Cost efficient deep-water lowering with HMPE rope

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Dec 02, 2016
Why are we looking for new solutions?

More demand to install larger components

Contractor/operator

More demand to reduce operational costs

Increasing requirements to go deeper - up to 4000m

Owner

Same investment higher payload
Why think beyond steel?

<table>
<thead>
<tr>
<th>Diameter (50mm)</th>
<th>50mm</th>
<th>50mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS</td>
<td>212 tons</td>
<td>212 tons</td>
</tr>
<tr>
<td>3km weight</td>
<td>34 tons</td>
<td>0 tons</td>
</tr>
<tr>
<td>Lift capacity @ 0m</td>
<td>70 tons</td>
<td>70 tons</td>
</tr>
<tr>
<td>Lift capacity @ 3000m</td>
<td>45 tons</td>
<td>70 tons</td>
</tr>
</tbody>
</table>

> 50% more payload

Higher payload at 3000 meters water depth
Why think beyond steel?

<table>
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<tr>
<th>Or</th>
<th>Same capability @ 3000m:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with a smaller rope</td>
</tr>
<tr>
<td></td>
<td>smaller winch</td>
</tr>
<tr>
<td></td>
<td>smaller sheaves</td>
</tr>
<tr>
<td></td>
<td>smaller crane</td>
</tr>
<tr>
<td></td>
<td>smaller vessel</td>
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</table>

= LOWER INVESTMENT
Industry leads the change

The industry develops solutions with synthetic ropes
Traction winches

Rolls-Royce (ODIM) CTCU
• 50 tons - 3000 meters
• 10 years’ field experience
• 125 tons - 3000 meters since 2010 on Skandi Santos
  2\textsuperscript{nd} one - 150 tons - in 2015

Logan
• 80 tons - up to 2800 meters
• Shell Perdido Spar
• Used for servicing subsea equipment
• In operation since 2010
Drum winches

DeepTek drum winch
- Expro AX-S system
  85 tons - 3kms
- MMA Prestige & Pinnacle
  - 110 tons @ 3kms

Swire Seabed Worker (2010)
- 30 tons - 6000 meters
- Salvage operations
- Apollo 5 engine @ 4600 meters
- 1400 tons of copper @ 3200 meters
Advancements in fiber and rope technology that have made this possible
The best of 2 worlds

With Dyneema® DM20 XBO you get the best of both worlds. ‘Trusted & proven with an unique resistance to creep’ and a ‘superior bending performance’.

Dyneema® Max Technology + Dyneema® XBO Technology
Dyneema® Max Technology

Proven & Trusted

Ropes with Dyneema® Max Technology (DM20) are as strong as SK78, and have a superior creep performance.

It allows for the maximization of line tensions, even at elevated temperatures as observed in severe bending conditions.
Dyneema® DM20: 3T Capacity

- Dyneema® DM20 synthetic filament has a maximum 3T capacity
- The MMA crane rope system has a maximum safe working load of 110 tons
- At its Performance Point (maximum rope tension of 110 tons and maximum rope temperature of 50°C) this rope has a margin to failure of 3, in continuous use (=24hrs/day), during its service lifetime of 10 years
- At lower rope temperatures, the margin to failure rapidly increases
Dyneema® XBO Technology

Wire rope data (Venneman)
Dyneema® at 80mm (improvement last decade)
Dyneema® and wire rope > 100mm

CBOS of rope with Dyneema® XBO on par with SWR

Also tested on par for rope over 100mm diameter
76mm Rope tested @ 880kN/8sec
You know us already

- Mooring lines
- Towing lines
- Lifting slings
- Installation lines
- Anchor handling lines
- Seismic lines
- Back-up lines
- Turret pull-in lines
- Protective netting
- Protective covers
You know us already

**Ropes with Dyneema®, the world’s strongest fiber™**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Lighter</td>
<td></td>
</tr>
<tr>
<td>Thinner</td>
<td></td>
</tr>
<tr>
<td>Longer lasting</td>
<td></td>
</tr>
<tr>
<td>No rust</td>
<td></td>
</tr>
<tr>
<td>No re-lubing</td>
<td></td>
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<tr>
<td>Torque free</td>
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<tr>
<td>Limited maintenance</td>
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<td>Resistant to chemicals</td>
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</table>
Total Cost of Ownership

- Reduced operational costs
- Increased productivity
- Durability
- Safety

Recorded webinar at YouTube via link below
https://www.youtube.com/watch?v=m9MVuCKEEJA
Costa Concordia parbuckling salvage operation with OTS ropes made with Dyneema®
Statoil’s first spar in the North Sea

Will be moored with Lankhorst’s synthetic rope protected from trawl wire damage with a cover made with Dyneema®
The Olympus, Shell’s largest Tension Leg Platform has been towed out with Samson lines made with Dyneema®.
Conclusion

• Several systems are in use with HMPE fiber ropes and all large crane manufacturers now have a system on offer.

• Synthetic fiber ropes and winches are key enablers for cost efficient deep-water lowering operations.

• Dyneema® Max Technology and Dyneema® XBO Technology enable maximization of line tensions and improve cycle bending performance of fiber rope.

• Rope engineering tools and monitoring tools have been developed to optimize the rope design and usage towards best value for the end user.

Acknowledgements:
Samson Ropes, Hampidjan, Lankhorst Ropes, Logan, ODIM, Deep Tek, DNV, Rolls Royce

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