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SUB-COMMITTEE ON SHIP DESIGN AND CONSTRUCTION

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GUIDELINES FOR USE OF FIBRE-REINFORCED PLASTICS (FRP) WITHIN SHIP STRUCTURES

Meeting IMO Standards with Hybrid FRP Manufacturing: The Synergy of Elium Resin, VARTM , and UV Cured Pultrusion for Sustainable Shipbuilding

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Executive summary: This paper explores a hybrid Fiber-Reinforced Polymer (FRP) manufacturing approach that combines Elium® resin, Vacuum-Assisted Resin Transfer Molding (VARTM), and UV-cured pultrusion technologies to meet these evolving requirements in developing countries.

Strategic direction if applicable: 4

Output : 6

Action to be taken: 5

Related documents: Elium® Resin Technical Datasheets – From Arkema

SAMPE (Society for the Advancement of Material and Process Engineering)

SNAME (Society of Naval Architects and Marine Engineers)

1. Introduction

The global shipping industry, a cornerstone of world trade, faces increasing pressure to achieve sustainability, safety, and circular economy compliance. Traditional shipbuilding materials like steel and thermoset FRPs suffer from corrosion, CO_2 emissions, and non-recyclable end-of-life disposal, making them incompatible with evolving IMO mandates.

To meet these challenges, we propose the adoption of a Hybrid FRP System, combining:

- Elium® Resin – a thermoplastic, recyclable, fire-modifiable resin
- VARTM (Vacuum Assisted Resin Transfer Molding) – a closed-mold, low-VOC, cost-efficient process
- UV-Cured Pultrusion – a fast, energy-efficient, automated method for complex shapes

This synergy offers lightweight, strong, fire-safe, and recyclable ship structures that align with IMO's sustainability goals, especially benefitting developing maritime nations seeking cost-effective, eco-friendly alternatives.

2. Relevance to IMO Objectives

i. SOLAS and FTP Code 2010 Hybrid FRP structures using Elium® resin with fire-retardant additives (ATH, phosphorus compounds, intumescent systems) can meet:

   - Part 2: Smoke and Toxicity
   - Part 3: Fire Resistance
   - Part 5: Surface Flammability

   This ensures full SOLAS Chapter II-2 compliance for fire safety.

ii. Hong Kong Convention (HKC) Elium® FRP's mechanical and chemical recyclability supports "cradle-to-grave" ship recycling, enabling compliance with the HKC's 2025 enforcement.

iii. MARPOL/MEPC/GHG Reduction Lightweight Hybrid FRP vessels reduce fuel consumption by 10–20%, cutting lifecycle CO_2 emissions by up to 70%. This directly supports MARPOL Annex VI, EEXI, CII, and MEPC decarbonization targets.

3. Real-World Demonstrations

Groupe Beneteau – Jeanneau Sun Fast 30 OD (2023):

- World's first series-produced yacht using 100% recyclable Elium® resin.
- Demonstrated industrial feasibility and performance equal to traditional polyester resins.
- Designed for easy end-of-life disassembly and chemical recycling.

Arkema Mini 6.50 Prototype:

- Hull and deck made entirely with Elium® resin via carbon-fiber infusion.
- Won a transatlantic race, proving durability and structural reliability in harsh marine conditions.

ABS Approval (2024):

- Toray Industries & MODEC received ABS type approval for VARTM-based repair on FPSO/FSO systems.
- Demonstrates acceptance of vacuum infusion FRP technologies in offshore and marine applications.

4. Need for Regulatory Development

a. No IMO guideline yet for thermoplastic hybrid FRP use in ship structures.
b. FTP Code 2010 focuses on thermosets; new fire test provisions are needed for thermoplastics.
c. Recyclability is not yet a Type Approval criterion — inclusion is vital to align with HKC.
d. Developing nations require clear frameworks and capacity building to adopt green materials.

5. Proposed Actions for SDC

a. Initiate IMO Guidelines for Hybrid FRP Systems (Elium® + VARTM + UV Pultrusion).
b. Define performance benchmarks for fire safety, recyclability, and structural integrity.
c. Amendments
    - Update FTP Code 2010 & SOLAS II-2 to cover thermoplastic FRPs.
    - Include recyclability criteria in IHM and Type Approval documentation.
d. Testing & Certification
    - Develop standardized FTP protocols (Parts 2, 3, 5) for thermoplastics.

- Promote Type Approvals via ABS, DNV, IRS.

e. Capacity Building

- Implement pilot shipyard projects in developing nations.
- Launch training modules on FRP sustainability under IMO model courses.
- Encourage industry–academia collaboration for data collection and innovation.

6. Expected Outcomes

- SOLAS & HKC Compliance
- Circular economy in shipbuilding
- Improved fire safety and durability
- Reduced lifecycle costs and maintenance
- Lower emissions and energy footprint
- Global technology transfer for developing nations

7. Conclusion

The Elium®–VARTM–UV Pultrusion hybrid system provides a transformative path toward sustainable, recyclable, and fire-safe shipbuilding. It directly supports IMO's environmental goals, addresses the 2025 HKC mandate, and contributes to MARPOL Annex VI compliance.

We urge the SDC to:

- Initiate a new work item on thermoplastic FRP guidelines,
- Develop amendments to include recyclability and fire testing criteria
- Promote capacity building for developing nations to adopt this innovation.

By doing so, the IMO can lead the maritime industry toward a circular, low-carbon future, enabling safe, green, and economically viable fleets for generations to come.