

# PETCem<sup>®</sup> - Unconventional Density Cementing Technology

## 1. System Description and Benefits

PETCem technology is normally used when less than 1.5g/cm<sup>3</sup> (PETCem LD) or greater than 2.0g/cm<sup>3</sup> (PETCem HD) slurry density is required in oilwell cementing design.

Slurry properties are difficult to maintain under extreme conditions which requires ultra-low or high slurry densities. In slurry design with PETCem technology, pumpable and stable slurry is still maintained at very high density (2.6g/cm<sup>3</sup>), and rapid compressive strength development can also be obtained at very low density (1.2g/cm<sup>3</sup>). Therefore, PETCem technology extends application ranges of traditional cement systems to much higher levels.

Characteristics	Benefits
Low additive loading	Cost-effective and add extra benefits to conventional cement slurries
Reduction of fluid loss	
Resistant to chemical corrosion	
Stable and pumpable system in low and high slurry densities	Extends performance of regular cement systems to much higher levels
Wide range of slurry density	
Improvement of compressive strength development	

## 2. PETCem Additives

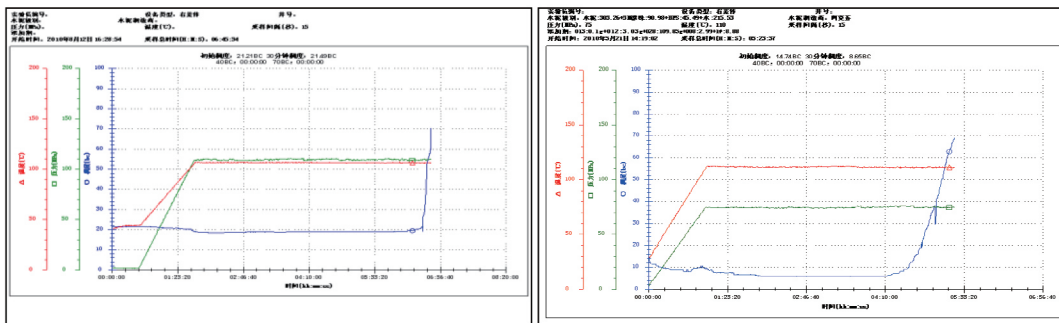
Product	Code	Form
High Density Coarse Particles	KCM019	Black Powder
Medium Density Coarse Particles	KCM020	Gray Particulates
Low Density Coarse Particles	KCM021	Gray Particulates
Multi-functional Extender	KCM029	Gray Particulates
Low Density Particles	KCM030A	White Particulates
	KCM030B	
	KCM030C	
	KCM030D	
Low Density Particles	KCM031	Gray Particulates
Micro Silica	KCM032	Gray Powder
Silica Fume	KCM033	Gray Powder

## 3. Typical Properties and Field Applications

PETCem technology was commercialized in 2011 successfully and has been applied in various oil and gas fields in the world. It has been proved to be effective in cementing oil or gas wells with the following conditions and properties:

Temperature: BHST 150-375°F (65-190°C)  
 Density: 8.0 ppg to 21.5 ppg (0.95 – 2.60 g/cm<sup>3</sup>)  
 Mix-water: Fresh water, brines (up to 18%)  
 API fluid loss: Less than 50 mL  
 Rheology: PV: 50-200 cP, YP: 5-30 lbs/100ft<sup>2</sup>

Further information about field jobs is described in documented “Case History of PETCem Technology”. Typical thickening curves of PETCem slurries are shown in the following Figures.



Density: 2.45 g/cm<sup>3</sup>

Density: 1.30 g/cm<sup>3</sup>

**PETCem Design in Flow-off Applications for H<sub>2</sub>S Sour Gas Wells**

## 4. Precautions and HSE Considerations

Coarse (KCM019, KCM020, KCM021, KCM030, KCM031), medium (cement, KCM032) and fine particles (KCM029, KCM033) are generally used in PETCem systems to design cement slurries at low or high densities. They are generally inert particulates which is compatible with other additives such as fluid loss agent, retarder, dispersant in PETCem systems.

