

## **GLOSSARY**

### **A**

**Absolute Permeability** – The ability of a single fluid or phase to flow through a rock. The symbol used for permeability is  $k$ , which is measured in darcies.

**Absolute Volume** - The volume a solid occupies or displaces when added to water divided by its weight, or the volume per unit mass. Given in units of  $m^3$ /tonne.

**Accelerators** - Added to the cement to shorten thickening times and to increase early strength. The most widely used accelerator is  $CaCl_2$ .

**Acidize** – A technique of pumping an acid down the wellbore to enlarge the pore space in producing formations and increase production.

**Acid Inhibitor** – A chemical additive used to protect wellbore components and equipment from the corrosive properties of an acid. Inhibitors are determined by the type and concentration of the acid, metal to be protected and wellbore conditions, such as temperature and exposure time of the treatment.

**Acid Pickle** – Acid is pumped down the tubing and reverse circulated back in order to remove scale, rust and deposits from the internal surfaces of equipment, treating lines, pumping equipment or to clean the tubing string.

**Acid Wash** – A wellbore acid treatment designed to remove scale or build up deposits from the perforations and well-completion components. Acid-wash jobs typically do not include injection of treatment fluid into the reservoir formation.

**Acoustic log** - A measurement of porosity, done by comparing the time it takes for a sonic impulse to travel through a given material.

**AFE** - Authority for expenditure. A document that summarizes the estimated expense of drilling and completing a well to a specified depth, casing point or geological objective, and then either completing or abandoning the well.

### **Aggressive vs. Non-Aggressive - Sand Schedule**

Aggressive sand schedule: when the least amount of fluid is used to introduce the sand quickly and usually in high concentrations to the targeted zone.

Non-Aggressive sand schedule: when the sand concentration is increased slowly resulting in larger volumes of fluid pumped.

**Alluvial Fan** – A fan-shaped deposit of sediment formed where a stream emerges from an upland or mountain range into a broad valley or plain. Alluvial fans are common in arid or semiarid climates but not restricted to them.

**Alluvium** – A general term for any sedimentary accumulations deposited by comparatively recent actions of rivers. This includes sediment laid down in river beds, flood plains and alluvial fans.

**Anion** - An ion with a negative charge. (e.g. Cl<sup>-</sup>)

**Annular Space** - The space surrounding the tubing/casing in the wellbore; sometimes termed the annulus.

**Anthracite** – A hard, natural and pure coal that burns slowly and gives intense heat.

**Antifoam Agent** – A chemical additive used to avoid the generation of foam during the preparation of treatment fluids or slurries at surface. Excess foam created during the mixing process may cause pumping and handling problems and might interfere with the performance or quality of the mixed fluid.

**API** – American Petroleum Institute. The primary U.S. oil industry trade association, based in Washington, D.C. API conducts research and sets technical standards for industry equipment and products from wellhead to retail outlet. It also compiles statistics which are regarded as industry benchmarks.

**API Cement** - One of several classes of cement manufactured to the specifications of the American Petroleum Institute (API) Specifications 10A. Classes of API cement are A, B, C, D, E, F, G and H.

**Arenaceous Rocks** – A group of detrital sedimentary rocks, typically sandstones, in which the particles range in size from 1/16 mm to 2 mm. It should be noted that the term sandstone is often used as a synonym for arenaceous rocks. Arenaceous rocks may be accumulated by either wind or water action and in the latter case may form in marine, brackish, or freshwater environments.

**Arenite** – Any arenaceous rock. (e.g. Sandstone)

**Argillaceous Rocks** – A group of detrital sedimentary rocks, commonly clays, shales, mudstones, siltstones and marls. Two grades of particle sizes are recognized; the silt grade where they range from 1/16 to 1/256 mm and the clay grade with particles less than 1/256 mm.

**Authigenic** – Formed or generated in place; specifically said of rock constituents that formed at the spot where they are now found; also, said of minerals that

came into existence at the same time as, or later than, the rock of which they constitute a part.

## **B**

**Barite ( $\text{BaSO}_4$ )** – Is a barium sulfate material primarily used to weigh drilling muds. Used in cementing to increase slurry viscosity.

**Base Slurry** - A conventional cement slurry used as the cementitious component of a foamed cement slurry.

**Bearden Units of Consistency (BC)** - The pumpability or consistency of a slurry. It is a dimensionless quantity with no direct conversion factor to more common units of viscosity.

**Bedrock** – The continuous solid rock that underlies the regolith (glacial till) everywhere and is exposed locally at the surface. An exposure of bedrock is called an outcrop.

**Bentonite** - A clay additive composed of sodium montmorillonite and derived from volcanic ash. It imparts viscosity and thixotropic properties to fresh water by swelling to about 10 times its original volume. Bentonite decreases slurry weight and increases slurry volume.

