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Basic study on High-Flow Concrete Using Coal Gasification Slag as Fine Aggregate

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Extended Abstract

Recently, Integrated Coal Gasification Combined Cycle (IGCC) has been attracting attention in Japan because of its superior power generation efficiency and environmental performance compared to conventional thermal power generation. Coal gasification slag (CGS) is discharged as a byproduct during power generation. The use of CGS as an environmentally friendly aggregate in the construction industry has already been studied extensively. On the other hand, high flow concrete is being used in the construction industry to save labor. However, there are few examples of using CGS as a fine aggregate in high flow concrete. Therefore, the purpose of this study was to evaluate the effects of using CGS as a fine aggregate in high flow concrete on the fresh and hardening properties of concrete.

Ordinary Portland cement was used as cement, river sand and CGS were used as fine aggregate, and crushed stone was used as coarse aggregate. As scientific admixtures, AE agents and high-performance AE water reducers were used as appropriate. CGS was used as a volumetric replacement of river sand, and three levels of CGS replacement were used: 0%, 25%, and 50%. Freshness tests were conducted based on the JSCE Standard Specifications for Concrete, and slump flow tests were conducted from mixing to 90 minutes. Mortar equivalent to the concrete used in the experiments was prepared, and the plastic viscosity was measured under static conditions using the feather sinking viscosity test. In addition to the CGS replacement ratio, the plastic viscosity was measured using different unit cement content under a constant unit water content. In addition, compressive strength tests were conducted to test the hardening characteristics. Standard cured specimens were used for the tests until the specified age.

The results of the slump flow test showed that the slump flow loss after 90 minutes of mixing decreased as the CGS replacement ratio increased. In addition, the use of CGS reduced the plastic viscosity of the cement when the unit cement content was changed. In compressive strength tests, it was confirmed that compressive strength increased with increasing CGS replacement ratio, and at a CGS replacement ratio of 50%, the compressive strength was approximately 10% greater than at a CGS replacement ratio of 0%. Previous studies have shown that the compressive strength of specimens cured in air using CGS decreases with increasing CGS replacement ratio. The reason this trend was not observed in this study is that the use of CGS in high flow concrete may have resulted in an increase in compressive strength due to the absence of bleeding. Based on the above, CGS can be used as a fine aggregate in high flow concrete in the same manner as natural aggregate in this study.