Bio-Lubricants

Oilfield Chemical Solutions

Engineered for Performance, Sustainable by Nature™

Emery Oleochemicals

Driving Innovation for Sustainable Lubricants

Engineered for Performance, Sustainable by Nature™

Founded in 1840, Emery Oleochemicals has a rich heritage developing and manufacturing natural-based chemicals made predominantly from renewable oils and fats. Emery Oleochemicals' philosophy of 'Creating Value' for our customers is evident through our wide-ranging product portfolio that caters to the diverse and unique needs of an evolving marketplace.

Today, over 180 years later, Emery Oleochemicals is known for world-leading, in-depth technical expertise and the production of high-quality specialty chemicals. Through our global operations, we provide our customers with best-in-class sustainable solutions, engineered for performance.

Oilfield Chemical Solutions

As a global provider of renewable-based, high performance and innovative solutions for oilfield drilling and production chemicals applications, we support our customers by providing a wide portfolio of effective and sustainable products with excellent environmental characteristics. With market knowledge and technical expertise in oilfield chemicals spanning more than 30 years, today, we offer a comprehensive portfolio of commercial products that have proven excellent performance even under the most challenging operating conditions.

Creating Value, Globally

With Emery's global footprint of technical and commercial contacts in the Americas, Europe and Asia, our Bio-Lubricants business offers strength in product development, manufacturing, distribution, sales and technical support to our customers around the world.

For more information about our comprehensive Oilfield Chemical Solutions portfolio, visit:

www.emeryoleo.com/bio-lubricants/oilfield

Learn more

CONTENT

Technology Advantage

Emery Oleochemicals' innovative product development and technical customer service teams are recognized by our customers as leading in the industry.

In our lab in Germany, Emery provides state-of-the-art flow assurance and corrosion inhibitor assessments as well as customer-specific evaluations of system conditions to support you in the selection of the most appropriate solution for your specific application.

Our expertise also includes running extensive drilling fluid testing for evaluation and comparison of chemical solutions. We offer:

- standard API drilling fluid testing which includes mixing, aging, rheology measurement and filtration, and
- lubricity (Falex and EP Tester), cleaner, foamer, and shale testing.

Achieving Sustainability & Regulatory Compliance

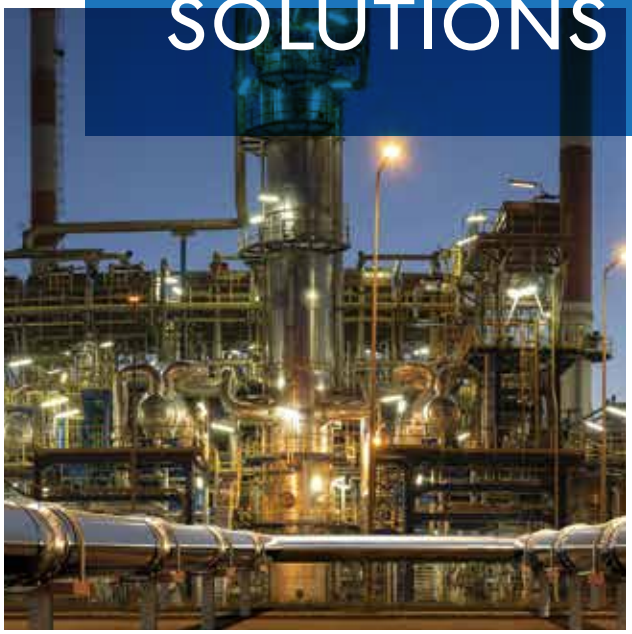
Emery's Bio-Lubricants business for oilfield applications places strong emphasis on providing environmentally-friendly products to help protect the environment and the health of workers in the field and/or on rigs.

Many of Emery's products are Ospar Commission and CEFAS approved for use in offshore drilling as per the high standards according to North Sea operations.

Through our production facility in Europe, the majority of our oilfield additive chemicals are REACH registered and compliant.

PRODUCTION CHEMICAL SOLUTIONS

Flow Assurance



Corrosion Inhibitors

Stimulation, Ca-Na Inhibition & CFPP

Production Chemicals

DEHYPAR® for Flow Assurance

Our low toxicity, biodegradable, and sustainable range of chemistries allows Emery Oleochemicals to serve our customers with unsurpassed performance in challenging environments. Our DEHYPAR® product portfolio includes high active pour point depressants (PPDs) which are liquid at extremely low temperatures where conventional products become solids (DEHYPAR® 150X product family) and which do not contain aromatic solvents.

Advantages

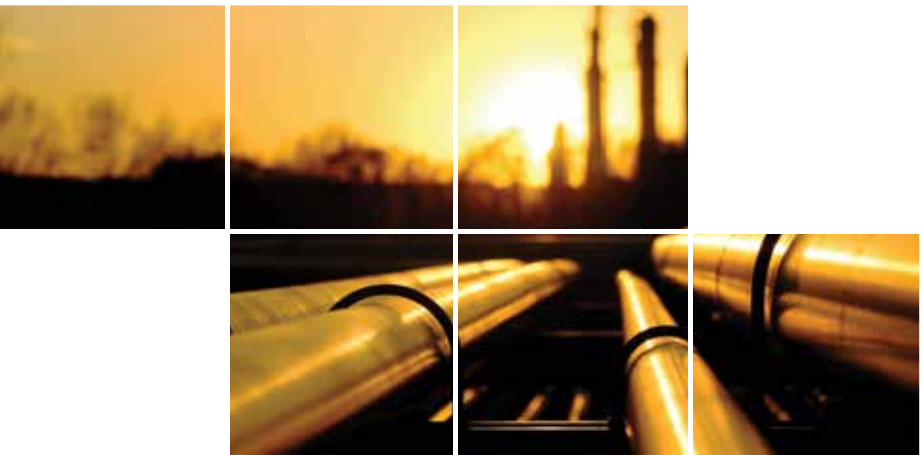
- Based on environmentally acceptable chemistries
- Low toxicity
- High renewable content

