Cellular Concrete FAQ's

Note: The answers which follow are correct to the best of our knowledge, but may not apply in specific applications or situations. Most of them are designed to provide general information, rather than information for a particular project or application.

What is the process for making cellular concrete?
There are two methods for producing cellular concrete. The first is the batch production method in which externally generated foam is injected into the drum of a mixer for a calculated amount of time. The second is the continuous production method in which foam is injected in-line, on the discharge side of a pump. Richway offers equipment for both production methods.

What is the strength of cellular concrete?
As density is decreased, the compressive strength also decreased. See strength tables and charts for more details, but as an example, 60 pcf density will have a strength ranging from 600 to 1000 psi. (See chart on the inside)

What is the set time for cellular concrete?
The set time for cellular concrete is typically a little longer compared to "normal" concrete, due to the surfactants used in producing the foam. However, like anything produced with Portland cement, there is a finite time for production and placement. Generally, we recommend that the working time be limited to about four hours once the Portland is mixed with water, or about three hours after the foam is added. After this much time, the material should be left alone to continue the set process. Continuing to pump or move the material can result in collapsing and failure of the material. However, the set time can vary depending on the application, jobsite conditions, and the use of either retarders or accelerators.

How much cement powder is used in a yard of cellular concrete?
If a neat cement slurry is used with a .50 w/c ratio, the base slurry per yard will have approximately 2060 lbs of cement and 1030 lbs of water, with a density of 115 PCF. If foam is then added until the density is 30 PCF, we'd have 3.65 yards of 30 PCF material, with approximately 565 lbs of cement per yard. We have a mix design calculator available for download on our website which calculates mix design batch weights, foam dose times, and cost scenario analysis.

When using the batch method, is truck clean-out a problem?
Usually it will be easier, but if there is cement paste without any foam incorporated into it coating the drum, it may be more difficult.

I have read a little bit about cellular concrete and the term "pre-formed foam" is used. Why do you use the term "externally generated"?
We think "externally generated" is much more clear terminology and does not suggest a rigid petroleum based foam or something that is made a long time before it is used. The foam has the consistency of rich stiff shampoo lather and is generated "on-the-go" as it is mixed or injected into the mixer. It is externally generated, rather than internally generated by the action of the mixer itself, as is the case with an air-entraining agent.

Can fly ash or other pozzolans be used in cellular concrete?
Yes. Just as in standard density concrete, the cure times might be extended. The maximum amount which can be used depends on the application. It is generally recommended that only type F fly ash be used, rather than the higher carbon type C. High carbon materials may tend to break down the foam. Low density cellular concrete with high amounts of any fly ash may shrink excessively after placement due to the action of free carbon. Most other cementitious materials may also be used in cellular concrete.

Can I use water reducers and other admixtures?
Yes, water reducers can be used and will help with dispersion and wetting of the cement powder before adding the foam. Most other admixtures can also be used, but in all cases tests should be run before mix design is finalized. Some super plasticizers may break down foam, so thorough testing is essential. Air entrainment admixtures are usually not used in production of the slurry for making cellular concrete because the foam is the air that is added to the mix.

What about placement and finishing?
Cellular concrete is easily pumped. With high water content and low density, it may be virtually self-leveling, but will always be more easily moved than standard density concrete. It is usually easy to finish, but at some densities, it is sticky and hard to trowel. Generally for geotechnical applications no finishing is needed.

RICHWAY
Cellular Concrete Equipment
www.cretefoamer.com

Richway Industries Ltd.
504 N Maple
Janesville, IA 50647

(800) 553-2404
info@richway.com

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Cellular Concrete Technical Information

What is Cellular Concrete?

Low density cellular concrete as defined by ACI chapter 523.1 is; concrete made with hydraulic cement, water, and preformed foam to form a hardened material having an oven-dry density of 50 pounds per cubic foot (PCF) or less. Although the ACI definition specifies low density cellular concrete with a density lower than 50 PCF, cellular concrete can range in density from 20 PCF to 120 PCF. In a broader sense, any cementitious slurry, or cementitious material, that uses an externally generated foam to increase air content above 10%, could be considered cellular concrete. Cellular concrete may go by other names including foam cement, foamed concrete, or lightweight flowable fill.

