Clay Stabilizer KHF002

1. Introduction

The clay stabilizer KHF002 is used to prepare the salt water for mixing fracturing fluids. The additive can also stabilize the clays in the formation during fracturing and flowback operations.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF002	White crystals	1.88-2.08	Soluble	Eyes, skin	None	6.0-8.0 (2 wt.%)

3. Chemical Properties and Application

KHF002 is an inorganic salt. The cations presented in KHF002 aqueous solution will inhibit swelling and dispersing of reactive clays in most sandstone formations.
KHF002 can be used for wide temperature ranges because of its inorganic nature.
KHF002 is compatible with most additives used in guar-based fracturing fluids.

4. Treatment

1-6 wt.% of KHF002 is generally used to prepare the salt water in mixing fracturing fluids.

5. Packaging

KHF002 is supplied in plastic-lined bags with net weight of 25 kg/bag. It should be stored in shaded areas with good ventilation.

Clay Stabilizer KHF002C

1. Introduction

Clay stabilizers are routinely added to aqueous-based fracturing fluids to help prevent damage to the formation caused by clay migration and swelling. These clay stabilizers are either a temporary or permanent type, and they are often used in combination.

The clay stabilizer KHF002C is a KCl substitute and can be used with Guar, HPG, CMHPG and Friction Reducer-based frac fluids. KHF002C is a temporary clay stabilizer that helps to prevent clay particles from swelling and plugging of reactive clays in water-sensitive formations during fracturing and flowback operations.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF002C	Colorless liquid	1.02-1.07	Soluble	Moderate-Eyes	None	6.5-8.0

3. Chemical Properties and Application

Temporary Clay Stabilizer KHF002C is an organic liquid clay stabilizer. It is NOT a solution of KCl, but it can be substituted for KCl in most oilfield applications.

KHF002C has been used at temperatures up to 350°F without any adverse effect on fluid rheology.

KHF002C can be batch mixed, or continuously mixed into the fracturing fluid using a liquid-additive system. This eliminates the time-consuming step of batch mixing dry KCl in the base fluid. KHF002C can be used in most aqueous-based fracturing fluids and is compatible with most additives used in the fracturing fluid systems.

KHF002C is highly recommended for systems that are sensitive to high salt concentrations.

4. Treatment

The recommended KHF002C concentration is 0.5 to 2 Gal/1,000 Gal (0.5 to 2 L/m^3). For specific formations such as high reactive clay content, the KHF002C concentration can be further optimized using laboratory core tests.

5. Packaging

KHF002C is supplied in 55 gallons high density polyethylene (HDPE) drums or 265 gallons HDPE totes. Keep it away from extreme conditions such as places near flames or direct sunlight.

Clay Stabilizer KHF002L

1. Introduction

Clay stabilizers are routinely added to aqueous-based fracturing fluids to help prevent damage to the formation caused by clay migration and swelling. These clay stabilizers are either a temporary or permanent type, and they are often used in combination.

The clay stabilizer KHF002L is a KCl substitute for KHF002 which can be used to prepare the salt water for mixing fracturing fluid. The additive can also stabilize the reactive clays in the formation temporarily during fracturing and flowback operations.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF002L	Colorless liquid	1.08-1.13	Soluble	Moderate- Eyes	None	7.0-8.0

3. Chemical Properties and Application

Temporary Clay Stabilizer KHF002L is an organic efficient liquid clay stabilizer. It is NOT liquid KCl, but it can be substituted for KCl in most applications.

KHF002L has been used at temperatures up to 350°F without any adverse effect on fluid rheology.

KHF002L can be batch mixed, or continuously mixed into the fracturing fluid using a liquid-additive system. This eliminates the time-consuming step of batch mixing dry KCl in the base fluid. KHF002L can be used in most aqueous-based fracturing fluids and is compatible with most additives used in the fracturing fluid systems.

4. Treatment

The recommended KHF002L concentration is 2 Gal/1,000 Gal (2 L/m^3). For specific formations such as high reactive clay content, the KHF002L concentration can be further optimized using laboratory core tests.

5. Packaging

KHF002L is supplied in 55 gallons high density polyethylene (HDPE) drums or 265 gallons HDPE totes. Keep it away from extreme conditions such as places near flames or direct sunlight.

