PRESENTATION ON
Application of FRP Pipes & Other Composites in Oil & Gas Sector: Opportunities and Challenges

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OUTLINE OF PRESENTATION

• Why composite materials?
• Properties & Benefits of composite materials
• Composite material applications in Oil & Gas Sector
• Composite material applications in ONGC – Onshore & Offshore
• Opportunities & Challenges
• Conclusions
WHY COMPOSITE MATERIALS?

Primary reasons for their use:

• Highly superior in corrosion resistance compared to carbon steel and other metallic materials
• Long service life of 25 – 30 years
• Light in weight
• Life cycle cost effectiveness
## TYPICAL PROPERTIES OF REINFORCEMENTS IN COMPOSITES

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Relative Density (g/cc)</th>
<th>Tensile Strength (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Glass</td>
<td>2.54</td>
<td>3.45</td>
</tr>
<tr>
<td>S-Glass</td>
<td>2.40</td>
<td>4.58</td>
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<tr>
<td>Carbon</td>
<td>1.76</td>
<td>4.03</td>
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<tr>
<td>Steel</td>
<td>7.86</td>
<td>1.50</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2.7</td>
<td>0.62</td>
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</tbody>
</table>
BENEFITS OF COMPOSITE MATERIALS

- High strength to weight ratio
- Light weight
- High impact & fatigue strength
- Electrical insulation
- Ease of transportation & installation
- Tailor made properties
- Minimal repair requirement
- Ease of maintenance & repair
COMPOSITE MATERIAL APPLICATIONS IN OIL & GAS SECTOR

• Pipelines and Piping for different applications
• Secondary Structures
• Downhole Well Tubing/ Casing
• Accommodation Modules
• O/G & U/G Mobile Storage Tanks
• Pressure Vessels
• Sucker Rod System for oil wells
COMPOSITE MATERIAL APPLICATIONS IN OIL & GAS SECTOR

Pipelines and Piping applications in Onshore

- Effluent Water Transfer
- Produced Water Transfer
- Injection Water Transfer
- Oil Flow Lines
- Gas Flow Lines
- Multi-phase Flow Lines
- Fire Water Service
- Potable Water Service
Spoolable Pipe Applications in Onshore

- 2-1/2” to 6-1/2”
- 750 to 2,500 psi
- 29°F to 140°F or 180°F
- 50 million feet (15.3 million meters) installed
COMPOSITE MATERIAL APPLICATIONS IN OIL & GAS SECTOR

Pipelines and Piping applications in Offshore

- Cooling Water
- Potable Water
- Sewer Water
- Fire Water
- Injection water
- Produced water
- Open drains
- Sea Water Lift Pump Column Pipe
COMPOSITE MATERIAL
APPLICATIONS IN OIL & GAS SECTOR

Secondary Structures

• Grating
• Stair & Stair-tread
• Handrail
• Ladder & Cage
• Cable Tray
COMPOSITE MATERIAL
APPLICATIONS IN OIL & GAS SECTOR

Sucker Rod System

- Increases production
- Reduces downtime
- Reduces operating cost
- Competitively priced with steel
- Successfully tested > 800 Wells
ADVANCED COMPOSITE MATERIAL APPLICATIONS IN OIL & GAS SECTOR

• Tethers/ Tendons
• Risers
• Umbilicals
• Sub Sea Equipment Protection Covers
Advanced Composite Material Applications in Oil & Gas Sector

The umbilical is the power and control lifeline in subsea production systems that connect the topside facilities with the subsea systems to provide utilities such as hydraulics, electric, fiber optic and TLP tendons as well as production and drilling risers. As projects move into deeper water, designers can reduce the weight of these loads by substituting carbon-fiber materials for steel.
COMPOSITE MATERIAL APPLICATIONS IN ONGC

- Subsea Protection Covers
- Tethers
- Risers
COMPOSITE MATERIAL APPLICATIONS IN ONGC

• GRE line pipes for effluent water, produced water, fire water in onshore

• GRE hydrocarbon flow lines on pilot basis in onshore

• FRP fencing for well heads in onshore

• FRP underground petroleum storage tanks

• Composite wraps for pipe repairs
Applications to be introduced:

- FRP/ GRE sea water lift pump column pipe for offshore
- GRE downhole tubing / casing in onshore
- FRP accommodation modules/ bunk houses in onshore
OPPORTUNITIES

• GRE line pipes for oil field applications in onshore

• GRE piping for top side applications of offshore platforms

• Secondary structures for offshore platforms.

• Composite material wrap repairs for onshore and offshore line pipes & piping

• Advanced composite material applications for deep offshore oil field applications
CHALLENGES

• Mindset and conservatism of the oil & gas industry
• The dominance of steel based structures throughout the industry
• Composites are perceived as new materials and there is limited knowledge on them within the industry
• Regulatory requirements
• Development of standards for new applications
CHALLENGES

• Limitations in applications for HPHT conditions

• High cost of development & prototyping

• Minimal tolerance to failure of new technology

• Standard test methods and procedures need to be established for understanding the material especially for critical applications such as deep offshore
CONCLUSIONS

• Composite materials have demonstrated their performance as new age versatile alternatives to carbon steel & metallic materials and have found acceptance for several applications in the Oil & Gas Sector.

• Composite materials are gradually overcoming the conservatism and reluctance of the oil & gas industry for more and more applications.

• Composite material pipes have emerged as the most widely used application for various services in the Oil & Gas Sector.

• Opportunities exist for several applications both onshore & offshore.
CONCLUSIONS

• With hydrocarbon explorations getting into deeper waters, advanced composite materials have opened up more avenues in terms of light weight cost saving applications for the oil & gas industry.

• Limitations remain for applications of composite materials for HPHT applications. The sooner these challenges are addressed by the industry, the better.

• For deep water applications, the composite industry has to overcome challenges such as lack of reliable data base, reference values & standards for composites to facilitate design and simulation.
THANK YOU