Attachment D-3:

Well Control Fluid Additives and

Material Safety Data Sheets

SS-25 and Porter 39A Relief Well Fluids and Fluid Additives

Date	Fluid Type	BBLS Pumped	Additive	Amount Added (lbs)	Additive	Amount Added (lbs)	Additive	Amount Added (lbs)	Additive	Amount Added (lbs)
10/24/2015	HEC Polymer Pill	60	GeoZan	360						
	KCL 3%	10	Kcl	106						
	Total BBLS	70								
11/13/2015	Polymer Pill	20	GeoZan	150	Amber Guard	50	CaCl 9.4	1,160		
	CaCl 9.4 ppg	696	CaCl	40,368						
	Total BBLS	716								
11/15/2015	Barite Pill 18 ppg	19	Barite	11,500	Desco	50	Caustic Soda	50	CaCl	1,102
	CaCl 9.4	220	CaCl	12,760						
	Total BBLS	239								
11/18/2015	Barite Pill 18 ppg	35	Barite	17,600	Desco	100	Caustic Soda	50	CaCl	2,030
	CaCl 9.4	185	Cacl	10730						
	Total BBLS	220								
11/24/2015	Polymer Pill	50	GeoZan	325						
	Barite Pill	35	Barite	17,600	Desco	50	Caustic Soda	50		
	Fresh Water	1006								
	Total BBLS	1091								
11/25/2015	Polymer Pill w/ LCM	150	GeoZan	900	Cacl	8,700	Nut Shell Fine	60	Nut Shell Med	60
			Saw Dust	60						
	CaCl 9.4	56	CaCl	3,248						
	Fresh Water	960								
	Total BBLS	1166								
12/22/2015	WBM 15 ppg	200	Gel	3,000	Barite	75,300				
	WBM 15 ppg /w LCM	125	Nut Shell	3750	DiaSeal-M	6,250				
	Total	325								
2/11/2016	Poly Tek+	1120	Kcl	11,872	GeoZan	840	DrisPac SL	2,240	Caustic Soda	1120
			PolyTek+	37,000	Amber Guard	550				
	Total BBLS	1120								

These are not exact volumes or materials used. This was calculated from all the Halliburton daily logs from all the pump jobs. Product and fluid discriptions are in the folder Product and fluid info

CANADIAN
Material Safety Data Sheet

DIASEAL M® LOST CIRCULATION MATERIAL

July 31, 1996

DRILLING SPECIALTIES COMPANY
Bartlesville, Oklahoma 74004

PHONE NUMBERS
Emergency: (918) 661-8118
Technical Services: (800) 221-1956
For Additional MSDSs: (918) 661-7354

A. Product Identification

Synonyms: LCM; Lost Circulation Material
Chemical Name: Mixture
Chemical Family: Mixture
Chemical Formula: Mixture
CAS Reg. No.: Mixture
Product No.: Not Established

Canadian Inventory Listing Status: DSL

All ingredients are listed in the Domestic Substances List (DSL) Impurities are exempt in accordance with Section 3 of the Canadian of Environmental Protection Act (CEPA).

B. Hazardous Components

Ingredients	CAS Number	% By Wt.	OSHA PEL	ACGIH TLV
Calcium hydroxide	1305-62-0	8	5 mg/m3	5 mg/m3
Diatomaceous earth may include,	61790-53-2	80	6 mg/m3	10 mg/m3
Crystalline silica (Quartz)	14808-60-7	< 1	0.1 mg/m3*	0.1 mg/m3*

* Respirable Dust

C. Personal Protection Information

Ventilation: Use adequate ventilation to control below recommended exposure levels.

Respiratory Protection: For concentrations exceeding the recommended exposure level, use NIOSH/MSHA approved respirator for protection against dusts and mists having an exposure limit measured as a time-weighted average not less than 0.05 mg/m3.

Eye Protection: Use chemical goggles.

Skin Protection: Use protective gloves for prolonged exposures.

NOTE: Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Do not get in eyes, on skin or on clothing. Do not breathe dust. Wash thoroughly after handling. Immediately remove and launder contaminated clothing before reuse. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Use only with adequate ventilation.

Store in closed container.

E. Reactivity Data

Stability:	Stable
Conditions to Avoid:	Not Applicable
Incompatibility (Materials to Avoid):	Fluorine, Oxygen difluoride, Chlorine Trifluoride, Hydrofluoric Acid
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid:	Not Applicable
Hazardous Decomposition Products:	Not Established

F. Health Hazard Data

Recommended Exposure Limits:

See Section B.

Acute Effects of Overexposure:

Eye: May cause severe irritation with prolonged contact.

Skin: May cause severe irritation with repeated or prolonged contact.

Inhalation: May cause irritation to the mucous membranes of the nose, throat and upper respiratory tract.

Ingestion: May cause irritation to the gastrointestinal tract.

Subchronic and Chronic Effects of Overexposure:

Inhalation of high dust concentrations of silicon dioxide over an extended number of years may produce fibrotic lung disease.

Chronic inhalation of dust containing crystalline silica may cause silicosis, a progressive pulmonary fibrosis which may be associated with significantly impaired pulmonary function, cardiopulmonary impairment and death. Symptoms may progress after dust exposure ceases. Silicosis typically results from silica dust exposure over many years.

Crystalline silica, a common component of sand, has been classified as probably carcinogenic for humans (2A) by the International Agency for Research on Cancer (IARC).

Other Health Effects:

No known applicable information.

Health Hazard Categories:

CLASS D: POISONOUS AND INFECTIOUS MATERIAL CATEGORIES

1. Materials Causing Immediate and Serious Toxic Effects

   A. Very Toxic _____
   B. Toxic _____

2. Materials Causing Other Toxic Effects

   A. Very Toxic

      1. Chronic Toxic Effects _____
      2. Teratogen/Embryo Toxin _____
      3. Carcinogen __X__ (Crystalline silica)
      4. Reproductive Toxin _____
      5. Respiratory Tract Sensitizer _____
      6. Mutagen _____

   B. Toxic

      1. Chronic Toxic Effects _____
      2. Skin or Eye Irritant __X__ (Calcium hydroxide)
      3. Skin Sensitizer _____
      4. Mutagen _____

   Specify: Eye irritant. Skin Irritant. Suspect Human Carcinogen. Known Animal Carcinogen. Lung Toxin.

   Other _____

First Aid and Emergency Procedures:

Eye: Immediately flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Skin: Immediately wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Inhalation: Immediately remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.

Ingestion: Give two glasses of water and induce vomiting, only if subject is conscious. Seek medical attention.

Note to Physician: Irrigation of the eye with a 0.01 to 0.05M (0.3 to 1.5%) EDTA solution at pH 4.6 to 7 may aid in loosening and dissolving any adherent calcium hydroxide particles. For

effective irrigation this procedure may require administration of a local anesthetic.

G. Physical Data

Appearance:	Light off-white coarse powder
Odor:	Mild (slight earthy)
Boiling Point:	Not Applicable
Vapor Pressure:	Not Applicable
Vapor Density (Air = 1):	Not Applicable
Solubility in Water:	Negligible
Specific Gravity (H2O = 1):	> 2
Percent Volatile by Volume:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Viscosity:	Not Applicable

H. Fire and Explosion Data

Flash Point (Method Used):	Not Applicable
Flammable Limits (% by Volume in Air):	LEL - Not Applicable UEL - Not Applicable
Fire Extinguishing Media:	Water, foam, dry chemical, carbon dioxide (CO2). Use media appropriate for surrounding fire.
Special Fire Fighting Procedures:	Evacuate area of all unnecessary personnel. Use NIOSH/MSHA approved self-contained breathing apparatus (SCBA) and other protective equipment and/or garments described in Section C if conditions warrant. Use water fog or spray to cool exposed containers and equipment.
Fire and Explosion Hazards:	Not Applicable.

I. Spill, Leak and Disposal Procedures

Precautions Required if Material is Released or Spilled:

Evacuate area of all unnecessary personnel. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Control dust levels. Vacuum spill. If sweeping is necessary, wet down spill or use sweeping compound.

Waste Disposal (Insure Conformity with all Applicable Disposal Regulations):

Place in an approved waste disposal facility.

J. DOT Transportation

Shipping Name:	Not Applicable
Hazard Class:	Not Applicable
ID Number:	Not Applicable
Packing Group:	Not Applicable
Marking:	Not Applicable
Label:	Not Applicable
Placard:	Not Applicable
Hazardous Substance/RQ:	Not Applicable
Shipping Description:	Not Applicable
Packaging References:	Not Applicable

K. RCRA Classification - Unadulterated Product as a Waste

Prior to disposal, consult your environmental contact to determine if TCLP (Toxicity Characteristic Leaching Procedure, EPA Test Method 1311) is required. Reference 40 CFR Part 261.

L. Protection Required for Work on Contaminated Equipment

Contact immediate supervisor for specific instructions before work is initiated. Wear protective equipment and/or garments described in Section C if conditions warrant.

M. Hazard Classification

Class D-Poisonous and Infectious Material
Division 2-Materials Causing Other Toxic Effects

N. Additional Comments

ENVIRONMENTAL TOXICITY:

Environmental effects testing has been conducted using Diaseal M® in a generic mud. The tests were conducted following the Environmental Protection Agency's (EPA), Region II drilling mud bioassay procedures.

The 96-hour LC50 for freshwater trout is >13,000 ppm. The 96-hour LC50 for saltwater stickleback is >5,600 ppm. The results of these tests classify Diaseal M® as a non-toxic drilling mud additive.

SARA 313

As of the preparation date, this product did not contain a chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

NFPA 704 Hazard Codes - - - - - - - - Signals

		Least - 0
Health	: 2	Slight - 1
Flammability	: 0	Moderate - 2
Reactivity	: 0	High - 3
Special Haz.	: -	Extreme - 4

REFERENCES

ACGIH	American Conference of Government Industrial Hygienists
ASTM	American Society of Testing and Materials
CFR	Code of Federal Regulations, U.S.

DOT	Department of Transportation, U.S.
EPA	Environmental Protection Agency, U.S.
IARC	International Agency for Research on Cancer
MSHA	Mine Safety and Health Administration, U.S.
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health, U.S.
NTP	National Toxicology Program, U.S.
OSHA	Occupational Safety and Health Administration, U.S.
RCRA	Resource Conservation and Recovery Act, U.S.
SARA	Superfund Amendments and Reauthorization Act, U.S.
TSCA	Toxic Substances Control Act, U.S.

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MATERIAL SAFETY DATA SHEET

MSDS No. 10048 **Trade Name:** NUT PLUG* **Revision Date:** 04/30/2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: NUT PLUG*

Chemical Family: Cellulose
Product Use: Drilling fluid additive. Lost circulation material.

Supplied by: M-I L.L.C.
P.O. Box 42842
Houston, TX 77242
www.miswaco.slb.com
Telephone Number: 281-561-1511
Emergency Telephone (24 hr.): 281-561-1600
Prepared by: Product Safety Group

Revision No. 8

HMIS Rating
Health: 1* **Flammability:** 1 **Physical Hazard:** 0 **PPE:** E

4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview: Caution! May cause mechanical irritation of eyes, skin and respiratory tract. Long term inhalation of particulates may cause lung damage. Cancer hazard. Contains crystalline silica which may cause cancer.

Canadian Classification:
UN PIN No: Not regulated. **WHMIS Class:** D2A

Physical State: Solid **Color:** Tan **Odor:** Mild (or faint)

Potential Health Effects:
Acute Effects
Eye Contact: May cause mechanical irritation
Skin Contact: May cause mechanical irritation. Long term contact can cause skin dryness.
Inhalation: May cause mechanical irritation.
Ingestion: May cause gastric distress, nausea and vomiting if ingested.