Applications

- Prevention of organic fouling
- Mitigation of deposit formation
- Suitable for a wide range of organic deposits in pipelines and production facilities

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
DEHYPAR® 1506	White to yellowish liquid	Pour point depressant Paraffin inhibitor	Crude oil	Pour point ≤ -12°C Flash point > 140°F / 60°C Viscosity @ 4°C < 100mPa.s (sea temperature)
DEHYPAR® 1540	Colorless liquid	Paraffin dispersant	Crude oil Paraffin deposit	Prevention and removal of deposit Environmentally friendly
DEHYPAR® 1492	Colorless to light yellow liquid	Paraffin dissolver	Paraffin deposit	Water dispersible blend Effective alternative to aromatic solvents



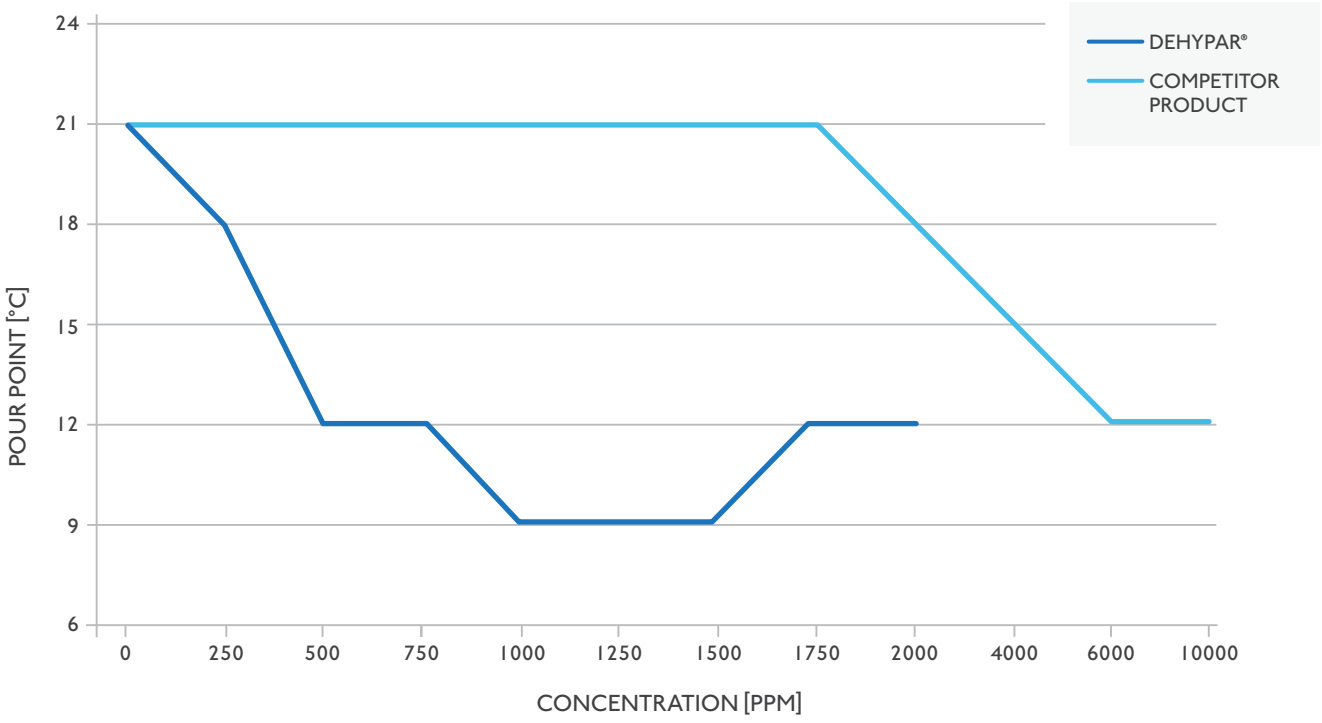
Learn more

Emery's PPDs improve the rheological properties of paraffinic crude oils by reducing the pour point, decreasing the yield value (yield stress) to allow restart operations at low temperatures, and reducing the viscosity which results in decreased energy consumption during transport.

These PPDs are designed for different properties such as continuous injection at a location where the temperature of the crude oil is still above the wax appearance temperature (the temperature at which paraffin crystallization is first observed). For example, Emery's DEHYPAR® 1503 is most suitable for dry crude oils with a free water content of less than 5%.

As demonstrated below, the performance of DEHYPAR® 1503 significantly exceeds conventional products based on polymer/aromatic solvent systems. While DEHYPAR® 1503 reaches peak performance at 1000ppm and starts to overtreat at higher dose rates, the competitor product only starts to perform at 2000ppm and does not even match total performance at 10,000ppm.

