The Future of Nonmetallic Composite Materials in Upstream Applications

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Downhole Challenges

Causes of corrosion

- ✓Water breakthrough
- ✓High water cut
- ✓Corrosive environment (CO₂,H₂s)
- ✓High Pressure and Temperature
- ✓Scale Formation (FeS)
- ✓Sand content (Erosion)

Downhole Corrosion

Tubular buckling/lock- up

➢ Tubular lock-up/stuck in ERD (High friction)

Consequence

- Corrosion/Erosion effect for downhole tubular
- Production lost
- Expensive workover jobs
- Upgrading metallic to CRA alloys materials

Driver of Nonmetallic for Upstream Applications

Strategy & EXPEC ARC integration with GRCs

NM Penetration in Downhole Applications

Nonmetallic Deployment Experience

Future Application

Full Tubing/Casing

(RTR)/GRE

RTP (Semi-Bonded)

TCP (Bonded)

Tubulars Development complexity Matrix

	Casing				
	9 5/8"	13 3/8"	16 5/8"	20"	24"
Outside Diameter	9 5/8"	13 3/8"	16 5/8"	20"	24"
Reservoir W&O&G	W&O&G	W&O&G	W&O&G	W&O&G	W&O&G
Burst pressure	6000	9500	3500	6500	1000
Collapse pressure	3500	9000	2000	4000	2000
Temperature	TBD*				
H2S content	TBD*				
CO2 content	TBD*				

	4 1/2"		
	Water	Oil	Gas
Outside Diameter	4 1/2"	4 1/2"	4 1/2"
Reservoir	Water	Oil	Gas
Burst pressure	5500		11000
Collapse pressure	5000		11000
Temperature	220° F	230° F	350° F
H2S Content	0	6%	10%
CO2 Content	0	10%	10%

Requirements of expanding the envelope of (casing/tubing)

Short Term R&D (On going)

High Temp Protective Coating

Expand Operating Envelope of Composite Tubulars

Thermomechanical Study of Thermoplastic (PVPDF)

Dissolvable Frac Plug

Long Term R&D (4IR)

Self-healing (cement, coating)

Self-healing Composite with filled Hollow Fibers

Intelligent Composite Pipeline

Carbon Fiber and natural reinforcement

Path Forward