CHAPTER 5 Product Quick Reference

In addition to providing high quality completion fluids, TETRA strives to remain at the leading edge of technology by developing innovative products to meet the ever-changing needs of the industry. This chapter is designed to provide a quick reference to a number of the Company's more popular products.

RQ *Product names are marked with this icon to indicate that they contain at least one ingredient with an established EPA reportable quantity (RQ).*

This chapter will cover:

1. Clear Brine Fluids
2. Fluids Specially Blended to Control Fluid Loss
3. Breaker Technology
4. Bridging Agents
5. Corrosion Control Additives
6. Dry Salt Weight Material
7. Formation Protection Additives
8. pH Control and Buffering Agents
9. Rheological and Filtrate Control Products
10. Filtration Products
11. Chemical Displacement Products
12. Specialized Rental Equipment
13. Specialty Wellbore Cleanup Tools

Clear Brine Fluids

Single Salt Fluids

RQ **Ammonium Chloride (NH_4Cl) Solution.** A clear brine fluid, ammonium chloride is used as a single salt brine in densities ranging from 8.4 lb/gal to 8.9 lb/gal. Ammonium chloride is used as a completion, workover, and gravel pack fluid when the ammonium ion is preferred. Ammonium chloride is an inherently acidic brine that offers many properties that serve to minimize or prevent formation damage. Ammonium chloride brines are shale inhibitive and compatible with most formation water.

Calcium Bromide ($CaBr_2$) Solution. A clear brine fluid, calcium bromide is used as a single salt brine in densities ranging from 8.4 lb/gal to 15.2 lb/gal. It is used as a completion, workover, gravel pack, and packer fluid. It can also be used as a spike fluid to increase density in fluids up to 14.2 lb/gal. Calcium bromide is often used when the chloride ion is not desirable. Due to its inhibitive properties, calcium bromide can help reduce formation damage induced by clay swelling and dispersion.

Calcium Chloride ($CaCl_2$) Solution. A clear brine fluid, calcium chloride is used as a single salt brine in densities ranging from 8.4 lb/gal to 11.6 lb/gal. The divalent calcium ion (Ca^{+2}) inhibits clay swelling, dispersion, and migration. Calcium chloride is one of the most economical brines used in oilfield completion and workover operations.

Potassium Chloride (KCl) Solution. A clear brine fluid, potassium chloride is used as a single salt brine in densities ranging from 8.4 lb/gal to 9.7 lb/gal. Potassium chloride is used when the potassium ion is preferred. It is also an effective clay/shale stabilizer in water sensitive formations.

Sodium Bromide (NaBr) Solution. A clear brine fluid, sodium bromide is used as a single salt brine in densities ranging from 8.4 lb/gal to 12.7 lb/gal. A pure sodium bromide brine is often selected when the chloride ion is not desirable and when sodium is preferred over calcium. It is often used in situations where formation waters contain high levels of sulfate or carbonate that may precipitate with the calcium ion.

Sodium Chloride (NaCl) Solution. A clear brine fluid, sodium chloride is used as a single salt brine in densities ranging from 8.4 lb/gal to 10.0 lb/gal. Sodium chloride is chosen frequently due to its wide availability and low cost.

Multisalt Fluids

Calcium Chloride/Calcium Bromide ($CaCl_2/CaBr_2$) Blend. A clear brine fluid, calcium chloride/calcium bromide blend can be formulated to meet individual density and crystallization temperature requirements in the density range from 11.6 lb/gal to 15.1 lb/gal. Calcium chloride/calcium bromide blends are the most economical clear brine fluids at their available density range.

Sodium Chloride/Sodium Bromide (NaCl/NaBr) Blend. A clear brine fluid, sodium chloride/sodium bromide blend can be formulated to meet individual density and crystallization temperature requirements, covering the density range from 8.4 lb/gal to 12.7 lb/gal. A sodium chloride/sodium bromide blend is often used when the calcium ion is not desirable and costs are a concern, as it is less expensive than pure sodium bromide brines.

RQ **Zinc Bromide/Calcium Bromide/Calcium Chloride ($ZnBr_2/CaBr_2/CaCl_2$) Blend.** A clear brine fluid, zinc bromide/calcium bromide/calcium chloride blend can be formulated to meet individual density and crystallization temperature requirements above the density range from 15.0 lb/gal to 19.2 lb/gal. This blend is used primarily when higher densities are required.

