Fe_2O_3 nanoparticles; 5% NP: specimen-coated by 5% of Fe_2O_3 nanoparticles. Box plots show medians and 10th and 90th percentiles.

Heavy Metal Removal:

- Permeable reactive barriers (PRBs) are a well-known technique for groundwater remediation that are affected by factories or other industries using reactive media such as zero-valent iron.
- One problem with PRBs is that they can be expensive to make.
- Permeable reactive concretes (PRCs) are a really good alternative to PRBs medium composed of relatively inexpensive materials such as cement and aggregate.

Conclusion

Our completed experiment gave us insight on the correct mixture of materials to make a solid chunk of permeable concrete. The process of making the concrete was simple and cost efficient as well as it did permit water flow through. In the future, we would like to complete more experiments on finding the correct mixture of materials and trials that measure the rate of water flow through.

Acknowledgements

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Literature Cited

Kia A, Wong HS, Cheeseman CR. Journal of Environmental Management. 2017;193:221–233.

Ortega-Villar R, Lizárraga-Mendiola L, Coronel-Olivares C, López-León LD, Bigurra-Alzati CA, Vázquez-Rodríguez GA. 2019. Journal of Environmental Management. 242:487–495.

Pervious Concrete | ACFCD. https://acfloodcontrol.org/projects-and-programs/green-infrastructure/pervious-concrete/.