

The background of the slide is a silhouette of an oil well pumpjack against a bright yellow and orange sky, likely at sunrise or sunset. The pumpjack's long arm and counterweight are prominent. To the left, there is a vertical red bar with a gradient from dark red at the top to bright red at the bottom. Two semi-transparent grey rectangular boxes are overlaid on the image, containing text.

Oil & Gas Industry

Oil Well Productivity
POWERED BY SCIENCE

OIL WELL PRODUCTIVITY

Putting the science of DuPont to work for our customers has allowed us to develop a wide range of products made specifically for enhancing oil well productivity in the oil and gas industry. Whether you're looking for stimulation additives, drilling fluid agents, surface tension reduction or bacterial control, DuPont has the products for your application, operational needs, critical issues, and your definition of success.



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DuPont™ Tyzor® Organic Zirconates and Titanates

Used to improve the recovery of oil and gas from production wells in a variety of applications including hydraulic fracturing, drilling, enhanced oil recovery.



Products

- Tyzor® products most commonly used in oil and gas field applications are water-stable chelates of zirconium or titanium. Selection of the proper grade depends on the fluid formulation and the conditions of the treatment process.
- A broad range is available for solvent, solvent-free, and water-based applications.

Functionality

- **As Crosslinkers** of functionalized polymers containing OH & COOH groups. This includes the guar and derivatized guar carbohydrate polymers traditionally used in hydraulic fracturing fluids, as well as newer synthetic polymers.
- Crosslink fatty acids and metal oxides to form materials which act as fluid loss additives in drilling fluids. Crosslinked surfactants may be used to stabilize these fluids against inorganic salt contamination also.
- **As Delay Agents;** Tyzor® DLA acts to slow the rate of crosslinking of polymers by Tyzor® zirconates and titanates. This allows fine tuning of crosslinking rates for optimal down-hole performance.

Applications

Hydraulic Fracturing

- Crosslink functionalized polymers (e.g. guar, its derivatives) to create viscous gels that can be used to fracture subterranean formations and carry proppants into these fractures.
- Choose from a variety of products to select an optimum crosslinker for particular treatment conditions
- In some cases, delayed cross-linking is required so that crosslinking does not occur prematurely. Tyzor® DLA is an effective, general-purpose delay additive when used in combination with Tyzor® crosslinkers.

Drilling Fluids

- Fluid-loss reduction agents prepared by reacting Tyzor® with a fatty acid (e.g. oleic / stearic acid) and a metal oxide.
- Stabilize drilling fluids against inorganic salt contamination using an additive prepared from an anionic emulsifier (e.g. calcium dodecyl benzene sulfonate) and Tyzor®

Enhanced Oil Recovery

- Used to create diverting zones in enhanced oil-recovery operations; formation of amorphous, gelatinous metal oxide plugs from hydrolysis of zirconium and titanium esters.
- Polymers (e.g. polyacrylamides) can be crosslinked with Tyzor® to form gelatinous fluid needed to selectively block and control fluid flow through a subterranean formation.

DuPont™ Zonyl® Fluorosurfactants

Well stimulation additives

Extremely effective at low concentrations and can be used in combination with existing surfactants in well stimulation fluids for faster, more complete fluid recovery.

Functionality

Very Low Surface Tension (16 dynes/cm)

- Better wetting of rock
- Low pressure/low permeability
- Reduces worm holes
- Prevents capillary blockage