Carcinogenicity & Chronic Effects: See Section 11 - Toxicological Information.
Routes of Exposure: Eyes. Dermal (skin) contact. Inhalation.
Target Organs/Medical Conditions Respiratory System. Skin. Eyes.
Aggravated by Overexposure:

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
Cellulose	9004-34-6	99 - 100	No comments.
Silica, crystalline, quartz	14808-60-7	0.5 - 1.5	No comments.

Composition Comments: Component LD50 and LC50 values are provided in Section 11, if available.

4. FIRST AID MEASURES

Eye Contact: Promptly wash eyes with lots of water while lifting eye lids. Look for and remove contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

Skin Contact: Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if any discomfort continues.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.

General notes: Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C): NA
Flammable Limits in Air - Lower (%): ND
Flammable Limits in Air - Upper (%): ND
Autoignition Temperature: F (C): ND
Explosion Data - Sensitivity to Mechanical Impact: NA
Explosion Data - Sensitivity to Static Discharge: If applicable, information is provided in Section 5 Special Fire-Fighting Procedures, Other Flammable Properties and Section 6 Spill Procedures.
Flammability Class: NA
Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways.

Hazardous Combustion Products: Oxides of: Carbon.

Conditions of Flammability: Products are classified as flammable/combustible based on flash point as defined in the Health Canada Controlled Products Regulations, U.S. Occupational Health and Safety Administration Hazard Communication Standard and transportation regulations. See Sections 1, 2, 5, 14 and 15 for flammable/combustible classification information. Flammable/combustible materials may ignite and burn if exposed to a flame or other sources of ignition.
Other Flammable Properties: Particulate may accumulate static electricity. Dusts at sufficient concentrations can form explosive mixtures with air. Palleted bags of some fine cellulosic materials have been reported to smolder under certain conditions. See Section 7 Handling and Storage.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.

Spill Procedures: Evacuate the spill area with the exception of the spill response team. Wet product may create a slipping hazard. Contain spilled material. Do not allow spilled material to enter sewers, storm drains or surface waters. Avoid the generation of dust. Sweep, vacuum, or shovel and place into closable container for disposal.

Environmental Precautions: Waste must be disposed of in accordance with federal, state and local laws.

7. HANDLING AND STORAGE

Handling: Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Avoid generating or breathing dust. Product is slippery if wet. Use only in a well ventilated area. Wash thoroughly after handling.

Storage: Store in dry, well-ventilated area. Keep container closed. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.
Palleted bags of some fine cellulosic materials have been reported to smolder. To minimize the risk of smoldering: 1. Minimize fines in the product. 2. Minimize moisture. 3. If shrink wrapped: a. Minimize dust on bags as being stacked prior to shrink wrapping. b. Allow to sit for at least 24 hours before loading. Observe for smoldering. c. Practice care if heat gun is used to seal shrink wrap. Avoid generation of sparks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Cellulose	9004-34-6	99 - 100	10 mg/m^3	15 mg/m^3 (Total); 5 mg/m^3 (Respirable)	NA	None
Silica, crystalline, quartz	14808-60-7	0.5 - 1.5	0.025 mg/m^3	see Table Z-3	50 mg/m^3 IDLH (NIOSH)	(R)

Notes
(R) Respirable fraction.
Table Z-3: PEL for Mineral Dusts containing crystalline silica are 10 mg/m^3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite. 29 CFR 1910.1000.

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Eye/Face Protection: Dust resistant safety goggles.

Skin Protection: Wear appropriate clothing to prevent repeated or prolonged skin contact. Chemical resistant gloves recommended for prolonged or repeated contact. Use protective gloves made of: Neoprene. Nitrile.

Respiratory Protection: All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent.

If exposed to airborne particles of this product use at least a NIOSH-approved N95 half-mask disposable or re-useable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or re-useable particulate respirator.

General Hygiene Considerations: Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Tan
Odor:	Mild (or faint)
Physical State:	Solid
pH:	ND
Specific Gravity (H2O = 1):	1.4 - 1.65 at 68 F (20 C)
Bulk Density:	577-641
Solubility (Water):	Insoluble.
Melting/Freezing Point:	ND
Boiling Point:	ND
Vapor Pressure:	ND
Vapor Density (Air=1):	ND
Evaporation Rate:	ND
Octanol/Water Partition Coefficient:	ND
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame. See Section 7 also.
Materials to Avoid:	Oxidizers.
Conditions of Reactivity:	See Conditions and Materials to Avoid, if applicable.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.
Hazardous Polymerization	Will not occur

11. TOXICOLOGICAL INFORMATION

Acute Exposure Effects, Irritation and Sensitization: See Section 2.
Chronic, Carcinogenicity, Reproductive Toxicity, Teratogenicity, Embryotoxicity, Mutagenicity Effects: See Component Toxicological Summary and Product Toxicological Information, if available.
Synergistic Products/Effects: ND

Component Toxicological Data: Any adverse component toxicological effects and acute toxicity values (LD50s, LC50s) are listed below. If no effects or acute values are listed for components, no such data were identified.

Ingredient	CAS No.	Acute Data
Cellulose	9004-34-6	Oral LD50: >5000 mg/kg (rat); Dermal LD50: >2000 mg/kg (rabbit); Inhalation LC50: >5800 mg/m³/4H (rat)

Ingredient	Component Toxicological Summary
Cellulose	Long term inhalation exposure to this particulate may cause a benign pneumoconiosis (irritation caused by dust inhalation which may lead to fibrosis (formation of fibrous tissue)). (NIOSH, HazardText)
Silica, crystalline, quartz	Crystalline silica is the most widely occurring of all minerals. The most common form of silica is sand. The International Agency for Research on Cancer (IARC) has designated crystalline silica in the form of quartz or cristobalite a Group 1 (carcinogenic to humans). This designation was based on an increased risk of lung cancer among crystalline silica exposed workers. IARC did note that carcinogenicity of crystalline silica in humans was not detected in all industrial circumstances studied. Further, carcinogenicity of crystalline silica may be dependent on inherent characteristics of the crystalline silica or external factors affecting its biological activity or distribution of polymorphs. (IARC Vol. 68, 1997, p. 41). The National Toxicology Program (NTP) classifies crystalline silica as "reasonably anticipated to cause cancer in humans" (6th Annual Report on Carcinogens, 1991). Long term inhalation of crystalline silica can also result in the lung disease, silicosis. Symptoms of this disease include coughing and shortness of breath. (NJ HSFS, January 1996)

Product Toxicological Information: Long term inhalation of particulate can cause irritation, inflammation and/or permanent injury to the lungs. Illnesses such as pneumoconiosis ("dusty lung"), pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma may develop.

12. ECOLOGICAL INFORMATION

Component Ecotoxicity Data: No data available.

Product Ecotoxicity Data: Contact M-I Environmental Affairs Department for available product ecotoxicity data.
Biodegration: ND
Bioaccumulation: ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT
Shipping Description: Not regulated for transportation by DOT, TDG, IMDG, ICAO/IATA.

Canada TDG Shipping Description: Not regulated.
UN PIN No: Not regulated.
IMDG Shipping Description: Not regulated.
ICAO/IATA Shipping Description: Not regulated.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Delayed (chronic) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Silica, crystalline, quartz	—	—	—	X	—	—	—

State Comments: Proposition 65: This product contains chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 to cause cancer and/or reproductive toxicity. See table under U.S. Federal and State Regulations for the specific chemicals.

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Components are listed or exempt from listing.
European Union EINECS/ELINCS - Components are listed or exempt from listing.
Japan METI ENCS - Components are listed or exempt from listing.
Korea TCCL ECL - Components are listed or exempt from listing.
New Zealand - Components are listed or exempt from listing.
Philippine PICCS - Components are listed or exempt from listing.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: D2A

16. OTHER INFORMATION

The following sections have been revised: 1, 2, 4, 8, 15, 16. Format changes.

NA - Not Applicable, ND - Not Determined.

*A mark of M-I L.L.C.

Disclaimer:
MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user´s risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MI SWACO
A Schlumberger Company

MATERIAL SAFETY DATA SHEET

MSDS No. 12153 **Trade Name:** WATER BASED MUD (GENERIC) **Revision Date:** 03/16/2011

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: WATER BASED MUD (GENERIC)

Chemical Family: Mixture
Product Use: Drilling fluid system.

Supplied by: M-I L.L.C.
P.O. Box 42842
Houston, TX 77242
www.miswaco.slb.com
Telephone Number: 281-561-1512
Emergency Telephone (24 hr.): 281-561-1600
Prepared by: Product Safety Group

Revision No. 3

HMIS Rating
Health: 1* **Flammability:** 1 **Physical Hazard:** 0 **PPE:** J

4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview: Caution! May cause eye, skin, and respiratory tract irritation. Cancer hazard. Contains crystalline silica which may cause cancer.

Canadian Classification:
UN PIN No: Not regulated. **WHMIS Class:** D2A D2B

Physical State: Liquid **Color:** Tan to grey **Odor:** Mud

Potential Health Effects:
Acute Effects

Eye Contact: May be irritating to the eyes.
Skin Contact: May be irritating to the skin. Long term contact can cause skin dryness.
Inhalation: Not expected to be an inhalation hazard. Prolonged inhalation of vapors or mists, however, may cause irritation.
Ingestion: May cause gastric distress, nausea and vomiting if ingested.

Carcinogenicity & Chronic Effects: See Section 11 - Toxicological Information.
Routes of Exposure: Eyes. Dermal (skin) contact. Inhalation.
Target Organs/Medical Conditions Aggravated by Overexposure: Eyes. Skin. Respiratory System.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
Water	7732-18-5	30 - 60	No comments.
Barite	7727-43-7	10 - 30	No comments.
Bentonite	1302-78-9	10 - 30	No comments.
Sodium chloride	7647-14-5	5 - 10	No comments.
Silica, crystalline, quartz	14808-60-7	1 - 5	No comments.
Sodium hydroxide	1310-73-2	0.1 - 1	No comments.
Silica, crystalline, Tridymite	15468-32-3	0.1 - 1	No comments.

Composition Comments: Component LD50 and LC50 values are provided in Section 11, if available.

4. FIRST AID MEASURES

Eye Contact: Promptly wash eyes with lots of water while lifting eye lids. Look for and remove contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

Skin Contact: Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if any discomfort continues.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.

General notes: Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C): Not flammable
Flammable Limits in Air - Lower (%): NA
Flammable Limits in Air - Upper (%): NA
Autoignition Temperature: F (C): NA
Explosion Data - Sensitivity to Mechanical Impact: NA
Explosion Data - Sensitivity to Static Discharge: If applicable, information is provided in Section 5 Special Fire-Fighting Procedures, Other Flammable Properties and Section 6 Spill Procedures.
Flammability Class: Not flammable
Extinguishing Media: This material is not combustible. Use extinguishing media appropriate for surrounding fire.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways.

Hazardous Combustion Products: None known.

Conditions of Flammability: Products are classified as flammable/combustible based on flash point as defined in the Health Canada Controlled Products Regulations, U.S. Occupational Health and Safety Administration Hazard Communication Standard and transportation regulations. See Sections 1, 2, 5, 14 and 15 for flammable/combustible classification information. Flammable/combustible materials may ignite and burn if exposed to a flame or other sources of ignition.
Other Flammable Properties: ND

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.

Spill Procedures: Evacuate the spill area with the exception of the spill response team. Spilled product is very slippery. Contain spilled material. Do not allow spilled material to enter sewers, storm drains or surface waters. Absorb in vermiculite, dry sand or earth. Place into containers for disposal.

Environmental Precautions: Waste must be disposed of in accordance with federal, state and local laws.