Pour point of a crude oil treated with DEHYPAR® vs competitor product



Our water-based and non-flammable DEHYPAR® 149X product family of environmentally-friendly surfactants offers equivalent performance for the removal of organic solids compared to xylene and can easily be applied on the fly by mixing with water (both tap and connate water).

In addition, Emery Oleochemicals provides a wide range of non-toxic and biodegradable paraffin dispersants which offer cost-effective alternatives to conventional products.

Production Chemicals

DEHYPAR® Corrosion Inhibitors

DEHYPAR® 1427 is Emery Oleochemicals' premier corrosion inhibitor for oilfield production applications. It is a water soluble, cationic surfactant designed for multiple applications.

Advantages

- Stable over the entire pH range
- Can be used in combination with most non-ionic surfactants

Applications

- General hydrophobic agent
- Hydrotropic, antistatic or softening agent
- Component for cleaning formulations

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
DEHYPAR® 1427	Slightly hazy liquid	Corrosion inhibitor	Various	Water soluble

Learn more

Production Chemicals

Production Chemicals for Stimulation, Naphthenate Inhibition & Cold Flow Improver (CFPP)

Emery Oleochemicals' DEHYPAR® portfolio of products is used for a wide range of production chemical applications.

DEHYPAR® 1262 as Foaming Agent

DEHYPAR 1262 is a highly concentrated surfactant designed for application as a foaming agent in the production of oil and gas. In addition to the removal of liquid loadings, this product can also assist unloading unwanted solids from oil and gas wells.

DEHYPAR® 1511 for Stimulation Package

To overcome the challenges associated with conventional HCl treatments, Emery developed a highly-active, organic acid-based stimulation fluids (chlorine free), which is 100% derived from renewable resources. DEHYPAR 1511 can be easily formulated into a variation of retarded acids for stimulation.

DEHYPAR 1511 improves production by removing carbonate restricted pores in chalk and/or limestone formation. It also reacts slowly in comparison with hydrochloric acid. It ensures deep penetration into the formation (retarded acid) and prevents chloride corrosion. In addition, DEHYPAR 1511 is easy to co-formulate into formulations to mitigate downhole emulsion remediation (asphaltene sludge).

DEHYPAR® 1512 for Calcium Naphthenate Prevention

DEHYPAR 1512 is also used to overcome the challenges associated with conventional HCl treatments. It can be easily formulated into a variety of retarded acids by maintaining a low pH during production and transport of crude oils with high naphthenic acid content to avoid phase separation. It prevents calcium naphthenate formation and has no negative impact on refinery operations. DEHYPAR 1512 is biodegradable.

DEHYPAR® 1580 as Cold Flow Improver (CFPP)

DEHYPAR 1580 is a cold flow improver and pour point depressant for middle distillates and heating oils. It improves the properties of middle distillates and of fuel oils at low temperatures. It is particularly suitable for middle distillates with a higher final boiling point. DEHYPAR 1580 is a flow improver that affects the growth of paraffin crystals, thereby the filterability limit (CFPP according to DIN EN 116) and the pour point (ISO 3016) of diesel fuels and of fuel oils are efficiently reduced. DEHYPAR 1580 blends well with middle distillates and fractions with high aromatics content.

Production Chemicals for Stimulation, Naphthenate Inhibition & Cold Flow Improver (CFPP)

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
DEHYPAR® 1262	Clear yellow liquid	Foaming agent	Crude oil	Removal of liquid loadings Helps unload unwanted solids
DEHYPAR® 1511	Liquid	Acidizing agent	Crude oil	Pour point < -50°C Alternative to hydrochloric acid
DEHYPAR® 1512	Liquid	Acidizing agent	Crude oil	Calcium Naphthenate Prevention Chlorine free
DEHYPAR® 1580	Opaque to lightly yellow liquid	Cold flow improver	Middle distillates Fuel oils	Affects growth of paraffin crystals Pour point depressant properties

Learn more

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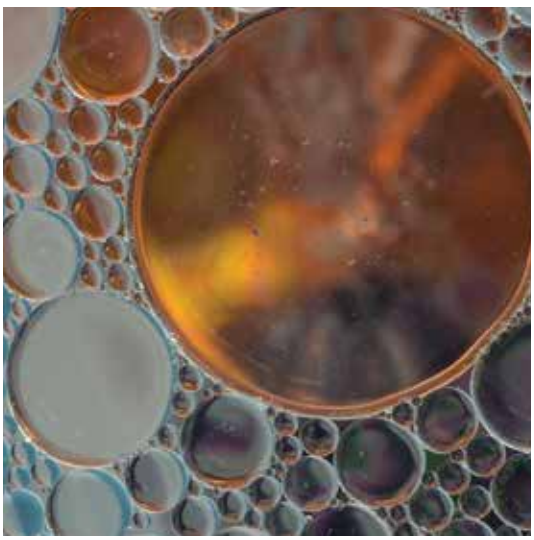
DRILLING CHEMICAL SOLUTIONS

Lubricants

Emulsifiers

Carrier Fluids

Rheology Modifiers



Cleaners

Drilling Chemicals

TERRADRIL® Carrier Fluids

TERRADRIL® CF esters are based on renewable raw materials, offering value-add by providing high- performance properties like superior lubricity, excellent low temperature behavior and high viscosity index. Combined with environmentally-friendly characteristics, including good biodegradability and low aquatic toxicity, esters are the right choice when formulating fluids for demanding applications.