Stock, Custom, and Specialty Fluids

RQ **Zinc Bromide ($ZnBr_2$) Solution.** A clear brine fluid, zinc bromide can be used as a single salt fluid when calcium ions (Ca^{+2}) or chloride ions (Cl^-) are undesirable. Zinc bromide is available as a 20.5 lb/gal (78 wt%) stock fluid and can also be used as a spike fluid in high density, three salt brines with densities greater than 18.0 lb/gal.

RQ **Zinc Bromide/Calcium Bromide ($ZnBr_2/CaBr_2$) Blend.** A clear brine fluid, zinc bromide/calcium bromide is available as a stock blend at densities of 19.2 lb/gal and 20.5 lb/gal, and as a specialty blend that can be designed to meet individual customer specifications. A zinc bromide/calcium bromide blend can also be used as a spike fluid in clear brine fluids.

Cesium Formate (CsO_2CH) Solution. A single salt, halide free brine fluid, cesium formate solution is available in densities up to 19.2 lb/gal.

Potassium Formate (KO_2CH) Solution. A single salt, halide free brine fluid, potassium formate solution is available in densities up to 13.1 lb/

gal. Potassium formate solution can also be used to reduce formation damage that is caused by clay swelling, dispersion, or migration.

Sodium Formate (NaO_2CH) Solution. A single salt, halide free brine fluid, sodium formate solution is available in densities up to 11.1 lb/gal.

Cesium/Potassium Formate (CsO_2CH/KO_2CH) Blend. A solid free, halide free multisalt fluid blend that is less expensive than the equivalent density of a pure cesium formate solution. These blends cover the density range from 13.1 lb/gal up to 19.2 lb/gal.

Sodium/Potassium Formate (NaO_2CH/KO_2CH) Blend. A solid free, halide free multisalt fluid blend that is available in densities from 8.4 lb/gal to 13.1 lb/gal.

Fluids Specially Blended to Control Fluid Loss

TETRAFlex™ FLC Seal. A premixed gelled polymer crosslinked pill, TETRAFlex FLC Seal pills can be formulated with sodium, potassium, calcium, and zinc completion based fluids, giving rise to a wide range of densities. TETRAFlex FLC Seal crosslinked pills can effectively control fluid loss in formations with permeabilities up to two darcies and bottomhole temperatures up to 250°F.

TETRA SmartSeal. A sized calcium carbonate pill, TETRA SmartSeal is used to treat moderate to high fluid losses by sealing the internal surfaces of screens in post gravel pack operations. The base clear brine fluid, polymeric carrying agents, and calcium carbonate particle size distribution are each selected for individual well applications. TETRA SmartSeal is used in conjunction with the TETRA SmartSeal Pad to provide high bridging efficiency, high return permeability numbers, and maximum liftoff at low pressures.

TETRA SmartSeal Pad. A solid free pill, TETRA SmartSeal Pad is used in conjunction with TETRA SmartSeal. It protects the integrity of TETRA SmartSeal and facilitates easy liftoff of the sealing cake. The SmartSeal Pad contains TETRA's proprietary releasing agent and is formulated with the identical base fluid and polymeric carrying agents as the TETRA SmartSeal pill with which it will be used.

Breaker Technology

TETRA carries an extensive range of unique breaker products that permit the degradation of filter cakes or fluid loss pills from ambient to high temperatures and in the presence of low to high density fluids. With TETRA's patented technology, breaker products can be formulated to remove the polymeric binding agents and release the bridging materials either as discrete particles or degraded material. The break time can be controlled by careful formulation to facilitate the removal of both the binding and bridging agents.

Breaker Products. TETRA's breaker products cover a wide range of applications with respect to specific temperatures and densities. Some of these products have proven to be especially effective at low temperatures. After being circulated into place, these breaker products are usually left until the well is brought online.

RQ **TETRAVis™ Breaker.** A viscosity breaker, TETRAVis Breaker is designed with the ability to incorporate a time delay in the breaking of an HEC pill.

Bridging Agents

Microfiber Bridging Agents

Microfibers are specially manufactured, acid soluble mineral fibers. The mineral fibers are long and flexible and will interlock to form a strong, dense filter cake. Microfibers are recommended for bridging and plugging voids and fractures. They are also the preferred choice to treat lost circulation in wells with high bottomhole temperatures. Microfibers are thermally stable in excess of 500°F and are compatible with fresh water, completion brines, and diesel oil based muds.

TETRA Magmafiber Regular®. Composed of fine acid soluble microfibers, TETRA Magmafiber Regular is used to build a robust filter cake. TETRA Magmafiber Regular is recommended to seal microfractures as well as permeable and underpressured sand formations.

TETRA Magmafiber Fine®. Composed of medium sized acid soluble microfibers, TETRA Magmafiber Fine is used to build a robust filter cake. TETRA Magmafiber Fine is recommended to bridge and plug voids and fractures.