7. HANDLING AND STORAGE

Handling: Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Avoid breathing vapors or spray mists. Use only in a well ventilated area. Wash thoroughly after handling.

Storage: Store in dry, well-ventilated area. Keep container closed. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Water	7732-18-5	30 - 60	NA	NA	NA	None
Barite	7727-43-7	10 - 30	10 mg/m^3	15 mg/m^3 (total); 5 mg/m^3 (resp)	NA	None
Bentonite	1302-78-9	10 - 30	NA	NA	NA	(1)
Sodium chloride	7647-14-5	5 - 10	NA	NA	NA	(1)
Silica, crystalline, quartz	14808-60-7	1 - 5	0.025 mg/m^3	see Table Z-3	50 mg/m^3 IDLH (NIOSH)	(R)
Sodium hydroxide	1310-73-2	0.1 - 1	2 mg/m^3 (ceiling)	2 mg/m^3	10 mg/m^3 IDLH (NIOSH)	None
Silica, crystalline, Tridymite	15468-32-3	0.1 - 1	0.05 mg/m^3	see Table Z-3	NA	(R)

Notes
(1) Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m^3 (Inhalable); 3 mg/m^3 (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m^3 (Total); 5 mg/m^3 (Respirable).
(R) Respirable fraction.
Table Z-3: PEL for Mineral Dusts containing crystalline silica are 10 mg/m^3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite. 29 CFR 1910.1000.

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazards present and the risk of exposure to those hazards. The PPE recommendations below are based on our assessment of the chemical hazards associated with this product. The risk of exposure and need for respiratory protection will vary from workplace to workplace and should be assessed by the user.

Eye/Face Protection:	Wear chemical safety goggles.
Skin Protection:	Wear appropriate clothing to prevent repeated or prolonged skin contact. Chemical resistant gloves recommended for prolonged or repeated contact. Use protective gloves made of: Neoprene. Nitrile.
Respiratory Protection:	All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent. If exposed to airborne particles of this product use at least a NIOSH-approved N95 half-mask disposable or re-useable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or re-useable particulate respirator.
General Hygiene Considerations:	Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Tan to grey
Odor:	Mud
Physical State:	Liquid
pH:	ND
Specific Gravity (H2O = 1):	ND
Solubility (Water):	Dispersible.
Flash Point: F (C):	Not flammable
Melting/Freezing Point:	ND
Boiling Point:	ND
Vapor Pressure:	ND
Vapor Density (Air=1):	ND
Evaporation Rate:	ND
Octanol/Water Partition Coefficient:	ND
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame.
Materials to Avoid:	Oxidizers.
Conditions of Reactivity:	See Conditions and Materials to Avoid, if applicable.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.

Hazardous Polymerization Will not occur

11. TOXICOLOGICAL INFORMATION

Acute Exposure Effects, Irritation and Sensitization: See Section 2.
Chronic, Carcinogenicity, Reproductive Toxicity, Teratogenicity, Embryotoxicity, Mutagenicity Effects: See Component Toxicological Summary and Product Toxicological Information, if available.
Synergistic Products/Effects: ND

Component Toxicological Data: Any adverse component toxicological effects and acute toxicity values (LD50s, LC50s) are listed below. If no effects or acute values are listed for components, no such data were identified.

Ingredient	CAS No.	Acute Data
Barite	7727-43-7	Oral LD50: 1400 mg/kg (rat)
Sodium chloride	7647-14-5	Oral LD50: 3 g/kg (rat); Dermal LD50: >10 g/kg (rabbit); Inhalation LC50: >42 g/m^3/1H (rat)
Sodium hydroxide	1310-73-2	Oral LDLo: 500 mg/kg (rabbit)

Ingredient	Component Toxicological Summary
Silica, crystalline, quartz	Crystalline silica is the most widely occurring of all minerals. The most common form of silica is sand. The International Agency for Research on Cancer (IARC) has designated crystalline silica in the form of quartz or cristobalite a Group 1 (carcinogenic to humans). This designation was based on an increased risk of lung cancer among crystalline silica exposed workers. IARC did note that carcinogenicity of crystalline silica in humans was not detected in all industrial circumstances studied. Further, carcinogenicity of crystalline silica may be dependent on inherent characteristics of the crystalline silica or external factors affecting its biological activity or distribution of polymorphs. (IARC Vol. 68, 1997, p. 41). The National Toxicology Program (NTP) classifies crystalline silica as "reasonably anticipated to cause cancer in humans" (6th Annual Report on Carcinogens, 1991). Long term inhalation of crystalline silica can also result in the lung disease, silicosis. Symptoms of this disease include coughing and shortness of breath. (NJ HSFS, January 1996)

Product Toxicological Information: No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

Component Ecotoxicity Data: No data available.

Ingredient	CAS No.	Data
Barite	7727-43-7	EC50 72H, 96H: 0.068 mg/l, 0.007 mg/l (Desmodesmus subspicatus); LC50 96H: 0.18 - 0.25 mg/l (Brachydanio rerio)
Sodium hydroxide	1310-73-2	LC50: 160 mg/l (goldfish) 24H, LC50 48H: 99 mg/l (bluegill sunfish), LC50 96H: 125 mg/l (mosquito fish), LC100 24H : 180 mg/l (carp), Lethal 48H : 100 mg/l (water flea), Lethal 48H: 700 mg/l (midge)

Product Ecotoxicity Data: Contact M-I Environmental Affairs Department for available product ecotoxicity data.
Biodegration: ND
Bioaccumulation: ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT
Shipping Description: Not regulated for transportation by DOT, TDG, IMDG, ICAO/IATA.
Canada TDG Shipping Description: Not regulated.
UN PIN No: Not regulated.
IMDG Shipping Description: Not regulated.
ICAO/IATA Shipping Description: Not regulated.
General Notes: The product is not covered by international regulation on the transport of dangerous goods (IMDG, IATA, ADR/RID). Water-based muds containing mixtures of prducts listed in Chapters 17 and 18 of the IBC Code and the latest MEPC.2/Circular and are permitted to be carried under Annex II of MARPOL and resolution A.673 (16) Offshore Supply Vessel Code.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Immediate (acute) health hazard. Delayed (chronic) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Silica, crystalline, quartz	---	---	---	X	---	---	---
Sodium hydroxide	---	---	1000 lb (454 kg)	---	---	---	---
Silica, crystalline, Tridymite	---	---	---	X	---	---	---

State Comments: Proposition 65: This product contains chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 to cause cancer and/or reproductive toxicity. See table under U.S. Federal and State Regulations for the specific chemicals.

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Contains a component that is not listed.
European Union EINECS/ELINCS - Contains a component(s) that is not listed.
Japan METI ENCS - Contains a component that is not listed.
Korea TCCL ECL - Contains a component that is not listed.
New Zealand - Contains a component that is not listed.
Philippine PICCS - Contains a component that is not listed.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: D2A D2B

16. OTHER INFORMATION

The following sections have been revised: 1, 4, 5, 6, 8, 9, 15, 16.

NA - Not Applicable, ND - Not Determined.

Disclaimer:
MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user´s risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

GEO Drilling Fluids, Inc.

Biocides/Corrosion Inhibitors

Amberguard 215

Description

AMBERGUARD 215 is a carbamate type biocide for use in drilling mud, completion fluids, and packer fluids.

Uses

In drilling fluids with the potential for biological growth, treatment with AMBERGUARD 215 will prevent problems. When biological growth occurs in fluids, the organisms can be killed with a treatment of AMBERGUARD 215. As a pretreatment the product is used in packer fluids that will be left in the hole for an extended period.

Benefits

AMBERGUARD 215 prevents or reduces the growth of organisms that interfere with the operation of drilling fluids. Organisms can consume organic polymers, rendering them useless which can cause viscosity problems and foaming. The malodorous byproduct of organisms in a drilling or completion fluid can make working on the mud pits difficult if not impossible. AMBERGUARD 215 prevents or eliminates these odors. AMBERGUARD 215 is a carbamate based biocide which is much more environmentally friendly than previous glutaraldehyde based biocides.

Treatment

A treatment level of 5 gallons per 100 bbls or 0.5 ppb is recommended for prevention of biological growth. This will provide 1000 to 1500 ppm in the system. For fluids with active colonies, the treatment must be increased by two to three times as much.

AMBERGUARD 215 can only kill the organisms it comes in contact with. Dead spots in a circulating system can harbor colonies of bacteria until the biocide has diluted and then reappear, contaminating the entire system again. Efforts should be made to stir up any dead spots.

Function

AMBERGUARD 215 kills aerobic and anaerobic infestations in drilling and completion fluids. Pretreatment will help to prevent the establishment of an infestation. Care should be taken not to use this product or other biocides when organic growth is desired, such as the use of H-Break 100, which depends on the multiplication of enzymes to work.

Drilling Fluids, Inc.

Biocide/Corrosion Inhibitor

Amberguard 215 (Continued)

Typical Physical Properties

Physical Appearance ....Yellow liquid.
Specific Gravity 1.064
Boiling Point.....>100°
pH 3.6
Freezing point 14ºF

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

AMBERGUARD 215 is packaged in 5-gallon plastic pails.

Bentonite-Diesel Oil (Gunk Squeeze) Continued

It is **important** that the gunk does not come up around the pipe. The drill pipe should be slowly reciprocated while the plug is being placed to avoid becoming stuck.

Barite Plug Guidelines - Introduction

If a formation breaks down during a well control operation or if lost returns causes a well kick, formation fluid can begin flowing into the annulus from the kick zone and into the zone of lost returns at an uncontrolled rate. This creates a well control situation which cannot be solved by conventional methods since the lost returns will not allow building the mud weight to the point required to shut off flow.

Usually, the first step in shutting off an underground flow is to spot a high density barite plug between the flowing and lost returns zones. The size of the plug that is spotted should be designed so that the resulting increase in hydrostatic pressure at the kick zone is large enough to shut off the flow and allow the barite to settle into a competent plug at the bottom of the hole. The settled plug will normally grow at a rate of one to three feet per hour. If the barite pill is spotted off bottom, the barite will settle below this point to a firm foundation which will stop further settling, usually the bottom of the hole. If the distance from where the pill is spotted to the bottom of the mole is too great, very little, if any, hard settled plug will result in a reasonable length of time.

Types of Barite Plugs

Types of barite plugs can be divided into two categories:

1. Balanced Plug - When the pressure or volume of flow is not too great, a balanced plug can be spotted on bottom and the drill string pulled up above it. The well can then be checked for flow. If it is dead, allow time for the barite to settle into a plug and then proceed with the operation of logging, running casing, etc. The risks of pulling out of a long plug or plug set to control an underground blowout are high. If the well is not dead, you are not in good position to immediately set another plug. In the case of an underground blowout, a noise log and temperature survey will probably be required to determine if the well is flowing.
2. "Barite-in" the Drill Collars - When the pressure or flow are excessive and when there is doubt that the first plug will hold, we do not want to pull up above the plug. In these cases, we elect to sacrifice the bottom-hole assembly rather than pull above the plug and risk being trapped off bottom with the well still flowing.

   In this case, the barite slurry is completely displaced from the drill string (over displace 3-5 bbl) and positive pressure maintained on the drill pipe so that the bit will not become plugged. In this manner, you are always prepared to set another plug in case the first one does not hold.