**Bituminous Coal** – A coal rich in tarry hydrocarbons that burns easily. Can produce economical quantities of methane.

**Bottom Hole Circulating Temperature (BHCT)** - The temperature at the bottom of a well while fluid is being circulated. This is the temperature used for most tests of cement slurry in a liquid state (such as thickening time and fluid loss). In most cases, the BHCT is lower than the bottom hole static temperature (BHST), but in some cases, such as in deep water or in the arctic, the BHCT may be higher than the BHST.

**Bottom Hole Static Temperature (BHST)** - The downhole temperature measured under static conditions and after sufficient time has elapsed to negate any effect of circulating fluids. The BHST is generally higher than the bottom hole circulating temperature (BHCT) and can be an important factor when using temperature-sensitive tools or treatments.

**Bottomhole Pressure (BHP)** - The pressure, typically measured in kilopascals (kPa), at the bottom of the well. This pressure can be calculated in a static fluid-filled wellbore.

**Bottomhole Temperature (BHT)** - The temperature in the borehole at a depth. The BHT lies between the bottomhole circulating temperature (BHCT) and the bottomhole static temperature (BHST).

**Bottom Hole Fracture Pressure (BHFP)** –The pressure required to continue fracturing a formation.

**Breakdown Pressure** – The pressure it takes to initiate a fracture in the formation. This pressure is generally greater than the Bottom Hole Fracture Pressure.

**Breccia** - A conglomerate (clastic rock) composed of angular grains and mineral cement.

**Bridge Plug** – A type of casing plug used to seal off part of a well temporarily or permanently.

**BS&W** – Bottom sediment and water. Usually expressed as a percentage by weight.

**Bulk Density** - Mass per unit volume of a dry material containing entrained air.

**Bulk Volume** – The specific volume plus the void space between material grains. Bulk volume is always greater than the specific volume.

## C

**Caprock** – An impermeable rock overlying an oil or gas reservoir that seals or inhibits the migration of oil or gas out of the reservoir.

**Carbon Dioxide (CO<sub>2</sub>)** – A gas constituent of the atmosphere and a product of the complete combustion of fuels. Its solubility in water increases with pressure. It is often used to energize or foam water used in fracturing operations. When used in oilfield applications it is pumped on surface as a liquid.

**Carbonate Mineral** – A mineral formed by the bonding of carbonate ions (Ca<sub>3</sub><sup>2-</sup>) with positive ions. (i.e. Calcite (CaCO<sub>3</sub>), Dolomite [CaMg(CO<sub>3</sub>)<sub>2</sub>]).

**Carbonate Rock** – A sedimentary rock composed mainly of carbonate minerals. Example: limestone, dolomite.

**Cased Hole** - The portion of the wellbore that has had metal casing placed and cemented.

**Casing** - Steel pipe placed and cemented in an oil or gas well to prevent the wall of the hole from caving in and to prevent movement of fluids from one formation to another.

**Cation** - An ion with a positive charge. (e.g.  $\text{Na}^+$ )

**Cement** – A diagenetic process where minerals precipitate and bind with sediments. Common cement mineralogy is calcareous (calcite) and siliceous (quartz).

**Cement Blend** – Mixture of dry cement and other dry materials.

**Cement Class** – An API classification of cement according to its intended use.

**Cement Grade** – Designation by API to denote the sulfate resistance of a particular cement.

**Cement Slurry** – A cement slurry is placed between the casing and borehole to provide hydraulic isolation.

**Cement Squeeze** – A remedial cementing operation designed to force cement into leak paths in wellbore tubulars. The required squeeze pressure is achieved by carefully controlling pump pressure. Squeeze cementing operations may be performed to repair poor primary cement jobs, isolate perforations or repair damaged casing or liner.

**Cementation** – A process in which the individual particles of a sediment are held together by a secondary developed mineral. This mineral may be introduced by groundwater or redeposition of previously dissolved rocks.

**Centralizers** - A mechanical apparatus used to position casing concentrically in the wellbore. A centralizer is generally used during cement operations to ensure a constant annular space around the casing.

**Chert** – Cryptocrystalline silica which may be of organic or inorganic origin. It occurs as bands or layers of nodules in sedimentary rocks.

**Choke (Nipple)** - An adjustable or removable bored steel fitting designed to restrict flow and/or control production from a gas or oil well.

**Clastic Rocks** – Rocks consisting of pre-existing rock fragments which have been produced by weathering and erosion and have been transported to the point of deposition.

**Clay Minerals** – The constituents of clay that give it its plastic properties. An important characteristic is their ability to lose or take up water according to the

temperature and amount of water present in the system. Clay minerals are produced by the degradation (weathering) of other silicates or silicate glasses. Five clay mineral groups are recognized – 1. Kaolinite, 2. Illite, 3. Montmorillonite, 4. Vermiculite and 5. Palygorskite.

