Halliburton's
Tuned Light™ Cement

Rig Operations
Best Practices

1. Bulk Blending: Special Considerations for Tuned Light™ Cement Blends

Tuned Light slurries can be harder to mix than conventional slurries. Tuned light slurries contain much less water than would conventional slurries at the same density. This is accomplished by distributing lightweight microspheres throughout the blend. If the blend is not uniform, the non-uniform sections may be difficult or even impossible to mix at the correct density or at least at the correct water requirement.

It is therefore critical that best blending and transfer techniques be observed. Conventional practices can lead to an increased level of non-uniformity in the blend that is delivered to the mixing unit.

The procedures outlined below for airing from the top, loading through the bottom, and not splitting blends require changes to existing best practices and in some cases minor equipment modifications. This effort will be rewarded by the improvements in service quality and ease of mixing.

Because of the above fact, one of the most critical aspects required to achieve success with Tuned Light cement is that proper technique being used with the bulk materials.

1. Following the process shown below to avoid splitting blends.
2. Following the process shown below for transfer methodology.

Splitting Blends

Blending may be done in as many partial batches as required and then later combined, if combined as complete batches, but never attempt to combine partial blends. A split blend is defined as any portion of a complete blend.

Do not put part of a Tuned Light blend into two or more separate storage vessels. When planning for a Tuned Light cement job, one needs to consider the sizes of all of the tanks the blend will visit. These different tanks include but are not limited to: scale, box, blend, bulk truck, field bin, silo, or supply boat.

After determining the size of all of the various tanks for a given job and the total required Tuned Light blend, map the flow of the bulk material from the bulk plant all the way to the mixer. With that plan in hand, the size of each blend can be calculated so no batch will ever require being split.

Example 1

If the job requires 800 ft^3 and the first blend quantity is 500ft^3 because that is the plant limit, the available material limit, or for whatever reason, it must be transported as one complete blend and stored as a complete blend. Should another 500ft^3 of blend be available, 300ft^3 of that blend **should not** be used. A complete blend of 300ft^3 should be made and used.

Example 2

A job requires 750 ft^3 of blend, the scale tank can hold 500 ft^3, and 660s are the available bulk trucks. Make three separate blends of 250ft^3 each. The pods on the bulk truck being the limiting factor.

Bulk Transfer Mechanics

All holding vessels are to be visually inspected for cleanliness. Confirm that top air can be isolated from pad air prior to loading product.

Blended bulk material should be loaded **ONLY** into the bottom of the vessel. Under no circumstances should the blend to be loaded into the top of any vessel. As the lighter beads fall, they are displaced towards the top and outside of the tank. Bulk operators should avoid "fluffing" the blend by aeration, because that procedure tends to segregate the microspheres to the top of the load. Either of these practices **CAN REQUIRE RE-BLENDING**.

Off-loading the blend from tank to tank or tank to mixer must be done by continual application of an air supply to the top of the blend. **NO** air is to be applied through the bottom air pads, spiders, or jet assemblies until maximum system pressure is achieved through application to the top of the blend and that system pressure can be maintained. Use pad air sparingly and only as required to assist moving the product.

Excessive air should not be blown through the blended material to completely empty a vessel. Understand that there will be material left in the tanks. Every effort can be made to minimize this remaining product; however excessive blow-down can segregate the blend and should not be done. Keeping blow-down to a minimum helps prevent the product from requiring re-blending. Try and stop the off-loading process as soon as possible after a drop in pressure is observed.

If extra material for bulk losses is not already included in your procedures, an extra 5% of blend can be loaded to alleviate the need to perform excessive blow-down.

The Spherelite spheres can be damaged. As such product shipping pressure should be controlled to the minimum requirement to move the product. Normally 20 psi should be the maximum to move within the bulk plant. Tank pressure above 20 psi to offload may be required for moving the material long distances. This practice should be evaluated on as-required basis, not as a standard procedure. Since 3M beads are much stronger, standard pressures may be used to transfer slurries that do not contain any Spherelite.