Stable in Harsh Environments

- Thermal
- Chemical

Minimize formation damage

Provide foaming properties

Decrease need for demulsifiers

Create non-depleting stimulation fluids

Wider performance than hydrocarbon surfactants

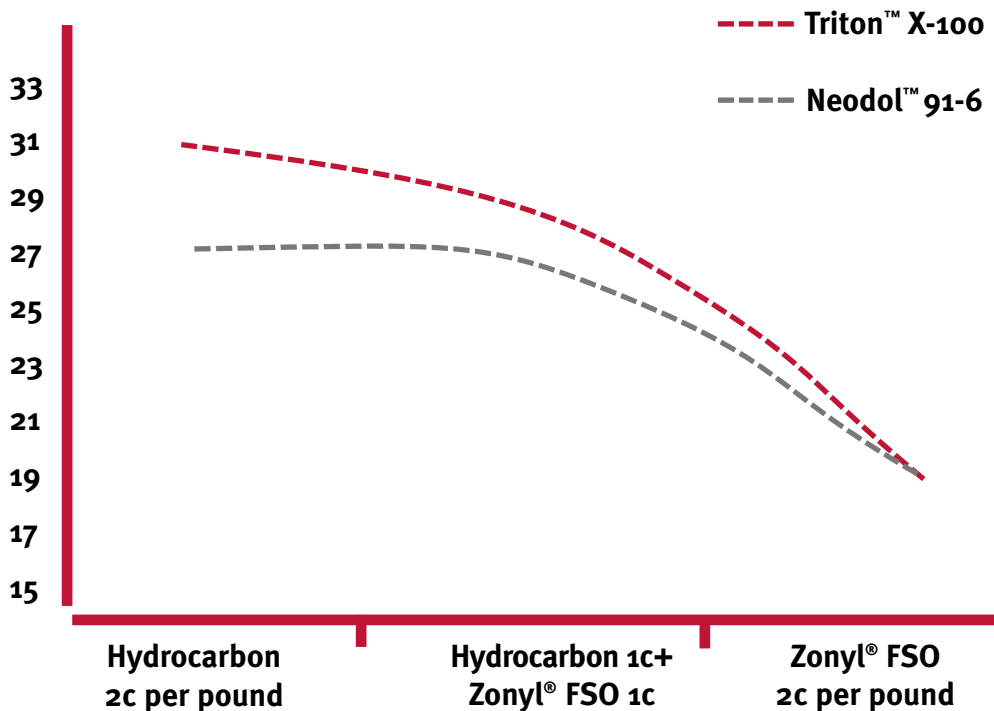
ZONYL® FLUROSURFACTANTS VERSUS HYDROCARBON SURFACTANTS

| Property | Fluorosurfactants | Hydrocarbon |
|--------------------|-------------------|--------------|
| Effectiveness | 16 dynes/cm | 30 dynes/cm |
| Efficiency | 0.005% to 0.1% | 0.1%-3% |
| Surface Activity: | | |
| Aqueous Systems | Excellent | Excellent |
| Strong Acids/Bases | Excellent | Poor to Good |
| Organic Solvents | Excellent | Poor |

Differentiation

- Compatible with other frac fluid / acidizing fluid chemicals – production increase is realized sooner
- Functions in high temperature, high pressure wells, low permeability wells
- Stable in strong acid conditions, slows acid reaction to allow acid to penetrate further from wellbore
- Depletes into the formation less than alternatives
- Create oil and water repellency in capillaries of well formation to reduce blockage and to maintain production in gas wells
- Eliminates steps needed to clean fluid before sending it to the refinery

DUPONT ZONYL® VS HYDROCARBON SURFACTANTS – COST EFFECTIVENESS



With the same formulated cost lower surface tension is achieved

DuPont™ Glycolic Acid and Polyglycolic Acid

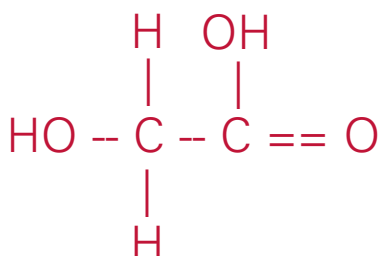
Oil Field & Petro Refining Applications

Glycolic acid is used for a number of downhole / other oil field applications, but most notably in acidizing, rehabilitation, and finishing.