Biocide KHF003

1. Introduction

The mixing water for the preparation of fracture fluid should be free of bacteria and enzymes. Either can cause degradation of the polymer and premature viscosity break. They can also prevent viscosity development. Bacteria produce enzymes to which most guar or guar derivative polymers are particularly sensitive.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF003	Colorless to yellowish liquid	0.95-1.00	Soluble	Eyes, skin, inhalation	Flammable	7.0-8.0

3. Chemical Properties and Application

The biocide KHF003 is added to the mix-water as early as possible before the bacterial problem develops. It can be continuously mixed during the treatment to prevent bacterial growth in the reservoir, but it will be of little or no benefit to the stability of the fracturing fluid if added by continuous mix. This product will kill bacteria but cannot remove enzymes.

When using polymer-free systems (such as SurFrac), biocides or bactericides are NOT required because KHF003 may interfere with rheological properties of SurFrac fluids.

KHF003 is compatible with most additives used in crosslinked guar based fracturing fluids, but certain additives such as scale inhibitors, demulsifiers especially enzyme breakers might not be compatible with KHF003. Laboratory testing is required before using these additives together in fluid systems.

4. Treatment

The recommended concentration for KHF003 is 0.25-0.75 Gal/1,000 Gal of mixing water.

5. Packaging

This product is supplied in 55 gallons high density polyethylene (HDPE) or steel drums. Keep it away from extreme conditions such as places near flames or direct sunlight.

Biocide KHF003G

1. Introduction

The mixing water for the preparation of fracture fluid should be free of bacteria and enzymes. Either can cause degradation of the polymer and premature viscosity break. They can also prevent viscosity development. Bacteria produce enzymes to which most guar or guar derivative polymers are particularly sensitive.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF003G	Colorless to light yellow liquid	1.10-1.15	Soluble	Eyes, skin, inhalation	Flammable	3.5-5.0

3. Chemical Properties and Application

KHF003G is added to the mix water as early as possible, and preferably put into tanks before the water is added. Before using, the tanks should be thoroughly cleaned. No residual fluids should remain in the tanks. Tanks containing residual fluid provide an ideal environment for bacteria to grow. When the tanks are used again, the bacteria count can be so elevated that the gelling agent will be rapidly degraded.

It can be continuously mixed during the treatment to prevent bacterial growth in the reservoir, but it will be of little or no benefit to the stability of the fracturing fluid if added by continuous mix. This product will kill bacteria but cannot remove enzymes.

KHF003G will not affect the rheology of most crosslinked guar based fracturing fluids, and it is also compatible with most additives used in OPTiFrac and EZFrac. Laboratory testing is required before using these additives together in fluid systems.

4. Treatment

The recommended concentration for KHF003G is 0.25-0.75 Gal/1,000 Gal of mixing water.

5. Packaging

This product is supplied in 55 gallons high density polyethylene (HDPE) or steel drums. Keep it away from extreme conditions such as places near flames or direct sunlight.

Stabilizer KHF005

1. Introduction

Guar or derivative products tend to degrade at elevated temperature. The rheological properties of guar-based fracturing fluids will deteriorate at high temperature. Stabilizer KHF005 is specifically designed to be used to prevent degradation of fracture fluids at temperatures greater than 250°F (121°C).

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF005	White granules	1.75-1.95	Soluble	Eyes, skin	None	7.5-8.5 (1%)

3. Chemical Properties and Application

Fracturing fluids will pick up oxygen either at surface or pumping down hole. The oxygen dissolved in fracturing fluids will degrade polymers presented in fluids and reduce fluid viscosity, especially at elevated temperature. KHF005 acts as an oxygen scavenger and prevent the rapid degradation of gelling agents caused by dissolved oxygen in fracturing fluids and improve fluid rheological properties significantly at high temperature applications (typically when bottom hole static temperature is greater than 250°F).
KHF005 is compatible with additives used in guar-based fracturing fluids, but it has to be added in either linear gel or dissolved in water and pumped through liquid additive line. It cannot be added into crosslinker solution.

4. Treatment

5-30 lbs/Mgal KHF005 is generally good enough to stabilize fluid properties at high temperature.

5. Packaging

KHF005 is supplied in plastic-lining bags with net weight of 25 kg/sack. It should be stored in shaded areas with good ventilation.