Composition

A barite slurry normally consists of barite, fresh water, chrome lignosulfonate, and caustic. The purpose of the lignosulfonate and caustic is to deflocculate the slurry so that high density slurries (20 to 22 lb./gal) can be mixed and pumped and to increase the barite settling rate. Some types of barite are more difficult to deflocculate than others and will require more lignosulfonate. However, a typical barite slurry will require about 4 lb./bbl of lignosulfonate at temperatures up to 300°F and 8 lb./bbl of lignosulfonate a temperatures above 300°F. Enough caustic should be used to obtain a pH of 10 to 11. About one pound of caustic to every eight pounds of lignosulfonate will usually be required. At temperatures less than 180°F, SAPP can be used instead of lignosulfonate except in some very contaminated barites (usually red barite). Approximately 0.5 lb./bbl of SAPP and o.25 lb./bbl caustic will be sufficient. The SAPP treated slurry has a much higher fluid loss than the lignosulfonate treated slurry, and may be preferred if the plug is to be spotted opposite a sand.

The density of the barite slurry to be used is not highly critical. First consideration should be given to obtaining a hydrostatic pressure sufficient to stop the flow into the annulus. Normally, a high density slurry (20-22 lb./gal) is preferred in order to achieve the necessary increase in hydrostatic pressure with a barite slurry column between

Composition
Continued

the kick and loss zones. Although the barite settling rates are slightly higher in lower density slurries, this is not as important as achieving a kill weight column of fluid in the annulus. Table I below shows the amount of barite necessary to build slurries of various densities.

TABLE I

Slurry Density lb/gal	Sacks Barite/ bbl of Final Slurry	Sacks Barite/ bbl of Water
19.0	5.88	9.79
19.5	6.16	10.58
20.0	6.43	11.42
20.5	6.71	12.32
21.0	6.96	13.29
21.5	7.26	14.32
22.0	7.53	15.44
22.5	7.81	16.64
23.0	8.06	17.94

A typical recipe for one barrel of 21 lb./gal barite slurry for use at temperatures less than 300°F is:

7.0 sacks of barite
0.525 barrels of water
4.0 pounds of Lignosulfonate (8 lb./bbl of water)
0.5 pounds of caustic (1 lb./bbl of water)

Mixing

When mixing barite slurries, it is necessary to use high energy jet mixing in order to dispense and wet the barite quickly. This must be done in order to achieve a smooth, minimum viscosity slurry and to attain the maximum desired density. The recirculating or low pressure mixers do not provide sufficient energy to allow mixing of high density barite slurries. The best mixer for this purpose is a Halliburton Twin-Jet mixer. (See Figures 2 and 3.) This mixer contains two replaceable jets. (See Figure 4.) The mix water should enter the jet hopper bowl at a pressure of 600-1000 psi in order to assure complete mixing of the barite. The mixing rate is set by the size of the jets that are used. Either No. 6 or No. 7 jets can be used. (See Figures 5 and 6.) Pressure-volume curves for various combinations of these two jets are shown in Figure 7. When mixing a 21 ppg barite slurry, the volume rate of the mixed slurry will be about twice the mix water pump rates shown on this figure. Assuming a 21 ppg barite slurry is being mixed at 600 psi jet pressure, the following appropriate mix rate will be attained with the various jet combinations:

Mixing
Continued

Jets	Barite Slurry bbl/min
2, No. 6	10
1, No. 6 & 1, No. 7	8
2, No. 7	6
1, No. 6 & Blank	5
1, No. 7 & Blank	3

By increasing the jet pressure, some increase in mixing rates will be achieved. This mixer also has a mix water by-pass line. The slurry density is controlled by adjusting the amount of water by-passed around the jets. This will also have an effect on mix rate.

If only a recirculating cementing unit is available, it can be converted to use a jet mixer by coming directly off the high-pressure pump through a line to a twin jet mixer set on the ground. This modification can be done quickly if the twin-jet mixer is available.

The mix water should be prepared before beginning the barite mixing operation. The lignosulfonate should be added to the water and mixed thoroughly, followed by the caustic. Approximately twice the concentration of lignosulfonate and caustic required in the final slurry should be added to the mix water. Mixing of the lignosulfonate is best accomplished by use of a hopper.

Mixing Continued	The barite slurry should be pumped through the by-pass line until the desired density and consistency are obtained. The density should be checked with a pressurized mud balance and monitored continually during the mixing operation.
Pumping and Displacement	Before beginning to mix the barite slurry, the equipment should be arranged similar to that shown in Figure 1. It is necessary to keep the barite slurry moving at all times so that plugging will not occur. The rig pump may be used to pump the slurry out of the drill string in case of a pump failure in the cementing unit. The barite slurry should be mixed and pumped as fast as is practical. The rate at which the service company can mix should be investigated before beginning the job. A positive pressure should be maintained at the cementing head at all times in order to prevent the barite slurry from falling away. A pressure gauge may be installed at the cementing head so that the pressure can be monitored at all times. When the barite slurry has been pumped into the drill pipe, it should be followed immediately by mud and displaced down the drill string. Provisions should be made to supply mud to the cementing unit at the required displacement rate. In an underground flow, the barite slurry must be pumped fast enough to minimize the mixing with the intruding fluid and the resulting reduction in slurry density.

Drilling Fluids, Inc.

Lost Circulation Material

Calcium Carbonate ($CaCO_3$)

Description

CALCIUM CARBONATE is used as a bridging agent and/or weighting material in oil base and water base drilling fluids, drill-in fluids, work over fluids, and completion fluids. CALCIUM CARBONATE comes in a wide variety of particle sizes ranging from 325 mesh (35 µ) to 30 mesh (550 µ). Custom sizing for particular applications is also available

Uses

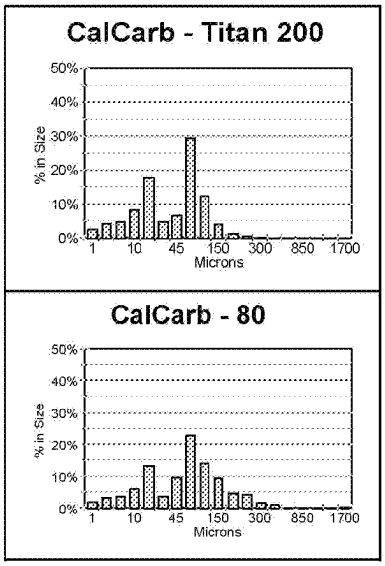
CALCIUM CARBONATE is used to prevent fluid invasion of permeable zones, and to prevent loss of circulation during drilling, workover, and completion activities. CALCIUM CARBONATE is applicable in all drilling fluids, aqueous and non-aqueous. It can be used to prepare a pill for spotting purposes.

CALCIUM CARBONATE is also used as an acid soluble weighting material for drill-in or workover fluids with a density of 14.0 ppg or less.

Benefits

CALCIUM CARBONATE is 98 to 99.5% soluble in 7.5-15% hydrochloric acid solution, thus minimizing permanent plugging of the producing formation. It is available in grades ranging from 325 mesh up 30 mesh to provide the particle sizes needed for effective bridging of the producing interval.

Particle Size Analysis



Mesh	Micron
400	35.56
75	190.80
60	250.00
50	300.00
40	425.00
30	600.00
20	850.00
14	1400.00
10	1700.00

Drilling Fluids, Inc.

Lost Circulation Material

Calcium Carbonate ($CaCO_3$) (Continued)

Treatment

CALCIUM CARBONATE concentrations of 5 to 10 ppb are usually sufficient as a bridging agent to prevent fluid loss in work over systems. Concentrations of 20 to 40 ppb are used in the preparation of LCM pills.

As a weighting agent, CALCIUM CARBONATE can be added to increase fluid densities up to 14.0 ppg. The weight up formula for CALCIUM CARBONATE is:

$$\text{Required lb/bbl of CALCIUM CARBONATE} = \frac{945\,(W_2 - W_1)}{22.5 - W_2}$$

Where:

W_1 = initial mud weight in ppg
W_2 = desired mud weight in ppg

Function

CALCIUM CARBONATE acts as a bridging agent like most solids but is used because of its acid soluble nature. As a weight material it is somewhat limited because of the low density, but this may be compensated for by the use of salt to increase the water phase density. In a water based system the pH of the drilling fluid needs to be above 7.0 since the CALCIUM CARBONATE is acid soluble. At a lower pH, it will begin to dissolve and contaminate the drilling fluid with calcium and will no longer be effective as a lost circulation material.

Typical Physical Properties

Appearance: .....white powder
Specific Gravity:.....2.7
Hygroscopic:.....no
pH in water: .....neutral
Bulk density: .....63 pcf

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

CALCIUM CARBONATE is packaged in 50 pound multiwall bags.

Drilling Fluids, Inc.

Commercial Chemical

CALCIUM CHLORIDE

Description

CALCIUM CHLORIDE ($CaCl_2$) forms a neutral salt solution in water. The product is available in powdered, granular, and flaked form and ranges in purity from 73 to 98% by weight. CALCIUM CHLORIDE is also available as a premixed liquid in various concentrations up to saturation.

Uses

CALCIUM CHLORIDE is used as an inhibitor to control active shale and clay dispersion. CALCIUM CHLORIDE can be used in polymer mud to minimize the formation of gas hydrates. CALCIUM CHLORIDE is used to retard the dissolution of massive salt sections and salt stringers. CALCIUM CHLORIDE can be used to balance the activity of the water phase in oil mud. CALCIUM CHLORIDE can be used as a weighting material up to 11.6 pounds per gallon plus additional weight/density can be obtained by using finely ground CALCIUM CHLORIDE in a saturated solution. In some applications, CALCIUM CHLORIDE is used as a bridging agent for lost circulation in saturated salt systems.

Benefits

In water-based fluids the high calcium and chloride content of CALCIUM CHLORIDE makes this a very inhibitive fluid. The density range of CALCIUM CHLORIDE makes it possible to use clear like brine up to 11.6 pounds per gallon with a very economical fluid.

In GEO MUL oil-based systems CALCIUM CHLORIDE is an effective means of providing high chloride ion concentration levels in the aqueous phase for balanced-activity mud systems for maximum shale stability.

Treatment

CALCIUM CHLORIDE is added to water to provide the desired specific gravity or chloride content. Drilling conditions and mud system requirements dictate concentration levels. CALCIUM CHLORIDE is soluble up to a density of 11.6 pounds per gallon in water. See chart on following page.

Drilling Fluids, Inc.

Commercial Chemical

CALCIUM CHLORIDE (Continued)

Function

CALCIUM CHLORIDE in water-based fluids can provide higher density at saturation than can be attained with either Sodium Chloride (NaCl) or Potassium Chloride (KCl). This product is an inexpensive alternative to the more expensive and environmentally undesirable Bromide Salts or Zinc Chloride.

Typical Physical Properties

Physical Appearance ....flaked, granular, powder, or liquid
Specific Gravity 2.15
Bulk Density .....51-60lb/ft^3
Hygroscopic: .....yes (extremely)
Solubility in water: .....192 pounds per barrel at 68°F
39.4% by weight

Safe Handling Recommendations

CALCIUM CHLORIDE is extremely hydroscopic and corrosive. Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Protect from moisture.

Transportation of CALCIUM CHLORIDE is not restricted by international or domestic regulatory agencies.

Packaging

CALCIUM CHLORIDE is packaged in 80 lb (36.3 kg) and 100 lb (45.4 kg) moisture-proof multi-wall bags. CALCIUM CHLORIDE is also sold as a liquid at a variety of densities.

Drilling Fluids, Inc.

