

# Definitions for products or functions in natural gas development

The product function classifications are those generally accepted by the IADC Subcommittee on Drilling Fluids. Some additives have multiple uses, and for those a primary and two secondary function categories are listed.

## **Biocide:**

An additive that kills bacteria. Bactericides are commonly used in water muds containing natural starches and gums that are especially vulnerable to bacterial attack. Bactericide choices are limited and care must be taken to find those that are effective yet approved by governments and by company policy. Bactericides, also called biocides, can be used to control sulfate-reducing bacteria, slime-forming bacteria, iron-oxidizing bacteria and bacteria that attack polymers in fracture and secondary recovery fluids. In polymers, the degradation of the fluid is controlled, thus avoiding the formation of a large biomass, which could plug the formation and reduce permeability.

## **Breaker:**

1. A chemical that reduces the viscosity of a fluid by breaking long-chain molecules into shorter segments. Drilling fluids are commonly emulsified or contain long-chain molecules that have sufficient viscosity to carry cuttings to surface. After the drilling fluid has done its job, a breaker may be added to reduce the viscosity of the fluid by breaking down the long chain molecules into shorter molecules. A surfactant may be added to an emulsion to reduce its viscosity.
2. A chemical used to reduce the viscosity of specialized treatment fluids such as gels and foams. Breaking down the fluid viscosity may be desirable either as part of a treatment, such as allowing flow-back of the spent treatment fluid, or following a treatment as part of the fluid-disposal process. Depending on the application, a breaker of predictable performance may be incorporated into the treatment fluid for downhole activation, or be added directly to the returned fluid for immediate effect at surface.

## **Calcium reducers:**

Soda ash, bicarbonate of soda, caustic soda and certain polyphosphates are used to reduce calcium in seawater, treat cement contamination, and overcome contaminating effects of anhydrite and gypsum, both forms of calcium sulfates.

## **Clay stabilizer:**

A chemical additive used in stimulation treatments to prevent the migration or swelling of clay particles in reaction to water-base fluid. Without adequate protection, some water-base fluids can affect the electrical charge of naturally occurring clay platelets in the formation. Modifying the charge causes the platelets to swell or migrate in the flowing fluid and, once these are dispersed, it is likely that some clay plugging of the formation matrix will occur. Clay stabilizers act to retain the clay platelets in position by controlling the charge and electrolytic characteristics of the treatment fluid.

## **Corrosion inhibitor:**

1. A chemical additive used in acid treatments to protect iron and steel components in the wellbore and treating equipment from the corrosive treating fluid. Corrosion inhibitors generally are mixed with the treatment fluid and are formulated to be effective in protecting the metal components the fluid is likely

to contact. This protection must remain effective under the anticipated pressure and temperature environment for the duration of the treatment.

2. In matrix treatments, a chemical added to acid that adsorbs on the pipe surface to form a protective film. This decreases the destructive reaction of acid with metals. The inhibitor does not completely stop the corrosion reaction, but it eliminates more than 99% of the metal losses that would occur if the inhibitor were not present. The inhibitor has little or no effect on the reaction rate of acid with limestone, dolomite or acid-soluble minerals. Specific corrosion inhibitors are environmentally compatible, effective in hydrogen sulfide [H<sub>2</sub>S] environments, effective on high chrome steel, and effective on special steel alloys, such as coiled tubing. These inhibitors may be used at temperatures approaching 500oF [260oC].

#### **Crosslinker:**

A compound, typically a metallic salt, mixed with a base-gel fluid, such as a guar-gel system, to create a viscous gel used in some stimulation or pipeline cleaning treatments. The crosslinker reacts with the multiple-strand polymer to couple the molecules, creating a fluid of high, but closely controlled, viscosity. Treatments using crosslinkers should take account of the conditions needed to break the gel structure to ensure satisfactory cleanup and disposal.

#### **Defoamers:**

Products designed to reduce foaming action, particularly in brackish and saturated saltwater muds. Lowers interfacial tension so that trapped gas will readily escape from mud. Mechanical degassing equipment is commonly used along with defoamer. Octyl alcohol, aluminum stearate, various glycols, silicones and sulfonated hydrocarbons are used as defoamers.