Properties

- High water solubility
- Low odor, Low corrosiveness
- Efficient pH Adjuster
- FIFRA Registered – Antimicrobial
- NSF/ANSI Standard 60 Certified
- for use in potable water systems
- Biodegradable (~90% in 7 days)
- Solubilizes hard water salts; Ca, Mg, Fe
- Non-volatile, very low vapor pressure
- Low toxicity; LD50 for rats = 4240 mg/kg
- VOC-exempt in California
- USDA approved for use as an acid cleaner

CARBOXYLIC ACID WITH ALCOHOL FUNCTIONALITY



The following properties contribute to glycolic acid's effectiveness and versatility for applications in the oil field industry:

- Glycolic acid chelates rust, scale and particulate found in wells and reduction equipment
- When glycolic acid complexes with the metal ions, a soluble salt is formed which can be easily pumped from the well
- Low corrosion to the metal parts of the well reduces the chance of equipment damage
- Good acidification properties to decompose carbonates and viscosity improving chemicals
- Acid additive compatible with other acids and additives
- Glycolic acid formulation available for Industrial boiler cleaner - focus on utilities to clean boilers that are fouled with various scales.



DUPONT™ GLYCOLIC ACID - LOW CORROSIVENESS

DuPont™ Glycolic Acid ensures economical cleaning by providing low-cost metal complexing in a readily biodegradable form that will not add potentially undesirable Biological Oxygen Demand (BOD) or Chemical Oxygen Demand (COD) to formulated products. It can be used with hydrochloric or sulfamic acids to prevent iron precipitation in cleaning operations or water flooding. NSF-certified with low odor, low vapor pressure and non-flammability, Glycolic Acid can effectively eliminate harmful deposits while minimizing corrosion damage to steel or copper piping systems, all with safety in handling and ease of use. Glycolic acid is less corrosive than other competitive NIK acids on common metals

% Weight Loss at 70C

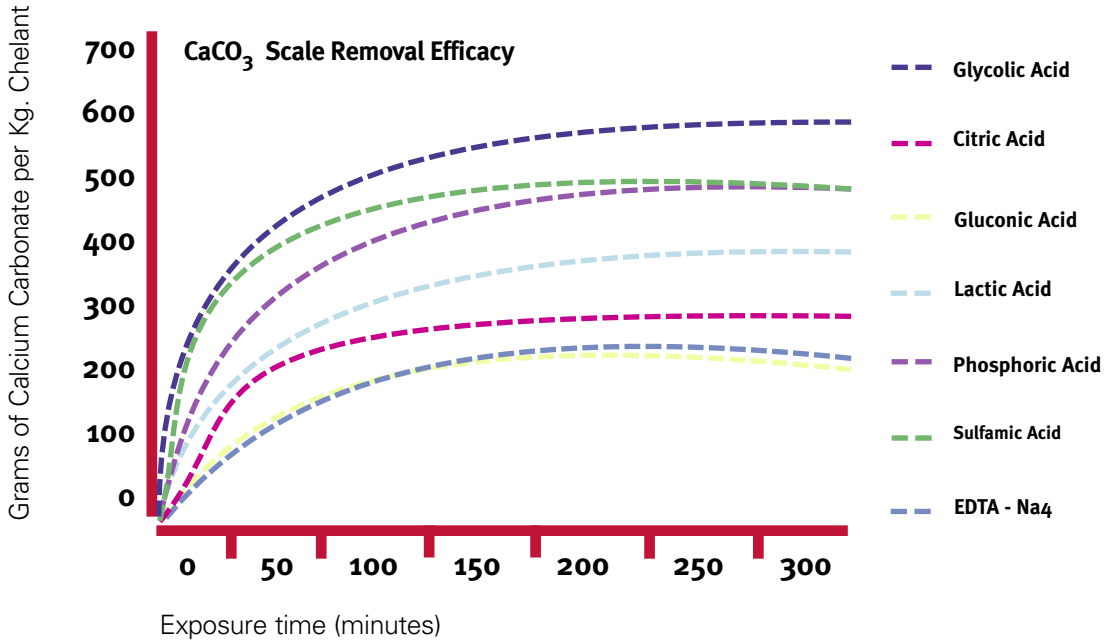
| Metal | Glycolic | Lactic | Phosphoric | Sulfuric | HCl |
|-----------------|----------|--------|------------|----------|--------|
| C1018 | 10.53 | 8.84 | 15.70 | 39.08 | 53.22 |
| AL1100 | 0.38 | 0.31 | 19.94 | 10.90 | 51.75 |
| SS304 | 0.008 | 0.007 | 0.007 | 2.360 | 15.220 |
| SS316 | 0.002 | 0.002 | 0.002 | 1.600 | 18.460 |
| Cu110 | 0.045 | 0.044 | 0.086 | 0.095 | 0.310 |
| CDA360 | 0.061 | 0.056 | 0.081 | 0.067 | 0.170 |
| Galv. CS | 15.50 | 20.33 | 83.81 | 100.00 | 100.00 |

