LIGHTWEIGHT SOLUTIONS

MicroMatrix™ Cement

- Designed for use in both remedial and primary cementing operations.
- Particle sizes are approximately 10 times smaller than standard cement.
- Able to penetrate openings as narrow as 0.05 mm, or sands as fine as 100 mesh.
- Low density with high compressive strengths, especially at temperatures lower than 110°F (43°C).
- Ideal for subsea completions.

Foam Cement

- Lightweight slurries— 6 to 11 lb/gal (0.72 to 1.32 kg/liter)—for well cementing.
- Ultra-lightweight slurries—3 to 4 lb/gal (0.36 to .48 kg/liter—for specialty applications.
- Especially useful for cementing wells that pass through zones having very sensitive fracture gradients.
- Economical - can increase the yield of a sack of cement by as much as four times.
- Acts as a lost circulation aid, reducing the amount of other additives required.
- Halliburton's FMCEM computer program can provide the proper mixing rates and volumes for the desired final slurry weight.

Spherelite™ Additive

- Hollow, inorganic spheres which are competent at high pressure.
- Allows preparation of slurries from 9 to 12 lb/gal (1 078 to 1 438 kg/m^3).
- Provides improved early compressive strength development.
- Results in a set cement that has improved heat insulation properties.
- Functions as a lost-circulation aid.
- Excellent choice for low-density cements when cementing offshore conductor and casing pipe in weak, unconsolidated formations, and for low-density, thermal cements for steam injection wells.

Econolite® Additive

- Provides slurry weights to as low as 11.4 lb/gal (1.37 kg/liter).
- Economical—can be used as a water-increasing mechanism, resulting in increased slurry volumes.
- Useful where an economical filler slurry is desired.
- Can be added directly into the mixing water, making it convenient where bulk blending facilities are not available.

Gilsonite

- A particulated non-cellular lightweight additive that also provides superior lost circulation control.
- Neither accelerates nor retards setting times.
- Provides very good fill-up above incompetent zones.
- Useful in various operations including full-column cementing, multiple stage cementing, and plugback operations to obtain circulation while drilling.

LIGHTWEIGHT SOLUTIONS

Halliburton Gel

- Because of its colloidal properties, Halliburton Gel absorbs and holds several times its own weight of water.
- The greater the percentage of Halliburton gel used, the greater the water requirement and the lighter the slurry weight.
- Actual slurry and set volume of cement is increased, resulting in an appreciable reduction in fill-up cost.

Silicalite™ Additive

- Imparts an early pozzolanic-type reaction that extends lightweight cement.
- Provides compressive strength enhancement for low-temperature, lightweight cements
- Provides the thixotropic properties necessary for squeeze cementing, lost circulation, and gas migration control.
- Acts as a low temperature accelerator for saturated salt slurries.

Pozmix A

- Economical slurry with premium properties.
- Increases resistance of cement to chemical attack.
- Compatible with all classes of cement and all cementing additives.

Halliburton Light Cement (HLC)

- Economical filler type cement.
- Variable density.
- Compatible with most cementing additives.

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SECTION NO. 230

TECHNICAL DATA
OIL WELL CEMENTS
AND
CEMENT ADDITIVES

NOTICE

The compressive strengths, thickening times, and other properties set forth in these materials are averages based on the testing of numerous samples and are provided to serve only as general guidelines for slurry design and well cementing.

HALLIBURTON

SECTION 230

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SECTION I

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HALLIBURTON BULK CEMENT ADDITIVES

HALLIBURTON®

HALLIBURTON BULK CEMENT ADDITIVES

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- Halliburton Gel
- Econolite
- Halliburton Light Cement
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- Micro-Flyash
- FWCA
- MicroBlock
- SilicaLite
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HALLIBURTON BULK CEMENT ADDITIVES CONTINUED

FREE-WATER AND SOLIDS SUSPENDING AGENTS
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- Spacer 500
- SuperFlush
- Tuned Spacer

Many of these additives serve more than one purpose when used in a cement slurry. Technical information for specific additives is available upon request.

(SEE CATALOG FOR ADDITIONAL INFORMATION)

BASIC CEMENTING MATERIALS

A basic cementing material Is classified as one that, without special additives for weight control or setting properties, when mixed with the proper amount of water, will have cementitious properties. This may be a single ingredient or a combination of two or more ingredients, but they are always used in this combination even when special additives are used with them. The following are of this class:

- Portland Cement
- High Early Cement
- Retarded Cement
- Pozmix Cement
- Pozmix 140

API CLASSIFICATION FOR OIL WELL CEMENTS*

Class A: Intended for use from surface to 6,000 ft. (1830 m) depth,* when special properties are not required. Available only in ordinary type (similar to ASTM C 150, Type I).**

Class B: Intended for use from surface to 6,000 ft. (1830 m) depth, when conditions require moderate to high sulfate-resistance. Available in both moderate (similar to ASTM C 150, Type II) and high sulfate-resistant types.

Class C: Intended for use from surface to 6,000 ft. (1830 m) depth, when conditions require high early strength. Available in ordinary and moderate (similar to ASTM C 150, Type III) and high sulfate-resistant types.

Class D: Intended for use from 6,000 ft. to 10,000 ft. (1830 m to 3050 m) depth, under conditions of moderately high temperatures and pressures. Available in both moderate and high sulfate-resistant types.

