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Glossary of Terms for HDD Environmental Drilling

Fostering Better Communications in the Environmental Industry

Horizontal directional drilling (HDD) is a relative newcomer to the environmental industry, and many practitioners find themselves confused when dealing with terms that are similar to well-known drilling terms, but mean something slightly different. We've compiled this glossary of terms to help foster better communication between HDD contractors and their clients, and promote better understanding through more accurate RFPs and proposals.

Disclaimer: As the leading HDD professionals specializing in environmental installations, DTD has developed some strong opinions about certain aspects of the technology. Although we have strived to keep our bias out of most of the terminology defined in this glossary, we have inserted our perspective in some of the terms. Hopefully you'll find this perspective enlightening as well!

air sparging – remediation technique – a method used to strip volatile contaminants from ground water by injecting air below the water table. The technique is often combined with soil vapor extraction. Some engineers sparge to increase dissolved oxygen in the groundwater and soil to enhance biodegradation. (See bioventing)

air stripping – remediation technique – a method used to strip volatile contaminants from ground water by injecting air below the water table. Essentially the same as air sparging, the technique is often combined with soil vapor extraction.

annular seal – well feature – A physical barrier that is placed within the annulus of a borehole, typically from the ground surface to a depth of approximately 20 feet or more. The seal prevents surface water from directly entering the borehole or from short-circuiting of air sparging or soil vapor extraction systems directly to the atmosphere. In a horizontal well, the annular seal typically comprises a bentonite plug, bentonite-cement grout, expanding polyurethane foam, an inflatable or other packer, or a combination of these.

annulus – well feature – The open volume between elements of a borehole or well. The borehole annulus is the open space between the walls of the boring being drilled and the drill string or well casing. Drilling mud usually flows through the borehole annulus while drilling. After the well materials are inserted, the borehole annulus (also called well annulus) is the open space between the well casing and the borehole walls. This is generally sealed in some manner near the surface.

back reamer – drilling tool – A tool designed to enlarge a pilot hole. A reamer is usually employed by attaching it to the drill string once the drill head exits the ground (in a surface to surface installation). The tool can also be used to forward ream a hole, but typically requires a pilot to be attached for this use.

bentonite – drilling material – A mineral used for making drilling mud and for sealing the upper part of a well annulus. Bentonite is a clay mineral, generally mined in Wyoming. It is noted for its ability to swell upon introduction of water into its crystal matrix, with different qualities of bentonite swelling (yielding) at different amounts and rates. Wyoming bentonite is typically high yield; the individual bentonite lattice structures swell to several times their original size when hydrated. Bentonite has traditionally been used as a drilling mud in vertical wells; it is used by most utility HDD contractors, as well. Bentonite has several advantages for general purpose drilling:

- ❖ It is inexpensive
- ❖ It is effective in building a filter cake that lines the borehole walls and prevents loss of drilling fluid and inflow of formation water during drilling
- ❖ Bentonite-based drilling mud supports the borehole walls well
- ❖ Bentonite-based drilling mud has relatively high viscosity and density, and effectively removes cuttings from the borehole
- ❖ Bentonite has a relatively high lubricity, and prevents friction during drilling and insertion of well materials.

The primary disadvantage of bentonite in an HDD well is that it is very difficult to remove from horizontal wells after completion. This is largely due to the very low open area of horizontal well screens, combined with borehole collapse in horizontal borings. This has a direct effect on well performance, since many of the features listed as benefits above during drilling become liabilities during well operation. For this reason, DTD uses bentonite infrequently, usually only in drilling projects where a well screen is not installed. The preferred alternative to bentonite for environmental wells is biodegradable polymer mud.