Calcium Carbonate Bridging Agents

Calcium carbonate ($CaCO_3$) bridging agents are acid soluble. They effectively bridge and seal formations with low to moderate porosity and permeability, and they enhance filter cake characteristics. Calcium carbonate bridging agents are used as the primary bridging agents in TETRA fluid loss control pills to rapidly establish an effective filter cake across permeable intervals during drilling operations.

TETRACarb Prime. A fine grind, high purity calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Prime has a particle size distribution ranging from 2.0 to 150 microns and a D_{50} value of 12 microns. TETRACarb Prime is sized to flow through prepacked screens without bridging and to be easily removed by acidizing.

TETRACarb Ultra. An ultra fine grind, high purity calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Ultra exhibits a narrow particle size distribution ranging from 1.5 to 20 microns and a D_{50} value of four microns. TETRACarb Ultra is sized to flow through prepacked screens without bridging and to be easily removed by acidizing. It is primarily used in prepack fluids as a bridging and sealing agent to maintain filter cake integrity across production intervals, while sand control tools, such as prepacked screens, are being used.

TETRACarb Fine. A select grind, high purity calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Fine has a particle size distribution ranging from 10 to 500 microns and a D_{50} value of 55 microns.

TETRACarb Medium. An intermediate range, select grind calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Medium has a particle size distribution ranging from 85 to 1200 microns and a D_{50} value of 370 microns.

TETRACarb Coarse. A select grind, sized calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Coarse has a particle size distribution ranging from 1000 to 3500 microns and a D_{50} value of 1800 microns.

TETRACarb Flake. A sized calcium carbonate ($CaCO_3$) bridging agent, TETRACarb Flake has the physical dimensions of a flat, sheet like material, rather than a conventional spherically shaped calcium carbonate.

Sized Salt Bridging Agents

Sized salt bridging agents are made from selected grades of sodium chloride (NaCl). Sized salt bridging agents are designed to provide optimum bridging and sealing of productive intervals. They are easily

removed by applying undersaturated sodium chloride brine fluid, produced water, or fresh water.

TETRA SS Fine. A select grind sodium chloride (NaCl) bridging agent, TETRA SS Fine has a particle size distribution of 1.0 to 800 microns and a D_{50} value of 48 microns. It is used to control seepage.

TETRA SS Medium. A select grind sodium chloride (NaCl) bridging agent, TETRA SS Medium has a particle size distribution of 100 to 1500 microns and a D_{50} value of 500 microns. It is used to control seepage and lost circulation.

TETRA SS Coarse. A select grind sodium chloride (NaCl) bridging agent, TETRA SS Course has a particle size distribution of 1,000 to 10,000 microns. It is used to control lost circulation.

Corrosion Control Additives

RQ **CORSAF™ SF Corrosion Inhibitor.** This amine based corrosion inhibitor is designed for use with solid free brines. CORSAF SF corrosion inhibitor is effective for sodium, potassium, calcium, and zinc brines. It is a water soluble, film forming amine that can be used at temperatures up to at least 350°F. CORSAF SF corrosion inhibitor is recommended for use in the treatment of brines in well applications utilizing chrome alloys where a thiocyanate based inhibitor is not appropriate. CORSAF SF may be used in conjunction with OxBan and OxBan HB oxygen scavengers.

RQ **TETRAHib™ Corrosion Inhibitor.** This water soluble, multi component, inorganic, film forming corrosion inhibitor is designed for use in low density clear brine fluids such as potassium chloride, sodium chloride, and calcium chloride. TETRAHib corrosion inhibitor is particularly effective in environments where hydrogen sulfide and carbon dioxide are present.

RQ **TETRAHib™ Plus Corrosion Inhibitor.** This water soluble, inorganic, film forming corrosion inhibitor is designed for use in midweight and high density clear brine fluids, including calcium chloride, calcium bromide, and zinc bromide brines. TETRAHib Plus corrosion inhibitor is effective at bottomhole temperatures from 100°F to 450°F. It effectively retards the rate of corrosion in calcium chloride and calcium bromide CBF environments. Unlike standard filming amines, TETRAHib

Plus corrosion inhibitor is compatible with most elastomers common in packer and seal assemblies.

Antimicrobial Biocide. This antimicrobial biocide solution is recommended in water based drilling, completion, and workover fluids. It is effective against sulfate reducing bacteria, iron bacteria, and bacterial slime formers, which cause bacterially induced corrosion.