Class E: Intended for use from 10,000 ft. to 14,000 ft. (3050 m to 4270 m) depth, under conditions of high temperatures and pressures. Available in both moderate and high sulfate-resistant types.

Class F: Intended for use from 10,000 ft. to 16,000 ft. (3050 m to 4880 m) depth, under conditions of extremely high temperatures and pressures. Available in both moderate and high sulfate-resistant types.

Class G and H: Intended for use as a basic well cement from surface to 8,000 ft. (2440 m) depth as manufactured, or can be used with accelerators and retarders to cover a wide range of well depths and temperatures. No additions other than calcium sulfate or water, or both, shall be interground or blended with the clinker during manufacture of Class G or H well cement. Available in moderate and high sulfate-resistant types.

*Reproduced by permission from API Spec. 10, “API Specification for Materials and Testing for Well Cements.” Depth limits are based on the conditions imposed by the casing-cement specification tests (Schedules 1, 4, 5, 6, 8, 9), and should be considered as approximate values.

**ASTM C 150: Standard Specification for Portland Cement. Copies of this specification are available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

ENGLISH/METRIC UNITS

THE MANUFACTURE AND COMPOSITION OF CEMENT

Manufacture—Cements are made of limestone (or other materials high in calcium carbonate content), clay or shale, some iron and aluminum oxides if they are not present in sufficient quantity in the clay or shale. These dry materials are finely ground and mixed thoroughly in the correct proportions either in the dry condition (dry process) or mixed with water (wet process). This raw mixture is then fed into the upper end of a sloping, rotary kiln at a uniform rate, and slowly travels to the lower end. The kiln is fired with powdered coal, fuel oil, or gas to temperatures of 2,600 to 2,800˚F. (1427˚C. to 1530°C) These temperatures cause certain chemical reactions to occur between the ingredients of the raw mixture with the resulting material called clinker. The clinker is ground with a controlled amount of gypsum to form the product we know as Portland cement.

Composition—The following are the principal compounds formed in the burning process and their functions:

Tricalcium Aluminate (C_3A) is the compound that promotes rapid hydration and is the constituent which controls the initial set and thickening time of the cement. It is also responsible for the susceptibility of cement to sulfate attack and to be classified as a high-sulfate resistant cement, it must have three percent or less C_3A.

Tetracalcium Aluminoferrite (C_4AF) is the low-heat-of-hydration compound in cement. The addition of an excess of iron oxide will increase the amount of C_4AF and decrease the amount of C_3A in the cement.

Tri-Calcium Silicate (C_3S) is the prevalent compound in most cement and the principal strength producing material. It is responsible for the early strength (1 to 28 days). High early cements generally have higher percentages of this compound than do Portland or Retarded cements.

Dicalcium Silicate (C_2S) is the slow hydrating compound and accounts for the small, gradual gain in strength which occurs over an extended period of time.

All cements are manufactured in essentially the same way and are composed of the same ingredients, only in different proportions. The water requirement of each type of cement varies with the fineness of grind or surface area. High early strength cements have a high surface area (fine grind), the retarded cements have a low surface area, and the Portland cements have a surface area slightly higher than the retarded cements. The chemical retarder used in retarded cements may be added to the clinker during the secondary grinding stage to provide uniform distribution, or to the finished product.

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API CLASS A & B CEMENT (Common Portland Cement)

This cement is intended for use in oil wells from surface to 6,000 ft. depth (1830 m) when no special properties are required. The recommended water-cement ratio, according to API, is 0.46 by weight (5.2 gals./sk.) (19.7 L/sk.). It is more economical than premium cements and should be used when no special properties are desired and well conditions permit.

API CLASS C CEMENT (High Early Cement)

This cement is intended for use in oil wells from surface to 6,000 ft. depth (1830 m). It is ground finer than Portland and has a high C_3S content, both of which contribute to the higher strength. The API water requirement for this cement is 0.56 (6.3 gals./sk.) (24 L/sk.)

The compressive strength of this cement is greater than Portland cement at curing times up to 30 hours; and the pumping time slightly less under the same test conditions. This cement is more expensive than Portland and, unless its special properties are needed, should not be used. Generally, Portland with calcium chloride will give better strengths than this type of cement without accelerators.

API CLASSES G OR H CEMENT (Basic Cement)

This cement is intended for use as manufactured from surface to 8,000 ft (2440 m) or can be modified with accelerators or retarders to meet a wide range of temperature conditions. It is chemically similar to API Class B cement but is manufactured to more rigorous chemical and physical specifications which result in a more uniform product. As manufactured it contains no accelerators, retarders or viscosity control agents other than gypsum normally ground with cement clinker. All necessary. additives are blended by the service Company. The API water requirement for Class G is 0.44 (5.0 gals/sk.) (18.9 L/sk.) and for Class H is 0.38 (4.3 gals/sk.) (16.3 L/sk.).

API CLASS D, E, AND F CEMENTS (Retarded Cement)

Most of these cements are retarded with an organic compound while some are retarded by chemical composition and grind. The most common retarders are of the lignin type, the most widely used being calcium lignosulfonates similar to HR-5. These cements are more expensive than Portland cement and, unless their special properties are needed, should not be used.

