# Advances in Sustainable Control Fluid Technology

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### **Overview**

- Sustainability & Hydraulic Fluids
- Environmental & Regulatory Compliance
- Technical Performance
- Summary
- Q&A







### **UN Sustainable Development Goals**

UN Department of Economic and Social Affairs Sustainable Development <u>https://sdgs.un.org/</u>









THE SUSTAINABLE DEVELOPMENT GOALS REPORT 2022: UNSTATS.UN.ORG/SDGS/REPORT/2022/

### Sustainable, Renewable, Recyclable, Environmental...

#### Poor Product Footprint

- Source: Fossil fuel, Petrochemical
- Energy: High fossil fuel use, high carbon dioxide emissions
- Can't Recycle/Reuse
- Linear Economy (Take-Make-Use-Dispose)
- Poor Product Carbon footprint
- Negative Environmental Impact
- Poor Environmental Fate



- Good Product Footprint
  - Source: Seed crops, Oleochemical
  - Energy: Low use. Renewable energy, low carbon dioxide emissions
  - Can Recycle/Reuse
  - Circular Economy (Make/Remake-Use/Reuse)
  - Good Product Carbon Footprint
  - Neutral/Positive Environmental Impact
  - Good Environmental Fate





#### US EPA :

Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations.

EU 'Green Transition' & EU Chemicals Strategy for Sustainability (2020):

- *`...sustainable climate neutral and circular economy by 2050...'*
- Use less chemicals i.e., lower carbon footprint
- Use less hazardous chemicals i.e., less harm to human health & environment
- Strive to use safe chemicals for toxic free environment

#### OSPAR Hazardous Substances Strategy (since 2002)

*`...to prevent pollution by hazardous substances, by eliminating their emissions, discharges and losses, to achieve levels that do not give rise to adverse effects on human health or the marine environment...'* 



Offshore Oil & Gas Industry ahead of the sustainability trend for 20 years How?

- Industry works to improve reliability, extend operational life and minimise discharge of chemicals to the marine environment
- Chemicals already assessed and ranked, depending upon regulations, for aquatic toxicity, biodegradation & bioaccumulation potential.
- Striving to use more sustainable chemicals and improve equipment reliability / performance, so less persistent chemicals are discharged into our natural environment



### **ISO Hydraulic Fluid Classes & Sustainability**

Hydraulic Fluids classed in 3 primary families:

- Mineral Oil Based Fluids (ISO 11158, ISO 6743)
- Fire Resistant Fluids (ISO 12922, ISO 6743)
- Environmentally Acceptable Hydraulic Fluids (ISO 15380, ISO 6743)



### **ISO Hydraulic Fluid Classes**

	Туре		Туре		Туре
ΗH	Mineral Oil	HFAE	Fire Resistant Emulsion ≥80% Water	HETG	Vegetable Oil
HL	HH + Rust & Oxidation Resistance	HFAS	Fire Resistant Solution ≥80% water	HEES	Synthetic Ester
HM	HL + Anti-Wear	HFB	Fire Resistant Emulsion (water-in-oil)	HEPG	Polyglycol
HR	HL + Improved VI	HFC	Fire Resistant Solution ≥35% water + Polymer	HEPR	Polyalphaolefin
ΗV	HM + Improved VI	HFDR	Fire Resistant Synthetic (Phosphate Ester)	HS	Synthetic Oil
HG	HM + Stick slip Resistance	HFDU	Fire Resistant Synthetic (Polyol ester or Polyalkylene glycol)		



### **ISO Hydraulic Fluid Classes**



### **Sustainable Hydraulic Fluids?**

#### Fire Resistant Water Based fluids (HFA, HFB, HFC)

- Low impact on environment (soluble, readily biodegradable, low toxicity & low bioaccumulation potential)
- Manufacturing by simple mixing (i.e., low energy use)
- Low carbon content = good carbon footprint
- Water (renewable)
- Glycol (petrochemical though renewable sources are appearing)
- Water & glycol can be recycled & reused



### **Ethylene Glycol from Renewable Ethylene Oxide**

- Ethylene Oxide widely used for plastics & surfactants
- Ethylene oxide reacted with water to yield ethylene glycol
- Major Specialty Chemical companies producing Ethylene Oxide from biomass (e.g., sugarcane) and bioethanol dehydration
- Renewable ethylene glycol sources are attractive and becoming more economically viable.



INEOS Launches new Bio-Attributed Ethylene Oxide, Completely Substitutes Fossil Feedstock With Renewable Biomass

🔇 Wednesday, July 27, 2022 🛛 🛇 INEOS Group, INEOS Oxide

INEOS Launches new Bio-Attributed Ethylene Oxide, Completely Substitutes Fossil Feedstock With Renewable Biomass

- The Bio-attributed Ethylene Oxide delivers 100% substitution of fossil feedstock on a mass balance basis, as certified by RSB and ISCC+.
- The material delivers a Greenhouse Gas saving of over 100% compared to conventionally produced EO
- Tobias Hannemann, CEO: "Our new EO delivers identical performance to traditional feedstocks the fundamental performance of the product is not changed, but it comes with huge savings in fossil fuel usage and Greenhouse Gas emissions."

