SIPLAST LIGHTWEIGHT INSULATING CONCRETE BULLETIN:

COMPARISON OF VERMICULITE-BASED INSULATING CONCRETE (ZIC) & CELLULAR (INSULCEL) CONCRETE

Bulletin #7: SRIS-9611 **February 13, 2024**

SIPLAST*FLASH*

Siplast offers a complete line of lightweight insulating concrete systems including both aggregate and cellular based products. Each type of product has its own unique set of application and performance characteristics. Unfortunately, these differences have become blurred in the market, causing the products to be incorrectly seen as interchangeable. The differences between aggregate and cellular based concrete can have a significant impact on ultimate product performance.

While ZIC and Insulcel Cellular are both lightweight insulating concrete, they have different performance/application characteristics, and should not be considered equal or interchangeable. This Technical Bulletin is intended to be a reference guide outlining product and performance comparisons between ZIC and cellular, and to clarify Siplast's recommended usage for each product.

PRODUCT DESCRIPTION

ZIC is a lightweight insulating concrete composed of vermiculite concrete aggregate, Portland cement, air entrainment, and water.

Insulcel concrete is generically referred to as cellular concrete. It is composed of Portland cement, pregenerated foam, and water.

Both ZIC and Insulcel are placed with Insulperm Insulation Board to create a Siplast Lightweight Insulating Concrete System. The primary differences between ZIC and cellular are:

1. The amount of Portland cement in each product (cellular contains approximately 1.7 times as much Portland cement as ZIC) and

2. The presence of vermiculite aggregate in ZIC. These compositional differences are the reason that the two products perform differently, especially in hot, arid climates.

14911 Quorum Drive, Suite 600
Dallas, Texas 75254-1491

201 Bewicke Avenue, Suite 208
North Vancouver, BC, Canada V7M 3M7

Customer Service in North America
1.800.922.8800 www.siplast.com

To go beyond a simple compositional comparison of ZIC to Insulcel, this section will review the performance of each product in five key areas: water retention, shrinkage/cracking, weather effects, workability, and weight.

Water retention:

ZIC develops its strength through the hydration of the Portland cement present in its composition. This hydration process is a chemical reaction that takes place between the constituents of Portland cement and the mix water over a period of time (weeks) after the material is poured. The vermiculite aggregate in ZIC helps retain, via capillary forces, the amount of mix water necessary for the cement to properly hydrate. In other words, the vermiculite aggregate creates controlled hydration.

If water is not available to the cement during the curing period, proper hydration will not occur, and the resulting strength of the concrete will be affected. Because it does not have vermiculite aggregate in its composition, cellular does not have a mechanism to aid in water retention during the hydration process. This lack of vermiculite aggregate, combined with the relatively high percentage of Portland in its composition, means that cellular concrete is best used in temperate weather conditions.

Shrinkage/cracking:

Curing and drying shrinkage are inherent characteristics of Portland cement. In structural concrete, mixtures of coarse and fine aggregates are used to distribute the stresses created by the shrinkage of the cement paste. The aggregates also serve to interfere with the creation of macroscopic cracks (larger cracking that is visible to the naked eye).

The vermiculite aggregate present in ZIC serves the same purpose as the coarse and fine aggregates in structural concrete. It helps to distribute the stresses caused by shrinkage, thereby disrupting the creation of macroscopic cracks. The strength achieved by ZIC during the hydration process described above also helps resist cracking.

With a higher cement concentration and without vermiculite aggregate to distribute shrinkage stresses, it is inevitable that cellular concrete will develop visible cracks. The extent and severity of the cracking is affected by the weather conditions that the concrete is exposed to during the hydration period. Cracking in cellular concrete is normal; it does not necessarily indicate a bad pour. The potential for problems with the cracks occurs when the deck is exposed to rain prior to roofing -- before the building is watertight. Water can enter through a crack and percolate through the concrete, settling on the substrate, where it can remain after application of the roofing membrane. This is commonly referred to as rainwater intrusion. There is an established process for removal of rainwater that is followed by lightweight applicators if this does occur. Please refer to SLIC Bulletin #20 Water Infiltration into Lightweight Insulating Concrete Applications.

14911 Quorum Drive, Suite 600
Dallas, Texas 75254-1491

201 Bewicke Avenue, Suite 208
North Vancouver, BC, Canada V7M 3M7

Customer Service in North America
1.800.922.8800 www.siplast.com

Weather:

Extreme heat, low humidity and wind all contribute to the removal of the mix water that is needed for cement hydration. The presence of vermiculite aggregate in ZIC helps retain mix water, making ZIC less susceptible to such weather conditions at time of placement and during the early hours of curing. ZIC is also more versatile than cellular concrete during application under cold conditions. Mix water may be heated to accelerate the early set of ZIC. Heating the mix water for application of cellular concrete causes the air cells to abnormally expand. As the material cools, air cell shrinkage occurs, potentially resulting in unacceptable thickness and density variations.

Workability:

On jobs where the roof has crickets, or is a special shape (such as a barrel or dome), the fluidity of ZIC can be adjusted because of the presence of aggregate. This adjustability makes it easier to hold a slope with ZIC than with cellular. ZIC can be poured successfully on very high slopes (4 in 12 is not unusual), whereas cellular is more suited for roofs with a slope not greater than 1/2 in 12. Cellular lightweight generally will have vermiculite blended in with its standard mix design to achieve greater than 1/2 of an inch per foot slope.

Weight:

Because the dry density of ZIC is lower than that of cellular, using ZIC results in less dead load on the structural system.

Application Predictability:

The composition of ZIC makes its performance during application very predictable and consistent. In contrast, the application of cellular concrete requires close monitoring by the contracting crew. The pregenerated foam present in cellular must be monitored on-site for quality, and the poured density of the concrete must be checked continuously. Adjustments to the foam quantity need to be made on a continual basis to ensure that the proper density is being placed.

Cost:

Cellular concrete is generally less expensive than ZIC. Often, this is the motivating factor for its use. However, the decision to use cellular should be based on its suitability for a particular application. Lower material cost does not justify the use of a product under conditions ill-suited for its characteristics and composition.

Membrane Longevity:

Research has shown that ZIC Systems provide the lowest membrane aging value. Further information can be found in SLIC Bulletin #14.

siplast
14911 Quorum Drive, Suite 600
Dallas, Texas 75254-1491
201 Bewicke Avenue, Suite 208
North Vancouver, BC, Canada V7M 3M7
Customer Service in North America
1.800.922.8800 www.siplast.com

SUMMARY:

The use of Insulcel cellular should be strictly limited to those jobs located in climates that are conducive to proper curing of cellular concrete. Insulcel should be monitored closely when used in hot, arid or windy conditions that threaten the quality of the end result. If cellular is used carefully under appropriate climatic conditions, it can provide owners with an excellent monolithic surface for roofing. The end product of a ZIC pour is extremely predictable and user friendly for the installer. ZIC is less prone to being affected by curing conditions, and ZIC mixing and application techniques are less complicated than the constant monitoring required by cellular concrete. For these reasons, Siplast encourages the use of ZIC (rather than cellular) in when budgets allow. If you have any questions about which Siplast Lightweight Insulating Concrete System is best for a specific project, contact Siplast at 1-800-922-8800.

14911 Quorum Drive, Suite 600
Dallas, Texas 75254-1491

201 Bewicke Avenue, Suite 208
North Vancouver, BC, Canada V7M 3M7

Customer Service in North America
1.800.922.8800 www.siplast.com