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POZMIX® CEMENT*

This basic cementing composition consists of portland cement, a pozzolanic material (Pozmix), and 2 per cent bentonite based on the total weight of cement and Pozmix. By definition a pozzolan is a siliceous material which reacts with lime and water to form calcium silicates having cementitious properties. Advantages of this reaction are utilized with Pozmix Cement since portland cements release approximately 15 per cent free lime when they react with water, and the lime will subsequently react with the Pozmix to yield a more durable mass of calcium silicates. Because this type of composition is less expensive than the other basic materials and performs well with most additives, it has almost universal application in well cementing.

POZMIX® 140*

Further utilization of the pozzolan-lime reaction occurs with Pozmix 140, which is a blend of Pozmix and hydrated lime (calcium hydroxide) containing no portland cement. Because calcium silicates form more slowly from this reaction than from cement, this composition is not normally used at temperatures lower than 140°F. (60°C.). However, its compatibility with retarders as well as its properties of thickening time and compressive strength provide excellent performance in the range from 140°F. (60°C.) to over 400°F. (204°C.).

HALLIBURTON “LIGHT” CEMENT*

This is a filler cementing composition that is both versatile and economical for those applications requiring a low or variable slurry density. It fills a need for a high yield, low cost slurry providing a permanent cement for those zones that do not present critical cement slurry design factors. “HLC” can be used without changing formulation to achieve slurry densities of 12.4 to 13.6 lbs per gallon (1.48 kg/L to 1.63 kg/L) with API Class A or B Cements. Still lower slurry densities of 12.0 to 12.8 lbs. per gallon (1.44 kg/L to 1.53 kg/L) can be achieved with Special Class C Cements.

*—for further information refer to the following section on Pozmix Cements.

ENGLISH/METRIC UNITS

LABORATORY PROCEDURE AND METHODS OF REPORTING

Standard procedures for testing oil well cements and additives are given in API Spec. 10, "API Specifications for Materials and Testing for Well Cements" and API RP 10B, "API Recommended Practice for Testing Well Cements."

SLURRY PROPERTIES

Water ratios, viscosities, densities and volumes are given for each of the various slurries tested. Water ratios are expressed in gallons and cubic feet per sack of cement (94 pounds) (42.6 kg). These water contents are in all cases greater than Minimum Water but such that the Free Water Content is never greater than API specification. Densities are given in pounds per gallon, pounds per cubic foot and (kg/L). Slurry yields are reported in cubic feet per sack of cement. For Pozmix®, water ratios and slurry yields are reported per sack of blend.

THICKENING TIMES

The thickening time test determines the length of time a slurry will remain pumpable under simulated well conditions. The thickening time test can simulate temperature, pressure and time. Other factors that can affect the slurry's pumpability during a job cannot be simulated exactly during a laboratory thickening time test (fluid contamination, fluid loss to formation, unforeseen temperature variations, unplanned shutdowns in pumping, etc.). Because these factors cannot be accounted for, simulating known well conditions as precisely as possible is very important when determining the thickening time of a slurry to be pumped into a well.

COMPRESSIVE STRENGTHS

The compressive strength test determines the strength of a cement composition under temperature conditions simulating well conditions. The maximum pressure used for curing is normally 3,000 psi (API), unless otherwise specified.

CRUSH STRENGTH TESTING

The crush strength test indicates the strength of a cement slurry after it has been pumped into the well and allowed to set static. The slurry is subjected to temperature (and normally, pressure) for various lengths of time. The strength test may be performed at bottomhole conditions or the conditions at a specific point of interest (at the top of a long cement column, at the top of a liner, across a producing zone, etc.).

SONIC STRENGTH TESTING

The sonic strength (UCA analyzer) test is a non-destructive test performed on a slurry to estimate its strength. Correlations have been developed to approximate the compressive strength of a cementing composition based on the time required for the ultrasonic signal to pass through the cement as it sets. Sonic strength and crush strength indications can vary considerably, depending on the temperature of the test, slurry composition, etc., and in most cases, the sonic strength may be as little as 50% of the crush strength. The sonic strength test is performed according to the procedures outlined in the ***API RP 10B***. The temperature and pressure schedule and the preconditioning options are the same as for the crush strength test.

ENGLISH/METRIC UNITS

RHEOLOGICAL TESTING

The rheology test determines the apparent flow properties (plastic viscosity, yield point, frictional properties, gel strength, etc.) of a cement slurry, using a rotational viscometer such as the Fann (6- or 12-speed), Chandler 12-speed or OFI 10-speed instruments.

FLUID LOSS TESTING

A fluid-loss test determines the effectiveness of a cement slurry composition in preventing the loss of water from the slurry to a formation in the wellbore. Two types of fluid-loss tests are commonly performed on cement slurries: the stirred fluid-loss test and the static fluid-loss test. In most cases, circumstances prevent you from obtaining a sample of the formation or simulating wellbore conditions exactly. Consequently, these tests utilize a standard sieve size to simulate an average formation permeability (usually a 325-mesh stainless steel sieve assembly).

FREE FLUID CEMENT SPECIFICATION TEST

The free fluid test for testing cement slurries used to cement a well helps determine a slurry's capacity to prevent fluid separation in static conditions, both during placement and after it has been placed into the wellbore. Excessive free fluid in a slurry can cause problems with water pockets, channeling, sedimentation, zonal isolation, etc. The maximum free fluid allowed by the API specification test for API class G or H is 3.5 mL (1.4%). The Texas Railroad Commission sets the maximum allowable free fluid content at 6 mL (2.4%) for "critical zone" slurries.