**Clay Stabilizer** – A chemical additive used in stimulation treatments to prevent the migration or swelling of clay particles when they react with water-based fluids. Water based fluids can upset the electrical charge of naturally occurring clay platelets in the formation. Changing the charge causes the platelets to swell or migrate in the flowing fluid. Once the particles are displaced they are likely to cause plugging of the formation matrix, which can cause formation damage.

**Clay Swelling** – A type of formation damage, which reduces formation permeability because of the change of clay equilibrium. When water based fluids from drilling, completion, workover or stimulation enters formations enriched with clays, clay swelling can occur. The most common swelling clays are smectite that create an almost impermeable barrier for fluid flow. Brines like potassium chloride (KCl) are used in completion workover operations to avoid clay swelling.

**Clean Fluid Rate** – The rate the fracturing fluid is pumped without including the sand component.

**Cleat** – Vertical fractures that naturally develop due to shrinking during devolatilization. A typical cleat system comprises two sets of sub-parallel fractures that are orientated perpendicular to the bedding. One orientation tends to dominate over the other. The dominant pair is termed 'face cleat' and the other is termed 'butt cleat'.

**Clinker** - Fused materials from the kiln in cement manufacturing that are interground with calcium sulfate to make cement.

**Closure Pressure** – Used as an analysis parameter in hydraulic fracture design to specify the pressure at which the fracture effectively closes without the proppant in place.

**Coal** – A fossil fuel consisting of carbonized plant material.

**Coalbed Methane (CBM)** – Natural gas, methane, that occurs in coal seams which has been created during the conversion of plant material into coal.

**Coalification** – The process that turns peat into coal through burial and dewatering. It is accompanied by the expulsion of volatile material, i.e.: hydrogen, oxygen and nitrogen.

**Coiled Tubing** – A long continuous length of pipe spun on a spool. The pipe is straightened before it is pushed into the wellbore and recoiled back to the spool after the treatment.

**Coiled Tubing Completion** – A completion that uses coiled tubing as the production medium or as a method of installing and conveying completion equipment or components. Problems associated with connections are avoided as the coil tubing string is continuous. Coil tubing operations can safely be done on live wells because of the pressure control equipment.

**Compaction** – A process of lithification which involves the close packing of the individual grains, mainly by the elimination of pore space and expulsion of entrapped water. Normally brought about by the weight of the overlying sediments.

**Conglomerate** - A clastic rock whose major component is gravel-size clasts (one-tenth inch and larger) cemented together.

**Connate Water** – Water that is trapped in the pores of a rock during the rock's formation. The chemistry of this water can change in composition throughout the history of the rock. This water can be dense and saline compared to salt water. Interstitial water or formation water, in comparison, is water that is found in the pore spaces of a rock, and might not have been present when the rock was formed.

**Corrosion Inhibitor** – A chemical additive used in acid treatments to protect steel and iron components in the wellbore and treating equipment from the corrosive treating fluids. Generally corrosion inhibitors are mixed with the treatment fluid and are formulated to be effective in protecting the metal components at the anticipated pressure and temperature.

**Crosslinker** – A mixture, characteristically a metallic salt, which is mixed with a base gel fluid, like a guar-gel system, to create a viscous gel used in some stimulation treatments. The crosslinker reacts with the multiple strand polymer to couple the molecules. This creates a fluid of high but controlled viscosity. When using a crosslinker one must regard the conditions needed to break the gel structure and to guarantee satisfactory fracture cleanup.

**Cryptocrystalline** – A term used to describe a finely crystalline aggregate in which the crystals are so small they are indistinguishable except under powerful magnification.

## D

**Damaged zone** – The area around the wellbore that has been damaged by the drilling process, typically as a result of mud or cement filtrate invasion. This type

of damage can greatly affect productivity and is typically easier to prevent than it is to cure. This type of damage is almost always present. A zone that is slightly damaged around the wellbore can be bypassed by perforation tunnels that create connecting channels from the reservoir to the wellbore. Damage that is more severe may require a matrix acidizing treatment or a hydraulic fracturing treatment to create a new high conductivity flow to the reservoir.

**Darcy** – The standard unit of measurement for permeability. One darcy depicts the permeability of a porous medium through which the route of one cubic centimeter of fluid having one centipose of viscosity flowing in one second under a pressure differential of one atmosphere where the porous medium has a cross-sectional area of one square centimeter and a length of one centimeter. A millidarcy (mD) is one thousandth of a darcy and is a commonly used unit for reservoir rocks.

**Defoamer** - A cement slurry additive used to lower interfacial tension so that trapped gas will readily escape from the slurry.