Antifoaming Agent KHF006

1. Introduction

Foams formed while mixing fracturing fluids cause many problems such as lower and wrong density reading, poor wetting and hydration efficiency, and pumping difficulties due to pump cavitation and loss of suction.
KHF006 antifoam agent is often required in mixing fracturing fluids to prevent foaming tendency and avoid problems described above.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF006	Colorless liquid	0.97-1.02	Soluble	Moderate-Eyes	None	7.0-9.0 (10% methanol solution)

3. Chemical Properties and Application

KHF006 is an effective antifoam agent in most fracturing fluids that do not have high salt concentrations. It is NOT a foam breaker. Therefore, KHF006 should be always added into mixing water before any foam forms. Higher agitation is required in cold weather for better dispersion.

4. Treatment

The recommended concentration for KHF006 is 0.1-0.5 Gal/1,000 Gal of mixing water.

5. Packaging

KHF006 is supplied in 5 gallons high density polyethylene (HDPE) pails. Keep it away from extreme conditions such as places near flames or direct sunlight.

Flowback Additive KHF007

1. Introduction

Surface active reagents were generally used in aqueous-based stimulation fluids to lower the interfacial tension that restricts fluid flow in the rock matrix. KHF007 surfactant lowers the capillary pressure by both improving the wettability of the pore throat and reducing the interfacial tension.

Both laboratory testing and field results have shown that KHF007 can provide superior cleanup due to the wetting properties and surface tension reduction that leads to lower capillary pressures. The use of KHF007 results in less swabbing time, faster cleanup and more complete recovery of stimulation fluids.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF007	Light yellow liquid	1.00-1.05	Soluble	Eyes, skin, inhalation	Fire	N/A

3. Chemical Properties and Application

KHF007 promotes fracturing fluid cleanup of the proppant pack and the invaded rock matrix because the contact angles resulting from the use of KHF007 are higher than those for other conventional cleanup surfactants. In addition, the surface and interfacial tension values from the use of KHF007 are also lower than most conventional surfactants used. This leads to significantly lower capillary pressures which reduces the force required to initiate flow of the stimulation fluid and therefore, KHF007 should provide better and quicker fluid recovery following a stimulation treatment.

KHF007 are compatible with all additives used in Guar-based fracturing fluids such as OPTiFrac. Lab testing indicates that KHF007 can be used for temperature applications up to 350°F.

KHF007 can reduce the surface tension to as low as 19 Dynes/cm.

4. Treatment

The CMC value for KHF007 is low. However, 1-2 Gal/1,000 Gal is the generally recommended concentration for most fracturing fluids.

5. Packaging

KHF007 is supplied in 55 gallons high density polyethylene (HDPE) drums or 265 gallons HDPE totes. Keep it away from extreme conditions such as places near flames or direct sunlight.

Flowback Additive KHF007S

1. Introduction

Surface active reagents were generally used in aqueous-based stimulation fluids to lower the interfacial tension that restricts fluid flow in the rock matrix. KHF007S surfactant lowers the capillary pressure by both improving the wettability of the pore throat and reducing the interfacial tension.

Both laboratory testing and field results have shown that KHF007S can provide superior cleanup due to the wetting properties and surface tension reduction that leads to lower capillary pressures. The use of KHF007S results in less swabbing time, faster cleanup and more complete recovery of stimulation fluids.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF007S	Light yellow liquid	1.00-1.05	Soluble	Eyes, skin, inhalation	Fire	7.0-9.5

3. Chemical Properties and Application

KHF007S promotes fracturing fluid cleanup of the proppant pack and the invaded rock matrix because the contact angles resulting from the use of KHF007S are higher than those for other conventional cleanup surfactants. In addition, the surface and interfacial tension values from the use of KHF007S are also lower than most conventional surfactants used. This leads to significantly lower capillary pressures which reduces the force required to initiate flow of the stimulation fluid and therefore, KHF007S should provide better and quicker fluid recovery following a stimulation treatment.

KHF007S are compatible with all additives used in Guar-based fracturing fluids such as OPTiFrac. Lab testing indicates that KHF007S can be used for temperature applications up to 350°F.

KHF007S can reduce the surface tension to as low as 22 Dynes/cm at 30°C.

4. Treatment

The CMC value for KHF007S is low. However, 1-2 Gal/1,000 Gal is the generally recommended concentration for most fracturing fluids.

5. Packaging

KHF007S is supplied in 55 gallons high density polyethylene (HDPE) drums or 265 gallons HDPE totes. Keep it away from extreme conditions such as places near flames or direct sunlight.