SLURRY SEDIMENTATION TEST

This test, which helps to determine if a cement slurry experiences particle sedimentation, is used in conjunction with the free fluid test to help determine the static stability of a cement slurry under downhole conditions. Excessive free fluid and settling can indicate stability problems in a cement sample.

STATIC GEL STRENGTH TESTING

The static gel strength (SGS) test determines the gel strength development charateristics of a static fluid under temperature and pressure conditions.

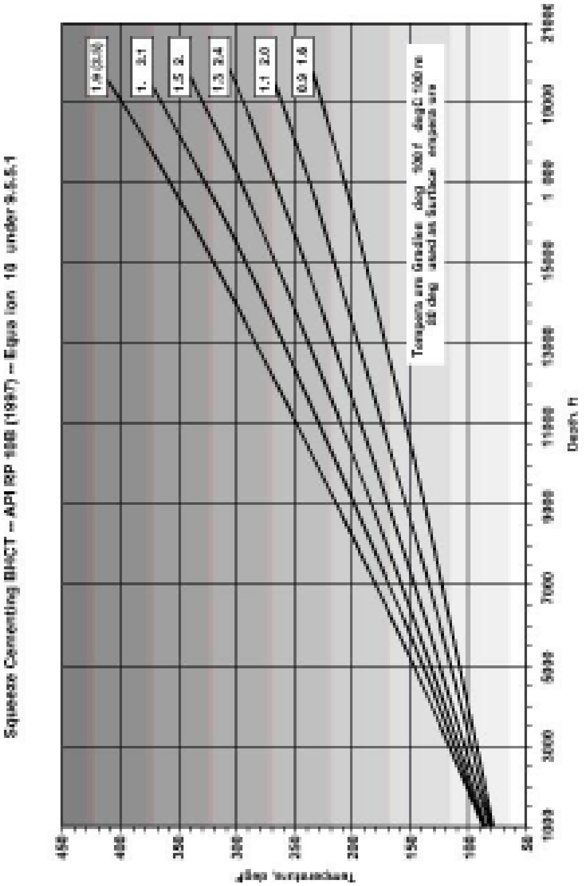
"Zero Gel" Time – the length of time from the point at which the fluid goes static until the SGS reaches 100 lb/100 ft^2 is referred to as the "zero gel" time. When the SGS value reaches 500 lb/100 ft^2, the fluid no longer transfers hydrostatic pressure from the fluid (or the fluid above it).

"Transition" Time – The time required for the fluid's SGS value to increase from 100 lb/100 ft^2 to 500 lb/100ft^2 is referred to as the "transition" time. To control gas migration, the "zero gel" time can be long, but the "transition" time must be as short as possible (preferably, less than 20 to 30 minutes).

COMPRESSIBILITY TESTING

Certain materials such as GAS-CHEK® additive and SUPER CBL® additive generate a gas after they have been mixed into a slurry. The reaction that generates the gas should occur while the cement is still fluid and before it sets. By performing a modified thickening time test with the MACS analyzer, the time of this reaction can be determined.

ENGLISH/METRIC UNITS



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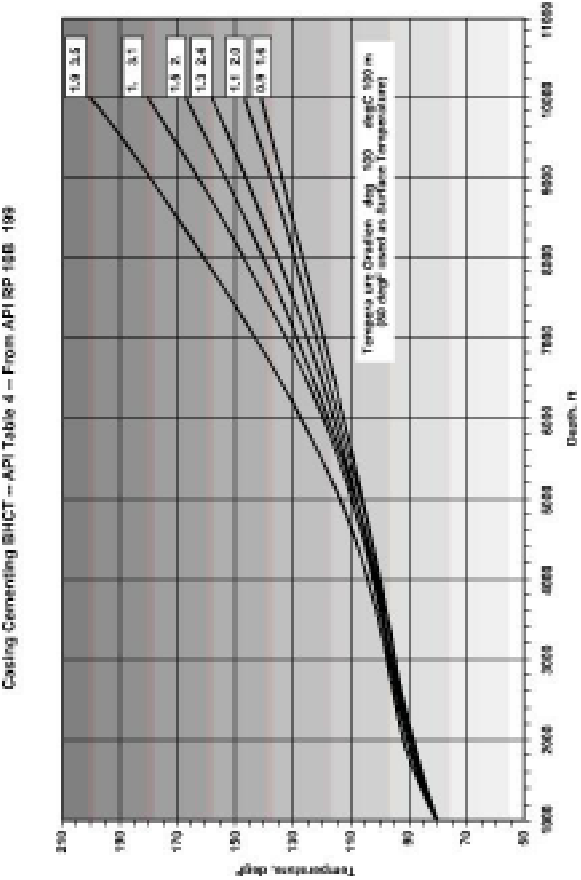