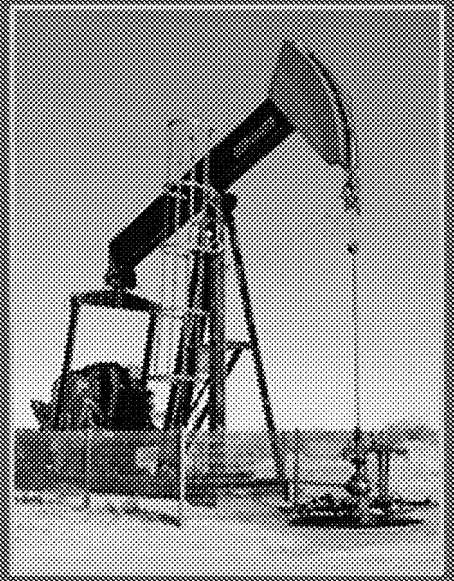
Commercial Chemical

Calcium Chloride (Continued)

Chlorides Chart
94%-97% $CaCL_2$l

$CaCl_2$ Concentration (% by weight)	Density (ppg)	$CaCl_2$ per finished barrel (ppb)	Percent Volume to Start	Ca+ (mg/l)	Cl- (mg/l)	$CaCl_2$ (mg/l)
0.90%	8.4	3	99.70%	5,485	3,100	8,585
2.20%	8.54	10.75	99.45%	14,403	8,141	22,544
3.60%	8.6	13	99.20%	23,569	13,322	36,891
4.60%	8.68	18.2	99.07%	30,070	16,996	47,066
5.50%	8.75	22.02	98.93%	36,780	20,789	57,569
6.50%	8.8	24	98.80%	43,487	24,580	68,067
7.40%	8.9	29.86	98.47%	50,132	28,336	78,467
8.30%	8.97	33.85	98.13%	56,770	32,088	88,858
9.30%	9	35	97.80%	63,543	35,916	99,459
11.90%	9.2	46	97.10%	82,352	46,548	128,901
14.70%	9.4	58	96.20%	103,379	58,433	161,812
16.00%	9.5	63.78	95.60%	114,636	64,796	179,431
17.40%	9.6	70	95.00%	126,246	71,358	197,604
19.70%	9.8	81	94.30%	145,589	82,291	227,880
22.40%	10	94	93.10%	168,366	95,166	263,532
24.70%	10.2	106	91.90%	189,294	106,995	296,289
27.00%	10.4	118	91.20%	210,188	118,805	328,993
29.20%	10.6	130	90.00%	231,093	130,621	361,714
30.30%	10.7	134.6	89.65%	243,521	137,646	381,168
31.30%	10.8	142	89.30%	256,342	144,892	401,234
33.30%	11	154	87.80%	277,537	156,873	434,410
35.50%	11.2	167	86.40%	300,724	169,979	470,703
37.60%	11.4	180	85.40%	323,912	183,085	506,998
39.40%	11.6	192	84.30%	345,400	195,231	540,632

Use of Calcium Carbonate as a Drilling Fluid Additive

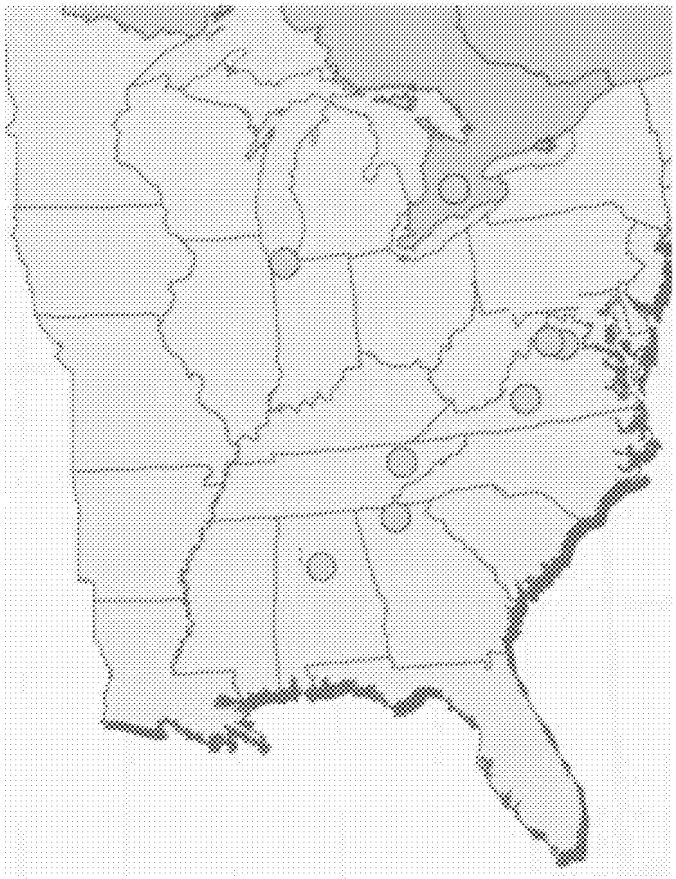


David Berg
Carmeuse Lime & Stone
June, 2013

CARMEUSE

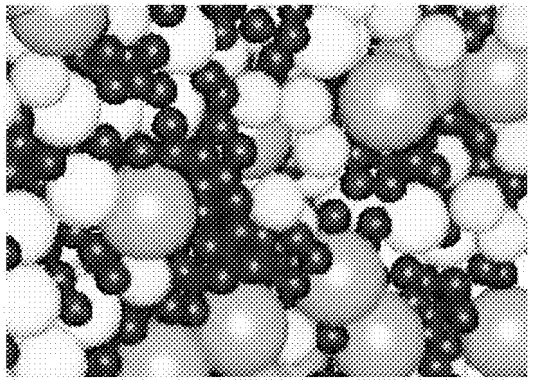
Who is Carmeuse?

- Largest lime (CaO) producer in North America
- Top 10 largest limestone ($CaCO_3$) producer in U.S.
- Eight pulverized/screen-grade limestone production sites in N.A.
- Oilfield Products Laboratory in Pittsburgh PA

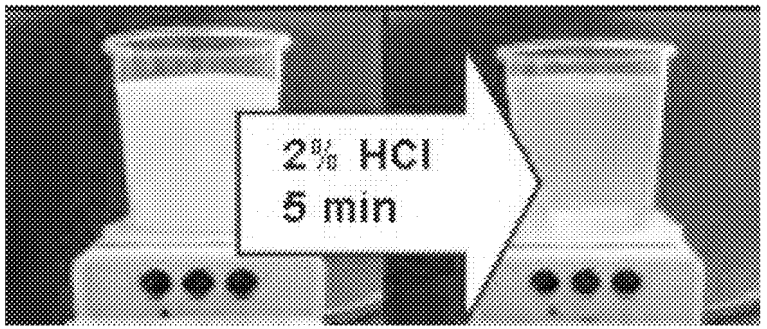


Calcium Carbonate **FAB Statement**

- Features
  - Limestone, marble
  - Milled or screened
  - Specific gravity (Rel. Density)
  - Particle size distribution…particle packing
  - Acid soluble
  - Readily available



- Advantages
  - Densifies drilling fluid
  - Controls circulation loss
  - Prevents formation damage



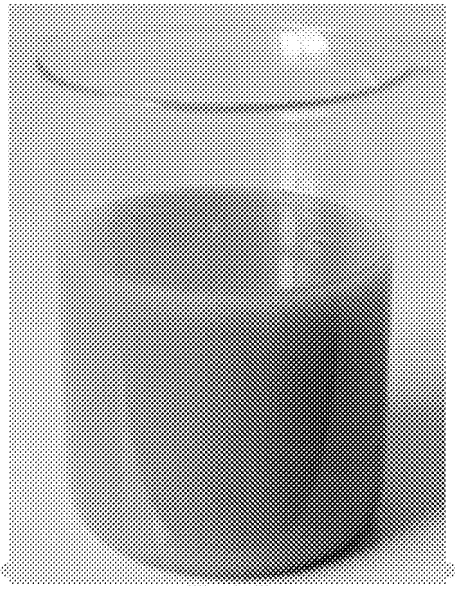
- Benefits
  - Safe
  - Cost effective
  - Versatile

CaCO3…Where it's Used?

	Drilling Fluids			Oilfield Cementing	
	Weighting Agent	Drill-in Fluid	Lost Circulation Material	Loss Circulation Material	Acid Soluble Cements
Calcium Carbonate	X	X	X	X	X

$CaCO_3$...How it's Used?

- Sold to service cos., then formulated (or blended on-site)
- Packaged (50 lb - 3000 lb)
- Purchased at corporate level
- Small portion of drilling fluid cost



Drilling Fluids

CARMEUSE

Drilling Fluids

- Drilling fluid, aka "mud," is added to the wellbore to facilitate drilling:
  - Suspend cuttings
  - Control pressure
  - Stabilize exposed rock
  - Provide casing buoyancy
  - Cool & lubricate
- Types:
  - Water
  - Oil
  - Synthetic oil-based
- Cost:
  - ~ 10% of the well drilling

Weighing Agent

- Used to increase density of drilling fluid:
  - finely divided solid
  - high specific gravity
- Fluid density required to:
  - Maintain borehole stability
  - Control formation pressures
  - Prevent penetration of formation fluids
  - Facilitate pulling dry pipe
- Calcium Carbonate:
  - Can be removed during well completion, minimizing formation damage

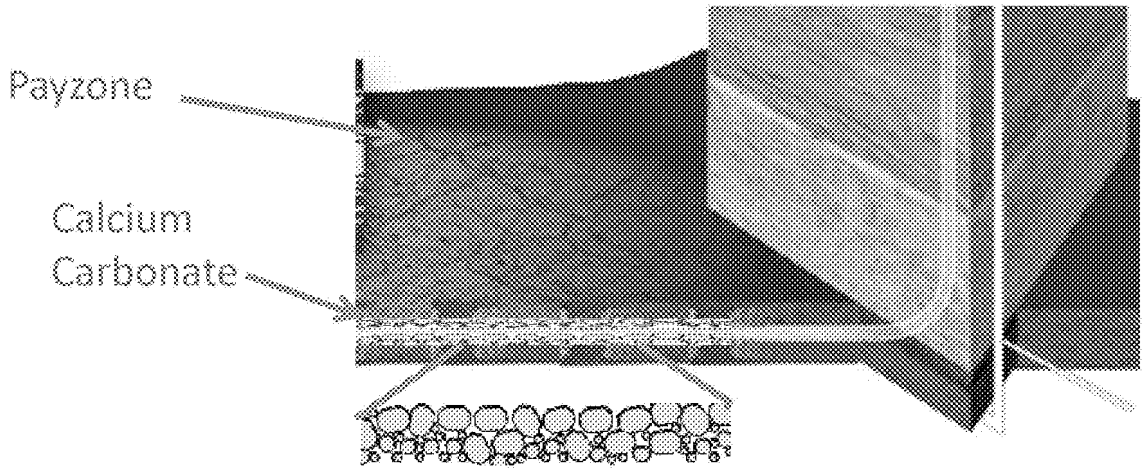
Weighting Agent

Mineral	Sp Gr	Mud Density	
CaCO3	2.7	Low	12 lb/gal
Barite	4.1	High	> 12 lb/gal

Shale Play	Average Depth, ft
Devonian	5,000
Marcellus	6,300
Barnett	8,000
Bakken	10,000
Woodford	11,500
Utica	13,000