Advantages

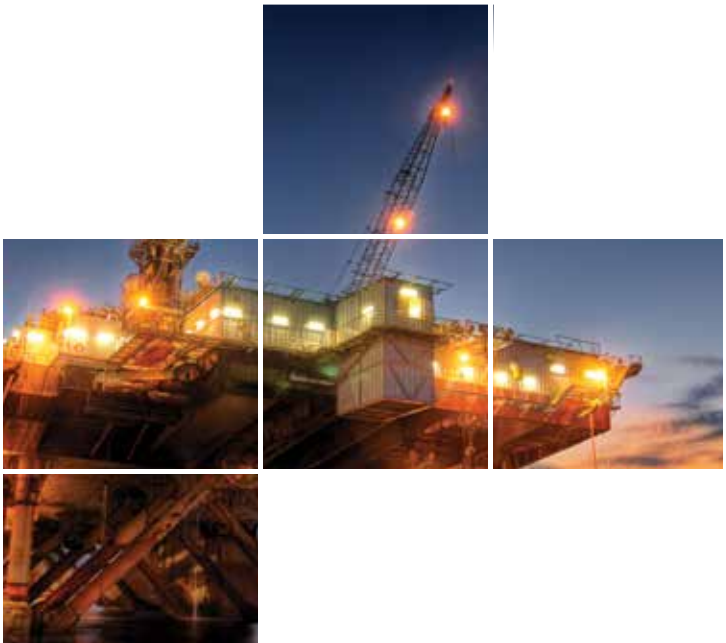
- Lower toxicity and improved biodegradability of oil-based mud systems
- Significantly increases polarity of a carrier fluid
- Systems with higher polarity improve mud additive performance/economics. This polarity results in a better lubricity coefficient and is advantageous in deviated well drilling operations.

Applications

- Alternatives to mineral oil or paraffin-based carrier fluid systems

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	VISCOSITY @ 104°F	POUR POINT	FEATURES
TERRADRIL® CF 1600	Ester	Carrier fluid	Oil-based mud	< 7 mm^2/s	< -4°F / -20°C	GoM permit Eco-friendly
TERRADRIL® CF 1000	Ester	Carrier fluid	Oil-based mud	< 9 mm^2/s	< -22°F / -30°C	Eco-friendly



Learn more

Drilling Chemicals

DEHYLUB® & TERRADRIL® Lubricants for Drilling Systems

Lubricants are required in oil and gas exploration in many different systems. As part of Emery Oleochemicals' Bio-Lubricants product portfolio, we offer lubricants specifically for the drilling sector for use in a variety of applications.

Advantages

- Excellent lubricity
- Temperature stability
- Good ecotoxicological data

Applications

- Freshwater-based muds / bentonite muds
- Saltwater-based muds (WBM)
- Silicate muds
- Oil-based muds (OBM)

Product Examples by Function

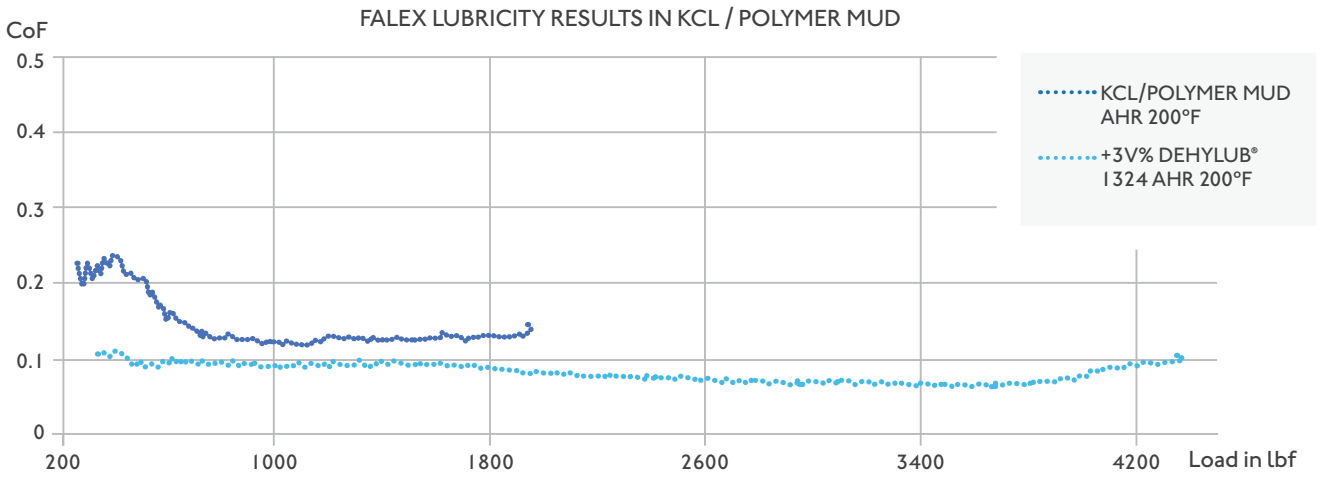
PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
DEHYLUB® 1324	Ester based	Lubricant	WBM + OBM	Eco-friendly CEFAS Gold ranking
DEHYLUB® 1316	Mixture	Lubricant	WBM + Silicate mud	Eco-friendly CEFAS Gold ranking Suitable for silicate muds High temperature stable
DEHYLUB® 1037	Ester based	Lubricant	WBM + OBM	High performance in monovalent salt-based systems
DEHYLUB® 1246	Ester based	Lubricant	WBM	High performance in monovalent salt-based systems
DEHYLUB® 1112	Glycerol derivative	Lubricant	OBM	Water soluble
DEHYLUB® 1560	Special blend	Lubricant	WBM	Water dispersible
TERRADRIL® CL 1500	Surfactant blend	Lubricant	Completion fluids	Clear brine soluble Eco-friendly

