Blended cements improve (and complicate) concrete mixtures for pavements

USING supplementary cementitious materials (SCMs), like ground granulated blast-furnace slag (GGBFS) and fly ash, in concrete mixtures for pavements can improve concrete workability, durability, and long-term strength.

However, experience shows that concrete performance varies with the source and proportion of SCMs used. In addition, SCM concrete often results in slower hydration, which can be an asset in hot weather but a challenge in colder weather.

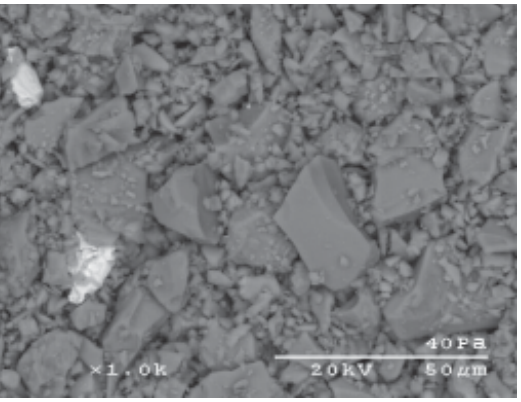
These are some of the findings of a recent research project conducted by a team of researchers at ISU led by Kejin Wang, assistant professor of civil engineering.

Advantages of using SCMs

SCMs are not used as cements by themselves in concrete mixtures for pavements. In Iowa, most blended cements used for pavement concrete contain 20–35 percent GGBFS , together with15 percent Class C fly ash.

Pavement owners and contractors can appreciate the advantages of using SCMs in concrete:

- SCMs are generally less expensive than portland cement.
- SCMs can improve certain concrete properties, such as workability, impermeability, and ultimate strength.
- SCMs can improve concrete durability, including enhanced resistance to alkali-silica reactions, corrosion of steel, and sulfate attack.



SEM photo of Holcim slag. *Image courtesy of Zhi Ge, ISU.*

General findings

Wang and her team investigated optimum mixture specifications and construction practices for proper use of slag-blended cement and fly ash replacement in concrete mixtures under certain weather conditions.

Among the findings were the following:

- Concrete mixtures containing SCMs generally display slow hydration, accompanied by slow setting and low early-age strength. This can be an advantage during the heat of the summer but can create challenges during cold weather.

  At normal and hot weather conditions, pavement concrete containing fly ash and/or slag has comparable or better performance than concrete without SCMs.

  When paving with SCM concrete in cold weather conditions, however, it is advisable to cover slabs to trap heat, extend the curing time, and/or use accelerators.

- Fly ash can function as a water-reducing agent, but GGBFS does not. As a result, concrete with both fly ash and GGBFS may have the comparable flowability as concrete mixtures containing only portland cement.

For more information

Contact Kejin Wang, 515-294-2152, kejinw@iastate.edu. The complete report, *Evaluating Properties of Blended Cements for Concrete Pavements*, is available online, www.ctre.iastate.edu/reports/blendedcements.pdf.

See also "Reclaimed Byproducts Boost Concrete Performance," an article in the January 2004 issue of *Better Roads*.

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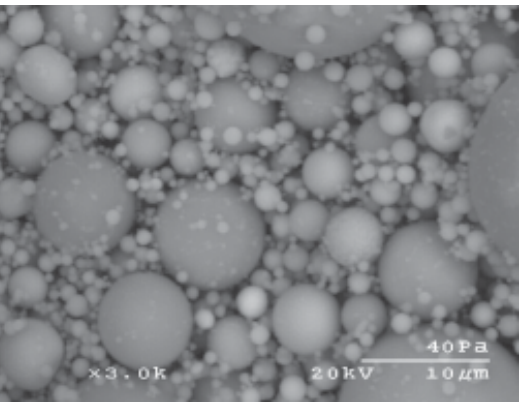

SEM photo of Lafarge fly ash. *Image courtesy of Zhi Ge, ISU.*

Environmental benefits of SCM

Using SCMs in concrete also has some environmental benefits:

- Most SCMs are industrial byproducts that fall under environmental regulations for waste disposal. Recycling these byproducts in concrete mixtures reduces the amount of GGBFS and fly ash that must otherwise be disposed of.
- Using SCMs in concrete mixtures reduces the need for portland cement, thereby reducing the environmental impacts of manufacturing it (e.g., carbon dioxide emissions at manufacturing plants, and energy requirements for clinker production).