Low Temperature Breaker KHF011

1. Introduction

Proppant-pack permeability can be severely damaged by gelling agents such as guar or its derivatives. The amount of damage increases as polymer concentration increases. Breakers are generally used to reduce the viscosity of the fracturing fluids by degrading the polymer that is concentrated in the proppant pack. KHF011 is an oxidizer breaker used in most guar or guar derivative based fracturing fluids.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF011	White crystals	1.89-2.09	Soluble	Eyes, skin	Oxidizer	3.0-7.0 (5%)

3. Chemical Properties and Application

The reactivity of KHF011 is strongly dependent on temperature. Thermal decomposition of KHF011 produces highly reactive radicals that can attack the guar-based polymer backbone.
By itself, KHF011 is effective in the temperature range of 125 to 225°F. KHF011 can be used at fluid temperatures less than 125°F when breaker aid is used together. Encapsulated breaker KHF012 should be used at high temperature greater than 225°F.
KHF011 is not compatible with reducing chemicals and stronger oxidizers. Care should be taken to avoid the use of reducing additives and stronger breakers together with KHF011.

4. Treatment

Breaker KHF011 is an oxidative breaker. It can be used in both linear gel and crosslinked fluids. Breaker KHF011 can be batch mixed, continuously mixed or used as a dry material.
Typical concentration of 0.01-2.0 lbs/Mgal is recommended to cover most fracturing operations.

5. Packaging

KHF011 is supplied in 55 lbs plastic-lining bags generally in buckets with net weight of 25 kg/packaging. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

Medium Temperature Encapsulated Breaker KHF012

1. Introduction

Proppant-pack permeability can be severely damaged by gelling agents such as guar or its derivatives. The amount of damage increases as polymer concentration increases. Breakers are used to reduce the viscosity of the fracturing fluid by degrading the polymer that is concentrated in the proppant pack. KHF012 is the encapsulated version of KHF011, which is used for breaking polymers in fracturing fluids.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF012	White to tan granules	1.76-1.96	N/A	Eyes, skin	Oxidizer	N/A

3. Chemical Properties and Application

KHF012 is a particulate material with specific size produced by coating (encapsulating) KHF011 with a water-resistant barrier. Encapsulation of the breaker greatly reduces fracturing fluid exposure to the breaker and enables the use of high concentrations of breaker that, without coating, would rapidly reduce the fluid viscosity. KHF012 cannot leak off and be lost to the formation, KHF012 remains in the fracture where it is needed to degrade concentrated polymers. After fracturing treatment, release of the breaker occurs as the reservoir temperature increases and the fracture closes.

The effective working temperature for KHF012 is in the range of 125-275°F.

KHF012 can be used in most guar and derivative based fracturing fluid systems such as OPTiFrac and UniFrac. It is compatible with most additives used in these systems except for reducers or stronger oxidizers.

4. Treatment

Breaker KHF012 is an oxidative breaker. It can be used in both linear gel and crosslink fluids. KHF012 can be used with proppant sizes 16/30 mesh and smaller. As much as 5 times of KHF011 loading (up to 10 lbs/Mgal) can be added into fracturing fluids by using encapsulation technique such as in KHF012.

5. Packaging

KHF012 is supplied in 55 lbs plastic-lining bags generally in buckets with net weight of 25 kg/packaging. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

High Temperature Breaker KHF013

1. Introduction

Proppant-pack permeability can be severely damaged by gelling agents such as guar or its derivatives. The amount of damage increases as polymer concentration increases. Breakers are generally used to reduce the viscosity of the fracturing fluids by degrading the polymer that is concentrated in the proppant pack. KHF013 is an oxidizer designed for breaking guar or guar derivative based fracturing fluids at high temperature applications.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF013	White granules	3.27-3.47	Soluble	Eyes, Skin	Oxidizer	7.0-8.0 (1%)

3. Chemical Properties and Application

The reactivity of KHF013 is strongly dependent on temperature. Thermal decomposition of KHF013 produces highly reactive radicals that attack the guar-based polymer backbone.
KHF013 is effective in the temperature range of 200 to 300°F. KHF011 can be used at fluid temperatures less than 200°F. KHF014 (encapsulated KHF013) should be used at high temperatures greater than 300°F.
KHF013 is a strong oxidizer which is reactive with most chemicals such as acids, salts, and all reducing agents. Toxic or corrosive gases may release from the above reactions. Care should be taken seriously to avoid the use of reducing agents, acids, salts and other oxidizers together with KHF013.