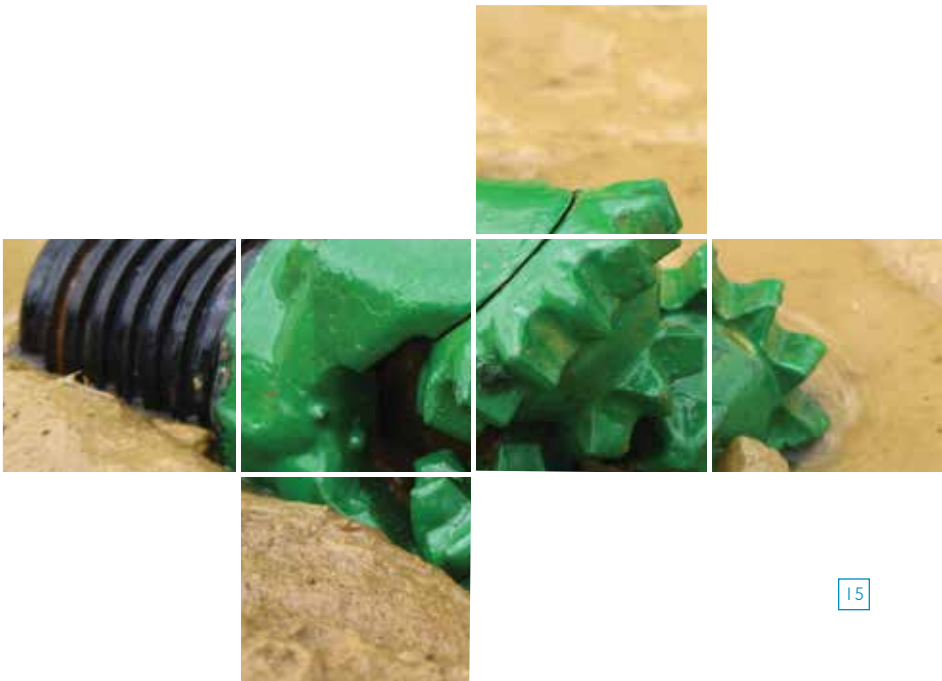
Learn more

Emery has a broad range of additional lubricants including those for completion / workover and high temperature drilling applications. More information about our lubricant portfolio and customized options are available by request.

The graph below shows the reduction in friction coefficient when 3V% DEHYLUB 1324 has been added to a KCL/ polymer-based mud system using Falex lubricity testing equipment. The mud was aged for 16 hours at 200°F and the change of the friction coefficient was measured. DEHYLUB 1324 reduced the average coefficient of friction by less than 40%. In addition, loadability increased by more than 200%.

Lubricity results of DEHYLUB® 1324 in WBM





Drilling Chemicals

TERRADRIL® V Rheology Modifiers for Oil-based Mud

To meet increasingly demanding global oil and gas exploration activities, Emery offers innovative drilling fluids systems based on esters derived from natural resources. They are used to drill reactive geological formations and highly-deviated wells.

Advantages

- Borehole stability
- Superior lubricity
- Benign ecological properties
- Unique ecotoxicological properties dramatically reduce impact of drilling fluid on marine environments, even allowing the disposal of drilled cuttings on the sea floor with a clear conscience

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
TERRADRIL® V 1075	Dimer fatty acid	Low end rheology modifier	Oil-based mud	Typical market standard
TERRADRIL® V 300	Fatty acid	Suspension agent	Oil-based mud	Powder Eco-friendly
TERRADRIL® V 1552	Polymer	Low end rheology modifier "Green" dimer alternative	Oil-based mud	Eco-friendly CEFAS D ranking
TERRADRIL® V 988	Specialty	Thinner	Oil-based mud	CEFAS E ranking
TERRADRIL® V 408	Surfactant	Wetting agent	Oil-based mud	Reduces flow properties caused by high solids

Learn more

TERRADRIL® V rheology modifiers (such as thinners, thickeners and viscosifiers) support increasing rheological properties in oil and synthetic-based drilling fluids. In addition to typical low end rheology modifiers and suspension agents, Emery also offers rheology modifiers for high temperature applications.

The table below shows the low-end viscosifying effect of TERRADRIL V 1552 compared to dimer fatty acid typically used in paraffin-based oil mud systems. TERRADRIL V 1552 increases the rheology of the mud at low shear rates, is environmentally friendly, and has a CEFAS D ranking.