The laboratory procedures, quality assurance program and guidelines for field mixing and handling of PETCem systems are described in PETCem fluid manual.

Refer to the technical sheet and SDS of the respective product for the health, safety and environmental information of each product.

# High Density Coarse Particles KCM019

## 1. Introduction

High pore pressure, unstable wellbores and deformable or plastic formations are controlled by high hydrostatic pressures, under such conditions, high density drilling fluid are required to maintain control of such wells, the equal or greater density of cement slurry are also required during the operation of cement placement.

Simply reducing the amount of mix water will increase the slurry density, but it would difficult to maintain mixing and pumpability, adequate fluid loss control, and acceptable slurry rheology and no solid settling. Therefore, when higher density is required, materials with high specific gravity are added with compatible particle size distribution with cement, lower mix water requirement, the material must be inert with respect to cement hydration and compatible

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM019	Black powder	4.80-5.20	Insoluble	>93	None	None	N/A

## 3. Chemical Properties and Application

KCM019 is an inert iron oxide mineral with high specific gravity, it greatly increases slurry density without adversely affecting the properties of cement system. KCM019 is finely disperse material which absorbs very little water.

The thickening time with KCM019 will vary depending upon the well condition and amount of KCM019 required; therefore, thickening time must be individually tested in the laboratory with actual material used.

Except large amount of KCM019 is used, there will be a little effect on the compressive strengths of various cement system. The slurry with higher concentration of KCM019 will have lower compressive strength than the reduced water slurries.

## 4. Treatment

KCM019 is normally used to prepare the cement slurry with densities up to 2.28g/cm<sup>3</sup> (19.0lb/gal), the concentration up to 100%BWOC.

## 5. Packaging

KCM019 is supplied in plastic-lining bags with net weight of 25kg/sack. It should be stored in shaded areas with good ventilation. Keep it away from high temperature, humidity and direct sunlight.

# Medium Density Coarse Particles KCM020

## 1. Introduction

Conventional high density cement slurries are prepared by adding regular weighting agents such as hematite or barite, reducing the amount of cement and water by adding dispersant to maintain slurry system pumpability. For high density cement slurries (more than 1.89 g/cc), the compressive strength is hard to achieve if there is not enough cement in the slurries.

Medium density particles KCM020 is specifically designed in PETCem cement systems to prepare high density (1.89 to 2.10 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM020	Gray particles	2.59-2.79	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM020 is medium density inorganic particulates that can be added into cement systems to increase slurry density. Engineeringly-designed particle size of KCM020 allows more cement and less water to be added into cement slurries so that high density is achieved while maintaining cement slurry pumpability.

Theoretically KCM020 can be used at any applicable cementing temperatures and densities due to its chemical and physical natures.

KCM020 is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM020 required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM020 is supplied in 25kg plastic-lining sacks.

# Low Density Coarse Particles KCM021

## 1. Introduction

Conventional low density cement slurries are prepared by adding regular light weight extenders such as bentonite and sand to reduce the amount of cement and water required in cement slurry. However, it is hard to design cement slurries if density is very low (less than 1.5 g/cc) since excess free water will be observed and the required compressive strength is hard to achieve.

Low density particles KCM021 is specifically designed in PETCem-LD cement systems in order to prepare low density (1.00-1.50 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM021	Gray particulates	0.68-0.88	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM021 is low density (0.7-0.8 g/cc) inorganic particulates that can be added into cement systems to reduce slurry density. Engineeringly-designed KCM021 allows more cement and less water to be added into cement slurries so that low density is achieved while maintaining compressive strength and slurry rheological properties.

KCM021 can be used at applicable cementing temperature (up to 250°C), however it should not be used if working pressure is greater than 4000psi.

Follow special procedures while mixing cement slurries containing KCM021 both in laboratory and in the field.