RQ **OxBan™ Oxygen Scavenger.** This oxygen scavenger consists of a specially formulated, concentrated liquid inorganic sulfite. OxBan oxygen scavenger eliminates oxygen as a corrosion promoter in fresh water and low density oilfield completion and workover fluids. It is designed for use in clear brine fluids containing monovalent ions such as sodium and potassium. Use of OxBan oxygen scavenger with chrome resistant alloy (CRA) metallurgy should be avoided.

Use of OxBan oxygen scavenger with CRA metallurgy should be avoided. OxBan HB should be used instead.

OxBan™ HB Oxygen Scavenger. This oxygen scavenger comprises a proprietary blend of polyfunctional organics that eliminates oxygen in midweight to high density fluids containing monovalent and divalent ions such as sodium, potassium, calcium, and zinc. OxBan HB oxygen scavenger is compatible with seawater. Additionally, it will not form undesirable byproducts with calcium or zinc brine fluids. Because it is free of sulfur containing chemicals, OxBan HB can be used safely with CRA metallurgy.

Dry Salt Weight Material

RQ **Ammonium Chloride (NH_4Cl).** A dry, 99% purity salt, ammonium chloride is used as weight material to increase density in completion fluids ranging from 8.4 lb/gal to 8.9 lb/gal. Ammonium chloride is an effective clay stabilizer and can be used to prevent formation damage after an acid treatment.

Calcium Bromide ($CaBr_2$). A dry, 95% purity calcium based salt, calcium bromide is used to increase density in higher density calcium based completion fluids.

EXPRESS® Calcium Chloride ($CaCl_2$). A dry, 94-97% purity calcium based salt, EXPRESS calcium chloride is used to increase density in completion fluids.

Potassium Chloride (KCl). A dry, 98% purity salt, potassium chloride is used as weight material to increase density in lightweight completion fluids. Potassium chloride can also be added to unsaturated calcium or sodium brines as an effective clay stabilizer.

Potassium Formate (KO_2CH). A dry, organic, 97% purity salt, potassium formate is used as weight material to increase density up to 13.1 lb/gal in formate based completion fluids.

Sodium Bromide (NaBr). A dry, 98% purity salt, sodium bromide is used as weight material to increase density in higher density sodium based completion fluids.

Sodium Chloride (NaCl). A dry, 99% purity salt, sodium chloride is used as weight material to increase density in sodium based completion fluids.

Sodium Formate (NaO_2CH). A dry, granular, organic, 97% purity salt, sodium formate is used as weight material to increase density up to 11.0 lb/gal and when making solid free completion fluids.

Formation Protection Additives

FerroBan™ Iron Control Agent. An organic iron reducer and sequestrant, FerroBan iron control agent is recommended for use in monovalent and divalent brines. It reduces ferric iron to the more preferable ferrous iron, which has a greater stability and solubility at a wider range of pH levels and in a wide variety of fluids. FerroBan iron control agent also maintains iron in solution by chelation, thereby preventing iron hydroxide and sulfide precipitation.

CT 100 FR Friction Reducer. A friction reducing additive, CT 100 FR friction reducer is used in coiled tubing operations.

CT Foam. A coiled tubing agent, CT Foam is designed to lighten hydrostatic pressure to allow a well to flow. It can also be used during cleanup operations to aid in circulating debris from the well.

PayZone® NE 200 Emulsion Preventor. An emulsion preventor that is designed to work with calcium based fluids, PayZone NE 200 emulsion

preventor inhibits the development of emulsion caused by a mixture of completion fluid and hydrocarbons, which impedes the formation's ability to transmit fluids and can cause formation damage.

PayZone® NE 300 Emulsion Preventor. An emulsion preventor that is designed to work with zinc based fluids, PayZone NE 300 emulsion preventor inhibits the development of emulsion caused by a mixture of completion fluid and hydrocarbons, which impedes the formation's ability to transmit fluids and can cause formation damage.

PayZone® Stay Clay Stabilizer. A proprietary clay stabilizing additive that is compatible with all completion fluids, PayZone Stay clay stabilizer is used to stabilize and prevent hydration and swelling in interstitial clay.

PayZone® StrataGlide Lubricant. A lubricant that is designed to be used in drilling applications, PayZone StrataGlide lubricant provides relief from friction between the drill string and the wellbore.

pH Control and Buffering Agents

RQ **Acetic Acid ($C_2H_4O_2$).** A mild organic acid, acetic acid is used to lower the pH level in clear brine completion fluids. Acetic acid is less corrosive than strong mineral acids.

Buff-10. An alkaline material, Buff-10 is used to establish alkalinity and resist pH changes up to a pH level of 10 in fresh water or brine systems.