Rheology Data

WEIGHT:	12 LB/GAL	OIL/WATER RATIO:	70/30
SALINITY:	250,000 PPM	MIX METHOD:	SILVERSON

Paraffin	bbl	
Fluid loss additive	lb	1-5
Lime	lb	1-5
Emulsifier	lb	8-14
Water	bbl	
Calcium chloride	lb	
BaSO4	lb	
Clay	lb	20
Low end rheology modifier	**lb**	**0.5**

		Base Mud		Dimer Fatty Acid		TERRADRIL® V 1552	
		BHR	AHR	BHR	AHR	BHR	AHR
Hours roilled / aged	h		16		16		16
Hot roll temperature	°F		150		150		150
Measuring temperature	°C	50		50		50	
Electrical stab	V.	300	390	550	906	600	811
600 rpm	skt	33	35	37	40	33	38
300 rpm		18	18	24	25	21	23
200 rpm		12	14	20	20	17	18
100 rpm		8	8	15	15	12	14
6 rpm		3	3	6	7	5	6
3 rpm		2	2	5	6	4	5
PV	cp	15	17	13	15	12	15
YP	lb/100ft^2	3	1	11	10	9	8
Gels	10" / 10 lb/100ft^2'	3/4	3/3	7/9	7/9	7/6	7/8

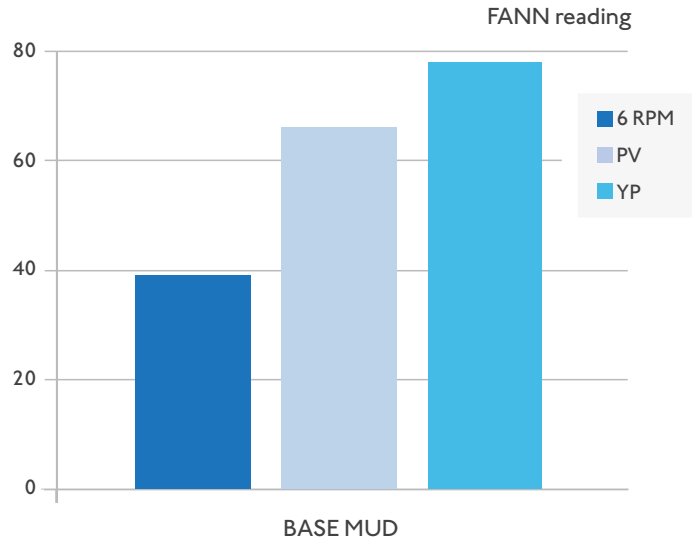
The charts below show the effect of TERRADRIL V 988 in a 14 lb/gal oil-based mud system. 2lb of thinner was added to the system and then, aged for 16 hours at 150°F. Rheology data including plastic viscosity (PV), yield point (YP) and low shear viscosity at 6 rpm was measured and compared to the base mud. TERRADRIL V 988 can reduce the viscosity by 50% without affecting the PV.

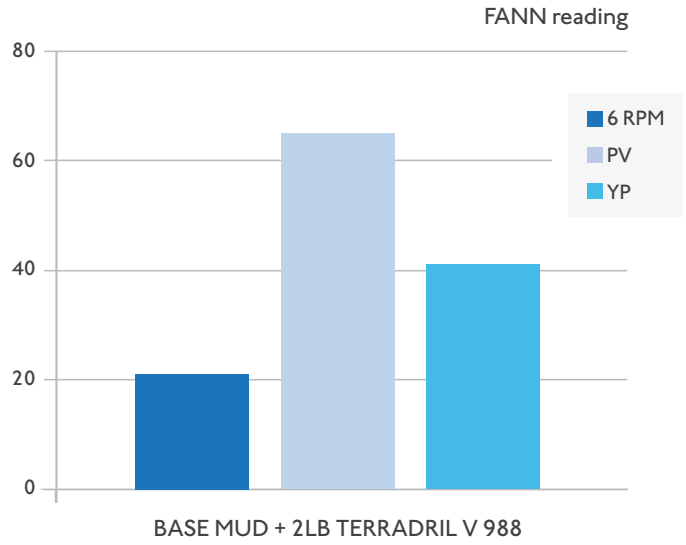
WEIGHT: 14 LB/GAL

OIL/WATER RATIO: 70/30

SALINITY: 250 000 ppm

Rheology results after aging for 16 hours at 150°F





Drilling Chemicals

TERRADRIL® EM Emulsifiers for Oil-based Mud Applications

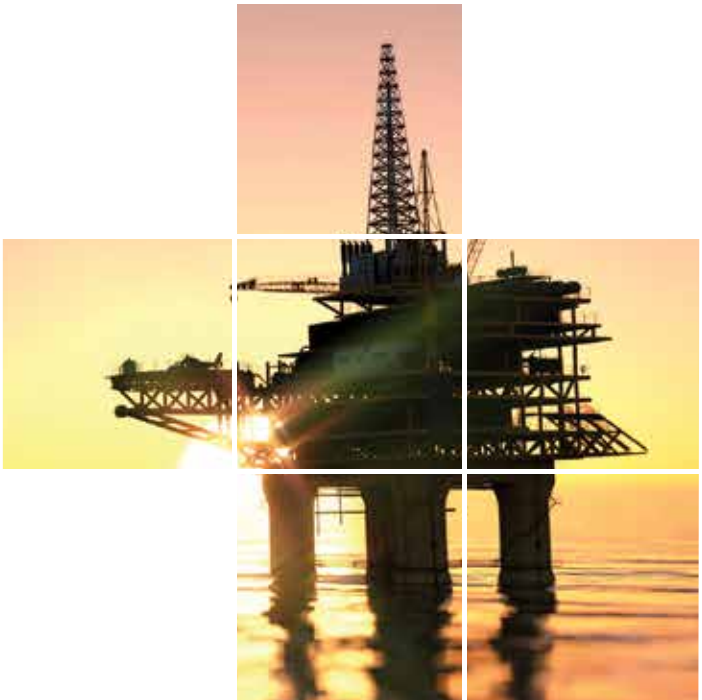
TERRADRIL® EM invert mud emulsifiers, which are based on esters derived from natural resources, are ideal for use in drilling applications to lower interfacial gravity and enable a liquid to form a stable, homogeneous emulsion of fine droplets.