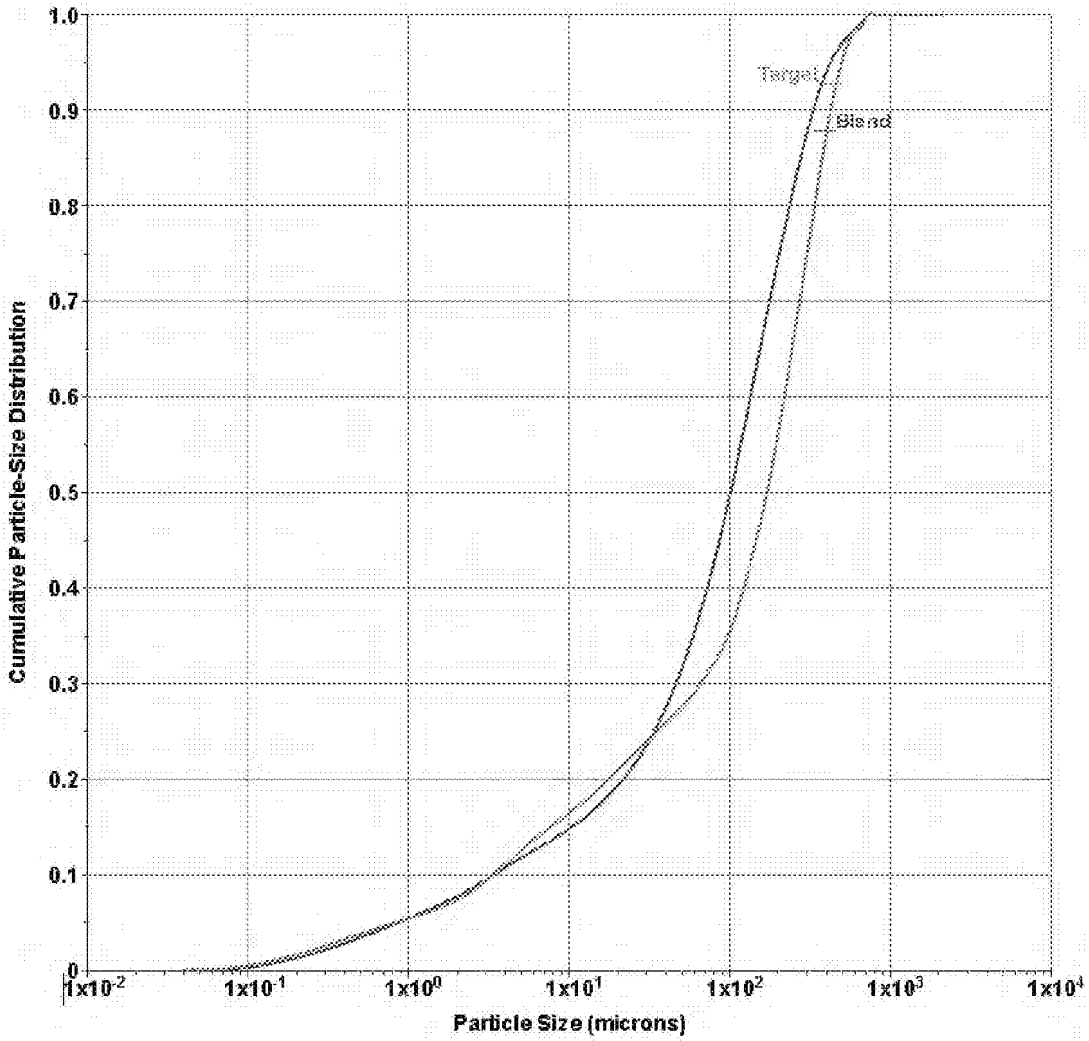
Drill-in Fluids

- Reservoir drilling fluid aka *"drill-in fluid"*...
  - Minimize formation damage when drilling into the "payzone"
  - **Calcium Carbonate** added to:
    - Form a "bridge" or "filter cake" over formation pores
    - Prevent migration of particles into the reservoir
  - Then remove with acid or chelant at a later stage



Source: M.I. Swaco

Optimum Bridging Agent Blend

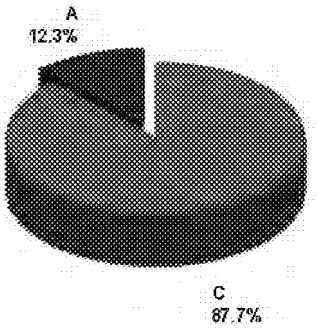


D10 - D50 - D90

D10 Target / Blend:	3.4	/	3.4	microns
D50 Target / Blend:	169.9	/	100.8	microns
D90 Target / Blend:	424.5	/	330.7	microns

Optimum Blend for 0 to 100 % CPS Range

Brand Name	Bridging Agent(kg/m³)	Vol %
A=MICARB 07-96	11.6	12.26
B=MICARB 160	0.0	0.00
C=MICARB 400	83.4	87.74



Simulation Accuracy

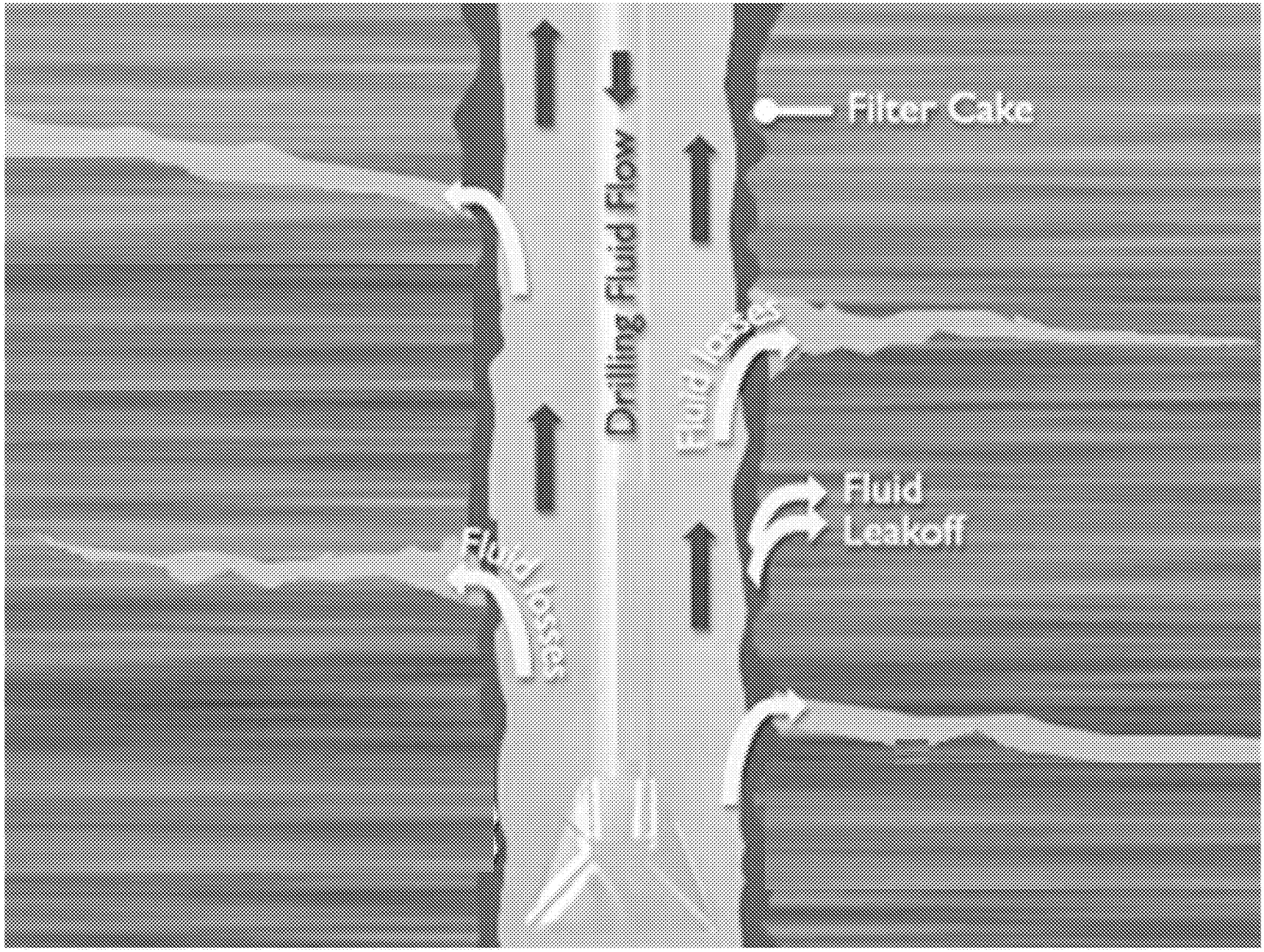
Calcium Carbonate added :	95	kg/m³
Avg Error 0 - 100 % CPS Range :	3.04	%
Max Error 0 - 100 % CPS Range :	18.70	%

AC_RWQCB_0001790

AC_CPUC_0130211

Lost Circulation Material (LCM)

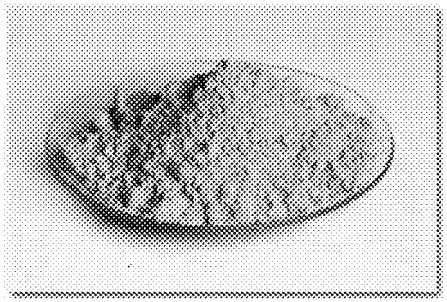
- Added to drilling fluid to prevent loss of fluid due to fractures in the formation
- OR as a "pill" treatment to seal fractures where significant losses have already occurred
- Forms:
  - Flake (mica)
  - Granular (DE, Calcium Carbonate)
  - Other (Gilsonite®)
  - Chemical (polymer thickening agents)
- Calcium Carbonate builds a filter cake at the entrance of the fracture to seal it up

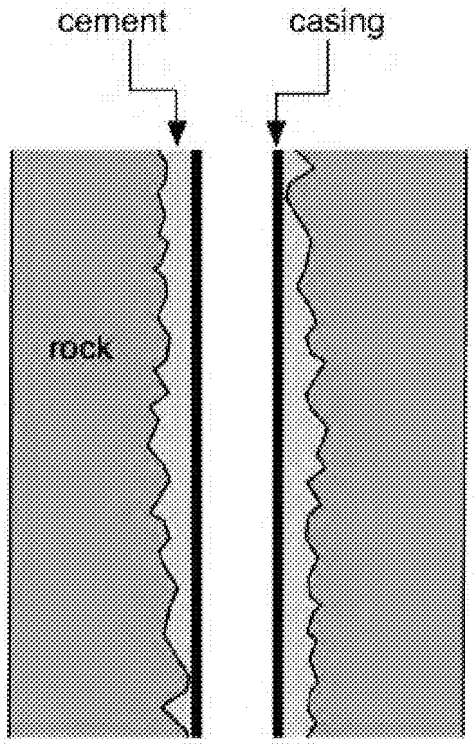


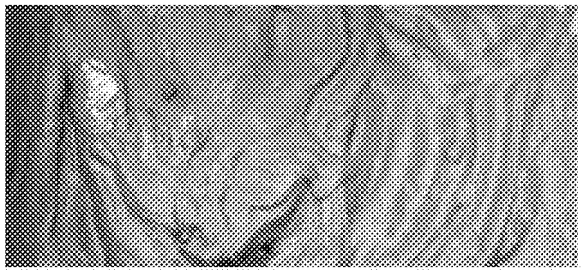
AC_RWQCB_0001792

AC_CPUC_0130213

Oil Well Cement







CARMEUSE

Oil Well Cement

- Cementing a well- pumping cement into place in a wellbore
  - Used to prepare for further drilling, production or abandonment
- Lost circulation addressed via *Calcium Carbonate*
  - Placement of a "pill" to seal the loss zones before cementing OR
  - Bridging/plugging agent into the cement slurry itself

Oil Well Cement

- Acid Soluble Cement (Shale Gas)
  - **Calcium Carbonate** ...component of cement
  - After frac'ing, broken cement pieces plug casing holes
  - Pump acid into casing to dissolve the cement ($CaCO_3$) pieces

Thank you!

Photos courtesy of:

Imerys
Oilfieldair.com
Osha.gov
tungsten-spheres.com
Leancrew.com
Chesapeake Energy

GEO Drilling Fluids, Inc.

Commercial Chemical

CAUSTIC SODA

Description

CAUSTIC SODA, sodium hydroxide (NaOH) is used primarily for pH and alkalinity control.