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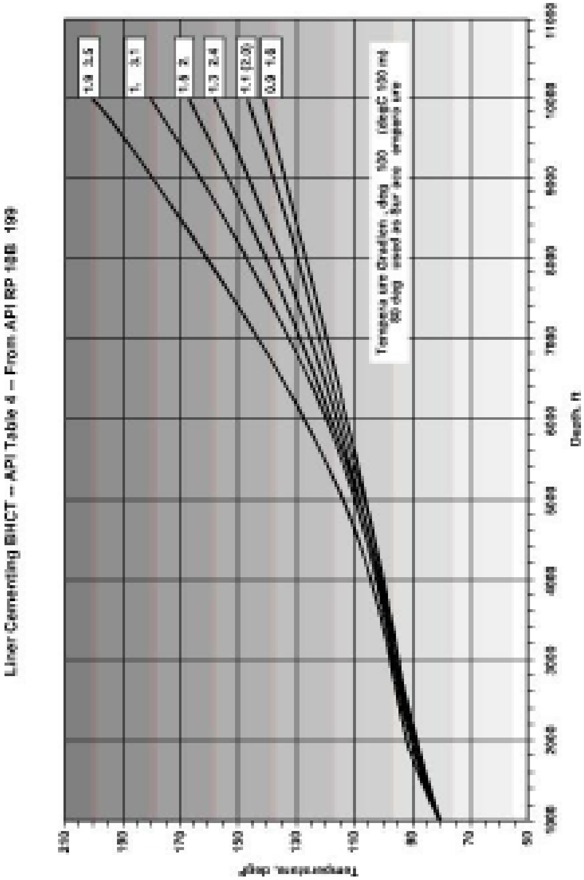

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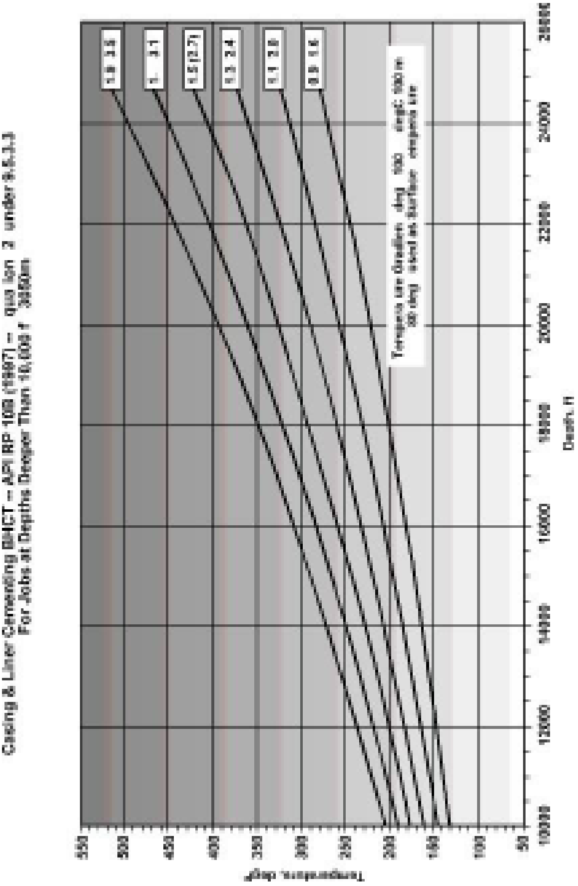

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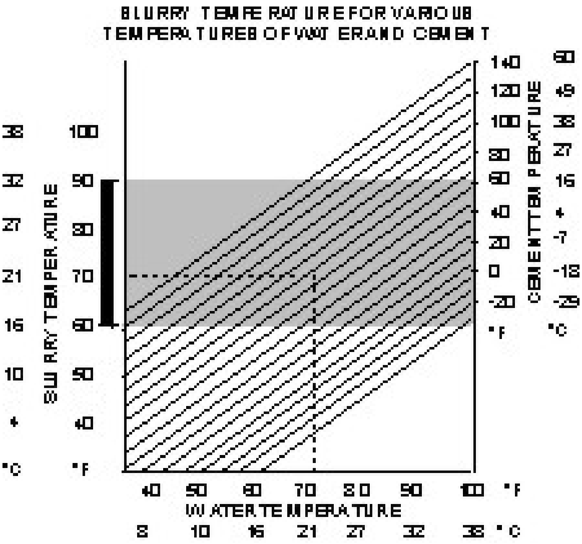

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
API Cements	94	3.14	0.0382	0.0051	100	Dry		0.045 to 0.055
Trinity Lite-Wate	75	2.8	0.0429	0.0057	100	Dry		0.080 to 0.103
Micro-Matrix	50	3	0.0400	0.0053	100	Dry		0.120 to 0.180
Micro-Fly Ash	65	2.54	0.0473	0.0063	100	Dry		0.120 to 0.180
Micro-Matrix Cmt Ret		1.15	0.1044	0.0140	100	Liquid	Water	
PozMix A	74	2.46	0.0488	0.0065	100	Dry		0.049 to 0.053
SilicaLite	18	2.52	0.0476	0.0064	100	Dry		0.4
Attapulgite	40	2.58	0.0465	0.0062	100	Dry		0.69
Barite	135	4.23	0.0284	0.0038	100	Dry		0.0264
Bentonite	60	2.65	0.0453	0.0061	100	Dry		0.69
Calcium Carbonate	22.3	2.71	0.0443	0.0059	100	Dry		none
Calcium Chloride	50.5	1.96	0.0612	0.0082	100	Dry		none
CAHT-1	45	1.75	0.0686	0.0092	100	Dry		none
CFA-S		1.05	0.1143	0.0153	100	Liquid	Water	
Cal-Seal	75	2.7	0.0445	0.0059	100	Dry		0.048