Advantages

- Increased emulsion stability
- Reduced water wetting tendency of insoluble solids
- Rheological stability
- Reduced high temperature, high pressure (HTHP) fluid loss

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
TERRADRIL® EM 1120	Specialty	Invert HT emulsifier	Oil-based mud	Eco-friendly CEFAS Gold/Silver ranking Temperature stable Flash point > 200°F / 93°C
TERRADRIL® EM 1530	Amido amine	Invert emulsifier	Oil-based mud	Flash point > 167°F / 75°C



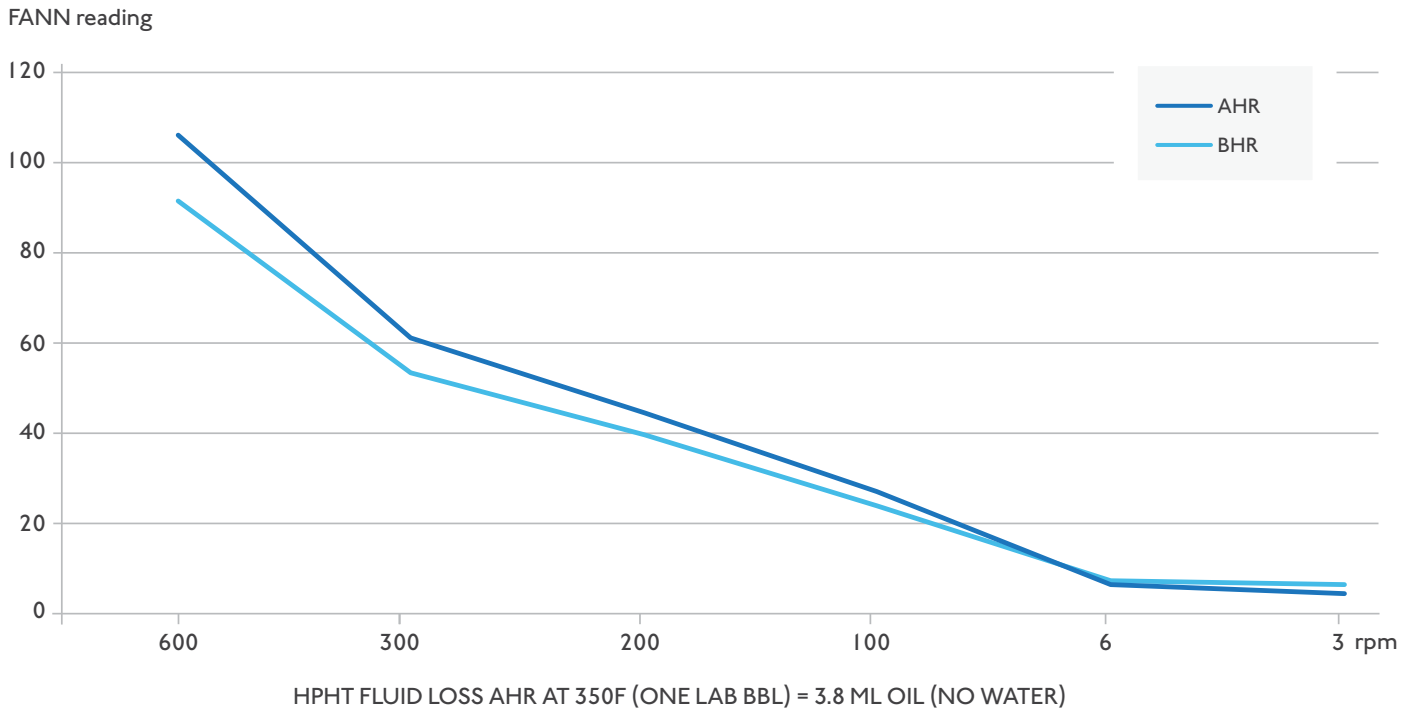
Learn more

In response to increasingly demanding global oil and gas exploration activities, Emery's emulsifiers are used to drill reactive geological formations and make it possible to drill highly-deviated wells where borehole stability, lubricity and benign ecological properties are essential. Their unique ecotoxicological properties have dramatically reduced the impact of the drilling fluid on marine environments, even allowing the disposal of drilled cuttings on the sea floor with a clear conscience.

The graph below shows the viscosity of an oil-based drilling fluid at different speed rates, before and after ageing, using the FANN rheometer. TERRADRIL® EM 1120 was used as an emulsifier in a 14 lb/gal paraffin-based mud system. The rheology of the drilling fluid is less affected after 16-hour hot rolling at 350°F when using Emery's high temperature stable emulsifier.

