

WHAT IS CONTROLLED LOW STRENGTH MATERIAL?

Controlled Low Strength Material (CLSM) is a self-compacting material, consisting principally of cementitious materials and aggregates, and is used as a backfill material in lieu of compacted fill. The material is known by several other terms such as flowable fill, controlled density fill, flowable mortar or lean-mix backfill. CLSM mixtures have compressive strengths of less than 1200 psi. In most cases, much lower compressive strengths of much less are desired to facilitate future excavation (300 psi is a typical 28 day strength value).

CLSM is a safe, economical alternative to granular fill. The highly flowable mixture is self-compacting and can be placed easily without vibration or tamping. The need to enter confined spaces or excavation areas to manually compact fill is eliminated.

The material can be used as structural fill for buildings and other structures as well as for backfill in utility and road construction. Among other applications, CLSM can fill abandoned tunnel shafts and sewers, plug voids under pavements, and facilitate erosion control.

CAN SLAG CEMENT BE USED IN CLSM?

Slag cement can be used in CLSM by itself, or in combination with other cementitious materials such as portland cement or fly ash. Depending on the job requirements, the need for portland cement may be eliminated.

Table 1 shows two CLSM designs using different combinations of cementitious materials. CLSM A demonstrates that a flowable fill based on 100% slag cement can achieve a moderate level of excavatable (> 300 psi) strength at a relatively low level of cementitious material (195 lb/cy slag cement). CLSM B shows two portland-slag mixtures that achieve moderate CLSM strength at almost half the cementitious material level as a portland-fly ash (Class C) material.

Table 1
Example CLSM Mixtures Using Various Combinations of Cementitious Materials

Description	Units	CLSM A			CLSM B		
		Portland-Slag	Slag-Only	Portland-Fly Ash (C)	Portland-Slag	Portland-Slag	Portland-Fly Ash (C)
Portland Cement	lb/cy	110	0	90	104	114	152
Slag Cement	lb/cy	290	195	0	156	171	0
Fly Ash	lb/cy	0	0	245	0	0	337
Total Cementitious	lb/cy	400	195	335	260	285	489
Fine Aggregate	lb/cy	2897	2803	2846	3407	3382	2803
Water	lb/cy	558	550	500	400	419	422
w/cm	-	1.39	2.82	1.49	1.54	1.47	0.86
7 day comp str	psi	334	101	50	200	240	421
28 day comp str	psi	771	218	72	460	660	696

CLSM is a highly flowable, self-compacting fill material that can be placed easily without vibration or tamping.

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SLAG CEMENT AND CONTROLLED LOW-STRENGTH MATERIAL

HOW IS CLSM DESIGNED AND ORDERED?

Strength, density in place, flow characteristics, subsidence, permeability, and durability are all characteristics that can be designed into slag cement CLSM. Trial mixtures are the best way to determine how well a given set of ingredients will achieve specific performance requirements. Some state highway departments have a recipe of components that will produce the acceptable qualities.

CLSM made with slag cement should be ordered for its intended use. Ready mixed concrete producers typically have developed mixture proportions that make the best use of local aggregates and other materials. Non-standard aggregates that do not meet the requirements for concrete can be utilized in slag cement CLSM.

HOW IS SLAG CEMENT CLSM PLACED?

Slag cement CLSM is placed using the same methods as traditional CLSM. It is normally delivered in a ready mixed truck, and chutes, conveyors, and buckets are used. Mixtures can also be designed for delivery in non-agitating equipment, such as dump trucks, depending on the flow characteristics required. Finally, volumetric mixing trucks, where CLSM components are transported in separate bins on the truck, then mixed immediately prior to placement, can be used to deliver, mix and place the material.

HOW IS SLAG CEMENT CLSM TESTED?

Slag cement CLSM is a high quality manufactured material. Established quality control tests for strength, density, and flow, are appropriate for use with slag cement CLSM. The test methods listed in ACI 229, *Controlled Low-Strength Materials*, provide guidance for establishing slag cement CLSM mixture proportions to meet job requirements.

As with all CLSM mixtures, trial batches should be performed to verify concrete properties. Results may vary due to a variety of circumstances, including temperature and mixture components, among other things. You should consult your slag cement professional for assistance. Nothing contained herein shall be considered or construed as a warranty or guarantee, either expressed or implied, including any warranty of fitness for a particular purpose.

Reference

1. ACI 229R, *Controlled Low Strength Materials*; American Concrete Institute, Farmington Hills, Michigan, 1999

About the Slag Cement Association...

The Slag Cement Association is the leading source of knowledge on blast-furnace slag-based cementitious products. We promote the increased use and acceptance of these products by coordinating the resources of member companies. We educate customers, specifiers and other end-users on the varied attributes, benefits and uses of these products.

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