The Composite Materials Revolt in Shipping

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N. BOGDANOS MARINE BUREAU

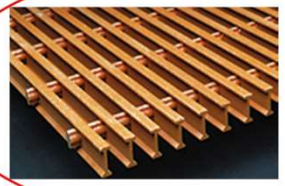
Since 1956

Company's Portfolio

The US world leader in Glass Reinforced Epoxy (GRE) piping for Ballast Lines, SOx Scrubbers, Ballast Water Treatment, SW Cooling, SW Fire-Fighting systems, highly-corrosive chemicals etc., making pipe corrosion a thing of the past, certified by all class societies.

ARTA is the expert supplier of modern coupling technology, fluid & gas transfer equipment (e.g. Ship-to-Ship LNG Transfer System Stainless Steel Couplings) using cutting-edge solutions.

The world's leading company for magnetic robot crawlers. From washing cargo holds clean while sailing to grit blasting, abrasive as well as underwater cleaning.



The US top brand name in Fiberglass Composite Phenolic Gratings (FRP) for platforms, passages, walkways, winch stands, deck ladders etc..

The global Leader in Underwater Inspections & Repairs, eliminating the need for drydock. Authorized by all class societies.

The **G**lassflake Vinylester coatings provide life protection against Corrosion & Erosion on Hulls, Scrubber Outlets, Rudders, Ducts & Thrusters.

The Dutch Propeller Repair Specialists, repairing propulsion systems in factory or globally via flying squads. DNV-GL certified for in situ propeller welding.

Singatac is a specialist in ship repairs & retrofits since 1997 in Singapore & Bintan, Indonesia with fully-equipped workshops.

Yard Shiprepair Services in Busan. From EGCS & BWTS Retrofits & Repairs to Dual Fuel LNG conversions and Energy Saving Devices.

Diesel & Gas Engines
Spares and Services
Machining of Engine Parts
Reconditioning of Parts
Workshop in Dubai

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COMPOSITES

- The very reason for Composite materials existence in ship-board applications is simply that many such applications involve seawater which is a very corrosive fluid. The three most important SW corrosion factors are : Chlorides, O_2 & temperature.

- Composite products such as Glass-Reinforced Epoxy Piping and Fiberglass Phenolic Gratings are gradually replacing steel or other steel-based compounds in areas such as ballast piping, SW cooling, SW Fire Fighting System piping and gratings in passages– center or flying ones-, deck ladders, bridge wings, rails, etc for FRP.

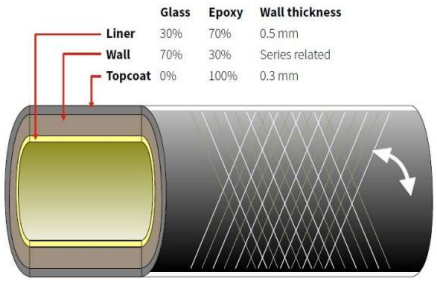
So, what do we really mean by ‘’Composite Materials” ?

- A composite material is made of two or more constituents with different chemical properties, which, when combined, produce a material with characteristics different from its constituents.

- Shipping’s needs, with seawater corrosion omnipresent, are today satisfied by composites like fiberglass (FGS), Fiber-reinforced Polymers (FRP), Glass-reinforced Epoxies (GRE) etc. GRE, for example, is 70% glass & 30% resin. Resin is at appr. 70% made of carbon, so, for example, a GRE pipe is only by 21% carbon-based, vs steel’s 100%.

- Due to huge weight difference between e.g. GRE pipes vs steel pipes (a ¼ ratio), maintenance-free lifetime, fire-endurance (L3, upgradeable to L2), totally corrosion-resistant nature, suitability for low temperatures in LNG transfer issues (leaks, flammable vapour etc) and an at least equal cost to carbon steel, GRE has become a ‘’standard’’ in vessel piping (like ballast lines) since late ’80s.