Uses

CAUSTIC SODA will minimize the solubility of calcium and magnesium contaminants in drilling muds. CAUSTIC SODA activates and solubilizes the organic dispersants such as Lignite, Lignosulfonate, and Desco. CAUSTIC SODA controls the pH and alkalinity properties of water-base muds to treat Carbon Dioxide (CO_2) contamination and assists in control of Hydrogen Sulfide (H_2S) contamination.

Benefits

CAUSTIC SODA is commonly used to control pH and alkalinity in water-base muds. CAUSTIC SODA is always added to solubilize and activate Lignite and Lignosulfonate. Increases pH without the addition of calcium (Lime) or carbonates (Soda Ash). May be used to adjust pH for fish-eye control in HEC.

Treatment

CAUSTIC SODA should be added as needed to control the pH and Pf alkalinity. The product should be added as a water solution from a chemical barrel. CAUSTIC SODA is a corrosive material and should be used with extreme caution. CAUSTIC SODA should not be mixed through the mud hopper. One sack should be added very slowly with careful agitation to 50 gallons of water in the chemical barrel. The solution can then be added to the mud system.

PH strips may be used to monitor the amount of CAUSTIC SODA to be added. For greater accuracy, an electronic pH meter is required.

Treating H_2S with CAUSTIC SODA is hazardous as the precipitate will dissolve into H_2S again when the pH drops.

Function

Increasing pH increases the solubility of many organic dispersants. Increasing pH reduces the solubility of Calcium and Magnessium. In the presence of Carbon Dioxide (CO_2) and free calcium CAUSTIC SODA converts the carbonates to Calcium Carbonate. If excess calcium is absent Lime should be used in place of or along with CAUSTIC SODA

Drilling Fluids, Inc.

Commercial Chemical

CAUSTIC SODA (Continued)

Typical Physical Properties

Physical Appearance: ...white, free-flowing beads, flakes, pellets, or clear liquid
Specific gravity: .....2.13 at 68°F
Bulk Density.....1.175g/ml
Hygroscopic.....Yes (strong)
pH: 14.0
Solubility in water:.....50% by weight at 68°F

Safe Handling Recommendations

International and domestic regulatory agencies classify CAUSTIC SODA as a corrosive material (UN 1823) for transportation.

CAUSTIC SODA is a very strong alkali and will cause severe burns. Read MSDS before use.

Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

CAUSTIC SODA is packaged in 50 lb plastic multi-wall bags.

Drilling Fluids, Inc.

Thinner

DESCO CF®

Description

DESCO CF® is a reddish-brown, tannin-type mud thinner designed to reduce the viscosity and gels of most water-base muds.

Uses

DESCO CF® is used as a viscosity reducer in water-based drilling fluids. It is particularly applicable in an elevated pH or high chloride environment. A profound effect on Yield Point and Gel strengths can be expected with its use. In addition fluid loss is reduced with the addition of DESCO CF®.
DESCO CF® is somewhat less effective in the presence of water phase contaminents.

Benefits

DESCO CF® is effective in drilling muds over awide pH range. It is readily soluble in water and may be used in conjunction with Lignites and Lignosulfonates to stabilize the flow of properties of water-base muds at elevated temperatures. Being a polyphenolic-type material, it also acts as a corrosion inhibitor by removing dissolved oxygen from the mud. DESCO CF® acts to thin freshwater, seawater, and brine water mud systems.

Treatment

DESCO CF® requires no caustic soda for activation of the product in the mud, but a pH of 9.0 to 11.0 is recommended. Depending on the mud type, DESCO CF ® can be used in concentrations from 0.1 ppb for native weight muds, and up to 2.0 ppb for weighted dispersed muds.

Function

DESCO CF® contains an organic polymer of moderate length. It is chemically enhanced to provide more charge sites for better dispersion.The charge sites are attravcted to mud solids that have opposite charges and satisfies those charges. This reduces the attraction of the particles for each other. Excess material in the electrolyte helps to repel solids from each other. Due to its small molecular size DESCO CF® may be adsorbed into the interlayer area of clays causing dispersion of larger clay particles.

www.geodf.com 1-800-GETS GEO

Drilling Fluids, Inc.

Thinner

DESCO CF (continued)

Typical Physical Properties

Physical Appearance.....reddish-brown powder
Specific Gravity.....1.5-1.7
Hygroscopic.....no
pH in water.....slightly alkaline

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

DESCO CF® is packaged in 25 lb multi-wall bags.

Drilling Fluids, Inc.

Fluid Loss Control

DRILLPAC SUPER LO

Description

DRILLPAC SUPER LO is a low-viscosity-grade polyanionic cellulosic polymer.

Uses

DRILLPAC SUPER LO controls the filtration rate of fresh and saltwater drilling fluids. Some degree of rheological control may be expected with moderate treatment levels. No increase in viscosity is produced, unlike regular or high viscosity versions.

Benefits

DRILLPAC LO is suitable for controling filtration in high chloride enviroments. It should be used to replace DMA when chlorides exceed 3,000 4,000 mg/l .DRILLPAC SUPER LO can control filtration of water-base drilling fluids without severe increases in the drilling fluid viscosity. DRILLPAC LV / DRILLPAC SUPER LO is somewhat resistant to the growth of microorganisms.

Treatment

Concentrations of DRILLPAC SUPER LO will vary with the filtration rate desired and overall salinity of the drilling fluid. Normally, a treatment level of 0.5 to 2.0 ppb will provide filtrate levels of 5-10 cc in most drilling fluids.

Function

DRILLPAC SUPER LO provide fluid loss control through polymer briging and encapsulation.

Typical Physical Properties

Physical Appearance.....	cream powder
Specific Gravity.....	
Bulk Density.....	
Hygroscopic.....	slightly
pH in water.....	7.0
Moisture as packaged.....	8% by weight

.

Drilling Fluids, Inc.

Fluid Loss Control

DRILLPAC SUPER LO (cont'd)

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

DRILLPAC SUPER LO is packaged in 50 pound multi-wall bags.

Drilling Fluids, Inc.

Viscosifier

GEO GEL

Description

GEO GEL is a premium-grade natural western bentonite meeting American Petroleum Institute (API) specifications for Bentonite.

Uses

GEO GEL is a sodium bentonite mined in Wyoming. GEO GEL provides viscosity, gel strengths, and filtration control properties in freshwater drilling fluids. The product can be extended to provide increased viscosity and gel properties by the addition of small concentrations of water-soluble polyacrylate polymers (BEN-EX). GEO GEL aids in reducing API filtrate and the high-temperature, high-pressure filtrate loss in water-base drilling fluids. GEO GEL develops the necessary viscosity and gels for suspension of BARITE and drill cuttings.

GEO GEL should be added through the mud hopper with good agitation. It is primarily for use in waters of low hardness (<200 mg/l) and low chloride levels. For maximum benefits in seawater muds, GEO GEL should be prehydrated in freshwater prior to its addition to the seawater.

GEO GEL is also used as a pond lining material, reducing percolation to acceptable levels at an affordable cost while providing a flexible barrier.

Benefits

GEO GEL is very cost effective for viscosity and basic filter cake deposition in fresh water drilling fluids. Being an inorganic material, GEO GEL is immune to biological attack.

Treatment

GEO GEL is used in spud mud at a rate of 18 to 22 ppb, depending on desired viscosity. Additional material should be added as needed to provide desired Yield Point and Gel Strengths.

Drilling Fluids, Inc.

GEO GEL (continued)

Viscosifier

Function

GEO GEL is a uniform and extremely high yielding clay of the Montmorillonite family. It breaks down in water to finely divided platelets that have positive charges from imbedded cations on the face and negative charges along the edges from broken bonds.

The shape and softness of the clay particles lends itself to fluid loss control. In a well stabilized liquid, one with deflocculants (DMA or OMNIPOL II) or dispersants (DESCO/DESCO CF, Lignite, or Lignosulfonate) the particles form a layered wall cake with minimal filtrate loss.

Typical Physical Properties

Physical Appearance.....tan powder
Specific Gravity.....
Bulk Density.....54 lb/ft³
Hygroscopic.....No
pH in water.....(3% solution) neutral
Density.....2.65

Safe Handling Recommendations

Discharges of drilling fluids containing Bentonite have been approved on a case-by-case basis by the United States Environmental Protection Agency (US EPA) for National Pollutant Discharge Elimination System (NPDES) permits environmentally sensitive areas.

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

GEL is packaged in 100 lb multi-wall bags.

Drilling Fluids, Inc.

Viscosifier

GEO ZAN

Description

GEO ZAN is a high molecular weight organic viscosifier. GEO ZAN is a clarified xanthan polymer.

Uses

GEO ZAN is a very efficient viscosifier. It works in most salt and fresh water systems. It should not be used in Calcium Chloride solutions exceeding 9.4 ppg (14% Calcium Chloride by weight). In muds contaminated by calcium or other divalent hardness cations the pH should be kept below 10.0 to prevent the precipitation of the GEO ZAN. In muds with a pH greater than 10.0 the hardness should be controlled less than 240 ppm. Simultaneous treatment with a biocide such as Ambergaurd 425 may be necessary to prevent the biological degradation of GEO ZAN. It can be used in clear brine fluids as the sole viscosifier to provide extremely high Low Rate Shear Viscosity (LSRV). In gel based mud GEO ZAN can be used to improve Yield Point for better hole cleaning without significantly increasing solids content.

Benefits

GEO ZAN develops extremely high LSRV, the factor most responsible for removal of drilled cuttings on the low side of the well, where fluid moves the slowest (*See Figure A Below*). GEO ZAN increases the yield point without increasing the plastic viscosity. GEO ZAN continues to work under salt and calcium contamination. GEO ZAN does minimal damage to producing formations and can be oxidized from the formation with SDIC, Lithium Hypochlorite, or Sodium Hypochlorite.

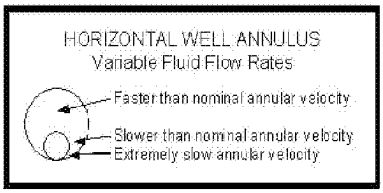


Figure A

Treatment

GEO ZAN is used in various concentrations ranging from 0.2 to 2.0 pounds per barrel. It should be mixed at 25 to 30 minutes per sack to minimize fish-eyes. GEO ZAN can be used in temperatures to 250°.

Drilling Fluids, Inc.

Viscosifier

GEO ZAN (Continued)

Function

GEO ZAN develops viscosity through the large molecular size and through molecule interaction. At high concentrations of over 1.5 ppb the molecules become entangled with each other increasing the viscosity.

Typical Physical Properties

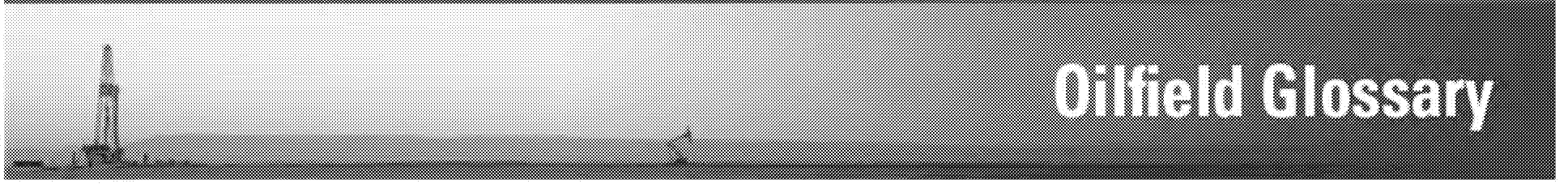
Physical appearance.....Tan free flowing powder
Specific Gravity.....1.5
Bulk Density..... lb/ft^3
pH in water.....Neutral

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

GEO ZAN is packaged in 25 lb multi-walled bags



Oilfield Glossary

Search for Term:

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Terms beginning with:
A B C D E F
G H I J K L M
N O P Q R S T
U V W X Y Z

polymer plug

English | Español

1. n. [Well Workover and Intervention]

A volume of polymer slurry placed in a wellbore, which, in time and under the correct temperature conditions, will develop to provide a high-viscosity platform on which a cement plug can be placed. Polymer plugs are typically used when a cement plug must be set accurately within the wellbore, The viscous material prevents the dense cement slurry from fingering through the lighter wellbore fluid during placement, helping to ensure that cement is placed over the desired interval.