**Demulsifier** – A chemical that is used to break emulsions (two phase fluid). The type of emulsion, either water-in-oil or oil-in-water, determines the type of demulsifier.

**Density** - The mass of a standard volume of a given material, or the mass of the sample divided by its volume.

**Detrital** – A term applied to any particles, minerals or rocks derived from pre-existing rock by weathering and/or erosion.

**Detrital Rock** - A rock made from detritus.

**Detritus** - The solid fragments resulting from either mechanical or chemical weathering.

**Devolatization** – A process that removes the volatile material in coal thus increasing its relative amount of carbon.

**Diagenesis (lithification)** – Chemical, physical and biological changes that occurred after the rock was deposited. These changes can significantly affect reservoir properties, by either improving or destroying rock permeability or porosity.

**Dolomite (dolostone)** - A precipitate rock consisting of the mineral also called dolomite, in which about half the calcium atoms of the original calcite have been replaced by magnesium, probably as a result of infiltration by fresh groundwater. Dolomite originates from limestone.

## E

**Effective Permeability** – The ability of a rock to permit flow of a particular fluid when other immiscible fluids are in the reservoir (e.g. effective permeability of gas in a gas-water reservoir). The relative saturations of the fluids as well as the nature of the reservoir affect the effective permeability. In contrast absolute permeability is the permeability of a rock when a single fluid / phase is present.

## F

**Facies** – A geological term describing the composition, characteristics and origin of a rock formation.

**Fault** - A break in the rock along which the two sides have moved with respect to each other.

**Fill Cement** - A cement system used to provide zonal isolation across generally nonproductive zones located above the zones of interest. The fill cement may also be called the lead cement.

**Filter Cake** – The build up of mud solids on the wall of a well or the build up of polymer on a fracture face.

**Filtrate** – Fluid that has leaked off into the formation while drilling the borehole, or when fracturing.

**Fissile** - Capable of being split or divided in the direction of the grain or along natural planes of cleavage.

**Float Collar** - A short length of casing that is fitted with a check valve. This valve may be a flapper valve, a spring-loaded ball valve or some other type. The float collar prevents the cement slurry placed in the annulus to U-tube, or reverse flow back into the casing.

**Float Joint or Shoe Track** – A full sized length of casing placed at the bottom of the casing string that is usually left full of cement on the inside to make sure that good cement remains on the bottom and outside of the casing. If cement were not left inside the casing in this manner, the risk of over-displacing the cement (due to improper casing volume calculations, displacement mud volume measurements, or both) would be much greater. A float collar is placed at the top of the float joint and a float shoe placed at the bottom to prevent reverse flow of the cement slurry back into the casing after placement.

**Float Shoe** – A tapered, often bullet nosed piece of equipment fitted with a check valve and typically found at the bottom of the casing string. The float shoe prevents reverse flow, or U-tubing of the cement slurry from the annulus into the

casing. The float shoe also guides the casing toward the center of the hole to minimize hitting rock ledges or washouts as the casing is run into the wellbore.

**Flow Back** – The process of allowing fluids to flow from the well following a treatment, either in preparation for a subsequent phase of treatment or in preparation for cleanup and returning the well to production.

**Fluid Compatibility Tests** – A test or series of tests to check that no undesirable reaction occurs with a specific fluid. These tests can include compatibility with other treating fluids, wellbore fluids, formation fluids, and the actual formation or reservoir. Mixing of fluids can create negative reactions that may damage the formation permeability permanently.

**Fluid Loss** – Fluid loss is the undesirable release of fluid from a slurry. Fluid losses diminish the ability of the slurry to perform the intended effort and the lost fluid or filtrated slurry typically enters the adjacent formations with the potential of causing formation damage. When fluid loss occurs a filter cake is built up on the slurry side which can also be damaging to the area of losses. Depending on the scenario slurries will be designed to diminish or enhance this event. Fluid loss can occur in many environments but commonly referred to in Cementing applications.

**Fluid Loss Additive** - A chemical additive used to control the loss of fluid to the permeable zones of the formation. In cementing operations, loss of the aqueous phase can severely affect the performance of the slurry and set cement. In most oilfield operations, loss of fluid to the reservoir formation carries a high risk of permeability damage.

**Flush** – The fluid that follows the sand laden fluid and places the sand into the formation. Rule of Thumb:  $0.5 \text{ m}^3$  less than the hole fill volume.

**Fluvial** – Pertaining to a river or rivers.

**Fluvial Environment** – The sedimentary environment of river systems.

**Foamed Cement** - This type of cement is created when nitrogen is chemically and physically stabilized within ordinary cement slurry. A high pH tolerant foaming surfactant and foam stabilizer should be added to the cement blend. The quality of the foam cement slurry is dependent on well depth, temperature, and desired density downhole.

