Cellular Concrete Pumping and Placement

In the majority of geotechnical cellular concrete projects pumping is the preferred, and sometimes only, method for placement. There are many factors to be considered when pumping cellular concrete. The production method, pump type, production rate, and mix design all play into pumping cellular concrete successfully. Generally, cellular concrete lends itself well to pumping; because of it's low density and flowability it can be pumped long distances at relatively low pressures using smaller hose sizes. In many applications two inch hose size is sufficient to place cellular concrete successfully at rates up to 100 yards per hour.

Cellular concrete pumps extremely well due to it's low density and good flowability

Typically progressive cavity pumps, also commonly called rotor stator pumps or "Moyno" pumps, and peristaltic pumps or squeeze tube pumps, are considered to be the pump types of choice for pumping cellular concrete. However piston pumps can be successfully used as well. The first two pump types lend themselves better than piston pumps when the batch production method is used. The pumping action of progressive cavity pumps and peristaltic pumps is gentler on foam bubbles than a piston pump, which is why when pumping a cellular slurry that has already been mixed, they're preferred. Piston pumps are capable of generating much higher pressures than the other mentioned pump styles. This is a contributing factor to why they're known to cause air loss, which subsequently increases the density at the point of placement.

When using the continuous production method, in which the foam is injected in-line on the discharge side of the pump, there are many inputs which all must be closely controlled and monitored, creating a very dynamic process. When any of the inputs change, (slurry pumping rate, foam flow rate, water rate for foam flow) , the properties and performance of the cellular material can change too. As an example when producing a 30 PCF material, nearly 80% of the material content is air, or foam, so if the foam output goes down, density goes up, and production rate goes down. If slurry rate decreases, density goes down, and so does production rate. If the water flow rate, used in producing foam, changes however, there is a negligible change in cellular slurry density, but there is change in the density of the foam which can have an effect on the stability of the cellular slurry, and the flowability. Additionally the foam density also affects the cost of the cellular slurry being produced.

When injecting foam in-line the slurry pump output rate and foam injection rate must be able to be controlled to obtain the correct density. Having properly designed equipment allows the operator to monitor both rates and adjust them as needed. An additional consideration is variances in line pressure due to changing hose lengths, discharge point heights, hose sizes, and whether the space being filled may create back pressure as it's being filled. Ideally the line size is maintained the full distance of the hose. This is especially important when using piston pumps or when pumping an already batched cellular material. If for example the first half of a line length is three inch hose and then it's stepped down to two inch hose, the transition between the two sizes can create a flow obstruction which creates the opportunity for sudden line pressure changes, potentially causing collapse, or rupturing of the bubbles within the cellular slurry. Again, with the proper equipment the operator can monitor this condition and use the machine controls to compensate for it.

As seen in this photo the foam hose comes from the stainless steel Foamhead TM (where the foam is physically generated) and is connected to a machined injection barrel on the discharge side of the pump. Part of this assembly includes the static mixer

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It is important to ensure homogeneous mixing of the foam and slurry when in-line mixing. Good practice is the use of a static mixer after the foam injection point. Heavily sanded mixes may not lend themselves well to the use of static mixer. Typically however mix designs that employ high sand contents are higher density materials, often 60 PCF and above, meaning that a lower proportion of foam is being injected. In this type of scenario lower mixing action is needed, thus reducing the need for a static mixer. In any scenario proper consideration of material density, production rates, hose sizes, and hose lengths can ensure proper mixing without a static mixer. However when possible, a static mixer is still the best measure to ensure consistent mixing.

Base slurry being discharged from the ready mix truck into the hopper on a CT-30G

A common question regarding pumping of cellular concrete is "How far can cellular concrete be pumped?" The answer depends on many factors such as production method, desired production rate, pump type, mix design, hose size, etc. However there are projects in which cellular concrete is known to have been pumped up to 15,000 feet. Richway has been directly involved in projects that have pumped cellular concrete up 4,500 feet. In this application, and commonly any application where cellular is to be pumped extremely long distances, the foam isn't injected immediately at the discharge point of the slurry pump, but rather is injected in-line within a couple hundred feet of end of the hose. Although, given the right equipment, foam can be injected immediately at the discharge side of the slurry pump and subsequently pumped 1000 + feet. Richway has done this numerous times with both two inch and three inch hose in testing outside of their factory.

Hose clean out is always a concern when pumping any cementitious material. For proper maintenance and life of your pumping hose thorough cleaning of the hoses should be done at the end of each job. Using foam to clean hoses out can be an effective method to accomplish this. If you choose to use foam to clean out your hose ensure that you either do a final flush with water to relieve line pressure or have another method to relieve line pressure. This is especially important on longer hose lengths. Once foam only is injected into a hose it can remain under pressure for quite a long time, which can create a dangerous situation when uncoupling hoses.

This photo shows one of the tests that Richway has done pumping 30PCF material through 1000′ of 3" PVC pipe. Richway has also performed similar testing with 2″ hose up to 1000′ in length successfully

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