Flowable Fill

Flowable fill used as bedding for large concrete pipes. Foundry sand was used as fine aggregate in this flowable fill.

Introduction

Flowable fill, also known as controlled low-strength material or controlled density fill, is technology that uses a cementations material as fill instead of compacted soil. In general, flowable fill is a mixture of water, coarse and fine aggregates and cementitious materials that is placed in a slurried form and allowed to harden. The material is self-leveling while in slurried form, does not require compaction like soil. The American Concrete Institute defines flowable fill as having a compressive strength less than 1,200 psi, though most applications use a working strength of 300 psi to allow for future excavation if needed. It is typically used to fill utility cuts in roads, as pipe bedding and backfill for retaining walls. Flowable fill is also an increasingly popular material for filling old mines and quarries and abandoned underground structures like oil tanks.

IRC Materials in Flowable Fill

The need for a cementations binder and fine and coarse aggregates allows for a number of industrial co-product and byproduct materials to be used very successfully in flowable fill. In fact, flowable fill was originally developed in the 1960s as a coal fly ash (CFA) based product. Refinements over the past decades have lead to significant body of knowledge about using CFA and other materials in flowable fill. Type C CFA has self-cementing properties and can be used as a Portland cement substitute in the binder. Class F CFA is not self-cementing, but does have pozzolonic properties that can be used to improve the long-term strength of the flowable fill. Slag cement (ground granulated blast furnace slag) can be used alone as the binder, or in combination with Portland cement and CFA to achieve specific performance goals.

A number of IRC materials have a granular form, and are well suited for use as aggregate in flowable fill. Foundry sands have been used very successfully in a number of large projects as fine aggregate. In fact, the lower strength requirements associated with flowable fill allow foundry sands with significant clay and carbon contents to be used. Similarly, “non-spec” CFA with elevated carbon levels has also been used a fine aggregate. The spherical nature of the CFA particles in particular helps the slurry flow, reducing the water demand of the mixture. Bottom ash and coarse slag products have be used as coarse aggregate. Recently, other materials have been included as coarse aggregate, such as glass cullet and rubber chips derived from old tires.

Benefits

There is a direct environmental benefit to using IRC materials rather than virgin materials in flowable fill because of the savings of water, energy and emissions associated with obtaining virgin materials. In particular, the use of slag cement and other Portland cement substitutes saves significant energy and reduces carbon dioxide emissions. Flowable fill is also increasingly accepted as a means to fill and stabilize existing underground hazards, proving an additional benefit as a remediation technology.

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