Resource Links

Schlumberger Oilfield Services
Oilfield Review
Curve Mnemonic Dictionary
Schlumberger Excellence in Education

Drilling Fluids, Inc.

Specialty Product

POLYTEK+

Description

POLYTEK is the base product for the POLYTEK mud system. POLY-TEK is a high performance water base mud system designed to provide wellbore stability that approximates OBM conditions.

Uses

POLYTEK+ is used in situations where highly inhibited mud systems are necessary such as when drilling through unstable shale and clay formations. POLYTEK+ is fully compatible with most salt systems. This is particularly true of Potassium Chloride.

Benefits

POLYTEK+ prevents the swelling of clays and is resistant to cement, salt water, and CO_2 contamination. It also provides some fluid loss control and rheology stabilization.

Treatment

POLYTEK+ is added at 22 ppb for initial and all additional volume. A biocide treatment for initial and new volume may be necessary to prevent biodegradation.

Function

POLYTEK+ functions by limiting the absorption of water into the clay matrix through the interactions of a proprietary blend of physical and chemical reactions. By limiting water adsorption clays do not swell.

Typical Physical Properties

Appearance..... Grey and white multi sized particles
pH at 22 ppb in Water..... 9.0

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

POLYTEK+ is packaged in 50 pound multiwall bags.

GEO Drilling Fluids, Inc.

Commercial Chemical

POTASSIUM CHLORIDE

Description

POTASSIUM CHLORIDE (KCl) is also known as Potash or Muriate of Potash. The product combines potassium (K^+) and chlorides (Cl^-).

Uses

POTASSIUM CHLORIDE provides potassium ions to inhibit shale (clay) swelling and dispersion. POTASSIUM CHLORIDE is used to drill troublesome "gumbo" shales and "dirty" sands. In producing sands the potassium ion prevents the swelling of clays, which might inhibit production of hydrocarbons. POTASSIUM CHLORIDE is a very economical source of potassium ions.

Benefits

POTASSIUM CHLORIDE is used to obtain the potassium ion level needed to maximize the integrity of drill cuttings and to maintain borehole stability. 2% to 6% by weight are commonly used concentrations for drill-in and completion activities. When combined with SALT (sodium chloride or NaCl) for higher densities, it is important to monitor the potassium level to insure that there is twice as much K^+ as Na^+. This 2 to 1 ratio preserves the inhibitive properties of the potassium ion. An ion meter or Atomic Adsorption Unit is required to determine the relative concentration of K^+ and Na^+.

Treatment

POTASSIUM CHLORIDE is readably soluble and can be added through the mud hopper or if necessary directly to a well agitated drilling fluid system. Drilling conditions and system requirements will determine concentration needed. It is suggested that the potassium level be monitored by approved test methods, including the specific ion electrode technique, in order to determine the daily treatment levels to follow. Concentrations of potassium and chlorides should be compared to a Chlorides Chart. Mixing high concentrations of POTASSIUM CHLORIDE requires a smaller starting volume of water. Refer to GEO Drilling Fluids Chlorides Chart.

Drilling Fluids, Inc.

Commercial Chemical

POTASSIUM CHLORIDE (cont'd)

Typical Physical Properties

Appearance.....white to reddish brown crystals or granular
Hygroscopic.....yes
Specific gravity.....1.98
Solubility in water.....24%

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and an apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

POTASSIUM CHLORIDE is packaged in 50 pound multi-wall bags.

DATA FOR POTASSIUM CHLORIDE SOLUTION

KCl Concentration (% by weight)	Density (ppg)	KCl per finished barrel (ppb)	Percent Volume to Start	Cl- (mg/l)	K+ (mg/l)	KCl (Mg/l)
1%	8.39	3.50	99.46%	4,786	5,278	10,064
2%	8.44	7.07	99.08%	9,608	10,596	20,203
3%	8.50	10.67	98.69%	14,500	15,991	30,491
4%	8.55	14.35	98.29%	19,464	21,465	40,928
5%	8.60	18.03	97.88%	24,498	27,017	51,515
6%	8.66	21.77	97.47%	29,603	32,647	62,250
7%	8.71	25.55	97.04%	34,744	38,316	73,060
8%	8.77	29.40	96.60%	39,955	44,064	84,019
9%	8.82	33.29	96.16%	45,238	49,889	95,127
10%	8.88	37.21	95.70%	50,556	55,754	106,310
12%	8.99	45.23	94.76%	61,440	67,757	129,197
14%	9.11	53.46	93.78%	72,607	80,073	152,680
16%	9.22	61.86	92.77%	84,023	92,663	176,686
18%	9.34	70.47	91.71%	95,758	105,605	201,362
20%	9.46	79.33	90.62%	107,741	118,820	226,560
24%	9.70	97.63	88.33%	120,043	132,387	252,430

GEO Drilling Fluids, Inc.

Lost Circulation Material

SAWDUST

Description

SAWDUST is made of wood shavings from machining wood. Particle sizes in the SAWDUST package are distributed from very fine to coarse.

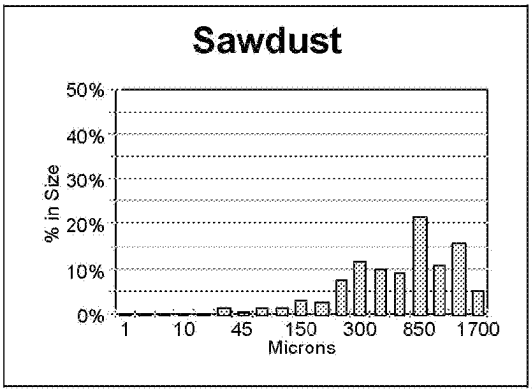
Uses

SAWDUST is used as a lost circulation material and as an absorbent for cleaning up spills in both water and oil based mud. Sawdust is often used as a lost circulation preventative. SAWDUST is a very absorbent material, so its use in oil base mud may be uneconomical.

Benefits

SAWDUST is a low cost non-reactive lost circulation material. SAWDUST is composed of various particle sizes which are useful in plugging a wide range of pore and fracture sizes.

Particle Size Analysis



Mesh	Micron
400	35.56
75	190.80
60	250.00
50	300.00
40	425.00
30	600.00
20	850.00
14	1400.00
10	1700.00

The data indicates a percent by weight and minimum particle size in microns for each sub-division.

Drilling Fluids, Inc.

Lost Circulation Material

SAWDUST (Continued)

Treatment

Mix SAWDUST through the hopper as needed to prevent or stop lost circulation. When treating lost circulation with only sawdust, 15 sacks per hundred barrels can be used. SAWDUST can also be used in conjunction with other lost circulation materials such as: PRIMA SEAL, ULTRA SEAL, and MAGMA FIBER.

Function

SAWDUST fills in cracks and pores in the formation retarding the flow of fluid into the formation. SAWDUST acts as a media to fill in fractures and prop the fracture open. Propping the fracture open will strengthen the well bore and reduce the likelihood of another fracture forming in the same location. The ability of wood to deform under pressure allows sawdust to successfully plug a wide range of pore and fracture sizes.

Typical Physical Properties

Appearance.....Wood shavings, light brown color
Specific Gravity .....0.45 - 0.65

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate respirator, gloves, goggles, and apron is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

SAWDUST is typically packaged in 3 cubic foot bags but may also be packaged in 6 cubic foot bags.

Drilling Fluids, Inc.

Lost Circulation Material

WALNUT HULLS

Description

WALNUT HULLS are dried and ground available in three grades (fine, medium, and coarse).

Uses

WALNUT HULLS, because of their high compressive strength, are the most resistant to breakdown and degradation of all lost circulation materials. As a lost circulation material WALNUT HULLS are especially adapted for plugging induced fractures. WALNUT HULLS are also used to reduce torgue and drag of drill pipe and drill collars, especially in high angle holes.

WALNUT HULLS are used as a sweep to scour the well bore and tools when sticking clay is a problem. Bit balling is often treated with this product.

Benefits

WALNUT HULLS provide a lost circulation material for plugging of fractures and high porosity formations. It is an important part of an LCM package.

More than 75% of the particles fall within the following size ranges for the three different grinds available:

- Fine 300 - 600 microns
- Medium 600 - 850 microns
- Coarse 850 - 1400 microns

In directional and horizontal drilling WALNUT HULLS can provide a means of reducing torque and drag.

As a sweep, WALNUT HULLS help clean the bit, tools, and well bore of sticky clays.

Treatment

WALNUT HULLS should be added to any mud type, in amounts indicated by the type of loss. 2-10 ppb is a recommended treatment level.

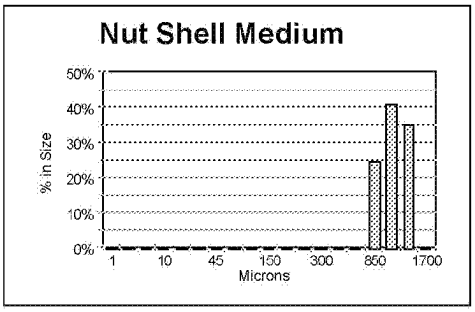
A slug of 5 to 10 sacks is used for reducing torque and drag. Larger sweeps may be required to effectively scour the tools and bit. A slug of 5 to 10 sacks can also be effective in reducing drag while tripping pipe and running casing.

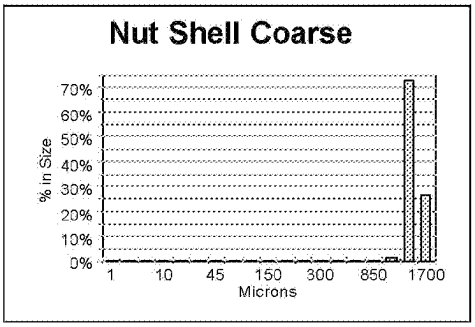
Drilling Fluids, Inc.

Lost Circulation Material

Particle Size Analysis

WALNUT HULLS (Continued)





Mesh	Micron
400	35.56
75	190.80
60	250.00
50	300.00
40	425.00
30	600.00
20	850.00
14	1400.00
10	1700.00

The data indicates a percent by weight and minimum particle size in microns for each sub-division.

Function

WALNUT HULLS provide a lost circulation material that is hard and somewhat spherical to provide throat plugging of fractures and high porosity formations. Used in conjunction with finer and more flexible fiber and plate type materials, it is an important part of a lost circulation material package.

In directional and horizontal drilling, WALNUT HULLS can provide a ball bearing effect because of their size, shape and hardness, reducing torque and drag.

As a sweep, WALNUT HULLS have a similar action to coarse sand, scouring the bit, tools, and well bore of sticky clays.

Drilling Fluids, Inc.

Lost Circulation Material

WALNUT HULLS (continued)

Typical Physical Properties

Appearance.....sized ground walnut hulls
Hygroscopic .....no
Specific Gravity 1.3

Safe Handling Recommendations

Utilize normal precautions for employee protection when handling chemical products. Use of appropriate equipment is recommended for employee comfort and protection. See Material Safety Data Sheet (MSDS) for this product prior to use.

Packaging

WALNUT HULLS are packaged in 50 pound multiwall bags.