

Polymers and Composites for Energy Industry An Operator's Perspective

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Operators Interests in Polymers and Composites

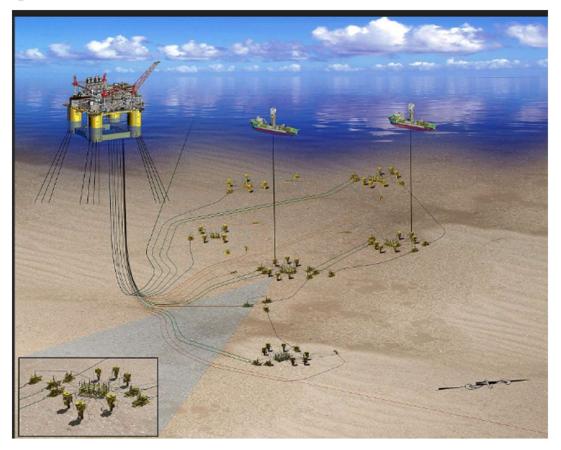
Driven by

- Low Capex and Opex Cost
- Low weight
- Enabler for equipment design
- High reliability in operations
- Ability to operate in corrosive environments
- Ease of Manufacturing
- Carbon footprint

Application of Polymers in Deepwater

Wells

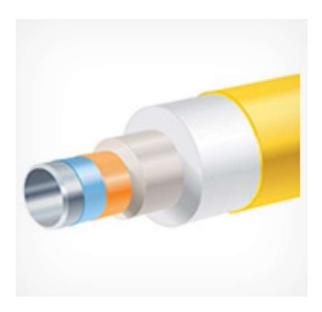
- 350F, 15Ksi Well Completions
 Subsea
- 350K, 15K Tree and subsea equipment Pipeline
- HT, Deepwater Insulation and Coatings
 Topsides
- Fabric Maintenance



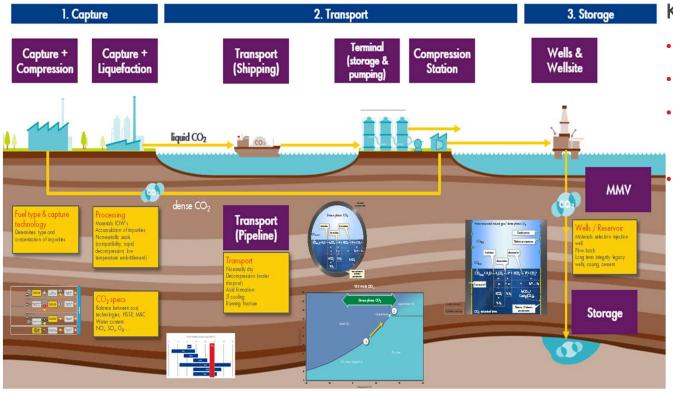
Deepwater Insulation and Coatings

Key Requirements

- Low Cost
- 25yrs Design Life
- Installation Method Compatible
- Thermal Performance
- Quality Application and Installation
- Enable low cost deployment



Applications by Sector- CCUS



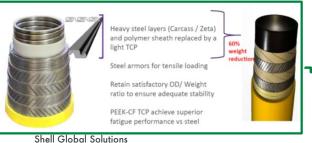
Key Technologies of Interest

- Nonmetallic Pipes
- Nonmetallic wells components
- MMV- Monitor, Measure,
 Verification
 - Integrity- Storage

Applications-Brazil: Flexible and Composite Pipe Carcass (Stainless Steel) Pressure Sheath (Polymer) Collapse Resistance Fluid Containment Pressure Armor (Carbon Steel) Tensile Armor (Carbon Steel) Internal Pressure **Increased Demand for** Tapes (Various) H₂S and CO₂ Manufacturing Aids/Anti-Friction Insulation (Syntactic Foam) Resistance External Sheath (Polymer) Seawater Ingress

> Thermoplastic Composite Pipe

Unbonded Flexible Pipe



Hybrid

Insulation Layer - Prevents excessive heat loss in bore fluids during operation Outer Shield - Protects the pipe against seawater ingress and external damage

for the entire riser

Carcass - Inner metallic layer prevents collapse due to hydrostatic pressure Fluid Barrier - Chemically resistant polymer boundary for conveyed fluids Composite Pressure Armour - Replacing Metallic 'Z' Profile Pressure Armour Wire

Tensile Armour - Provides axial support

Stainless Steel

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Select Example – Energy Transition

Corrosion Protection Strategy

- Design life is minimum 25 years
- Coatings and Cathodic Protection
- Maintenance free for more than 25 years
- Non-accesibility of offshore structures
- Offshore conditions not favourable for coating maintenance







Key Challenges - Nonmetallic Opportunities- Brazil

Challenges

- CO2-SCC
- 20K HPHT Subseq
- Polymer Fluid Interactions
- Manufacturing at Scale
- Nonmetallics Inspection- tools, guidelines
- HPHT Wells 350F, 15K
- Fabric Maintenance
- Automation
- 3D Printing
- Industry Standards
- Low-Cost Subsea Insulations

Opportunities

- New Polymers Development
- HPHT Seals
- Nonmetallic Pipes
- Inspection Technologies
- Asset integrity monitoring

Brazil and Global Collaborations

- Industry Standards
- JIPs
- Brazil Universities: e.g. UFRJ, UFRGS
- Companies: Flexibles, Inspection, Modeling

Thank You