Velocity of the material is more critical in the bulk delivery process than pressure. Excess velocity can damage the spheres.

Most bulk operations are not accustomed to filling tanks from the bottom. The bottom discharge line **WILL** work as a fill line. Often slight modifications are required to pressurize tanks from the top. Either the normal fill line or the vent line can be used to pressurize the tank from the top.

2. Bulk Sampling: Special Methods for Tuned Light™ Cement Blends

There are two approved sampling techniques for Tuned Light blends. Manual samples should not be taken from a valve in the discharge line.

Samples are to be taken (at a minimum) between the blend plant and first transportation vessel and between the last transport vessel and the rig storage.

Gustafson Samplers

Ideally sampling will be done throughout the transfer process to the bulk trucks or marine vessels that will be transporting the blend to the jobsite. The **Gustafson Model PR Sampler** is the recommended device for catching these samples. This is an automatic, inline sampler that gathers a composite sample of the load. A probe stretches completely across the transfer line and samples throughout the transfer process helping assure that the gathered sample is truly representative of the blend.

Because these devices combine many little samples, they are the best method for determining whether all of the bulk materials have been added and are in the proper concentration. To determine the quality of the blending operations (are the additives that are present evenly distributed), catch three separate samples (1 from the 1st third, 1 from the 2nd third, & 1 from the last third of the blend). The sample should be tested for quality and performance before the load is transported to the jobsite.

These samplers can be used to sample directly from tanks to verify a homogeneous blend, as well as flow lines. For this option we recommend an 8 ft brass, partitioned, sample probe, 101295120 @ $500.

Grain Thief Probe Type Sampler

A second approved sampler, similar to a grain thief, is used to probe the bulk tank to obtain a representative sample. With this device the probe is inserted into the tank and separate samples are taken from various depths in the tank simultaneously. Upon mixing the various samples together you will have a representative sample of what was delivered to location. The individual samples can also be used to determine the homogeneity of the blend from side to side or top to bottom.

When the blend reaches the jobsite, a quality assurance test can be conducted to determine whether segregation has occurred. Halliburton operators can re-blend the load at the jobsite if needed. This procedure requires staging an empty bulk tank at the site and transferring the blend one time between tanks. This same process can be used when combining two or more complete blends.

A simple "density float" test (see **Testing on Location,** p. 6) can be conducted to indicate segregation or sphere damage. If excess damage to the spheres has occurred, lab test data can determine if the product is usable for the application.

All holding vessels are to be visually inspected for cleanliness and confirm that top air can be isolated from pad air prior to loading product.

The Spherelite spheres can be damaged. As such product shipping pressure should be controlled to a minimum requirement to move the product. Tank pressure above 20 psi to offload may be required for moving the material long distances. This practice should be evaluated on as required bases not as a standard procedure. Since 3M beads are much stronger standard pressures may be used to transfer slurries that do not contain any Spherelite.

When offloading to field bins, silos, or for the job straight to the mixing equipment, it is critical to initially pressure the current bulk tank(s) from the top. This top pressure must be maintained throughout the job. **DO NOT** pressurize from the bottom to aid discharge until full tank pressure has stabilized and then only as needed for stable flow.

Often the pad or spider air line is the same line as the tank pressure line. The addition of a 1" ball valve will allow isolation until the tank has been fully pressurized. In case where spider air is currently the only air source, in addition to the ball valve a tee with another valve and a connection to the fill or vent line will be required.

Once the tank has reached full operating pressure and the discharge line has been opened, as long as top air is maintained, bottom air can be applied to aid discharge. At this point bottom air should exit through the discharge line and not blow the beads to the top of the tank.

When offloading to field bins or silos, blended bulk material is to be loaded **ONLY** into the bottom of the vessel. Under no instance should the blend be loaded into the top of any vessel. As the lighter beads fall they get displaced towards the top and outside of the tank. Tanks as big as 1700 ft^3 have been loaded this way. This is not a problem, just a new procedure. Bulk operators should avoid "fluffing" the blend by aeration, because that procedure tends to segregate the microspheres to the top of the load. Either of these practices **CAN REQUIRE RE-BLENDING**.