TERRADRIL® EM 1120

in paraffin-based mud (14 lb/gal, o/w ratio: 80/20) aging for 16hours at 350°F



HPHT FLUID LOSS AHR AT 350F (ONE LAB BBL) = 3.8 ML OIL (NO WATER)

Our water-based and non-flammable DEHYPAR® 149X product family of environmentally-friendly surfactants offers equivalent performance for the removal of organic solids compared to xylene and can easily be applied on the fly by mixing with water (both tap and connate water).

In addition, Emery Oleochemicals provides a wide range of non-toxic and biodegradable paraffin dispersants which offer cost-effective alternatives to conventional products.

Drilling Chemicals

TERRADRIL® S Borehole Cleaners for Drilling Applications

Drilling mud and associated contaminants such as pipe dope, rust, scale and other solid materials must be removed for successful drilling both onshore and offshore. Insufficient clean up can lead to problems such as lower mud recovery, higher costs, reduced productivity and increased rig time. Emery's contribution to the increasingly demanding activities in global oil and gas exploration is our innovative drilling fluids systems based on esters derived from natural resources.

Advantages

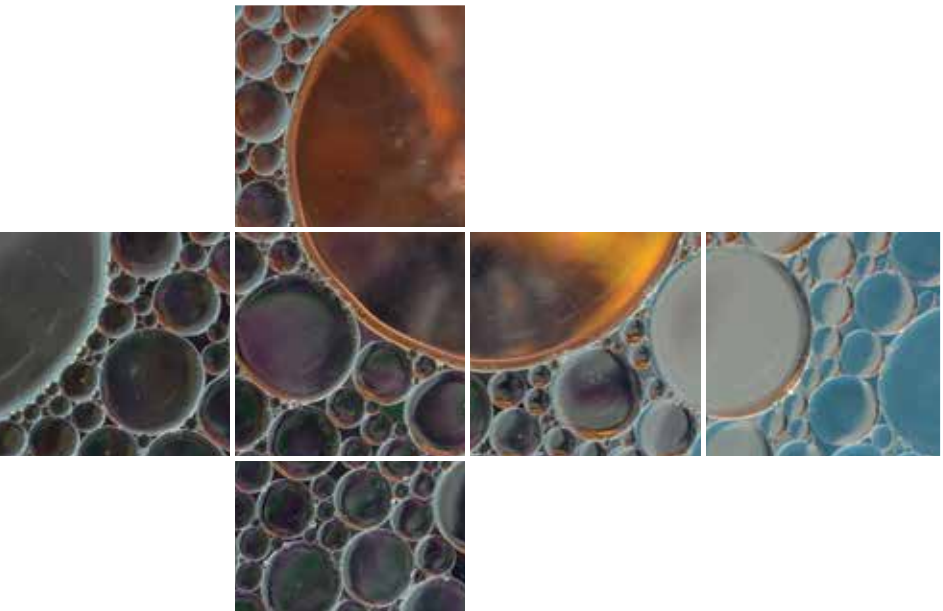
- Borehole stability, superior lubricity and benign ecological properties
- Unique ecotoxicological properties that reduce impact of drilling fluid on marine environments
- Allows for disposal of drilled cutting on the sea floor with a clear conscience

Applications

- Drilling reactive geological formations
- Cleaning agents for metal surfaces and equipment
- Drill and casing cleaning

Product Examples by Function

PRODUCT	DESCRIPTION	FUNCTION	FLUID SYSTEM	FEATURES
TERRADRIL® S 809	Surfactant / alcohol blend	Casing cleaner	OBM / WBM	Milky dispersion in water / brines
TERRADRIL® S 1310	Concentrated surfactant blend	Casing cleaner	OBM / WBM	CEFAS Gold ranking



Learn more

Global Manufacturing

As a global provider of renewable-based, high-performance and innovative solutions for industrial lubricant applications, Emery Oleochemicals provides a unique and comprehensive portfolio for a wide variety of industries, available worldwide from our global manufacturing facilities.

Located on 35 acres in Cincinnati, Ohio, USA, our North American manufacturing facility is home to many pioneering oleochemical technologies that make Emery the largest oleochemicals manufacturer in the Americas and the largest global producer of azelaic acid. This site is RSPO certified to manufacture products in accordance with mass balanced (MB) requirements.

In addition, our purpose-built Specialty Esters plant, dedicated reactors and backward integration into various raw materials ensure security of supply.

Located in Loxstedt, Germany, our European manufacturing plant spans 32 acres and has been operational since 1902.

Our dedicated Esterification plant can produce the entire range of Emery's esters in both liquid and solid form. This site is also RSPO certified to manufacture esters in accordance with mass balanced (MB) requirements.

CREATING VALUE FOR OUR CUSTOMERS, ANYWHERE IN THE WORLD.

Global Network

Emery Oleochemicals' operations are supported by a global workforce and an extensive distribution network covering over 50 countries worldwide. Our technical and industry experts located around the world are ready to help you select the best product to meet your specific requirements.

The availability of our products is subject to regional demand and regulations. Detailed information and certifications are available upon request.

Visit our website to learn more about our comprehensive Bio-Lubricants solutions:
www.emeryoleo.com/bio-lubricants

For more information, contact your nearest regional office.

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