**Formation** - A body or layer of rock with distinct upper and lower boundaries, consisting of a single type of rock or of closely related types; the basic unit of stratigraphy. They may be grouped together in larger assemblages called groups, series, and systems.

**Formation Damage** – Any process causing a reduction in the natural inherent productivity or injectivity of a zone (formation).

**Formation Fluid** – Any fluid found in the pores of a formation rock.

**Formation Fracture Pressure** – The pressure that will cause the formation to fracture hydraulically.

**Formation Water** – Water that occurs naturally within the pores of the rock. This water may not have been present when the rock originally formed.

**Frac Gel** – Is a generic term used to describe a fluid composed of a base fluid and additives designed to hydraulic fracture a formation. Specific fluids and additives will vary as needed for formation variations and operating conditions.

**Fracture Closure Pressure** – Equivalent to minimum horizontal stress. It can be determined from analysis of the pressure decline curve after a pumping stage.

**Fracture Gradient** – The bottom hole fracture pressure divided by the depth.

**Fracture Height** – The difference between the upper and lower boundary of a created fracture.

**Friction Gradient** – Is the friction pressure divided by the depth.

**Friction Pressure** – The pressure increase associated with the viscous drag on fluid moving through tubing or casing.

**Friction Reducer** - Friction reducers or dispersing agents are added to cement slurries to improve their flow properties. Dispersed slurries have lower viscosity and can be pumped in turbulence at lower pressures. This minimizes the horsepower required and lessens the chance of lost circulation and premature dehydration.

## **G**

**Granite** - A granular igneous rock with granitic mineral content.

**Granitic** - The mineral content of rocks like granite, dominated by orthoclase feldspar and quartz.

**Guide Shoe** - A tapered, often bullet-nosed piece of equipment found at the bottom of a casing string. The tool guides the casing towards the center of the hole as it lowers. This minimizes problems associated with hitting formation or rock ledges and washouts in the wellbore. The outer portions of the guide shoe are made from steel, generally matching the casing in size and threads, if not

steel grade. The inside (including the taper) is generally made of cement or thermoplastic, since this material must be drilled out if the well is to be deepened beyond the casing point. It differs from a float shoe, in that it lacks a check valve.

## H

**Heavy Weight Additive** - Added to the cement to increase the weight or density of the cement slurry.

**Hole Fill** – The volume of fluid that occupies the tubing and casing configuration, to the top of the perforation.

**Hydrate** – An odd occurrence of hydrocarbon deposit where molecules of natural gas, usually methane, are trapped within a crystal structure. These hydrates form in areas of permafrost and in deep cold water environments.

**Hydrochloric Acid (HCl)** – Hydrochloric acid or hydrogen chloride (HCl) is a colorless, corrosive gas. HCl has a pungent, suffocating odor. It is made in great quantities in the soda process industry, by the action of sulphuric acid on common salt. It has a great affinity for water, and the commercial article is a strong solution of the gas in water. It is a typical acid and is an indispensable agent in commercial and general chemical work. Also called muriatic or chlorhydric acid.

**Hydrofluoric Acid (HF)** – A poisonous liquid acid composed of hydrogen and fluorine. Hydrofluoric acid (HF) is used because it is an inexpensive mineral acid that can dissolve siliceous minerals. HF is generally mixed with hydrochloric acid (HCl). These mixtures are called mud acids and are the main fluid used in a sandstone acid treatment as they remove formation damage. HF acid should not be used in sandstone formations with high carbonate content as it may risk calcium fluoride precipitation.

**Hydrostatic Head (HH)** – The pressure exerted by a fluid at a given depth.

## I

**Igneous Rocks** – A rock formed by the crystallization of magma.

**Ion** - Any atom or group of atoms (a radical) with a net electrical charge. (i.e. Na<sup>+</sup>, Cl<sup>-</sup>)

**Impermeable** – Pertains to a rock that does not allow for the flow of fluids because of low permeability.

**Instantaneous Shut-In Pressure (ISIP)** – The pressure recorded when the pumps are shut down after the fracture treatment.

**Integer** - A mathematical term to define the set of whole numbers both positive and negative, as well as 0.

(i.e. 5, 4, -3, -2 are integers, but 4.2 is not an integer)

## **K**

**Kill Fluid** - Drilling mud that has hydrostatics great enough to equal or exceed the pressure exerted by formation fluids.

## **L**

**Leaching** –The removal of sediment by the action of a percolating liquid.

**Leak-off** - The rate at which a fracturing fluid is lost to a formation.

**Leak-off Coefficient (C1)** – A measurement of how fast a fluid leaks off into a formation. A typical value is 0.002 to 0.01 ft/min<sup>½</sup>.

**Leak-off Test** - A gradual pressurizing of the casing to permit estimation of the formation fracture pressure at the casing seat.