Immersed in 200ml of solution for 48 hours. No Agitation.

Results are the average of triplicate analysis, 10% Acid (100% basis)

DUPONT™ GLYCOLIC ACID - COMPLEXION ABILITY

Glycolic acid uses both the hydroxyl and carboxylic group to form five member ring complexes with polyvalent metals



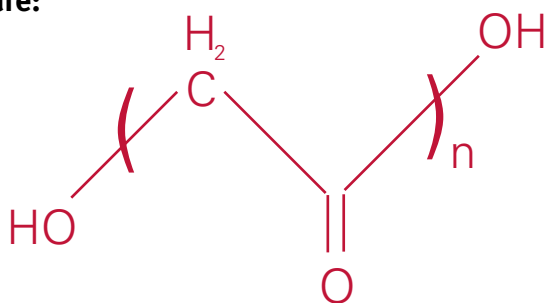
| minutes | Glycolic Acid | Citric Acid | Gluconic Acid | Lactic Acid | Phosphoric Acid | Sulfuric Acid | EDTA-Na ₄ |
|---------|---------------|-------------|---------------|-------------|-----------------|---------------|----------------------|
| 0 | 0g/Kg | 0g/Kg | 0g/Kg | 0g/Kg | 0g/Kg | 0g/Kg | 0g/Kg |
| 15 | 223 | 201 | 56 | 110 | 202 | 272 | 58 |
| 30 | 347 | 310 | 88 | 222 | 297 | 386 | 87 |
| 60 | 463 | 323 | 139 | 319 | 405 | 470 | 137 |
| 120 | 554 | 323 | 178 | 397 | 489 | 505 | 193 |
| 240 | 603 | 323 | 211 | 445 | 514 | 512 | 225 |
| 300 | 612 | 323 | 222 | 447 | 521 | 510 | 237 |

DuPont™ Polyglycolic Acid (PGA) TLF 6267

Oil Field & Petro Refining Applications

TLF 6267, Polyglycolic Acid is a crystalline polyester with a molecular weight of approximately 600.

Structure:



PGA Properties:

- Appearance: finely ground tan powder
- Melting Point: 200 - 210F
- Density: 1.58 g. per cc. (lump form)
- Particle Size: 20 micron average
- Toxicity :Oral ALD: >11,000mg/kg in rats
- Solubility: insoluble in water and organic solvents
- Readily dispersible in water.

