BENSEAL®/EZ-MUD SLURRY

Sealing and Plugging System

By Halliburton

PRODUCT SUBMITTAL

- Technical Data Sheet
- MSDS Sheet

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BENSEAL®/EZ-MUD® SLURRY

Sealing and Plugging System

Description

The BENSEAL® and EZ-MUD® slurry combines two widely used Baroid products into a patented technique that provides a simple, economical method to seal and grout boreholes, well casings and earthen structures. The slurry develops a high quality grout with low permeability.

Applications/Functions

- Can seal or grout plastic and steel casings
- Can seal downhole instrumentation in test and observation holes
- Can plug abandoned boreholes for mineral, water and seismic exploration
- Can stabilize broken or unconsolidated formations
- Can grout ground source heat pump loops

Advantages

- Develop strong bond between grout, casing and formation
- Form a flexible seal with a very low permeability that prevents commingling of aquifers and entry of surface contaminants
- Delay bentonite swelling on surface so that unyielded bentonite will swell in situ
- Pump at reduced pressure
- No heat of hydration
- Easy to mix
- Re-hydratable
- Minimal grout level subsidence
- Allow hole reentry
- Both products are NSF/ANSI Standard 60 certified

Typical Properties

Slurry weight	9.5 lb/gal (1.14 g/cm^3)
Total active solids	20% by weight
Permeability	1.2 x 10^{-8} cm/sec (in fresh water)
Yield volume	26.3 gal per one 50-lb sack BENSEAL grout
Thermal conductivity	0.1 m^3 per 22.7 kg sack BENSEAL grout 0.43 btu/hour ft °F (0.74 watts/meter °C)

Recommended Treatment

The procedure described below must be followed closely to ensure proper mixing. To pump BENSEAL and EZ-MUD slurry, use a piston, diaphragm or gear-type pump. **Do not use a centrifugal pump.**

Recommended Treatment (continued)

Typical mixing procedure:

Note: Effective mixing and placement of BENSEAL and EZ-MUD grout requires the use of specific equipment capable of mixing and placing a highly reactive, pumpable bentonite grout such as a commercial grouter or proven low-shear mixing device and pump.

Do not over mix and do not use a centrifugal pump.

1.) Pre-treat make-up water with Soda Ash to less than or equal to 100 mg/l total hardness and to a pH range of 8.5 – 9.5.
2.) Accurately measure 24 U.S. gallons (91-liters) of freshwater into grout mix tank and mark tank to help ensure repeatability.
3.) With mixing paddles at high speed add 8-10 fluid ounces (240-300 ml) of EZ-MUD liquid polymer to the 24 U.S. Gallons (91-liters) of freshwater.
4.) With mixing paddles maintained at high speed, blend one sack of BENSEAL grout into EZ-MUD water mixture. Rate of addition for BENSEAL grout should always be controlled and consistent. Normal application rates will generally range from 15 to 30 seconds per 50-lb (22.7 kg) bag. Rate of addition will vary based on mixing efficiency of selected grouting equipment. Mixing of grout should continue only as long as necessary to achieve uniform suspension of granular BENSEAL grout within the EZ-MUD water mixture prior to pumping.
5.) Pump BENSEAL grout and EZ-MUD slurry grout through a 1.0–1.25 inch (25-32 mm) ID tremie pipe into hole without delay. Paddle speed should be maintained at a moderate speed during active pumping to help ensure continuous suspension of the granular BENSEAL grout. Grout should be pumped through tremie pipe from bottom of interval to surface to ensure effective displacement. Maintain submergence of tremie pipe a minimum of 10-feet within grout column for uniform displacement.
6.) Continuous grouting operations should continue until competent grout is present at the surface.

Heat loop grouting

Refer to typical mixing procedure. Do not over mix to avoid entrapment of air that will result in reduced thermal conductivity.

For grout volume requirements refer to the following table:

Diameter (inches)	Diameter (mm)	gal/ft	m^3/meter	ft/gal	meter/m^3
2	51	0.16	0.002	6.25	493.3
3	76	0.37	0.005	2.70	219.2
4	102	0.65	0.008	1.54	123.3
5	127	1.02	0.013	0.98	78.9
6	152	1.47	0.018	0.68	54.9
7	178	2.00	0.025	0.50	40.3
8	203	2.61	0.032	0.38	30.8
9	229	3.30	0.041	0.30	24.4
10	254	4.08	0.051	0.25	19.7
12	305	5.87	0.073	0.17	13.7
14	356	8.0	0.099	0.13	10.1
16	406	10.5	0.130	0.10	7.7
18	457	13.2	0.164	0.08	6.1
20	508	16.3	0.203	0.06	4.9
24	610	23.5	0.292	0.05	3.4
36	914	52.9	0.657	0.03	1.5

Note: Volume of annular space = volume of hole - volume of casing O.D

Recommended Treatment (continued)

Sealing casing

1. Pump the prepared BENSEAL and EZ-MUD slurry through a tremie pipe inserted down the annular space to the bottom of the hole.
2. Fill the annulus uniformly from the bottom up, and withdraw the tremie pipe slowly as the slurry is discharged.

Notes:

- In sealing casing, make sure that a "casing shoe shut-off" has been established between the bottom of the casing and the hole. This helps ensure that the sealing slurry remains in the annulus.
- Pump until the grout returned at the surface is of the same consistency as the grout being pumped into the hole.

Plugging and abandoning boreholes:

1. Pump the prepared BENSEAL and EZ-MUD slurry through an open-ended drill pipe.
2. Fill the hole from the bottom up and withdraw the drill pipe slowly as the hole fills to prevent pipe from becoming stuck.

Additional Information

- The grouting method selected will depend upon, and you should carefully consider, all prevailing geological and hydrological factors and any existing regulatory requirements. The grouting process may not be complete until the grout is static at the desired level.

- The subsurface environment that the respective bentonite sealing material or grout is to be placed into should always be taken into consideration when selecting the appropriate material to compose the well seal. If the formation water chemistry has a total hardness of greater than or equal to 500 parts per million and/or a chloride content of greater than or equal to 1500 parts per million the use of a bentonite material may not be appropriate for this environment. In the event that questions regarding subsurface environments arise it is always best to consult your local Baroid IDP representative to determine if the Baroid product of choice is appropriate for the given conditions.

Packaging

BENSEAL grout is packaged in 50-lb (22.7 kg) multiwall paper bags, containing 0.7 ft^3 (0.02 m^3).
EZ-MUD grout is packaged in 5-gal (19 liter) plastic containers. It is also available in cardboard cartons, which contain four 1-gal (3.8 liter) containers.

Availability

BENSEAL grout and EZ-MUD grout can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid Industrial Drilling Products
Product Service Line, Halliburton
3000 N. Sam Houston Pkwy E.
Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BENSEAL®**

Revision Date: 25-Mar-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BENSEAL®
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.025 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.025 mg/m^3	$\frac{10\ mg/m^3}{\%SiO2 + 2}$

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Personal Protective Equipment	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.6
Density @ 20 C (lbs./gallon):	62
Bulk Density @ 20 C (lbs/ft3):	63- 73
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).

EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2A Very Toxic Materials Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****