biodegradable polymer mud (biopolymer mud) – drilling material – A drilling fluid used in horizontal directional wells. The mud comprises a blend of naturally-derived vegetable gums that create long polymer chains when hydrated. These drilling fluids provide similar benefits as bentonite drilling mud while advancing the borehole, but break down to simple sugars and water after the well screen has been installed and developed. The primary advantage of biodegradable polymer mud is that it has no residual negative effect on well performance, as is the case with bentonite. The primary disadvantage of biodegradable polymer mud is its cost, which is several times that of bentonite for equal volumes. Biopolymer mud properties can be extremely variable depending on the proportions used in the mix, and inferior mixes are far less capable of creating a borehole seal and have less ability to carry cuttings from the borehole.

bioaugmentation – remediation technique – A method used to degrade environmental contaminants by introducing microorganisms to enhance cleanup. The microorganisms (bacteria or fungi) consume or alter the hazardous components, rendering them less harmful or binding them to prevent migration.)

bioremediation – remediation technique – A remediation technique used to degrade environmental contaminants using native microorganisms. Typical bioremediation methods increase the available nutrients or oxygen to native populations of microorganisms in order to enhance their activity.

bioventing – remediation technique – A method used to enhance bioremediation by increasing the oxygen supply to native *in situ* organisms.

blind well – drilling term – A horizontal, directionally drilled well that is drilled and completed from one end. These are also called single-entry wells. To install a blind well, a pilot bore is drilled at the desired location and depth, using a guidance system and steering. Then the pilot bit is removed from the borehole. In most cases the pilot bore must be reamed to a larger size prior to well casing installation, so a forward reamer is attached to the drill string and is advanced through the pilot bore. This may be done in stages, if the bore diameter is large. Finally, the reamer is removed and the well materials (screen and casing) are pushed into the borehole.

bore or borehole – drilling term – The elongated cavity created by the drilling process. Often the borehole is not a void, but rather a hole filled with drilling mud and cuttings. Well casing is pulled or pushed into the borehole to complete a well.

BOREGEL™ – drilling material – A drilling mud manufactured by BAROID consisting of bentonite, polymer, and soda ash. Typically used in horizontal directional drilling for utilities. Because it contains bentonite, BOREGEL is usually not suitable for environmental applications.

box – drilling term – The female thread portion of a drill rod.

bubbling pressure or **air entry value** or **threshold pressure** – remediation term – The pressure required to force air into the saturated zone.

cable sonde – drilling tool – A downhole transmitter or probe that is powered by electricity from the ground surface rather than batteries internal to the probe. The cable sonde is connected to a power source on the drill rig by a wire that is run inside the drill rod. With the addition of each rod to the drill string, a length of wire must be threaded through the rod and attached to the wire extending from the existing string. The surface end of the wire is attached to a swivel arrangement that provides electrical contact at the drill rig.

casing – drilling term – The non-perforated or non-slotted pipe that comprises the entry and exit sections of a horizontal well, as opposed to the well screen. Surface casing is a pipe that is set through loose surficial deposits to stabilize the bore so the deeper sections can be drilled without difficulty from caving or collapse in the upper section of the borehole.

chinese finger – drilling equipment – A woven wire device used to pull materials into a bore. The finger is placed over the material. When it is pulled, it tightens on the material, becoming tighter the harder it is pulled upon.

CleanDrill™ - drilling material – A biopolymer drilling powder manufactured by CETCO primarily consisting of corn starch, guar gum, and xanthan gum. When mixed with water the viscous drilling fluid is stable for 24-36 hours, after which time biological action begins to consume the long chain polymers and convert them to sugars and carbon dioxide. The thinning of the drilling fluid to the viscosity of water can be accelerated by injecting enzyme breaker or a hypochlorite solution into the well.

compaction reamer – drilling tool – A type of reamer that enlarges a borehole diameter through compaction of the soil surrounding it. In an environmental well, which requires good hydraulic communication with the surrounding formation, compaction of the formation surrounding the well bore is generally not beneficial.

