Engineering Fit-For-Purpose Dyneema® Ropes for the Stiesdal TetraSpar Demonstrator

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TetraSpar Demonstrator

• World’s first industrialized offshore foundation

• Commissioned & fully operational in 200-meter water depth since mid-2021

• Competitive advantages:
  • Lean manufacturing
  • Lean assembly
  • Streamlined installation
  • Material efficiency (today’s focus)
    • Optimal use of materials to lower total system costs

Photo credit: The TetraSpar Demonstrator Project ApS

Floating Wind Solutions
How can Dyneema® fibers help Stiesdal achieve lower LCOE?

• Facilitate structural light-weighting – *getting the steel out*
  • with keel lines made with Dyneema® DM20

• Ensuring mooring integrity – *proving safety & reliability*
  • with GAMA98® mooring lines made with Dyneema® DM20

• Flexible deployment – *adjusting to operational changes*
  • with winch lines made with Dyneema® SK99

Over 40+ fiber grades including:

DM20
  • Optimized for Fatigue Lifetime

SK99
  • Optimized for Breaking Strength
Facilitating Structural Light-Weighting

Winch lines made with Dyneema® SK99

Keel lines made with Dyneema® DM20

Photo credit: Dock90
Total Weight of Keel Lines Reduced by 91%

- When submerged, Dyneema® is neutrally buoyant – saving 30+ mt of extra buoyancy
- Meeting breaking strength requirement is only the first step
Regaining Design Freedom

• Today there is no standard for synthetic keel lines - *How can we validate the system holding capacity for the keel lines?*

• DSM has developed an engineering method for achieving safe & reliable rope performance for offshore applications

• Ropes developed with the engineering method are certification-ready via DNV

TetraSpar Assurance Case:
• **Reduced** full-scale testing facilitated by:
  • Fatigue performance modeling
  • Scaled testing (Ex. bending fatigue)
  • Splice integrity testing for end terminations
Leveraging the Full Potential of Synthetics

Elastic Response: Deformation and load are directly proportional.

Viscoelastic Response: Over time deformation can increase and loads can decrease.

- 50% of load sharing capability occurs in 1st hour

- TetraSpar Keel Lines: length differences within the rope construction are reduced
Ensuring Mooring Integrity

GAMA98® Mooring lines made with Dyneema® DM20

Photo credit: Dock90
Assuring Mooring Performance over a 25-year Operational Life

• Defined the worst-case environmental conditions:
  • Gather inputs on the maximum loads
  • Applied at maximum temperatures
  • For 25 years of operational life
  • Following DNV & ABS guidelines

• Utilized DSM’s Fatigue Performance Model with core-equations certified by DNV.

• Results: **Negligible creep deformation (<0.1%) on all three GAMA98® mooring lines made with Dyneema® DM20.**
Flexible Deployment

Towing occurred with keel deployed.

Photo credit: Dock90
Adapting to Operational Needs

- Reduced rope diameter ~15% by utilizing Dyneema® SK99 fiber to accommodate an existing winch assembly.

- Decision to tow floater with keel deployed supported by optimal deflection system.

- Positive buoyancy allows mooring pre-lay to form an arch thereby avoiding contact with the sea floor.
Transitioning to Commercial Scale

• Designing components based on lifetime
  • Ex: Reusing winching lines to install all floaters for a wind farm (or multiple wind farms!).

• Material availability is not a bottleneck
  • Upwards of 10,000 km of Dyneema® SK78 vessel mooring lines are in use today.

• Optimizing installation plans
  • Ex: No pre-stretching sequence for GAMA98® mooring lines (waiver via ABS)
  • Ex: Using smaller (local) vessels to accommodate port infrastructure constraints.
Thank You

We're design agnostic.

Let’s co-engineer the optimal systems for your floating wind project. Moorings, tethers, slings.

Lightweight, certified, tested, proven.

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Visit Dyneema.com to learn more