INEOS OXIDE has launched new Bio-Attributed Ethylene Oxide (EO), based on certified bio-based sources which do not compete with food production.

First sales of this Bio-Attributed EO have already been made.

This new product reaffirms INEOS' commitment to developing more sustainable ways to produce the materials we use and rely on every day. INEOS Oxide is developing a suite of solutions to deliver carbon neutrality by 2050, of which this new product is one.

## JV to become a leading supplier of renewable ethylene oxide derivatives

3/11/2021

#### f 💟 in 📴 📥

Clariant, a focused, sustainable and innovative specialty chemical company, and India Glycols Limited (IGL), a leading company in the manufacturing of green technology-based chemicals, announced a strategic partnership to establish a 51-49% joint venture in renewable ethylene oxide (EO) derivatives.

By combining production and distribution capacity, the joint venture is expected to become a leading supplier of renewable materials to the rapidly growing consumer care market in India and neighboring countries, while providing Clariant the ability to leverage the EO derivatives globally across the home care, personal care and industrial applications segments of its Industrial and Consumer Specialties business. The partnership is subject to customary regulatory approvals.

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### **Sustainable Hydraulic Fluids?**

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- Water & glycol can be recycled & reused

#### Bio-based Oil (HETG, HEES)

- Low impact on environment (insoluble, readily biodegradable, low toxicity & low bioaccumulation potential due to metabolism)
- Manufacturing by simple mixing (i.e., low energy use)
- High carbon content
- Bio-based Oils renewable





### **Control Fluids: Water Based vs Ester based?**

	Water based Fluid	Bio-based Oil
Sustainability	Good/Excellent	Good/Excellent
Seawater Soluble	Yes	No
Low temperature	<-50°C / -58°F	<-50°C / -58°F
Viscosity	Low	Medium
Incompressible	$\checkmark$	×

Subsea Control Fluids designed to meet application requirements rather than Hydraulic Fluid Standard. Control fluids considered hybrids.

Water-based control fluids better suited for subsea vent-to-environment systems Bio-based Oil fluids suitable for closed or vent to production systems



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### **Environmental Fate & Regulations**

#### Hydraulic fluid impact on marine ecosystem

• Depletion of dissolved oxygen in ocean

#### Hydraulic fluid impact on marine species

- Ability of species to biodegrade chemicals
- Potential of chemicals to bioaccumulate in species
- Toxicity of chemicals to marine species

Minimise discharge during operations

Use more environmentally acceptable chemicals



### **Environmental Regulation Systems**

#### Component Based System

- Biodegradability
- Bioaccumulation potential
- Aquatic toxicity

#### Product Based System

- Aquatic Toxicity
- No static oil sheen





- Australia
- Operator Best Practice System





### **Environmental Regulation: Component based**



Hydraulic Fluid Best in Class: UK Cefas OCNS Group D. Norway NEMs Yellow Colour Advances in Sustainability focussed on Performance Additive chemistry

### **Environmental Regulation: Product based**



Hydraulic Fluid acceptable if NOEC >50mg/l

- General HSE compliance prioritises safety of people over sustainability, environmental profile etc.
- Chemical regulatory compliance isn't directly concerned with equipment reliability, performance or consequences of failures
- All chemicals used in a hydraulic control fluid must be listed with local authorities/inventories (e.g., EU REACH, USA TSCA...)
- REACH designed to "encourage design of sustainable chemistry" but cost of regulatory compliance may stifle R&D into new chemistry/chemicals
- Regulatory Trade offs may be required
- Balance technical feasibility with available technology/chemistry

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### **Technical Performance**

- Control fluids used in safety critical applications
- Equipment design & operational life exceeds 25 years
- Advances in sustainability focussed on performance additive chemistry
- Improvements in sustainability must not impact technical performance of control fluids
- Control Fluid properties & requirements set out in API 17F Annex C

### API 17F (4<sup>th</sup> Ed) Annex C: Properties of Control Fluids

- C.3: Thermal Stability High Temperature
- C.4: Thermal Stability Low Temperature
- C.5: Thermal Stability with 10% Seawater Contamination
- C.6: Seawater Compatibility (Aqueous fluids only)
- C.8: Control Fluid Compatibility
- C.9: Completion Fluid Compatibility
- C.10: Miscellaneous Fluid Compatibility
- C.11: Metal Compatibility
- C.12: Elastomer Compatibility
- C.13: Thermoplastic Compatibility
- C.14: Filterability
- C.15: Fluid Lubricity and Wear
- C.16: Microbial Resistance

### Stability

#### Compatibility

#### Performance

### **Sustainable Performance Additives**

Thermal Stability

Metal Compatibility

Degradation Corrosion

Lubrication **Performance** 



### **Sustainable Control Fluid**

Thermal Stability

Metal Compatibility



6 months @170°C



Lubrication **Performance** 









### Summary

- Offshore Oil & Gas Industry ahead of the sustainability trend for 20 years
- Water-based fluids used in >95% subsea production control systems
- Improved availability of bio-based & renewable chemicals
- Environmental regulations favour improvements in Biodegradability
- R&D using holistic approach i.e., advances in sustainability must not impact technical or environmental performance of control fluids



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## **Any Questions?**







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