4. Treatment

KHF013 concentration depends on factors such as polymer concentration, temperature, break time requirement, and polymer type. Typical concentration of 0.01-2.0 lbs/Mgal is recommended to cover most fracturing operations. Laboratory testing may be required for optimized breaker schedule design.

5. Packaging

KHF013 is supplied in 55 lbs plastic-lining bags generally in buckets with net weight of 25 kg/packaging. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

High Temperature Encapsulated Breaker KHF014

1. Introduction

Proppant-pack permeability can be severely damaged by gelling agents such as guar or its derivatives. The amount of damage increases as polymer concentration increases. Breakers are used to reduce the viscosity of the fracturing fluid by degrading the polymer that is concentrated in the proppant pack. KHF014 is the encapsulated version of KHF013, which is used for breaking polymers in fracturing fluids at high temperatures.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF014	Light yellow granules	1.92-2.12	N/A	Eyes, Skin	Oxidizer	N/A

3. Chemical Properties and Application

KHF014 is a particulate material with specific size produced by coating (encapsulating) KHF013 with a water-resistant barrier. Encapsulation of the breaker greatly reduces fracturing fluid exposure to the breaker and enables the use of high concentrations of breaker that, without coating, would rapidly reduce the fluid viscosity. KHF014 cannot leak off and be lost to the formation, KHF014 remains in the fracture where it is needed to degrade concentrated polymers. After the fracturing treatment, release of the breaker occurs as reservoir temperature increase and the fracture closes.

The effective working temperature for KHF014 is in the range of 200-350°F.

KHF014 can be used in most guar and derivative based fracturing fluid systems such as OPTiFrac and EZFrac. It is compatible with most additives used in these systems except for reducers, acids, salts, and other oxidizers, which require extra care to confirm using them together.

4. Treatment

As much as 5 times of KHF013 loading (up to 10 lbs/Mgal) can be added into fracturing fluids by using encapsulation technique such as in KHF014.

5. Packaging

KHF014 is supplied in 55 lbs plastic-lining bags generally in buckets with net weight of 25 kg/packaging. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

Hydration Aid KHF023

1. Introduction

Proper polymer hydration is important for achieving optimum fluid properties. Ideally the polymer should be at least 85% hydrated before the crosslinker is added. At hydration levels less than 85%, some of the polymer especially CMHPG left under-hydrated, significantly reduces the effective polymer concentration.
The pH should be below 6.0 for proper hydration of the polymer. Since normal fracturing water has a pH of above 7.0, it requires pH adjustment during hydration. KHF023 is used to adjust the fluid pH for proper hydration of the polymer, and this is more important in the case of CMHPG fracturing fluids.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF023	Colorless liquid	1.05-1.10	Miscible	Eyes, skin	Moderate-Fire	4.5-5.5

3. Chemical Properties and Application

Complete hydration of the polymer is necessary to obtain the maximum fluid stability, and the degree of hydration is dependent on the pH of the hydrating fluid. The buffered effect of seawater and other mix water require the addition of KHF023 to control the fluid pH low during hydration.
KHF023 can be added directly to water. For most water sources, a KHF023 concentration of up to 2 Gal/1,000 Gal maintains the fluid pH within the recommended range of 6.0 to 7.0 during polymer hydration. The KHF023 concentration may require adjustment depending on the water source. Most fresh water requires only 0.5 Gal/1,000 Gal and needed to be added before the addition of polymer, high pH buffer and crosslinker.
The guar or guar derivative based fracturing fluids can be stabilized easily at temperature 350°F (177°C) if the fluid is designed properly.

4. Treatment

Typically, a KHF023 concentration of 0.5 to 2 Gal/1,000 Gal is sufficient for the proper hydration of the polymer. Sea water is usually buffered, and the pH is above 8, and when using sea water, the use of Hydration Aid KHF023 is very critical.