Buff-6. An organic carboxylic acid, Buff-6 is used to buffer pH to a moderately acidic level.

RQ **Caustic Potash (Potassium Hydroxide, KOH).** A strong mineral base, caustic potash is used to increase pH levels in potassium based clear brine fluids.

RQ **Caustic Soda (Sodium Hydroxide, NaOH).** A strong alkaline (base) compound, caustic soda is used to control the alkalinity in sodium based clear brine fluids.

Citric Acid ($C_6H_8O_7$). A mild organic acid with strong metal complexing capabilities, citric acid is used predominately in sodium and potassium based clear brine fluids to increase the pH level. Citric acid is less corrosive than strong mineral acids.

Hydrochloric Acid (HCl). A strong mineral acid, hydrochloric acid is used to decrease the pH level in halide based clear brine fluids and to degrade calcium carbonates.

Lime ($Ca(OH)_2$). A mild mineral base, lime is used to increase the pH level in calcium based clear brine fluids.

Magnesium Oxide (MgO). A strong alkaline earth base, magnesium oxide is capable of increasing the pH level up to 10.0 in sodium/potassium based halide and formate clear brine fluids as well as calcium based halide clear brine fluids.

Soda Ash (Sodium Carbonate, Na_2CO_3). A high, purity base, soda ash is used as a chemical precipitant for calcium in sodium based brine fluids. Soda ash reacts with available calcium to form calcium carbonate, which is then removed through filtration. Large amounts of soda ash can increase pH levels.

Rheological and Filtrate Control Products

ActiVis™ Viscosifier. Environmentally friendly, ActiVis viscosifier is a liquid HEC viscosifier. The recommended treatment concentration range of ActiVis viscosifier easily passes the U.S. Gulf of Mexico's 96-hour acute toxicity test.

BioPol™ Viscosifier. A complex, high molecular weight polymer, BioPol viscosifier is used as a viscosifier and suspending agent in clear brine fluids, spacers, and fluid loss control pills. It is highly resistant to shear degradation and acts to elevate the yield point and shear rate viscosity, enhancing hole cleaning and promoting gel strength development for suspension. BioPol viscosifier provides stable rheology to temperatures in excess of 250°F. It is a fine, granular product that is easily dispersed in clear brine fluids.

BioPol viscosifier can be used at higher temperatures with certain clear brine fluid systems.

BioPol™ L Viscosifier. A liquid, high molecular weight polysaccharide polymer in a light hydrocarbon based oil, BioPol L viscosifier is used as a primary viscosifier and suspending agent for clear brine fluids, spacers, and fluid loss control pills. It is highly resistant to shear degradation and

acts to elevate the yield point and shear rate viscosity, enhancing hole cleaning and promoting gel strength development for suspension. BioPol L viscosifier provides stable rheology to temperatures in excess of 250°F. It is an easily mixed liquid product.

BioPol™ HT Viscosifier. A dry polymer that is more compatible with divalent clear brine fluids, BioPol HT viscosifier provides stable rheology at temperatures up to 300°F.

PayZone® HPS. A chemically modified high performance starch, PayZone® HPS is used to reduce fluid invasion into the reservoir. The addition of PayZone HPS to a brine based drill-in fluid or a fluid loss control pill reduces API and HPHT filtration rates.

PseudoPol™ Polymer. A proprietary, high performance, temperature tolerant polymeric viscosifier, PseudoPol polymer is designed for use during drilling operations and in high temperature fluid loss control applications. It is extremely stable at high temperatures and provides excellent drill cutting integrity. PseudoPol polymer reduces the API and HPHT filtration rates of brine based drill-in fluids and fluid loss control pills at temperatures up to 325°F. It mixes easily into the active system and tolerates high levels of calcium and zinc.

PseudoPol™ D Polymer. A dry, high performance synthetic polymer, PseudoPol D polymer is used to control filtration rates in lower density clear brine fluids.

PseudoPol™ HT Polymer. A dry, synthetic polymer, PseudoPol HT polymer has all of the performance characteristics of PseudoPol polymer at temperatures exceeding 325°F. PseudoPol HT polymer is used for high temperature fluid loss control.

PseudoPol™ HT Liquid Polymer. A high performance, synthetic liquid polymer, PseudoPol HT liquid polymer is used as a viscosifier and to control filtration rates in higher density brines.

TETRAFlex™ 110 Polymer. A prehydrated gel, TETRAFlex 110 polymer is used in the formulation of crosslinked polymer pills that function as nondamaging fluid loss control/lost circulation control pills. TETRAFlex 110 can be used in conjunction with sodium, potassium and calcium completion brines with densities less than 12.0 lb/gal. TETRAFlex 110 crosslinked pills can effectively control fluid loss on formations with permeabilities up to two darcies and bottomhole temperatures up to 250°F.