CON DET® – drilling material – A water soluble anionic surfactant manufactured by BAROID used to prevent formation materials from balling and sticking to drilling tools.

cornstarch – drilling material – A common food ingredient, cornstarch is a polymer used to thicken liquids. The starch is concentrated from grains of corn by the removal of sperm, endosperm, gluten and other compounds. In drilling the cornstarch powder is mixed with other polymers to create a drilling fluid.

deflection – drilling term – The amount of flex exhibited by the drill rods. The drill head is steered by pushing it into the formation without rotation. There are limits to which the rods can be pushed before they deflect excessively.

double-entry well – drilling term – A horizontal, directionally drilled well that is drilled and completed from both ends. To install a double-entry well, a pilot bore is drilled at the desired location and depth, using a guidance system and steering. The pilot bore is steered to the surface at the distal end of the well, where the drill bit is removed. In most cases the pilot bore must be reamed to a larger size prior to well casing installation, so a reamer is attached to the drill string and is pulled back through the pilot bore. As the reamer is retracted, additional drill rods are added behind it, to maintain a continuous string of drill steel through the borehole. This may be done in stages, if the bore diameter is large. When the final diameter is achieved, the product line (well casing, conduit, etc.) is attached to the drill string and pulled back.

DrillTerge® – drilling material – A water soluble anionic surfactant manufactured by CETCO used to prevent formation materials from balling and sticking to drilling tools.

drilling mud – drilling material – aqueous slurry that is used during drilling to transport drill cuttings from the borehole, prevent borehole collapse, and provide lubrication for the drill string. Most horizontal drilling uses drilling mud of some sort, although in some conditions it is possible or preferable

to drill using air or water. Drilling mud made be made using the mineral bentonite, synthetic or natural polymers, or some combination of the two.

dry hole – drilling term – A condition that occurs when the drilling tools advance beyond the drilling mud. Typically caused by trying to advance the borehole too quickly.

EnviroFlex well screen – drilling material – A type of well screen, developed by DTD employees for horizontal well applications, that employs an internal filter membrane to prevent fine grained soil from entering the well interior.

enzyme breaker – drilling material – A liquid solution containing proteins produced through biological action that act as a catalyst to speed the biodegradation of the long chain polymers that compose biodegradable drilling fluids. CETCO manufacturers an enzyme breaker named LEB-CD to break down CleanDrill drilling fluid. The LEB-CD is mixed with low pH water and injected into the bore to break the drilling fluid.

EZ MUD® - drilling material – A polymer additive used to increase viscosity and gel strength of bentonite drilling mud.

fiberglass reinforced epoxy (FRE) – well casing and screen material – FRE has high tensile strength, moderate compressive strength and slots cut into the materials are dimensionally stable. It can be made with strong integral bell joints or relatively weaker flush outside diameter joints. The product is of moderate cost, more expensive than HDPE and less expensive than stainless steel.

filter cake – drilling term – The cake that forms along the walls of the borehole, composed of layered mineral platelets in bentonite-based drilling mud. Filter cake creates a barrier between the borehole and the formation, limiting the amount of drilling mud needed to complete the borehole and preventing influx of groundwater.

forward reamer – drilling tool – A type of reamer used to enlarge the diameter of the borehole in a blind or single-entry well.

frac out – drilling term – During normal drilling operations, drilling fluid flows from the drill head and travels up the borehole into a collection pit. If the borehole becomes obstructed, collapses, or the fluid pressure becomes too great inside the borehole, the fluid pressure can fracture the surrounding formation, creating a pathway for the fluid to migrate from the borehole, typically upward to the ground surface.

front locate point – drilling term – Walkover locating systems determine the azimuth of the drill head using the magnetic field created by the down hole transmitter (sonde). This magnetic field is hourglass in shape when viewed in map view, in front of the sonde the field is positive and behind the field is negative. The Front Locate is the point in the magnetic field created by the sonde where the field is both positive and oriented vertically.

gel strength – drilling term – The property of drilling fluid that permits it to suspend and transport drill cuttings from the borehole. More specifically defined as the [shear stress](#) measured at low [shear rate](#) after a [mud](#) has set quiescently for a period of time (10 seconds and 10 minutes in the standard [API](#) procedure, although measurements after 30 minutes or 16 hours may also be made).