Pipe Design

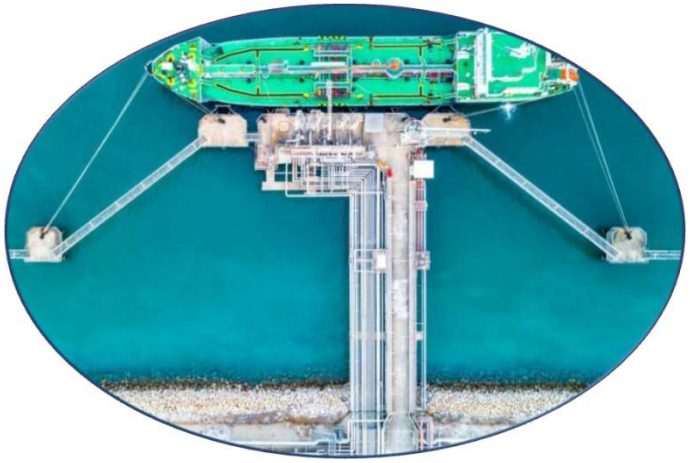


GRE Piping wherever there is corrosion risk

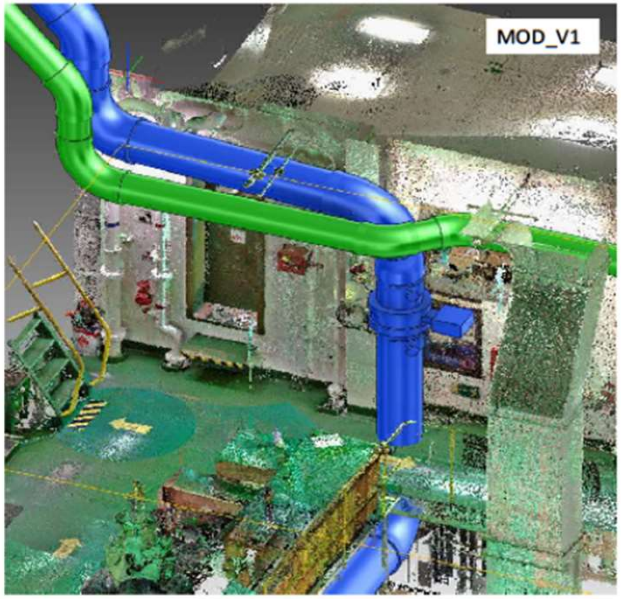
Seawater
Cooling Piping

Ballast Water Piping

Jetty Infrastructure



Firewater Piping



NOV FGS Glass Reinforced Piping (GRE) in Scrubber Systems

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Fiber Glass Systems | NOV Completion & Production Solutions

SCRUBBER ORDERS REGISTRY FOR NOV FGS PIPING BY GREEK OWNERS – Dec. 2019

1	STARBULK SA / OCEANBULK S.A.
2	TMS BULKERS LTD
3	TMS DRY LTD
4	TMS TANKERS LTD
5	MARAN DRY MANAGEMENT INC (MDM)
6	MARAN TANKERS MANAGEMENT INC (MTM)
7	NEPTUNE LINES SHIPPING & MANAGING
8	TRAFIGURA MARITIME VENTURES LTD
9	NEDA MARITIME TANKERS
10	NEDA MARITIME BULKERS
11	SAFE BULKERS INC
12	ALASSIA NEWSHIPS MANAGEMENT INC
13	SPRINGFIELD SHIPPING CO / OLYMPIC SHIPPING S.A.
14	KYKLADES MARITIME CORP
15	IONIC SHIPPING MANAGEMENT
16	COSTAMARE SHIPPING COMPANY S.A.
17	ALMI TANKERS S.A.
18	MINERVA MARINE INC.
19	MARMARAS NAVIGATION LTD
20	DELTA TANKERS LTD

Scrubber Retrofits Piping Overview 2018-2022 YTD

- 25 Major Greek owners
- 10 Fleet-wise Agreements
- 360 vessel Scrubber Retrofits
- > 75% of the total Greek market

Greek owners consistently chose NOV FGS Glass Reinforced Epoxy piping for their Scrubber installations