#### **Emulsifier:**

**Oil-Mud Emulsifier:** A chemical used in preparation and maintenance of an oil- or synthetic-base drilling fluid that forms a water-in-oil emulsion (invert emulsion). An oil-mud emulsifier lowers the interfacial tension between oil and water, which allows stable emulsions with small drops to be formed. Historically, oil-mud emulsifiers have been classified as primary and secondary. Secondary emulsifiers are generally not used alone to make a stable oil mud. Emulsifiers can be calcium fatty-acid soaps made from various fatty acids and lime, or derivatives such as amides, amines, amidoamines and imidazolines made by reactions of fatty acids and various ethanolamine compounds. These emulsifiers surround water droplets, like an encapsulating film, with the fatty acid component extending into the oil phase. Emulsifier molecules that cannot fit around drops form clusters (micelles) in the oil phase or adsorb onto solids. Oil-mud emulsion drops each behave like a small osmotic cell. The emulsifier around the drops acts like a semipermeable membrane through which water can move but ions cannot pass. Thus, oil muds have the special capability (which water muds do not have) to control water transfer to and from the drops simply by adjusting salinity within the water phase of the oil mud.

**Water-Mud Emulsifier:** A chemical used in preparation and maintenance of an emulsion mud, which is a water mud containing dispersed oil (or a synthetic hydrocarbon). Numerous types of emulsifiers will disperse oil into water muds, including sulfonated hydrocarbons, ethoxylated nonylphenols, alkali-metal fatty-acid soaps, lignosulfonate, lignite and lignin at high pH. Even clays, starch and carboxymethylcellulose aid emulsion mud stability.

#### **Fluid loss additives:**

The leakage of the liquid phase of drilling fluid, slurry or treatment fluid containing solid particles into the formation matrix. The resulting buildup of solid material or filter cake may be undesirable, as may the penetration of filtrate through the formation. Fluid-loss additives are used to control the process and avoid potential reservoir damage.

**Flocculant:**

A chemical that causes a dispersed colloidal system (such as clay) to coagulate and form flocs. Most flocculants are either multivalent cations such as calcium, magnesium and aluminum, or long-chain polymers. High pH, high salinity and high temperature can also cause clay flocculation. Deflocculant: A thinning agent used to reduce viscosity or prevent flocculation; incorrectly called a "dispersant." Most deflocculants are low-molecular weight anionic polymers that neutralize positive charges on clay edges. Examples include polyphosphates, lignosulfonates, quebracho and various water-soluble synthetic polymers.

**Foaming agents:**

An additive used in preparation of foam used as a drilling fluid. Drilling foam is water containing air or gas bubbles, much like shaving foam, and it must withstand high salinity, hard water, solids, entrained oil and high temperature. Foaming agents are usually nonionic surfactants and contain polymeric materials.

**Fracturing agents:**

Fluids comprised of water, hydrocarbons, acids to create fractures underground. The addition of carbon dioxide or nitrogen to the fracturing fluids can aid in fluid recover and reduce the need for wellbore cleanouts.

**Friction reducers:**

**Fluid friction reducer:** A chemical additive that alters fluid rheological properties to reduce friction created within the fluid as it flows through small-diameter tubulars or similar restrictions. Generally polymers, or similar friction reducing agents, add viscosity to the fluid, which reduces the turbulence induced as the fluid flows. Reductions in fluid friction of 50 to 60% are possible.

**Friction reducer :** An additive, generally in slurry or liquid form, used to reduce the friction forces experienced by tools and tubulars in the wellbore. Friction reducers are routinely used in horizontal and highly deviated wellbores where the friction forces limit the passage of tools along the wellbore.

**Mud additive:**

A material added to a drilling fluid to perform one or more specific functions, such as a weighting agent, viscosifier or lubricant.

**Non-emulsifier (demulsifier):**

A chemical used to break emulsions (that is, to separate the two phases). The type of demulsifier selected depends on the type of emulsion, either oil-in-water or water-in-oil. Demulsifiers are used in the chemical analysis of oil and synthetic muds and to treat produced hydrocarbons.