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
CFR-2	43	1.3	0.0923	0.0123	100	Dry		none
CFR-2L		1.18	0.1017	0.0136	33	Liquid	Water	
CFR-3	38	1.28	0.0938	0.0125	100	Dry		none
CFR-3L		1.17	0.1026	0.0137	33	Liquid	Water	
D-Air-1	25.2	1.35	0.0889	0.0119	100	Dry		none
D-Air-2		1.01	0.1189	0.0159	100	Liquid	Suspension	
D-Air-3		1	0.1200	0.0160	100	Liquid		
Diacel A	60.3	2.62	0.0458	0.0061	100	Dry		none
Diesel Oil		0.85	0.1412	0.0189	100	Liquid		
DSMA		1.006	0.1193	0.0160	40	Liquid	Water	
Econolite	75	2.4	0.0500	0.0067	100	Dry		Varies
Econolite Liquid		1.4	0.0857	0.0115	40	Liquid	Water	
EX-1		2.4	0.0500	0.0067	100	Dry		Varies
Flocele	15	1.42	0.0845	0.0113	100	Dry		none
FWCA	32	1.4	0.0857	0.0115	100	Dry		none

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
GasCon 469		1.1	0.1091	0.0146	15	Liquid	Water	
GasStop	19	1.19	0.1009	0.0135	100	Dry		none
GasStop HT	19	1.43	0.0839	0.0112	100	Dry		none
GasStop LXP		0.994	0.1208	0.0161	42.3	Liquid	Suspension	
Gilsonite	50	1.07	0.1122	0.0150	100	Dry		0.04
Halad-9	37.2	1.22	0.0984	0.0132	100	Dry		none < 0.5%
Halad-9 LXP		0.987	0.1216	0.0163	42.6	Liquid	Suspension	
Halad-14	39.5	1.31	0.0916	0.0123	100	Dry		none
Halad-22A	23.5	1.32	0.0909	0.0122	100	Dry		none < 0.5%
Halad-22A LXP		1.003	0.1197	0.0160	41.9	Liquid	Suspension	
Halad-100A	15.62	1.36	0.0883	0.0118	100	Dry		none
Halad-100AL		1.034	0.1161	0.0155	10	Liquid	Water	
Halad-322	35.2	1.28	0.0938	0.0125	100	Dry		none
Halad-322 LXP		0.984	0.1220	0.0163	50	Liquid	Suspension	
Halad-344	19	1.19	0.1009	0.0135	100	Dry		none
Halad-344 LXP		1.01	0.1189	0.0159	42.3	Liquid	Suspension	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
Halad-413	42	1.48	0.0811	0.0108	100	Dry		none
Halad-413 Liquid		1.11	0.1082	0.0145	25	Liquid	Water	
Halad-447	55.8	1.64	0.0732	0.0098	100	Dry		none
Halad-361A		1.07	0.1122	0.0150	20	Liquid	Water	
Halad-600LE+		1.097	0.1094	0.0146	20	Liquid	Water	
Hi-Dense #4	165	5.2	0.0231	0.0031	100	Dry		varies
HR-5	38.4	1.6	0.0750	0.0100	100	Dry		none
HR-6L		1.21	0.0992	0.0133	40	Liquid	Water	
HR-7	30	1.28	0.0938	0.0125	100	Dry		none
HR-12	23.2	1.14	0.1053	0.0141	100	Dry		none
HR-12L		1.2	0.1000	0.0134	40	Liquid	Water	
HR-13L		1.24	0.0968	0.0129	40	Liquid	Water	
HR-25	45	1.76	0.0682	0.0091	100	Dry		none
HR-25L		1.2	0.1000	0.0134	40	Liquid	Water	
SCR-100	45	1.42	0.0845	0.0113	100	Dry		none
SCR-100 Liquid		1.16	0.1035	0.0138	40	Liquid	Water	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
Hydrated Lime	31	2.34	0.0513	0.0069	100	Dry		0.153
Hydromite	68	2.15	0.0558	0.0075	100	Dry		0.03
Iron Carbonate	114.5	3.7	0.0324	0.0043	100	Dry		none
KCl (in solution)								
3%		1.019	0.0443	0.0059	100	Dry		
5%		1.031	0.0450	0.0060	100	Dry		
Sat.		1.178	0.1019	0.0136	26.5	Liquid	Water	
LAP-1	50	1.33	0.0903	0.0121	100	Dry		none
LA-2		1.1	0.1091	0.0146	54	Liquid	Water	
Latex-2000		0.996	0.1205	0.0161	50	Liquid	Water	
Microbond	61	2.4	0.0500	0.0067	100	Dry		0.048
Microbond E		3	0.0400	0.0053	100	Dry		
Microbond HT	112	3.57	0.0336	0.0045	100	Dry		0.048
Microbond M	65	3.61	0.0333	0.0044	100	Dry		0.088
MicroBlock		1.4	0.0857	0.0115	50	Liquid	Water	
MicroMax	84	4.9	0.0245	0.0033	100	Dry		0.05