TETRAFlex™ 135 Polymer. A prehydrated gel, TETRAFlex 135 polymer is used in the formulation of crosslinked polymer pills that function as

nondamaging fluid loss control/lost circulation control pills. It can be used in sodium, potassium, calcium, and zinc completion brines with densities greater than 12.0 lb/gal. TETRAFlex 135 crosslinked pills can effectively control fluid loss in formations with permeabilities up to two darcies and bottomhole temperatures up to 250°F.

TETRAVis™ Viscosifier. A dry HEC polymer, TETRAVis viscosifier is used to viscosify low density clear brine fluids.

TETRAVis™ L Viscosifier. A concentrated, multipurpose, liquefied HEC polymer, TETRAVis L viscosifier is used in low density clear brine fluids.

TETRAVis™ L Plus Viscosifier. A double strength, liquefied hydroxyethylcellulose (HEC) polymer, TETRAVis L Plus viscosifier is suited for use in most completion and workover fluids. It provides a wide range of viscosities for fluid loss control, hole cleaning, spacer formulation, and gravel pack applications. TETRAVis L Plus viscosifier also functions as a friction reducing agent. The liquid formulation provides superior dispersability characteristics and general ease of handling. It is degradable by time, oxidizing agents, enzymes, and temperatures above 275°F.

TETRAVis™ Extender. An amine-glycol thermal extender, TETRAVis Extender is typically recommended for use with TETRAVis products.

TETRA Temperature Stabilizer. An antioxidant temperature stabilizer, TETRA Temperature Stabilizer is used in the formulation of fluid loss control pills.

Filtration Products

Filtration Equipment

SafeDEflo™ Plate and Frame (DE) Filtration Units. TETRA's SafeDEflo plate and frame diatomaceous earth (DE) filtration systems are recommended for filtering brines, chemicals, and produced water in completion, stimulation, and workover operations. There are five sizes available: SafeDEflo 600, SafeDEflo C600, SafeDEflo 1100, SafeDEflo 1300, and SafeDEflo 1500. The SafeDEflo 600 and C600 units are recommended for use in wells with volumes up to 500 barrels, and the SafeDEflo 1100, 1300, and 1500 units are recommended for use in wells with volumes greater than 500 barrels.

SafeDEflo™ Automated DE Delivery System. The SafeDEflo automated DE delivery system facilitates the quick and safe handling of filtration media. The system includes an automated dispensing system and control panel as well as preloaded intermediate bulk carriers (IBCs) containing either medium or fine DE filter media. Each IBC holds 1,000 pounds of filter media. The SafeDEflo automated DE delivery system can be used with TETRA's SafeDEflo 1100, SafeDEflo 1300, and SafeDEflo 1500 plate and frame filtration systems.

Cartridge Filtration Unit. TETRA's dual pod filtration cartridge unit is recommended for filtering brines, gels, chemicals, and produced water in completion, stimulation, and workover operations. The pods are connected by a manifold, providing staged filtration capability. Staged filtration utilizes cartridge filters with different ratings to maximize filtration efficiency. Cartridge filtration is designed for use with fluids containing a low percent by volume of suspended solids. Cartridge filtration is not economical when fluids are contaminated with oil or other substances.

Filtration Consumables

Celatom FW 60 Diatomaceous Earth (DE). Celatom FW 60 diatomaceous earth is a general purpose brine filter aid. It has a relatively coarse particle size (median particle diameter 48 microns) and is used in routine filtration operations.

Celatom FW 20 Diatomaceous Earth (DE). Celatom FW 20 diatomaceous earth has a slightly smaller particle size (median particle diameter 33 microns) and slightly lower permeability than Celatom FW 60 diatomaceous earth. It is used in applications where clarity is of the utmost importance and the additional head loss can be tolerated.

TETRA C2 Pleated Cellulose Filtration Cartridges. Pleated cellulosic filtration cartridges (PCCs) are of a fixed pore construction of high quality cellulosic fibers bonded with phenolic resin. The PCCs are recommended for completion, workover, and stimulation operations as well as for diatomaceous earth (DE) guard filtration. These cartridges have a beta ratio of 1000 at two microns. (See "Filter Rating Systems," beginning on page 209.)