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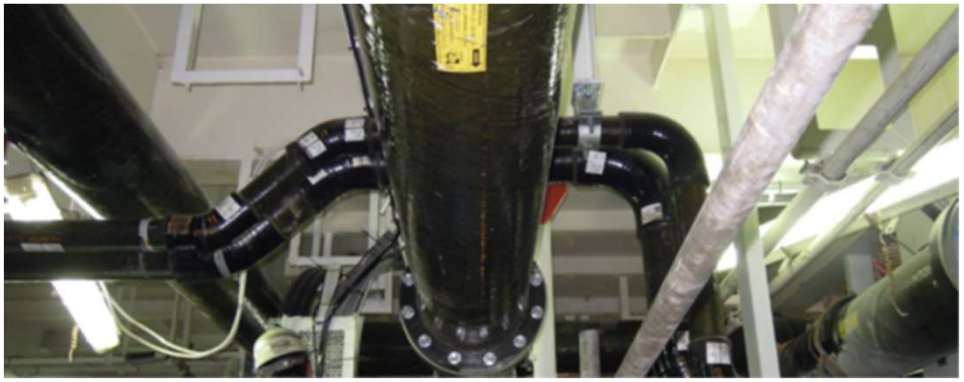

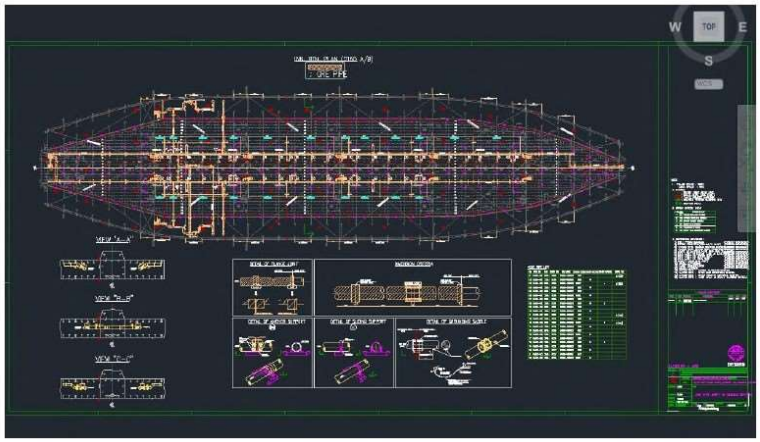

BALLAST PIPING :

NOV FGS (Bondstrand Series) is the globally renown state-of-the-art GRE piping, with thousands of installations, over 1,000 on Greek-owned vessels of all types & sizes

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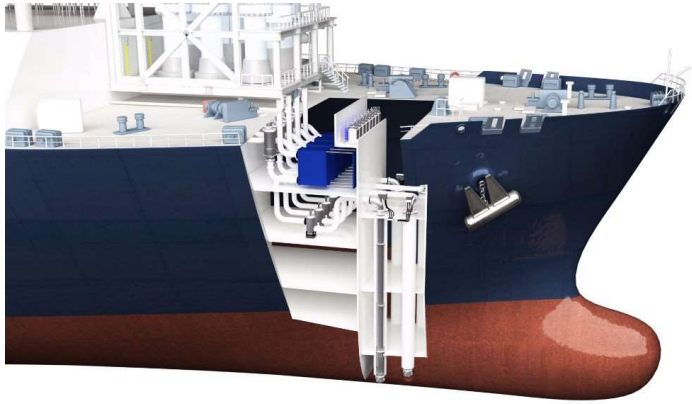
Greek-Owned LNG Newbuildings 2014-2021 with NOV FGS Ballast Lines						
	OWNER / YARD	DSME	HHI	HSHI	SHI	TOTALS
1	Maran Gas (MGM)	28		10	4	42
2	TMS Cardiff Gas		7		4	11
3	Capital Gas		15			15
4	GasLog Ltd				8	8
5	Dynagas	5	6			11
6	Alpha Gas	4				4
7	Latsco (LMM)			6		6
8	Minerva Gas	2				2
9	Chandris	2				2
	TOTALS	41	28	16	16	101

Typical application : GRE Ballast Lines Reference List of Greek-owned LNGs at Korean Shipyards, built 2014-2021 : NOV FGS has proven to be the primary choice of both owners and shipyards



Bondstrand for Ballast & Regas Lines

1000 meters of pipes from 6” to 40” installed on these, and seven other similar REGAS LNG Carriers.