**Light Weight Additive** - Added to cement to reduce the weight or density of the cement slurry.

**Lignite** – The lowest rank of coal. Lignite does not produce economical quantities of coal bed methane.

**Limestone** - A sedimentary rock consisting mainly of Carbonate minerals, Calcium carbonate, deposited by the remains of marine organisms. Metamorphosed limestone is called marble.

**Liner** - A string of casing in which the top does not extend to the surface but instead is suspended from inside the previous casing string. Production liners are used to set across the reservoir interval in many conventional well designs.

**Lithic** – A description term applied to rock fragments occurring in a later formed rock.

**Lithification** – The generation of rock from sediments using pressure.

**Lithology** - The detailed nature of the rocks found in a given locality.

**Lost Circulation** – A term used to describe the loss of returns to surface when fluid is being circulated in a wellbore.

## M

**Marl** - A shale or siltstone with limy cement.

**Mass spectrometer** - A device for separating different isotopes by weight. The device propels a beam of ionized isotopes through a magnetic field which causes particles of different weight to follow separate paths. These paths can be analyzed to determine the number of particles of each different weight.

**Matrix Acidizing** – The use of a reactive acid stimulation fluid to treat reservoir formation. In a carbonate formation, the acid dissolves the entire formation matrix. In sandstone formations, the acid reacts with the soluble substances in the formation matrix to enlarge the pore space. In either case, the acidizing treatment improves the formation permeability to enhance production of the reservoir fluids. This type of stimulation treatment is ideally performed at a high rate, but at treatment pressures below the fracture pressure of the formation. This allows the acid to penetrate the formation and extend the depth of treatment while avoiding damage to the formation.

**Material Safety Data Sheet (MSDS)** - A document that shows important physical and chemical characteristics of a chemical or product to alert a user, transporter or other interested party to the potential safety hazards associated with the material. The MSDS also contains treatments for exposure or ingestion as well as the type of equipment needed for safe handling. An MSDS is a legal requirement in most countries for all aspects of commerce involving chemicals.

**Metamorphic Rocks** - Rocks which have been subjected to high temperature, high pressure, and/or chemical alteration resulting in the deformation or growth of new or previously present minerals.

**Metamorphism** - The deformation and recrystallization of pre-existing rocks as a result of high temperature, high compressional stress, or a change in chemical environment.

**Methanol** – (Wood alcohol). The simplest form of alcohol: it can be made from coal and natural gas and it's used as an antifreeze and solvent. It is a light, volatile, flammable, poisonous, liquid alcohol. As a fuel, it blends easily with gasoline (to produce gasohol), burns with a sootless flame and contains no heavy hydrocarbons. Its greatest polluting emission is formaldehyde. This makes methanol a potentially less harmful alternative to petroleum products in transportation.

**Migration of Fines** – Fine materials present in the pore system are drawn to the wellbore and become entrapped in small pore throats, reducing permeability and

flow rate. Presence of dolomite, calcite, quartz, kaolinite, smectite and other fine clay in the pore system along with leached clasts cause the migration of fines.

**Mils** – One thousandth of an inch. Units of Caliper

**Mineral** - A naturally occurring substance with a fixed chemical composition and a defined crystal lattice.

**Mix Water** – The sum of the water required for all the specific materials in a tonne of blend.

**Mohs' scale** – A scale of mineral hardness established by comparison to a set of ten standard minerals. The usual standards are: 1. talc, 2. gypsum, 3. calcite, 4. fluorite, 5. apatite, 6. feldspar, 7. quartz, 8. topaz, 9. corundum, 10. diamond.

## N

**Neat Cement Slurry** - Cement slurry consisting of only cement and water.

**Nitrogen (N<sub>2</sub>)** – An inert, colorless, gaseous, tasteless and odorless element, constituting about 4/5 of the atmosphere by volume. It is stored as a cryogenic liquid and pumped as a gas in oil field operations.

## O

**Open Hole (OH)** – The portion of the wellbore that has no casing.

**Outcrop** – An exposure of bedrock.

## P

**Packer** - A piece of downhole equipment that consists of a sealing device, a holding or setting device, and an inside passage for fluids. It is used to block the flow of fluids through the annular space between the pipe and wall of the wellbore by sealing off the space between them.

**Pad** – The volume of fluid that initiates the fracture. This fluid is generally viscous.

**Pay Sand** - The producing formation. Also called pay, pay zone, and producing zone.

**Perforate** - To pierce the casing wall and cement of a wellbore providing holes through which formation fluids may enter. Jet plasma charges are used to generate holes 0.5 – 1.0m in length.

