Compaction of Glass Fill

Material: Recycled Glass

Issue: *Material handling and compaction procedures usually represent a greater cost in a construction fill operation than the fill material itself. Engineers, permitting authorities, and contractors must be familiar with proper handling methods and compaction characteristics of fill material so that practical specifications can be written, permits can be issued, costs can be estimated, and the fill operation can be performed. Because recycled glass is a relatively new fill material for construction applications, it is especially important to understand its handling characteristics.*

Best Practice: A typical fill operation begins with the preparation of the subgrade on which the fill will be placed and compacted. The subgrade must be firm and dry so that the risk of subgrade settlement is minimal and the fill can absorb the compaction energy. The glass fill may consist of 100% glass cullet, or a cullet-soil or cullet-gravel mixture. For 100% cullet, the apparent cohesion, which results from the surface tension of moisture, is low. This means that the material flows relatively freely. Therefore, using hoppers for directing flow has been found to be efficient and successful. However, some cullet particles are sharp so inflated rubber tires can be punctured and damaged. Experience has indicated that solid rubber tires are a better alternative.

The dumped or transported material should be leveled into a horizontal lift 4 to 12 inches thick. Generally, the lift thickness should be 4 to 6 inches for manually operated equipment, and 8 to 12 inches for automatic compaction equipment. The leveling can be achieved using a bulldozer in open areas, and hand shovels and rakes in confined areas. For 100% cullet fill, the material can be moved about relatively easily using hand tools because of the smooth particle surface and lack of apparent cohesion.

Vibratory compactors are effective for cullet or cullet mixtures. In open areas, vibratory roller compactors weighing two to ten tons can be used. In confined areas, backhoe or trackhoe mounted hoepacs are effective. Hand-held equipment such as Jumping Jacks and “Walk-Behind” Rollers can also be used. The compaction effort of a plate or “Slick” compactor penetrates only the top two to three inches, and has been generally found to be ineffective.

The shear strength of cullet fill is proportional to its confining pressure. At the top one to two feet of the fill where confining pressure is low, the material can be rutted by the tires of construction equipment due to the low shear strength. This rutting may seem to imply an unstable material, but it should not be alarming. The surface of cullet fill should always be covered by asphalt, concrete, natural soil or natural aggregate. The cover will prevent direct skin contact with glass, and provide stability to the surface. The thickness and type of cover depends on the loading conditions planned in the fill areas. For non-loading areas, a three-inch layer of crushed rock has been found to be adequate in providing stability for foot traffic. The lack of confinement near the surface and the low apparent cohesion of glass also mean that pieces of glass can fly up during material handling and compaction. Therefore, personnel working with the material should follow normal safety rules and precautions. Under normal conditions, these rules include wearing long sleeve shirts, gloves and eye protection.

The compaction of cullet fill is relatively insensitive to moisture content. However, if the material contains more than ten- percent fines (particles smaller than No.200 sieve), retained moisture can prevent effective compaction. If there is a substantial amount of fines in the glass, it is a good practice to cover the stockpiles with a thick plastic sheet during wet weather. In dry weather, water can be applied to the stockpile for dust control. It is generally not necessary to wet the material to assist in compaction.

The quality of the compaction can be tested by field density tests using a nuclear densometer. The test frequency varies for different applications, but typically involves one test per 2,500 square feet of fill but not less than one test per lift. The material is porous, therefore field density tests using the backscatter mode will produce lower than actual values and should be avoided when possible. The direct transmission mode with the source probe extending the full depth of a lift is a preferred test mode. For a complete discussion of the use of nuclear densometers with glass aggregate, see the *Density Testing of Glass Aggregate Using a Nuclear Densometer* Best Practice.

Implementation: Special seminars or discussions with the permitting offices at the city, county, and state should be held so that the material handling and compaction procedures are understood and acceptable. Information should also be disseminated among engineers and contractors so that the use of cullet fill can be included in project specifications.

Benefits: Handling and compaction procedures for cullet fill are similar to those of soil, gravel, and rock fill. Dissemination of the best practice information presented here will help engineers, contractors and permitting authorities to understand that: (1) cullet fill has been successfully used on construction sites, (2) cullet fill is a viable alternative to natural materials, and (3) no special machinery or preparation is required.

Application Sites: Construction sites and testing laboratories.

Contact: For more information about this Best Practice, contact CWC, (206) 443-7746, e-mail info@cwc.org.

References:

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