5. Packaging

KHF023 is supplied in 55 gallons high density polyethylene (HDPE) drums. Keep it away from extreme conditions such as places near flames or direct sunlight.

pH Buffer KHF024

1. Introduction

Crosslinked CMHPG based fracturing fluids reaches optimum properties while pH is in the range of 9-9.5. Zirconium crosslinker itself does not offer sufficient buffering and the crosslinking takes place very slowly. To get optimum crosslinking efficiency, the pH needs to be raised to above 9, and the pH buffer KHF024 is generally used.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF024	White granules	2.01-2.21	Soluble	Eyes, skin	Corrosive	9.5-10.5 (2%)

3. Chemical Properties and Application

CMHPG powder needs lower pH to hydrate. Zr-based crosslinking is temperature activated, but at low pH, crosslinking will be very low. To increase the effectiveness of crosslinking, the fluid needs to be maintained at a pH in the range of 9.0 to 9.5. Addition of Caustic will increase the pH dramatically to above 10, and Caustic is not recommended for CMHPG fluids. pH Buffer KHF024 is very effective in maintaining the pH value between 9.0 and 9.5 and is the widely recommended additive for CMHPG crosslinked fluids.

The guar or guar derivative based fracturing fluids can be stabilized easily at temperature 350°F (177°C) if the fluid is designed properly.

KHF024, together with Zirconium crosslinker (KHF026) and Delaying agent (KHF025), is generally used to prepare crosslinker solutions for most guar or guar derivative based fracturing fluid systems. It is compatible with all additives used in these systems.

4. Treatment

The concentration range for the activator KHF024 is 6-8 lbs/1,000 gal of fracturing fluid.

5. Packaging

This product is supplied in plastic-lining bags with net weight of 25 kg/bag. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

Delaying Agent KHF025

1. Introduction

Crosslinked CMHPG based fracturing fluids crosslink readily when the pH is in range of 9-9.5. Minimizing the friction pressure experienced by the viscous fluid when going through the tubular can be achieved by delaying the cross-linking of the fluid. Delay agent KHF025 can maintain the pH at around 8.2 while the fracturing fluid is going through the tubular, and thus the crosslinking will be delayed. This will dramatically reduce the friction and is a recommended practice in fracturing applications.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF025	White powder	2.13-2.33	Soluble	N/A	Corrosive	8.0-9.0 (1%)

3. Chemical Properties and Application

Borate based crosslinking of guar-based fluids are time dependent while zirconium crosslinking is temperature dependent. The fluid containing crosslinker and polymer at a pH above 9 during pumping through the tubular will crosslink immediately. This will result in excessive friction pressure due to high viscosity. To minimize the horse power on location, the friction needed to be reduced and this can be materialized by delaying the crosslinking by using the KHF025. The pH value is controlled by KHF025 in the range of 8.0 to 8.5 at most application conditions, and this will delay the crosslinking to 3 to 10 minutes. The delay can be controlled by using specific quantities of KHF025.

The guar or guar derivative based fracturing fluids can be stabilized at temperature 350°F (177°C) if the fluid is designed properly.

4. Treatment

KHF025 is not generally added as a solid while continuous mixing. It must be dissolved in water and metered into the blender before the crosslinker is added. For batch mixing, the solid can be used at 12 lbs/1,000 gal.

5. Packaging

This product is supplied in plastic-lining bags with net weight of 25 kg/bag. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

Zirconium Crosslinker KHF026

1. Introduction

Crosslinkers are generally introduced to polymer-based fracturing to improve rheological properties of the fracturing fluids. Crosslinker KHF026 is a zirconium chelate crosslinker used for crosslinking guar-based fluids for high temperature applications. Crosslinking of zirconium fluids are temperature dependent.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF026	Light yellow liquid	1.15-1.20	Miscible	Moderate- Eyes	Moderate-Fire	5.5-6.5

3. Chemical Properties and Application

Crosslinker KHF026 is a zirconium crosslinker used for crosslinking guar and guar derivative based fracturing fluids. The crosslinking is very slow if KHF026 is added into linear gel (pH 6-8). However, the crosslinking is activated by raising the fluid pH value above 8.5, and it causes rapid crosslinking to occur in HPG and CMHPG fluids. Since crosslinking of zirconium fluids are temperature dependent, higher temperature is needed to crosslink.
KHF026 can be used to crosslink most guar or guar derivative based fracturing fluids. It is compatible with most additives used in fracturing fluid systems which are engineered for use up to 375°F.

4. Treatment

Batch mixing KHF026 into the fluid is NOT recommended. If the KHF026 must be batch mixed, it is added only after the polymer is fully hydrated and the fluid pH value is 6 to 6.5. 1.2 to 2.0 Gal/1,000 Gal of KHF026 is generally sufficient to obtain good crosslink property and fluid stability at any temperature.