**Permeability** – The capacity of a material to permit flow through its matrix.

**Poisson's Ratio** – In addition to the strain in the z direction an applied stress causes strains in the x and y directions. The ratio of the deformation in the x direction to that in the z direction is known as Poisson's Ratio.

$$\nu = \frac{\Delta L_x}{\Delta L_z}$$

**Porosity** – The amount in percentage of non occupied space in a material, the void space in a rock.

**Pozzolan or Fly Ash** – A siliceous or siliceous and aluminous material that possesses little or no cementitious value. In a finely divided form and in the presence of moisture, however, pozzolan reacts chemically with calcium hydroxide to form compounds possessing cementitious properties, contributing to both strength and water tightness. Fly ash is a combustion by-product of coal and is widely used in the oil industry as a pozzolan to reduce cement slurry density. This is the only pozzolan covered by both the API and ASTM specifications.

**Pozzolanic** - Refers to material that possesses little or no cementitious value, but that is capable of reacting chemically with calcium hydroxide at ordinary temperatures to form compounds with cementitious properties.

**Production Casing** - The last string of casing cemented in a well. A tubing string is often suspended inside the production casing to help lift formation fluids.

**Proppant** – Sized particles mixed with fracturing fluid to hold fractures open after a fracturing treatment. Generally, naturally occurring sand grains are used, but man made or engineered proppants, such as resin-coated sand or high strength ceramic materials can be used. Material used for a proppant are carefully sorted for size and sphericity to provide a capable conduit for fluid production from the reservoir into the wellbore.

**PBTD** – Plug Back Total Depth.

**Q**

**Quartzite** - A rock composed of interlocking crystals of quartz, usually the result of contact metamorphism of clean sandstone.

**R**

**Reducing Agent** – A chemical added to acid to stabilize iron.

**Regolith** – The blanket of soil and loose rock fragments overlying the bedrock, often referred to as glacial till.

**Relative Permeability** – A measurement of the capability of two or more fluid phases to pass through a formation matrix. Relative permeability reflects the ability of a given formation to produce a mixture of water, oil or gas. In contrast, absolute permeability measures a single phase fluid, generally water.

**Remedial Cement** – Cementing operations performed to repair primary-cementing problems or to treat conditions arising after the wellbore has been constructed. There are two main categories of remedial cementing, these include squeeze cementing and the placement of cement plugs.

**Reservoir** - A subsurface, porous, permeable rock body in which oil and/or gas has accumulated.

**Reservoir Pressure** – The pressure of fluids within the pores of the reservoir. Usually hydrostatic pressure, or the pressure exerted by a column of water from the formation's depth to sea level. Reservoir pressure changes as fluids are produced from the reservoir.

**Retarder** – Chemical additive used to increase the thickening time of cement slurries. The high temperature typically associated with deep wellbores requires the use of such performance enhancing additives to enable efficient placement without premature setting.

## **S**

**Sand Laden Fluid or Slurry** – Fluid that suspends and carries proppant used in fracturing.

**Sand-Off** – Used to describe a fracture treatment where all of the designed sand was not placed into the fracture. Generally characterized by a sudden increase in pressure. When maximum pressure is reached, for safety purposes, the treatment is stopped.

**Sandstone** – A clastic rock consisting of sand consolidated with some type of cement (silica, calcite, chlorite).

**SAPP** – Sodium Acid Pyrophosphate or SAPP is designed to aide in removal of bentonite based drilling muds by chemically dispersing the mud which aids in removing the mud.

**Screen Tip** – Or otherwise known as a tip screen-out. This is when a fracture treatment is designed to sand-off at the end of the treatment. The purpose is to maximize the conductivity of the created fracture, back to the wellbore.

**Sedimentary Rock** – Rock formed from a sediment by lithification and/or cementation.

**Shale** - A clastic rock composed mostly of microscopic clay grains. Technically, it is called shale if it is fissile; otherwise it is called mudstone.

**Shoe Track** – See Float Joint.

**Shut-in Pressure (SIP)** - The pressure when the well is completely shut in, as noted on a gauge installed on the surface pumping or flow lines.

**Single-Phase** – Refers to the flow of one component, usually water, oil or gas.

**Single Phase Flow** – The flow of a single-phase fluid, such as water, oil or gas, through a porous media.

**Slurry** – A mixture of suspended solids and liquids. Muds in general are slurries, but are seldom called that. Cement is a slurry and is often referred to as such.

**Slurry Density** – The weight per unit volume of cement slurry, usually given in units of  $\text{kg/m}^3$ .

**Slurry Rate** – The rate of the sand laden fluid.

**Slurry Yield** – The sum of each material's absolute volume in a tonne of blend, including the mix water. Given in units of  $\text{m}^3/\text{kg}$ .

**Sorted** - Composed of sand grains of roughly the same size.

**Spacer (1)** - A viscous fluid used to aide in the removal of drilling fluids before a primary cement job. The spacer is prepared with specific fluid characteristics, such as density and viscosity, which are engineered to displace the drilling fluid while enabling placement of a complete cement sheath.