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
MicroSand	38	2.65	0.0453	0.0061	100	Dry		0.05
Perlite (0 psi)	8	0.67	0.1792	0.0240	100	Dry		0.5
Perlite (3000 psi)		2.2	0.0546	0.0073	100	Dry		
Perlite Six (0 psi)	38	1.575	0.0762	0.0102	100	Dry		0.158
Perlite Six (3000 psi)		2.4	0.0500	0.0067	100	Dry		
NF-3		0.981	0.1224	0.0164	100	Liquid	Water	
NF-4		1.01	0.1189	0.0159	100	Liquid	Water	
NF-4E		0.998	0.1203	0.0161	100	Liquid	Water	
NF-5		0.94	0.1277	0.0171	100	Liquid	Water	
SA-541	47	1.4	0.0857	0.0115	100	Dry		none
Spherelite (0 psi)	25	0.685	0.1753	0.0234	100	Dry		0.95
Spherelite (500 psi)		0.759	0.1582	0.0211	100	Dry		
Spherelite (1000 psi)		0.785	0.1529	0.0204	100	Dry		
Spherelite (2000 psi)		0.828	0.1450	0.0194	100	Dry		
Spherelite (3000 psi)		0.864	0.1389	0.0186	100	Dry		
Spherelite (4000 psi)		0.902	0.1331	0.0178	100	Dry		

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
Spherelite (5000 psi)		0.943	0.1273	0.0170	100	Dry		
Spherelite (6000 psi)		0.98	0.1225	0.0164	100	Dry		
SSA-1 (Silica Flour)	70	2.65	0.0453	0.0061	100	Dry		0.049
SSA-2 (Coarse Silica)	100	2.65	0.0453	0.0061	100	Dry		none
Sea Water		1.025	0.1171	0.0157		Liquid		
Salt (dry)	71	2.17	0.0553	0.0074	100	Dry		
Salt (in Solution)								
6% - 0.5 lb/gal		1.041	0.0372	0.0050	6	Dry		
12% - 1.0 lb/gal		1.078	0.0391	0.0052	12	Dry		
18% - 1.5 lb/gal		1.112	0.0405	0.0054	18	Dry		
24% - 2.0 lb/gal		1.145	0.0417	0.0056	24	Dry		
Sat.- 3.1 lb/gal		1.2	0.0458	0.0061	37.2	Dry		
Sand								none
35% porosity	106.6	2.63	0.0456	0.0061	100	Wet		
39% porosity	100	2.63	0.0456	0.0061	100	Dry		
Super CBL	56.9	2.6	0.0462	0.0062	100	Dry		none

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight lbs/cuft	Specific Gravity	Absolute Volume gals/lb	Absolute Volume cu ft/lb	Activity %	Dry/ Liquid	Liquid Base	Water Requirements gals/lb
Suspend HT	55	1.53	0.0785	0.0105	100	Dry		varies
Tuf Plug	48	1.28	0.0938	0.0125	100	Dry		none
VersaSet	50	2.32	0.0517	0.0069	100	Dry		none
Water		1	0.1200	0.0160		Liquid		
ZoneSeal Retarder	29	1.36	0.0883	0.0118	100	Dry		none

