VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

2017 Research Symposium & STIC Annual Meeting

Freeze-thaw and salt durability of pervious concrete

RESEARCH PROJECT TITLE
Project 730 *Laboratory freeze-thaw durability of pervious concrete with respect to curing time and addition of sand, slag, silica fume, and saltguard*

STUDY TIMELINE
2012 – 2016

PRINCIPAL INVESTIGATOR
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MORE INFORMATION
Research will add link to the final report and other materials on VTrans website

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Fact sheets can be found for additional projects featured at the 2017 Symposium at http://vtrans.vermont.gov/planning/research/2017symposium

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Introduction or What was the Problem?

Concerns persist regarding pervious concrete (PC) pavement durability in cold climates related to freeze-thaw and exposure to salt. This study was conducted as an extension to previous work regarding PC in Vermont, to further investigate freeze-thaw durability with salt exposure in a laboratory environment representative of field conditions.

Methodology or What was done?

PC specimen variations included the addition of sand, replacement of cement with slag, replacement of cement with slag with silica fume, curing time, and saltguard treatment.

Conclusion or What are the next steps?

In general, the presence of sand replacing a small portion of coarse aggregate (up to about 10%) seems to improve freeze-thaw durability of PC. Adding sand to a PC mix design without making adjustments to water-to-cement ratio and other ingredients will most likely be not beneficial, as adding sand makes the cement ratio lower, resulting in decreased workability, and lower densities. Replacing up to 20% of cement with slag or slag with silica fume also appears to have benefits in improving freeze-thaw durability of PC. Use of slag or slag with silica fume seems to yield better durability than using fly ash as cement replacement. It is likely that incorporating both sand replacement and cementitious alternatives (slag and slag with silica fume) may represent a more durable PC mix.

What are potential impacts? What is the benefit to VTrans?

An improved PC mix design with a small amount of sand (up to 10%) as a replacement of coarse aggregate and replacement of up to 20% cement with either slag or slag with silica fume is worth considering. Saltguard treatment is promising; however, its possible environmental impacts need to be investigated. It is worth considering using very well-made precast PC slabs that may allow much better quality control (e.g. extended curing time, dipping in saltguard) and quality assurance (e.g. uniformity, target void content, durability). In comparison to cast-in-place PC, precast PC slabs may allow removal and replacement as needed as part of routine maintenance. Typically, PC has orders of magnitude higher initial infiltration capacity than what is needed; however, it also makes it prone to clogging. Therefore, it is worth to consider sacrificing some initial infiltration capacity to gain durability, which may in turn help reduce clogging. PC pavements are more suitable for sites with reasonably pervious subsurface and relatively deep (in excess of 10 ft) groundwater tables. Rather than building the entire lot of PC, a combination of asphalt and PC may facilitate longevity. The application of salt should be avoided, delayed, or at a minimum limited. Regular maintenance should be performed to prevent clogging, and ensure the continued performance of PC.