**Spacer (2)** – A spacer is used to separate incompatible fluids (i.e.: Drilling fluid and cement) but is compatible with both fluids. Spacers can be oil or water based. Oil based spacers are more compatible with oil based drilling muds and do not damage water sensitive formations however cement bonds better to water wet formations.

**Specific Gravity** - The ratio of fluid density to water density. Water has a specific gravity of 1.0.

**Specific Volume** – A graded sand in hydraulic fracturing. The “specific volume” of a granular material is the actual volume occupied by the grains.

**Spud** - To begin drilling; to start the hole; to break ground.

**Squeeze Cement** – A cement blend designed to be able to permeate small cracks and fissures.

**Squeeze Pressure** – The maximum or final pressure that can be applied during a squeeze operation.

**Stimulation** – A treatment that enhances or restores a well's productivity. Stimulation treatments fall into two main groups, hydraulic fracturing treatments, and matrix treatments. A frac treatment is done above the fracture pressure of the reservoir formation and creates a highly conductive flow path between the reservoir and the wellbore. Matrix treatments are done below the reservoir fracture pressure and typically are designed to restore the natural permeability of the reservoir following damage in the near wellbore area.

**Sulfate** – A salt mineral whose anion is the sulfate radical. (e.g.  $\text{SO}_4$ )

**Sulfide** – A compound of sulfide and another element. Hydrogen sulphide ( $\text{H}_2\text{S}$ ) or sour gas is often produced in deep foothills gas wells.

**Surfactant** – A chemical that acts as a surface active agent. This includes a multitude of materials that perform as dispersants, oil-wetters, water-wetters, emulsifiers, foamers and defoamers.

## T

**Tail Cement** – The last cement system pumped during a primary cement job. The tail cement covers the lower sections of the well, especially planned completion intervals, and is typically of higher density than the lead slurry that precedes it.

**Thickening Time** – The time it takes for a cement blend to become essentially un pumpable (deemed 100 Beardon units of consistency, Bc) while constantly being stirred. The thickening time is a function of the cement, its additives, temperature, density, pressure and surrounding media.

**Thief Formation/Thief Zone** - A formation that absorbs drilling fluid as it is circulated in the well. Lost circulation is caused by a thief formation. Also called a thief sand or a thief zone.

**Thin Section Petrography** – A technique to identify and quantify detrital matrix cement and pore components. It is also a good technique to describe the nature and distribution of porosity.

**Thixotropic** – Pertaining to the ability of a fluid, such as cement or drilling mud, to develop gel strength over time when not subject to shearing, and then to liquify when agitated. A good example of thixotropic fluid is ketchup.

**Tonne of Cement** – A tonne of cement is 1000 kg of cement plus pozzolan, to which all other additives are added. The other additives represent a particular percentage of the cement's weight.

**True Vertical Depth (TVD)** – The depth from surface without deviation.

**Tubing** - A small-diameter pipe that is run into a well to serve as a conduit for the passage of oil and gas to the surface.

**Turbulent Flow** – A type of fluid flow characterized by swirling or chaotic motion as the fluid moves along the flow path. This is a preferred flow regime for mud removal during a primary cement job because it is perceived to result in better removal of mud, especially of mud at the formation wall.

## U

**Unconformity** - An eroded surface which has been re-buried under younger sedimentary rock; an unconformity was therefore once an exposed surface.

**Underbalanced** – A condition in which pressure in the wellbore is less than the pressure in the formation.

## V

**Viscosity** - The resistance of a fluid to shear force and flow.

## W

**Wait on Cement (WOC)** – To suspend drilling operations to allow cement slurries to solidify, harden and develop compressive strength. The WOC time ranges from a few hours to several days, depending on the difficulty and criticality of the cement job in question. WOC time allows cement to develop strength, and avert development of small cracks and other fluid pathways in the cement that might impair zonal isolation.

**Water-Wet** – A solid that is in contact with a water phase. Water-wet rocks better absorb water. Typically sandstones and carbonates are water-wet.

**Weathering** - The physical and chemical process that reduces solid rock at the earth's surface into sediment.

## X

**X-Ray Diffraction (XRD)** – A rapid method to identify and quantify bulk and clay mineralogy.

## Y

**Young's Modulus** – Most rocks, prior to failure, will deform in an elastic manner. That is, when a load is applied and then removed, the deformation completely and instantly disappears. It is common to assume that in perfectly elastic materials, the strain is proportional to the induced stress. This constant of proportionality is the Modulus of Elasticity and is defined as:

$$E = \frac{\sigma_z}{S_z}$$

In a physical sense it represents the “stiffness” of a material.