TETRA PP2 Pleated Polypropylene Filtration Cartridges. Pleated polypropylene filtration cartridges (PPCs) are made from pure polypropylene. The PPCs are recommended for completion, workover, and stimulation operations as well as for diatomaceous earth (DE) guard filtration. PP2 cartridges have a beta ratio of 100 at two microns. (See "Filter Rating Systems," beginning on page 209.)

Resin Bonded Filtration Cartridges. Resin bonded filtration cartridges (RBCs) are long life, nominally rated, filter elements that are especially suited to viscous liquids and high flow rate applications. The RBCs are recommended for completion, workover, and stimulation operations as well as for diatomaceous earth (DE) guard filtration.

Chemical Displacement Products

TDSP™ I. Incorporating a blend of polymers and a variety of weight material, TDSP I weighted spacers are specially formulated to fit the given circulating temperature and density requirements. The thermal stability of TDSP I weighted spacers can be enhanced up to 450°F.

TDSP™ II OMD. A surfactant wash and dispersant consisting of oxylated alcohols and water, TDSP II OMD surfactant wash spacers are used to remove water based and diesel oil based mud residue.

TDSP™ II O-Sol. Used during the surfactant wash stage of a displacement, TDSP II O-Sol surfactant wash spacers are used to disperse diesel oil based and synthetic oil based mud residue.

TDSP™ II O-Sol Plus. Comprising a combination of surfactants, TDSP II O-Sol Plus surfactant wash spacers are designed for greater cleaning. They can be mixed with fresh water, saltwater, or an 11.6 lb/gal clear brine fluid.

TDSP™ III. A blend of polymers and thermal stabilizers, TDSP III viscosified sweep spacers are mixed in high density brines in accordance with specific wellbore conditions. TDSP III viscosified sweep spacers are designed to remove any residual materials that are dispersed by the surfactant wash spacer.

TETRA OMD. A dispersant, TETRA OMD is used to clean casing and tubing of water based and diesel oil based mud residue during the displacement of mud by a clear brine completion fluid. TETRA OMD is also effective at cleaning oil mud residue from rig mud pits and surface equipment prior to receiving clear brine fluids on location.

TETRA O-Sol. Comprising a proprietary blend of surfactants, TETRA O-Sol is designed to disperse and remove diesel oil based and synthetic oil based muds. Additionally, it is used in the formulation of TDSP II O-Sol surfactant wash.

TETRASol. Made up of a proprietary blend of surfactants and solvents, TETRASol removes hydrocarbons, oil based materials, pipe dope, asphaltines, and resins from metal surfaces. TETRASol can be used onshore and offshore as a concentrate to displace diesel oil based muds from the wellbore prior to introducing a completion fluid.

TETRA Dirt Magnet. A displacement fluid, TETRA Dirt Magnet works to flocculate mud, pipe dope, sand, oil, polymers, and other solids. TETRA Dirt Magnet should be used to remove solids and oil from the wellbore prior to introducing a completion fluid.

TETRAClean™ System. An environmentally friendly displacement system that can be designed for wellbore cleanup of water based as well as diesel oil based and synthetic oil based muds. The TETRAClean system is a one pill system that contains wellbore cleanup surfactants and suspension polymers that act to disperse, remove, and suspend solids in one sweep. This system can be utilized in direct and indirect displacements and has been used successfully in the North Sea in numerous displacement operations.

TETRAClean™ 105. An environmentally friendly surfactant, TETRAClean 105 is used in the formulation of TETRAClean systems. TETRAClean 105 has the best environmental rating possible for the North Sea.

TETRAClean™ 106. An activator, TETRAClean 106 is used to boost the cleaning power of TETRAClean 105. TETRAClean 106 is used in noncalcium containing clear brine fluids.

Specialized Rental Equipment

Coiled Tubing Solid Control System. The coiled tubing solid control system provides solid control and chemical blending capabilities during coiled tubing operations. The equipment package consists of a 200-barrel open top tank and a hydraulically operated shale shaker and gas buster assembly. The tanks contain three separate compartments, two of which aid in the gravimetric settling of solids and a third which contains a gunline circulating system for blending chemical additives. The hydraulically operated shale shaker and gas buster assembly allows operating personnel to view and collect real-time samples of debris such as bridge plugs, composite plugs, cement, and sand. This feature allows our fluid engineers to modify circulating fluid properties to improve well cleaning operations. Improving the control of solids increases the rate of

penetration and may reduce the time required for coiled tubing and well intervention operations.

Frac Water Supply Equipment. TETRA's Frac Water Supply Solutions utilize high volume pumps, large aluminum tubulars, specialized filters, and an array of chemical additives to supply water to live frac operations at rates up to 200 bbl/minute. Along with providing the water supply pumping operation, the best source of water supply is procured and tested as acceptable for frac use. Special patented frac tank gauges monitor volumes for this operation and prevent personnel from climbing the tanks to monitor volumes. This service reduces heavy truck traffic and also reduces location pad size requirements by limiting the number of frac tanks required for frac jobs.