guar – drilling material – A common food ingredient, guar is a polymer used to thicken liquids. It is produced by milling the dehusked seed of the Guar Tree (a species native to India and Pakistan). In drilling the guar powder is mixed with other polymers to create a drilling fluid.

high density polyethylene (HDPE) - well screen or casing material – HDPE is often used for horizontal environmental wells because of its flexibility, chemical resistance, cost, and moderate tensile strength. Its low compressive strength limits its use in blind well installation.

hydro-lock – drilling term – A condition where the well casing and screens become “locked” in the borehole during pullback. This occurs when borehole collapse traps drilling inside the borehole in front of or behind the well materials. Pressure increases (or decreases) to the point where the drill can no longer pull the casing into the hole.

hypochlorite – drilling material – Either calcium (powder) or sodium (liquid) based, these compounds are chlorine and bleach compounds typically used in cleaning and sterilization. Moderate concentrations of hypochlorite are used to rapidly reduce the viscosity of biopolymer drilling fluids.

inertial guidance system – drilling tool – A system used to navigate and steer an HDD drill, usually in deep and long bores that have precise bore path requirements. The systems uses gyroscopes and/or sensitive accelerometers connected via a wireline (run inside the drill rod) to a computational subsystem in order to locate and steer the drillhead in three dimensions. In environmental drilling, the system is most frequently used when boring depth, surface obstructions, and/or radio interference preclude the use of a walkover or Tru-Tracker system.

locator – drilling tool – A hand-held electronic device, operated by a steering technician on a drilling crew, which works in concert with a downhole sonde to determine the drillhead depth and horizontal placement during drilling operations. Locators are used in a walkover navigation system, which usually requires that the technician has physical access to the ground surface directly above the bore path. In a walkover system the sonde broadcasts a radio signal which contains the pitch and rotary orientation of the drillhead. In addition, the locator interprets a magnetic field emitted by the sonde to determine the horizontal position and depth. Displays on the locator present the depth, pitch, and rotary orientation for the steering technician to record. The locator also transmits the data to a remote display located at the drill rig for the driller’s interpretation.

Since the depth, location, and direction of the drillhead are computed from the strength and field shape of a broadcast electromagnetic field, this data can sometimes be distorted by local interference from electrical or electronic equipment or ferrous masses. The signal can be boosted, enabling use in deeper borings or in areas with electronic interference by using a wireline system, which replaces the battery with an electrical conductor that draws power from the drill rig electrical system.

For deep installations (75+ feet) or areas with other obstructions or interference, a different navigation system may be required. Common alternative systems use a surface coil to induce a magnetic field (Tru-Tracker), which is detected by downhole electronics, or systems that use a compact downhole inertial guidance system.

lubricity – drilling term – The lubrication properties of a given material. Certain drilling mud additives improve the lubricity in a borehole.

packer – well material – A mechanical device used to isolate segments of a borehole or well. Packers are used to divide a well into two or more separate compartments, which can then be managed individually, or to provide a part of an annular seal to prevent influx of surface water or communication of injected or extracted fluids (chemicals, air, or other) between the well and the surface.

pilot bore – drilling term – The initial boring made in a horizontal well installation. The pilot bore is steered, using any of several technologies, from a designated entry point, along a predetermined bore path, to a designated end point, either at the ground surface or at depth. The pilot bore subsequently may be reamed to a larger diameter to accommodate the desired size well screen and casing.

pin – drilling term – The male threaded end of a drill rod.

pitch – drilling term – The vertical angle of the drillhead in a horizontal drilling system, measured in either percent or degrees. Most walkover systems use percent while inertial or wireline systems measure in degrees. This provides a direct measurement of the dip of the drill string at or next to the drill bit.

polymer mud – drilling material – A type of drilling mud that is composed of long-chain organic molecules. Polymer mud may also be biodegradable. Biodegradable polymer mud is preferred for horizontal remediation well construction.

pothole – drilling term – a small hole excavated from the surface to a buried utility in order to provide positive verification of its location.