**PH control:**

1. A chemical system that resists a change in pH. It comprises three components: water, weak acid (or weak base) and salt of the weak acid (or salt of weak base). In a buffered system, the concentration of H<sup>+</sup> and OH<sup>-</sup> ions remain relatively constant because they are in equilibrium with one or more of the other two components, even with the addition of acids or bases.

2. A chemical used to adjust and control the pH of stimulation fluids. Gels and complex polymer fluids are sensitive to pH changes, especially during the mixing phase when the dispersion and hydration of some polymers require specific pH conditions. In addition, the performance of crosslinked fluids is optimized over a relatively narrow pH range. Buffers, added to the aqueous phase before mixing, adjust

the base-fluid pH to achieve a stable treatment fluid with the desired characteristics and predictable performance.

**Proppant:**

Sized particles mixed with fracturing fluid to hold fractures open after a hydraulic fracturing treatment. In addition to naturally occurring sand grains, man-made or specially engineered proppants, such as resin-coated sand or high-strength ceramic materials like sintered bauxite, may also be used. Proppant materials are carefully sorted for size and sphericity to provide an efficient conduit for production of fluid from the reservoir to the wellbore.

**Sealers:**

The geological barriers that isolate fluid compartments within reservoirs or that hydraulically isolate reservoirs from each other. The seals may contain fluids (for example shales) but have very low permeability. The properties of seals can determine the height of hydrocarbon column trapped below them.

**Shale Inhibitor-Stabilizer (inhibitive mud):**

A mud that slows or stops hydration, swelling and disintegration of shales. A variety of mud types have been labeled as "inhibitive muds." The degree of inhibition is not quantitative, but qualitatively they range from highly inhibitive (balanced-activity oil muds), moderately inhibitive (potassium muds and silicate muds), fairly inhibitive (calcium-based fluids) to slightly inhibitive (lignosulfonate, lignite water muds) to non-inhibitive (freshwater, nontreated muds).

**Suspended solids (suspension):**

Dispersed particles in a slurry that can be separated by filtration and are not dissolved. In the water, oil and solids test (retort test), the retort solids are divided into two types, dissolved and suspended solids. Suspended solids are the particulates. In calculating solids content of water- or oil-base muds, suspended solids are divided into high-gravity and low-gravity solids (HGS and LGS). LGS are sometimes further subdivided into active (clay) and inactive solids.

**Surfactant:**

A chemical that acts as a surface active agent. This term encompasses a multitude of materials that function as emulsifiers, dispersants, oil-wetters, water-wetters, foamers and defoamers. The type of surfactant behavior, whether acting as an emulsifier or dispersant or otherwise, depends on the structural groups on the molecule (or mixture of molecules). Hydrophile-lipophile balance (HLB) number helps define the function that a molecular group will perform.

**Thinner – deflocculant:**

A thinning agent used to reduce viscosity or prevent flocculation; incorrectly called a "dispersant." Most deflocculants are low-molecular weight anionic polymers that neutralize positive charges on clay edges. Examples include polyphosphates, lignosulfonates, quebracho and various water-soluble synthetic polymers.

**Viscosifier:**

A material that increases the viscosity of a mud.

**Weighting material:**

A high-specific gravity and finely divided solid material used to increase density of a drilling mud. (Dissolved salts that increase fluid density, such as calcium bromide in brines, are not called weighting

materials.) Barite is the most common, with minimum specific gravity of 4.20 g/cm<sup>3</sup>. Hematite is a more dense material, with minimum specific gravity of 5.05 g/cm<sup>3</sup>, per API and ISO specifications. Calcium carbonate, specific gravity 2.7 to 2.8, is considered weighting material but is used more for its acid solubility than for density. Siderite, specific gravity around 3.8, has been used to densify mud, but can cause problems by dissolving into the mud at high pH. Ilmenite, specific gravity of 4.6 has been used in drilling mud and cement. Only barite and hematite have API/ISO standards.