Fruehauf based bulk equipment may be used to transport Tuned Light blend, but should not be used to discharge directly to the mixing unit. The blend should be first unloaded to a storage bin or silo. This will effectively re-blend the bulk material. The exception to this would be if there was one Fruehauf for each pod of a batch mixer and the entirety of the Fruehauf was added to each pod.

3. Testing on Location

During the final transfer or upon arrival to location, random samples are taken and tested with field laboratory equipment to confirm initial laboratory results. The grain thief probe type sampler is the recommended device to collect these samples. In the case of an offshore platform or rig, samples may be taken at the time of loading using the Gustafson Model PR Sampler and sent to the field laboratory for confirmation testing.

A simple "density float" test can be conducted to indicate segregation or sphere damage. If excess damage to the spheres should occur lab test data can determine if the product is usable for the application. In this procedure, two tests are done. A lab prepared sample is compared to the location sample.

Float Method

1. Add 25 cc chloroform (or other approved fluid) to a clean graduated cylinder
2. Add 10 cc of a lab prepared reference blend
3. Disperse blend in the chloroform (shake, swirl)
4. Wash down the side until 50 cc volume reached
5. Allow spheres to float and solids to settle
6. Repeat process with location blend sample
7. Compare location cylinder with the reference test for Spherelite and solids volumes.

If chloroform is not available any high density brine will work. Saturated salt water is always an option but if heavier completion brine is available, it would be preferable.

4. Slurry QC during the Job

When preparing cement for injection into an oil or gas well, it is critical that the slurry be mixed at the correct water to cement ratio. With blended cement slurries containing high concentrations of microspheres, maintaining this correct water ratio is more difficult. The addition of the spheres reduces the density of the blend. The closer this blend density comes to that of the mixing fluid, the more difficult it becomes for density based mixing systems to maintain this ideal water ratio. Because of this phenomenon, it is very important to monitor the mix water usage while mixing Tuned Light™ slurries. This is a good plan even when using the Tuned Light mixing system (TLMS), but is absolutely required when using a density-based mixing system.

A chart based on the table below is recommended for this purpose. If the slurry is mixed with fluid from the displacement tanks it is easy to keep track of the mixing fluid used.

Refill the tank after the initial volume of slurry to fill the tub has been blended. Record the slurry volume after each displacement tank is emptied. If you refill the tank to account for the slurry in the mixing tub, the second and third columns should match. If less slurry is being mixed, the water ratio is too high. Mix the slurry thicker. Less likely, there will be more slurry mixed which means that the slurry will be too thick. Mix the slurry thinner. Continuous monitoring of the water:slurry ratio (if corresponding adjustments are made) will allow us to deliver a quality solution under difficult circumstances.

Volume Mix Fluid (bbl)	Theoretical Slurry Volume (bbl)	Actual Slurry Volume (bbl)
10	19.5	
20	39	
30	58.5	
40	78	
50	97.5	
60	117	

Table 1 Slurry QC

Mud Cup Calibration

Since mixing at the proper cement to water ratio is critical, it is even more important that our density measurements are correct. Thus it is suggested that a second laboratory supplied sample of cement and water be supplied. After mixing the sample the pressurized mud cup should be tested with the sample of known density. Use this reading to calibrate the Unipro™ controller during the job.

Marsh Funnel

The Marsh funnel test can be used to help ensure that we are mixing our slurry at the right cement to water ratio. This test can be used to replace the mud cup or in addition to.

Use the following steps for Tuned Light Marsh Funnel testing:

1. Add 600 ml slurry to a Marsh funnel, through the strainer (if possible), with your finger on the bottom hole.
2. Place a graduated cylinder underneath to collect the slurry.
3. Remove your finger and start the stop watch.

Compare this time to the lab readings. Viscosity/density may be adjusted to match lab design.