pre-pack casing – well material – A type of well screen that is constructed by telescoping a larger diameter well screen over a smaller diameter one, and filling the inter-screen space with a granular filtration material, such as sand, ceramic beads, or other media. The two screens are held in position by end caps. In horizontal environmental wells, pre-pack is often difficult to install due to its rigidity and is subject to breakage. See EnviroFlex well screen for an alternative.

rear locate – drilling term – when using a walkover locating system the point along the drilling path behind the drill bit and the front locate point. The point in the magnetic field created by the sonde where the field is both negative and oriented vertically.

reamer – drilling tool – a cutting tool used to enlarge the diameter of a borehole after the pilot bore has been drilled.

remote – drilling equipment – walkover equipment typically includes a direct reading receiver held by the locating technician and a remote unit that receives a radio signal containing information from the locator. The remote is located at the drilling machine and enables the driller to see the same information as the locator.

riser – well component – The non-slotted or non-perforated well casing that extends from a well screen to the ground surface.

rod wiper – drilling equipment – A rubber or synthetic grommet placed over the drill rods during pullback to strip excess mud from the rods before they are stowed.

screen – well material – Well screen is a slotted or perforated pipe, installed in a borehole, which enables hydraulic connection with the groundwater or soil gases in the surrounding formation. It is connected to well casing or riser pipe, which provides access to the ground surface for the installation of pumps, conveyance of fluids, sampling, etc.

sand pack – well material – In a vertical well, an attempt is usually made to create a graded filter system surrounding the well screen, by pouring sand down the borehole annulus, between the well screen and the bore wall. During development, this filter, called a “sand pack” rearranges to provide progressively greater filtration of fine soil particles with greater distance from the surface of the well screen. In a horizontal well, there is no practical, economical way to inject sand into the borehole annulus surrounding the well screen, which may be hundreds of feet long. Most horizontal wells are completed with a “natural filter pack” which is simply the creation of some degree of graded filter with the collapsed in situ soil material, through removal of fines by jetting and pumping.

single-entry well See Blind Well

sonde – drilling equipment – The downhole component of an electronic locating system. Same as a transmitter.

strike alert – drilling equipment – A protective device used while drilling that sounds an alarm if the drill string contacts a buried electrical utility.

thread compound – drilling material – An anti-seizing compound, frequently a high-pressure, copper-petroleum based grease, used to prevent the drill rods threads from seizing. It is also used to treat the threads on threaded well screen or casing. Environmentally-friendly, inert compounds are also available for sampling or remediation wells.

transmitter – drilling equipment – A sonde. The downhole component of an electronic locating system that is positioned directly behind the drill bit in the drill string. The device has gravity sensing accelerometers that allow determination of the sondes pitch and roll. This data is transmitted either by radio signal or direct continuous wire (inside the drill rod) to the ground surface and the locating technician. The device also emits a magnetic field that allows a determination of an over bit position when used in with a walk-over locator. The accuracy of the over bit position is affected by ferrous

metals (either in the ground or on the ground surface) that can warp the orientation of the magnetic field.

Tru-Tracker – drilling equipment – A steering tool (manufactured by Tensor™) that uses a sensor placed directly behind the drill bit and a wire-line coil placed on the ground surface. The wire-line coil's position is surveyed and when pulsed with DC current it creates an electromagnetic field of known orientation. The borehole position is determined by sensing the orientation and strength of the magnetic field at the sensor behind the drill bit.

wing cutter – drilling equipment – A reaming tool with wing-shaped extensions, used to expand the pilot hole to its final diameter. A wing reamer is used to effectively mix the soil cuttings with the drilling fluid for effective removal from the borehole.

Xanthan – drilling material – A common food ingredient, xanthan is a polymer used to thicken liquids. It is produced by the fermentation of a sugar by the [*Xanthomonas campestris*](#) bacteria. In drilling small quantities of xanthan are used to thicken and increase the carrying capacity of the drilling fluid.

