Thermoplastic Composite Pipe: Enabler for Enhanced Oil Recovery

Martin van Onna
Airborne’s Thermoplastic Composite Pipe™ concept

- One plastic compound in liner, composite and coating
- Glass fibres provide strength and stiffness
- Benefits:
  - Lightweight
  - No corrosion
  - Spoolable
  - Superior fatigue
Airborne Thermoplastic Composite Pipe™ Concept

Fully bonded flexible pipe (melt-fused): one solid wall
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Fully bonded flexible pipe (melt-fused): one solid wall

- Smooth bore
- High collapse
- Vacuum capability
- No Rapid Gas Decompression issues
TCP Downline: THE solution to maximize production

- **High flow**: one 3” ID coil = 20+ BPM
- Multiple operations per year, for years, with one downline: **superior fatigue performance**
- **Easy** and **safe** to operate: light-weight, no spring effect, no heavy weight requirements
- **Fast running**: 2.5 hrs to 2100 meters water depth
TCP Downline: THE solution to maximize production

- **Reducing cost per intervention:**
  - No logistics
  - Fastest running
- **Increased oil recovery**
System overview

1. Reeler
2. Downline
3. Bend restrictors
4. Lifting Collar
5. Jumper
System overview

6. Overboarding chute
7. Tensioner
8. Deck arch
System overview

- Preparation for deployment
- Deployment – running the downline
Challenge: Dynamic stability

- Lightweight pipe is more susceptible to currents
  - System must allow all current directions; vessel cannot always be turned

- Vessel motions can result in large hang-off angles
  - Low terminal velocity, issues on the overboarding chute to be avoided

- Fluid versus gas operation
  - When gas-filled the downline is buoyant
  - Avoid downline jumping on the chute – risk of overbending

- Fast deployment benefit not to be lost
Solution: Dynamic stability

- Configuration without mid-water arch
- Clump weight 4-6 mt continuously attached to downline
- Dynamic analysis to cover worst cases
Solution: Dynamic stability

- If possible, turn vessel to ensure proper exit from overboarding chute
- Use bellmouth
- Overboarding chute to ensure that downline never touches hull
Challenge: Fatigue loading in operation

- Reeling / unreeling
- Vessel motions
- Downline used for injection of large volumes, long duration overboard
- Both bending fatigue, tension fatigue & combination

Low cycle bending (reeling / unreeling)

High cycle bending + tension (dynamics)

High cycle tension (dynamics)
Solution: Fatigue mitigation in operation

- Reeler barrel diameter to cover all reeling / unreeling cycles
  - E.g. 15 years x 14 deployments x 4 cycles = 840 cycles
- Overboarding chute to cover all high cycle loading from dynamics
  - E.g. 15 years x 14 deployments x 3 days per deployment x wave frequency = 1+ million cycles
The operation

- Deployment – fluid / gas injection
- Deployment – currents
Operation – damages during use
Operation – other damages

Tensioner pads missing

Protruding bolts
Operation – other damages

Blister due to tensioner malfunction – repaired offshore
Conclusions

- Composite Downline proven in 2140 meter water depth
  - 33 deployments completed successfully to date
  - 100 days fully deployed
- Dynamic stability addressed as key issue
- Pipe system rugged – can cope with offshore handling
The Future is Here
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