Specialty Wellbore Cleanup Tools

AdvanceClean™ Brush Tool. The AdvanceClean brush tool is a self stabilizing tool with high tensile strength stainless steel brushes. The design eliminates the need for a separate stabilizer. The proprietary, spring loaded brushes work independently to permit contact with the entire surface area, including any casing irregularities.

AdvanceClean™ Scraper Tool. The AdvanceClean scraper tool is a self sharpening tool with a patented, opposing blade design. It is recommended when working in high solid environments.

AdvanceClean™ Brush/Scraper Combination Tool. The AdvanceClean brush/scraper combination tool is a cleanup tool equipped with both brushes and scrapers. It is an economical alternative to running two tools in undemanding environments and shallow wells.

AdvanceClean™ Circulating Tool. The AdvanceClean circulating tool allows a high circulation rate and annular velocities above liner top to assist in well cleaning. The tool's multiaction feature allows for changing tool position, reciprocating, or rotation.

Flow Check Sub Tool. The flow check sub tool is a flow control tool that blocks fluid down flow, diverting the fluid flows through an accompanying tool. It is ported to allow fluid movement to the annulus below the plug, it is easily modified to allow partial flow through its ports, and it can be modified to redirect fluid flow. Additionally, a check valve prevents reverse fluid flow.

Multi-Use Waste Retriever Tool. The multi-use waste retriever tool is a uniquely designed waste retriever system that can be utilized either as a sealed annular waste retriever or as a more conventional junk basket waste retriever. This waste retriever tool is multifunctional in that it can be used with a labyrinth seal to prevent fluid and debris flow around the tool, or can be used without the seal to serve as a conventional junk basket waste retriever. Its large capacity basket holds five U.S. gallons.

AdvanceClean™ Riser Brush Tool. The AdvanceClean riser brush tool is a large adaptation of the time and field proven AdvanceClean casing brush. It is used to remove caked material from the wall of the riser system during displacement operations to enhance chemical cleanup performance. For tough jobs such as gumbo buildup within the riser, its brushes can be changed to conventional scraper blades and it can be run to eliminate this buildup. The tool provides redundant 100% coverage of the riser wall with the patented blade angle design of its long stainless steel brushes. This blade angle allows unrestricted fluid flow and complete bypass of cuttings and debris. Additionally, its brushes are protected by a stabilizer element, located on the mandrel, which also ensures uniform 360° brush contact with the riser wall.

Riser Waste Retriever Tool. The riser waste retriever tool is a special type of junk basket used to capture heavy solids that are generally not easily removed from the riser and/or the wellbore during displacements or riser cleanup displacements. With its 14 U.S. gallon capacity basket, the tool is effective in the removal of heavy solids. Additionally, the riser waste retriever tool is designed with a series of Venturi jets (patent pending) that manipulate fluid flow to assist in the capture of solids and includes automatic drains for fluid removal.

Riser Jet Tool. The riser jet tool is a three position fluid flow jetting tool that has been designed to clean riser walls and subsurface BOP stacks using jet nozzle force to efficiently remove attached solids from these areas. The three position design allows for fluid flow direction toward the riser and BOP wall or toward the end of the work string. All fluid flow positions are designed to easily handle flow rates of more than 20 bbl/min. Flow direction is changed by the use of darts that can be easily removed if necessary.

Selective Rotation Circulating Tool. The AdvanceClean™ selective rotation circulating tool is a multi-functional, mechanically activated flow tool. Run in the extended position, flow ports are sealed and rotational drive is transmitted through the tool. Exceed the preset shear force to allow the tool to stroke and close. Flow ports are now open and the drive is disengaged, thereby allowing free rotation above the tool.

Swivel Tool. The swivel tool is designed for use with the circulating tool. It allows rotation of the work string in an upper section of the wellbore, while preventing rotation of the work string in a lower section of the wellbore. This feature is sometimes necessary due to mechanical or geometric limitations in the wellbore. The tool is sealed to prevent fluid bypass at the swivel and is designed for wobble resistance.

Wellhead Jet Tool. The wellhead jet tool is a single body tool designed to thoroughly clean the wear bushing of the wellhead as well as subsea BOP stacks at high flow rates. The tool consists of 16 size-adjustable jets that can be easily manipulated for a desired impact force. With its large ports, this tool can easily handle flow rates in excess of 20 bbl/min.

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