5. Packaging

KHF026 is supplied in 55 gallons high density polyethylene (HDPE) drums. Keep it away from extreme conditions such as places wet and humid or direct sunlight.

CMHPG Gelling Agent KHF031

1. Introduction

Gelling Agent KHF031 is a dispersible carboxymethyl hydroxyl propyl guar (CMHPG) for the use in hydraulic fracturing fluids. Addition of appropriate crosslinker and stabilizer converts it to the corresponding highly viscous gel fracturing fluid for applications at very high temperatures. CMHPG is known to be cleaner than the traditional guar and yield better conductivity to the proppant pack.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF031	Light yellow powder	1.40-1.60	Soluble	Eyes	Fire, dust, water slick	N/A

3. Chemical Properties and Application

KHF031 can be used to prepare fluids in batch mixing or on the fly. The fluid application temperature ranges from 80 to 350°F (27 to 177°C). It can be mixed with freshwater and salt water, depending on the application requirement. Together with crosslinker, activator and the delaying agent, the gelling agent KHF031 provides wide range of delay time and rheological property at all temperature and shear. The pH should be below 6.0 for proper hydration of the polymer. Since normal fracturing water has a pH of above 7.0, it requires pH adjustment during hydration. Polymer Hydration Aid KHF023 is used to adjust the fluid pH for proper hydration of the polymer, and this is more important in the case of CMHPG fracturing fluids. The delay time can vary from 0~6 minutes depending on the amount of type of delay additive used.

The high temperature stabilizer KHF005 can be used to prevent degradation of fracturing fluids at temperatures greater than 200°F (93°C).

4. Treatment

The 20-60 lbs/1,000 gal gel loading is generally required to get enough viscosity to initiate fracture and transport of the proppant in to the fracture. The gel loading is dependent on the formation bottom hole temperature. Typically, higher the temperature, higher the gel loading quantity is required to achieve sufficient viscosity.

5. Packaging

KHF031 is supplied in plastic-lined bags with net weight of 25 kg/bag or 900 kg/jumbo bag. It should be stored in shaded areas with good ventilation. Keep it away from high temperature, humidity and direct sunlight.

CMHPG Slurry KHF031L

1. Introduction

Gelling Agent KHF031L is a high-yielding CMHPG slurry for continuous or batch mixing of fracturing fluids. Its hydration rate is faster compared to CMHPG powder, and is easier to meter, disperse and hydrate in water.

2. Physical Properties and Hazards

Additives	Form	S.G.	Water Solubility	Health Hazard	Physical Hazard	pH
KHF031L	Light yellow liquid	1.06-1.11	Soluble	Eyes, nose, throat	Fire, water Slick	N/A

3. Chemical Properties and Application

For fracturing applications, specially-treated free-flowing dry CMHPG powder is liked by the operating companies due to the absence of diesel and similar oils. However, its metering and use at the well site is difficult. When mixed with water, these dry CMHPG powder can form fish eyes, and thus many times cannot achieve the desired maximum viscosity on hydration. For this reason, CMHPG powder is slurry in diesel or mineral oils, and provides much better crosslinking properties (viscosity) allowing much lower gel loading and leads to better fracture conductivity. In addition to proppant carrying in hydraulic fracturing, this slurry can also be used as a pad for both hydraulic and acid fracturing. Together with crosslinker, activator, and the delaying agent, the gelling agent KHF031L provides wide range of delay temperature and rheological property at temperature and shear. The fluid can be used even above 400°F if properly optimized.

The use of suitable buffer, high temperature stabilizer and stabilizer aids can be used to prevent degradation of fracturing fluids at temperatures greater than 200°F (93°C).

4. Treatment

CMHPG slurry equivalent to 20-60 lbs/1,000 gal CMHPG gel loading is generally required to get enough viscosity to initiate the fracture and transport the proppant in to the fracture. The gel loading is dependent on the formation bottom hole temperature, pumping time, and cool down. Typically, higher the temperature, higher is the gel loading required to achieve the required viscosity.

5. Packaging

KHF031L is supplied in 265 gallons high density polyethylene (HDPE) totes. It should be stored in shaded areas with good ventilation. Keep it away from high temperature, fire, humidity and direct sunlight.