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
API Cements	1506	3.14	0.3190	100	Dry		0.376 to 0.459
Trinity Lite-Wate	1201	2.8	0.3578	100	Dry		0.668 to 0.859
Micro-Matrix	801	3	0.3339	100	Dry		1.001 to 1.502
Micro-Fly Ash	1041	2.54	0.3944	100	Dry		1.001 to 1.502
Micro-Matrix Cmt Ret		1.15	0.8711	100	Liquid	Water	
PozMix A	1185	2.46	0.4072	100	Dry		0.409 to 0.442
SilicaLite	288	2.52	0.3975	100	Dry		3.338
Attapulgite	641	2.58	0.3883	100	Dry		5.758
Barite	2162	4.23	0.2368	100	Dry		0.22
Bentonite	961	2.65	0.3780	100	Dry		5.758
Calcium Carbonate	357	2.71	0.3697	100	Dry		none
Calcium Chloride	809	1.96	0.5111	100	Dry		none
CAHT-1	721	1.75	0.5725	100	Dry		none
CFA-S		1.05	0.9541	100	Liquid	Water	
Cal-Seal	1201	2.7	0.3710	100	Dry		0.401
CFR-2	689	1.3	0.7706	100	Dry		none
CFR-2L		1.18	0.8490	33	Liquid	Water	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
CFR-3	609	1.28	0.7827	100	Dry		none
CFR-3L		1.17	0.8562	33	Liquid	Water	
D-Air-1	404	1.35	0.7421	100	Dry		none
D-Air-2		1.01	0.9919	100	Liquid	Suspension	
D-Air-3		1	1.0018	100	Liquid		
Diacel A	966	2.62	0.3824	100	Dry		none
Diesel Oil		0.85	1.1786	100	Liquid		
DSMA		1.006	0.9958	40	Liquid	Water	
Econolite	1201	2.4	0.4174	100	Dry		Varies
Econolite Liquid		1.4	0.7156	40	Liquid	Water	
EX-1		2.4	0.4174	100	Dry		Varies
Flocele	240	1.42	0.7055	100	Dry		none
FWCA	513	1.4	0.7156	100	Dry		none
GasCon 469		1.1	0.9107	15	Liquid	Water	
GasStop	304	1.19	0.8418	100	Dry		none
GasStop HT	304	1.43	0.7006	100	Dry		none
GasStop LXP		0.994	1.0078	42.3	Liquid	Suspension	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
Gilsonite	801	1.07	0.9363	100	Dry		0.334
Halad-9	596	1.22	0.8211	100	Dry		none < 0.5%
Halad-9LXP		0.987	1.0150	42.6	Liquid	Suspension	
Halad-14	633	1.31	0.7647	100	Dry		none
Halad-22A	376	1.32	0.7589	100	Dry		none < 0.5%
Halad-22ALXP		1.003	0.9988	41.9	Liquid	Suspension	
Halad-100A	250	1.36	0.7366	100	Dry		none
Halad-100AL		1.034	0.9689	10	Liquid	Water	
Halad-322	564	1.28	0.7827	100	Dry		none
Halad-322LXP		0.984	1.0181	50	Liquid	Suspension	
Halad-344	304	1.19	0.8418	100	Dry		none
Halad-344LXP		1.01	0.9919	42.3	Liquid	Suspension	
Halad-413	673	1.48	0.6769	100	Dry		none
Halad-413 Liquid		1.11	0.9025	25	Liquid	Water	
Halad-447	894	1.64	0.6109	100	Dry		none
Halad-361A		1.07	0.9363	20	Liquid	Water	
Halad-600LE+		1.097	0.9132	20	Liquid	Water	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
Hi-Dense #4	2643	5.2	0.1927	100	Dry		varies
HR-5	615	1.6	0.6261	100	Dry		none
HR-6L		1.21	0.8279	40	Liquid	Water	
HR-7	481	1.28	0.7827	100	Dry		none
HR-12	372	1.14	0.8788	100	Dry		none
HR-12L		1.2	0.8348	40	Liquid	Water	
HR-13L		1.24	0.8079	40	Liquid	Water	
HR-25	721	1.76	0.5692	100	Dry		none
HR-25L		1.2	0.8348	40	Liquid	Water	
SCR-100	721	1.42	0.7055	100	Dry		none
SCR-100 Liquid		1.16	0.8636	40	Liquid	Water	
Hydrated Lime	497	2.34	0.4281	100	Dry		1.277
Hydromite	1089	2.15	0.4660	100	Dry		0.25
Iron Carbonate	1834	3.7	0.2708	100	Dry		none
KCl (in solution)							
3%		1.019	0.9831	100	Dry		
5%		1.031	0.9717	100	Dry		
Sat.		1.178	0.8504	26.5	Liquid	Water	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
LAP-1	801	1.33	0.7532	100	Dry		none
LA-2		1.1	0.9107	54	Liquid	Water	
Latex-2000		0.996	1.0058	50	Liquid	Water	
Microbond	977	2.4	0.4174	100	Dry		0.401
Microbond E		3	0.3339	100	Dry		
Microbond HT	1794	3.57	0.2806	100	Dry		0.401
Microbond M	1041	3.61	0.2775	100	Dry		0.734
MicroBlock		1.4	0.7156	50	Liquid	Water	
MicroMax	1346	4.9	0.2044	100	Dry		0.417
MicroSand	609	2.65	0.3780	100	Dry		0.417
Perlite (0 psi)	128	0.67	1.4952	100	Dry		4.172
Perlite (3000 psi)		2.2	0.4554	100	Dry		
Perlite Six (0 psi)	609	1.575	0.6361	100	Dry		1.318
Perlite Six (3000 psi)		2.4	0.4174	100	Dry		
NF-3		0.981	1.0212	100	Liquid	Water	
NF-4		1.01	0.9919	100	Liquid	Water	
NF-4E		0.998	1.0038	100	Liquid	Water	

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
NF-5		0.94	1.0657	100	Liquid	Water	
SA-541	753	1.4	0.7156	100	Dry		none
Spherelite (0 psi)	400	0.685	1.4625	100	Dry		7.927
Spherelite (500 psi)		0.759	1.3199	100	Dry		
Spherelite (1000 psi)		0.785	1.2762	100	Dry		
Spherelite (2000 psi)		0.828	1.2099	100	Dry		
Spherelite (3000 psi)		0.864	1.1595	100	Dry		
Spherelite (4000 psi)		0.902	1.1106	100	Dry		
Spherelite (5000 psi)		0.943	1.0624	100	Dry		
Spherelite (6000 psi)		0.98	1.0222	100	Dry		
SSA-1 (Silica Flour)	1121	2.65	0.3780	100	Dry		0.409
SSA-2 (Coarse Silica)	1602	2.65	0.3780	100	Dry		none
Sea Water		1.025	0.9774		Liquid		
Salt (dry)	1137	2.17	0.4617	100	Dry		

CEMENTING MATERIALS AND ADMIXTURES
PHYSICAL PROPERTIES AND WATER REQUIREMENTS

Material	Bulk Weight Kg/m3	Specific Gravity	Absolute Volume L/Kg	Activity %	Dry/Liquid	Liquid Base	Water Requirements L/Kg
Salt (in Solution)							
6% - 0.5 lb/gal		1.041	0.9623	6	Dry		
12% - 1.0 lb/gal		1.078	0.9293	12	Dry		
18% - 1.5 lb/gal		1.112	0.9009	18	Dry		
24% - 2.0 lb/gal		1.145	0.8749	24	Dry		
Sat.- 3.1 lb/gal		1.2	0.8348	37.2	Dry		
Sand							none
35% porosity	1708	2.63	0.3809	100	Wet		
39% porosity	1602	2.63	0.3809	100	Dry		
Super CBL	911	2.6	0.3853	100	Dry		none
Suspend HT	881	1.53	0.6548	100	Dry		varies
Tuf Plug	769	1.28	0.7827	100	Dry		none
VersaSet	801	2.32	0.4318	100	Dry		none
Water		1	1.0018		Liquid		
ZoneSeal Retarder	465	1.36	0.7366	100	Dry		none