Although there are a number of lightweight cementitious materials, the key differentiating factor between cellular concrete and other lightweight cementitious materials is the use of externally generated foam to reduce the density. Probably the closest material to cellular concrete is aerated autoclaved concrete (AAC). The primary differences are the processes used to create the air within the material, and the required equipment. AAC uses a chemical reaction within the slurry itself to generate air voids for density reduction. However producing cellular concrete with externally generated foam provides a more versatile material at a fraction of the capital costs required for equipment.

30 PCF material being used to fill underneath a slab floor in a meat locker. The subsoil had washed out over the years due to the drain pipe being broken, causing a large void to form, followed by the slab collapsing.

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Uses and Advantages

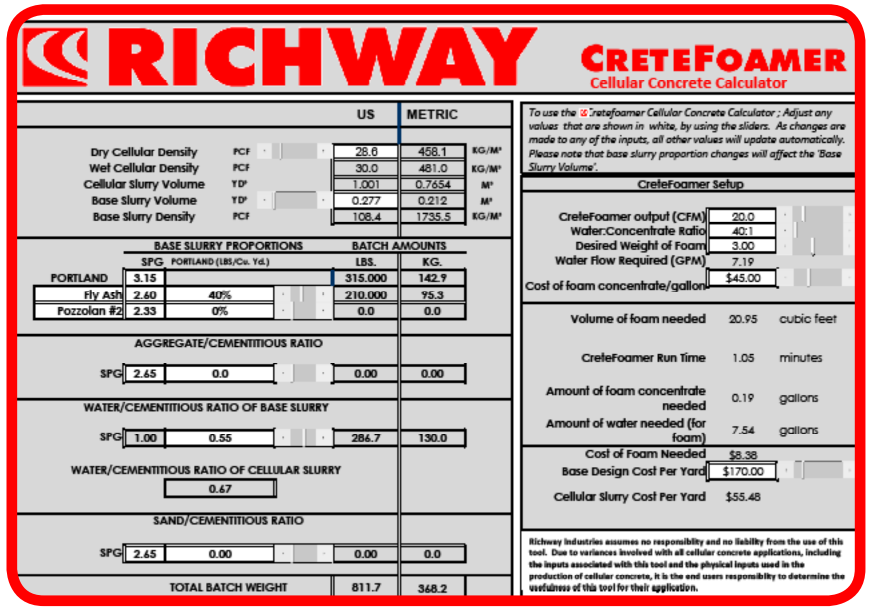
Cellular concrete has many uses and does not have one singular advantage. Depending on the application it may be chosen for it's thermal and acoustical insulative properties, pumpability and flowability, ease of handling due to its light weight, or as a cost saving alternative to fill materials. Throughout the world cellular concrete is used in building and construction applications such as roof decks and floor decks. Geotechnical applications such as annular space filling in slip lining, and void fill abandonment. Cellular concrete can also be found in architectural and precast applications. Below are many of the more common applications for cellular concrete, however it is not an exhaustive list.

- Soil Stabilization
- Retaining Wall/MSE Wall Backfill
- Precast Block/Walls
- Sub slab fill material
- Alternative to flowable fill (CLSM) and geofoam
- Roof Decks/Floor Decks
- Bridge/Overpass Abutment Fill
- Utility Trench Fills
- Annular Pipe Grouting
- Pipe and Tunnel Abandonment
- Carved Cellular Concrete Sculptures
- Mine Abatement

Mix Designs and Economics

Cellular concrete is most often specified by density and strength. A cardinal rule of cellular concrete is that as density decreases, so does compressive strength, making it a primary factor in cellular concrete mix designs. Because of this, when creating mix designs the desired, or required, density is typically the starting point. (See the chart on the inside for general performance characteristics.) A very basic cellular concrete mix design would consist of Portland cement, water, and externally generated foam. Water cement ratios typically vary from .40-.80, and the amount of foam can be up to 80% of the total slurry volume. Other cemtitisuous materials can be used in lieu of Portland, including Metakaolin, Slag, Silica Fume, and most often Fly Ash. These materials are used for a variety of reasons, with the primary reasons being improved economics and increasing strength. Generally cellular concrete below 50 PCF does not include fine or coarse aggregates. The use of these materials in low densities further decreases the strength, so they are left out. However in higher density mix designs fine and coarse aggregates can be used.