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FRP

Fiberglass-Reinforced Phenolic Gratings

STRONGWELL

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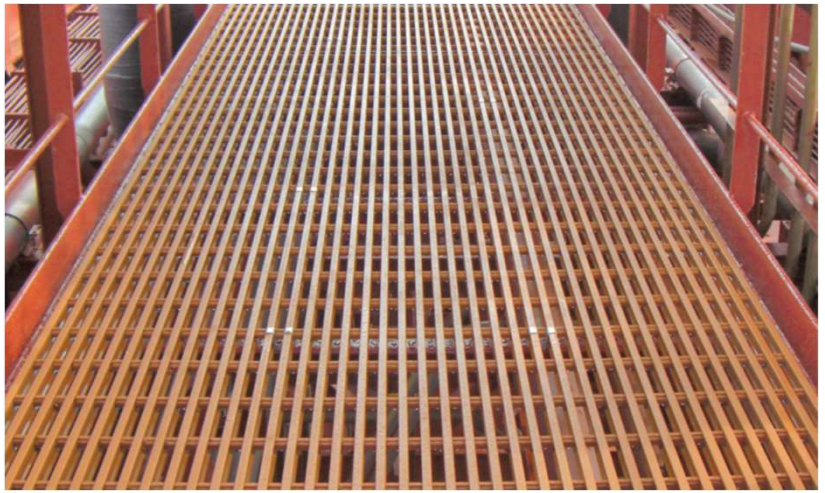

PROBLEM:

Rusting Steel Grating

SOLUTION: DURAGRID® PHENOLIC

Strongwell Fire Integrity Pultruded Grating

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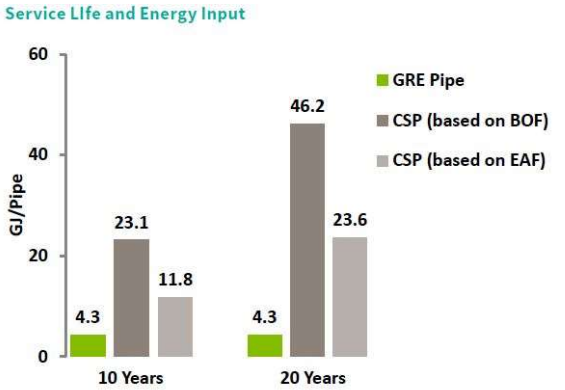
The two leading GRE piping & FRP gratings producers are :

- **NOV FGS (USA)** with Asian Marine HQ in Singapore, factories in Senai, Malaysia & Qingdao, China, Plymouth UK and service stations all over the world

- **STRONGWELL (USA)** with HQ in Virginia, three factories in the US, stock in Busan, Korea & Plymouth UK & support at key maritime global locations

Truly Global Technical Support

Last but not least : the CO2 footprint



1. **Energy use in manufacturing**
   On a per pipe length basis, GRE piping systems requires 80% less energy to produce than that made from new steel, and 50% less energy to make than that of recycled steel.
2. **Energy use in operation**
   GRE can produce 90% energy savings throughout a twenty-year life cycle. This is due to a smoother inner pipe surface which halves the pumping energy required as compared to carbon steel pipe.
3. **Carbon Sink Effect**
   The carbon-stored in GRE piping systems prevents the same carbon from entering the atmosphere and causing the green house effect.

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- Reliability & Accountability
- Quality of Materials & Services
- Value for Money / Competitive Price
- Strong Global Support Network
- Proven Marine Track Record
- Green Solutions with Quick Payback
- An Honest Partnership Philosophy

Thank you !

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