Features

- Insoluble Polymer prepared to specific particle size
- Hydrolyses predictably to free acid monomers

Advantages

- Does not leave residue vs other alternatives
- Provides multi-functionality (breaking, diversion, release)

Benefits

- Reduced time & equipment costs per job
- Superior conductivity vs. alternatives

DuPont™ Polyglycolic Acid- TLF 6267 Applications

Oil Field & Petro Refining Applications

PGA is readily biodegradable

Many diverting & fluid loss agents leave a residue in the wellbore or formation upon completion

Oilfield Chemical Placement Process

PGA used as a time release agent for corrosion inhibitors, dispersants, decomposition inhibitors for lubricants in moving equipment in the wellbore and other channels of the formation

Time Delayed Gel Breaker

Temporary Plugging Agent

Diverting Agent

Ensures uniform injection of treatment area by creating a temporary blocking agent by reducing permeability of subterranean formations

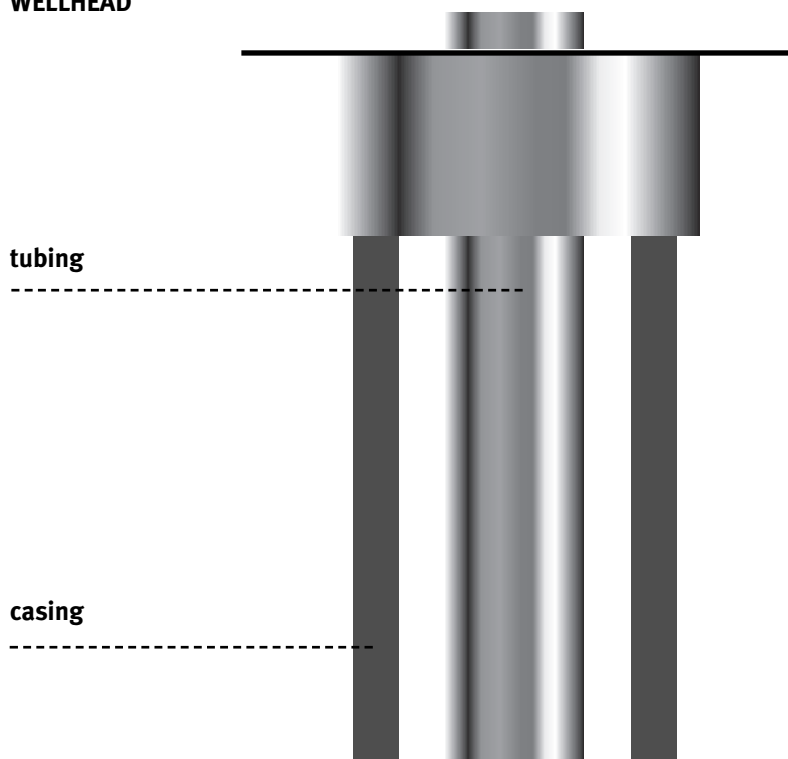
Completion Fluid / Fluid Loss additive

Added to an inert fluid used in the casing – tubing annulus to dissolve scale and prevent corrosion

Oilfield Chemical Placement Process

PGA used as a time release agent for corrosion inhibitors, dispersants, decomposition inhibitors for lubricants in moving equipment in the wellbore and other channels of the formation

WELLHEAD





DuPont™ Anthium Dioxide® & Chlorine Dioxide

Bactericides and oxidizers for oil & gas applications

DuPont™ Anthium Dioxide® is a highly effective bactericide for specific Gas and Oil-Field applications.

Chlorine dioxide selective oxidizer for biofilm treatment. Mainly for water facilities that are affiliated with a refinery or power/utilities plant.

Pipe Transfer Lines

- Reduces Bacteria
- Reduces H₂S
- Aids Corrosion Control
- Prevents Sour Crude

Off-Shore

- Biocide and Preservative for Drilling Muds
- Stored Potable Water Treatment

Drilling

- Biocide and Preservative for Drilling Muds
- Well Completion Treatments
- Polymer/LCM Preservative

Oil-Field Water Floods

- Retards Injection Well Clogging
- Hydrogen Sulfide Neutralizing Agent
- Aid in Corrosion Control
- Well Stimulation



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