The economics of cellular concrete is an important aspect of why it is used in many applications, often times being the most economical solution to a problem. A simple example of calculating the cost for cellular concrete is done by adding the cost of slurry to the cost of foam, divided by total volume of material produced. If the cost of one yard of slurry at $150.00 is added to three yards of foam, at $15 per yard, we'd have four yards of material at a total cost of $195.00. The resulting price per yard is then $48.75. Roughly speaking this would result in a 30 PCF material density.



Richway's Cellular Concrete Calculator is an extremely useful tool in determining batch amounts for producing cellular concrete batches of any size and also production cost analysis.

When creating cellular concrete mix designs, as with any concrete mix design, calculating the proportions can be challenging. Richway has developed a mix design calculator that is available for anyone to download free from our website. Our calculator is extremely valuable in determining batch proportions for all materials required in producing cellular concrete, including foam volumes and the required amounts of foam concentrate and water needed for producing the foam. Additionally, the Richway calculator can provide costing for any given mix design allowing q uick and easy cost analysis for your project.

Producing and Placing Cellular Concrete

There are many methods for producing and placing cellular concrete. The simplest way to produce cellular concrete, referred to as the batch method, is to add externally generated foam to a mixer with an already prepared slurry. Once the foam is mixed in, the cellular material can then be discharged, or dumped out of the mixer. A second method with much higher efficiency and productivity is the continuous production method. In this type of production foam is pumped and mixed in-line on the discharge side of a pump. Similarly, foam can be mixed into the mixing auger on a volumetric mixer. Although in this method a pump is often still required for placement of the material.

Placing cellular concrete is often done by pumping. Because of cellular concretes fluidity and low density it can be pumped extremely long distances and at relatively speaking, low pressures. However, pumping cellular concrete does come with its own challenges. Pump type, hose sizes, production methods, and other factors will all affect how successfully cellular concrete can be placed via pumping. As mentioned the easiest placement method is to gravity feed cellular off of mixer chute or transfer hopper. Although not too often applicable, for precast operations or small void fill projects this method can be very practical and effective.

Cellular Concrete Quality Control

As with the production of any product or project, quality control is paramount in ensuring consistent success when producing cellular concrete. There are a myriad of components and inputs that must be monitored and controlled. However there are four primary factors that should be considered; the use of quality foam generation equipment, foam concentrate that is designed for producing cellular concrete, well prepared slurry, and density control/monitoring. Because density correlates to compressive strength, controlling and monitoring density is one of the most important factors and absolutely should be done at the point of placement. Other important factors include water to concentrate ratio of the foam, foam density, and slurry mix design. Additionally the importance of using of a high quality foam concentrate cannot be overstated. Many of these factors are controlled by utilizing well designed, reliable, and consistent equipment.

Shown here is a customer with their CT-100D. Cellular concrete is being used for mine abatement within a city to prevent additional subsidence.

Small, uniform bubble size and shaving cream consistency are representative characteristics of good foam. To achieve this, it's important to start with foam concentrate developed specifically for cellular concrete, and foam generation equipment that's also designed for producing cellular concrete and is capable of consistently producing a small uniform bubble structure. A good foam concentrate should be capable of producing a strong bubble that is able to withstand the mixing, pumping, and curing process. ASTM C869 is a standard for foam concentrates used in cellular concrete applications and although any foam that is able to meet this standard should not be considered equal, a foam that isn't tested to this standard should be questioned as to its ability to perform well in any capacity for the production of cellular concrete.

For more information about all of the topics discussed go to our website at www.cretefoamer.com. You'll find technical documents that provide more in depth discussion about each of these subjects. Richway strives to provide quality equipment, foam concentrate, and knowledge to ensure your success with cellular concrete.

Richway's CT-30G on the jobsite of an annular space fill for a slip lining project.

Compressive Strength Data and Insulative Values

Cured Density PCF	*Strength* PSI	*Foam Volume* Ft³ / Yd³ Concrete	*Insulative Value* R value per inch	*Mix Design*
Low Density				
20	30 to 900	12 to 25	.75 to 1.85	Neat Cement
30				
40				
50				
Medium Density				
80	400 to 1500	6 to 10	.25 to .30	Sand Mix
90				
100				
High Density				
105	1500 to 4000	3 to 6	.1 to .2	Sand Mix &/or Aggregate
115				
125				

The cellular concrete data above is compiled from industry publications. These are generalized values which should be verified by testing with the use of local materials and equipment for any given project. Local materials, equipment, slurry preparation, along with processing and quality control can produce wide variances in the results for any given mix design.