KCM021 is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM021 required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM021 is supplied in 25kg plastic-lining sacks.

# Multi-functional Extender KCM029

## 1. Introduction

Addition of conventional cement extenders into low-density cement slurries causes poor compressive strength development and high permeability of cement. Addition of KCM029 not only reduces slurry density but also improves compressive strength development and decreases permeability of set-cement.

Further density reduction is obtained if KCM029 is properly added into PETCem-LD cement systems.

## 2. Physical Properties and Hazards

Additive	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM029	Gray particulates	2.89-3.09	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM029 is fine inorganic particulates that can be added into cement systems to reduce slurry density. More water can be added into cement slurry while maintaining stability and good compressive strength development because of high surface area of KCM029 particles. Further slurry density reduction can be achieved if controlled-size KCM029 is added into low density cement slurries.

Experimental results indicate that KCM029 improves cement resistance to chemical corruptions significantly due to chemical and physical nature of KCM029.

Theoretically KCM029 can be used at any applicable cementing temperature and hydrostatic pressure.

KCM029 is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Typically, 5-20% BWOC is good enough in designing slurries containing KCM029. However, special job designing tool is available to calculate the amount of KCM029 required for PETCem system design. Please contact field engineers for advice.

## 5. Packaging

KCM029 is supplied in 25kg plastic-lining sacks.

# Low Density Particles KCM030A

## 1. Introduction

Conventional low density cement slurries are prepared by adding regular light weight extenders such as bentonite and sand to reduce the amount of cement and water required in cement slurry. However it is hard to design cement slurries if density is very low (less than 1.5 g/cc) since excess free water will be observed and the required compressive strength is hard to achieve.

Low density particles KCM030A is specifically designed in PETCem-LD cement systems in order to prepare low density (1.00- 1.50 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM030A	White particulates	0.45-0.65	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM030A is low density (0.45-0.65 g/cc) inorganic particulates that can be added into cement systems to reduce slurry density. It allows more cement and less water to be added into cement slurries so that low density is achieved while maintaining compressive strength and slurry rheological properties.

KCM030A can be used at any applicable cementing temperature, and up to 7971psi hydrostatic pressure.

KCM030A is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM030A required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM030A is supplied in 25kg plastic-lining sacks.

# Low Density Particles KCM030B

## 1. Introduction

Conventional low density cement slurries are prepared by adding regular light weight extenders such as bentonite and sand to reduce the amount of cement and water required in cement slurry. However, it is hard to design cement slurries if density is very low (less than 1.5 g/cc) since excess free water will be observed and the required compressive strength is hard to achieve.

Low density particles KCM030B is specifically designed in PETCem-LD cement systems in order to prepare low density (1.00- 1.50 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM030B	White particulates	0.40-0.60	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM030B is low density (0.40-0.60 g/cc) inorganic particulates that can be added into cement systems to reduce slurry density. It allows more cement and less water to be added into cement slurries so that low density is achieved while maintaining compressive strength and slurry rheological properties.

KCM030B can be used at any applicable cementing temperature, and up to 5797psi hydrostatic pressure.

KCM030B is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM030B required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM030B is supplied in 25kg plastic-lining sacks.



# Low Density Particles KCM030C

## 1. Introduction

Conventional low density cement slurries are prepared by adding regular light weight extenders such as bentonite and sand to reduce the amount of cement and water required in cement slurry. However, it is hard to design cement slurries if density is very low (less than 1.5 g/cc) since excess free water will be observed and the required compressive strength is hard to achieve.

Low density particles KCM030C is specifically designed in PETCem-LD cement systems in order to prepare low density (1.00- 1.50 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM030C	White particulates	0.50-0.70	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM030C is low density (0.50-0.70 g/cc) inorganic particulates that can be added into cement systems to reduce slurry density. It allows more cement and less water to be added into cement slurries so that low density is achieved while maintaining compressive strength and slurry rheological properties.

KCM030C can be used at any applicable cementing temperature, and up to 10000psi hydrostatic pressure.

KCM030C is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM030C required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM030C is supplied in 25kg plastic-lining sacks.

# Low Density Particles KCM030D

## 1. Introduction

Conventional low density cement slurries are prepared by adding regular light weight extenders such as bentonite and sand to reduce the amount of cement and water required in cement slurry. However, it is hard to design cement slurries if density is very low (less than 1.5 g/cc) since excess free water will be observed and the required compressive strength is hard to achieve.

Low density particles KCM030D is specifically designed in PETCem-LD cement systems in order to prepare low density (1.00- 1.50 g/cc) cement slurries.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM030D	White particulates	0.50-0.70	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM030D is low density (0.50-0.70 g/cc) inorganic particulates that can be added into cement systems to reduce slurry density. It allows more cement and less water to be added into cement slurries so that low density is achieved while maintaining compressive strength and slurry rheological properties.

KCM030D can be used at any applicable cementing temperature, and up to 17971psi hydrostatic pressure.

KCM030D is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Job designing tool is available to calculate amount of KCM030D required in cement slurry. Please contact field engineers for advice.

## 5. Packaging

KCM030D is supplied in 25kg plastic-lining sacks.

# Micro Silica KCM032

## 1. Introduction

Medium density extender KCM032 is one of the medium density extenders conventionally used for preparing low density cement slurries. Addition of KCM032 will reduce the amount of cement and increase the amount of water required in cement slurry so that slurry density is decreased.

Further density reduction is obtained if KCM032 is properly added into PETCem-LD cement systems.

## 2. Physical Properties and Hazards

Additive	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM032	Gray powder	2.48-2.68	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM032 is fine inorganic particulates that can be added into cement systems to reduce slurry density. More water can be added into cement slurries while maintaining stable slurry and good fluid loss control of cement slurry because of high surface area properties of KCM032 particles.

Further slurry density reduction can be achieved if controlled-size KCM032 is added into low density cement slurries while maintaining proper compressive strength development and slurry rheological properties.

KCM032 can also be used at high temperature cement slurries to prevent cement strength retrogression problems. Theoretically KCM032 can be used at any applicable cementing temperature and hydrostatic pressure.

KCM032 is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Typically, 5-20% BWOC is good enough in designing slurries containing KCM032. However, special job designing tool is available to calculate amount of KCM032 required for PETCem system design. Please contact field engineers for advice.

## 5. Packaging

KCM032 is supplied in 25kg plastic-lining sacks.

# Silica Fume KCM033

## 1. Introduction

Light weight extender KCM033 is one of the light weight extenders conventionally used for preparing low density cement slurries. Addition of KCM033 will reduce the amount of cement and increase the amount of water required in cement slurry so that slurry density is decreased.

Further density reduction is obtained if KCM033 is properly added into PETCem-LD cement systems.

## 2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Melting/Flash Point (°C)	Health Hazard	Physical Hazard	pH
KCM033	Gray powder	2.36-2.56	Insoluble	>93	Eyes, inhalation	Dust	N/A

## 3. Chemical Properties and Application

KCM033 is fine inorganic particulates that can be added into cement systems to reduce slurry density. More water can be added into cement slurries while maintaining stable slurry and early compressive strength development because KCM033 is a reactive cement extender. Generally, KCM033 is used at low temperature range (less than 200°F) since it is too reactive at high temperature. Light weight extender KCM033 is used for preparation of cement slurry in density range of 1.3 to 1.6 g/cc. Caution should be taken while adding higher concentration (greater than 10%BWOC) of KCM033 since it increases fluid loss and viscosity of cement slurry.

KCM033 is compatible with most cement additives and can be used in fresh, salt and seawater cement slurries.

## 4. Treatment

Typically, 5-15% BWOC is good enough in designing slurries containing KCM033. However special job designing tool is available to calculate amount of KCM033 required for PETCem system design. Please contact field engineers for advice.

## 5. Packaging

KCM033 is supplied in 25kg plastic-lining sacks.