COMPA Repairs and Reinforcements with Composite Materials

Technology Overview and Application Cases

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Use of COMPA Repairs

• Leakage prevention (tightness restoration)
• Prevention of further corrosion development
• Strength reinforcement
• Reduction of crack growth
• Durability
Solution for corroded and cracked ship structures

• Problems of corrosion and cracks on ships occur frequently

• Affecting different systems and structures: pipes, valves, decks, tanks...
COMPA Repairs
Composite repair technology

• Fast and reliable
• No hot works involved
• Done during port time or during voyage
• Applicable for complex shapes and structures
• Low added weight
COMPA Repairs technology

- Lamination of carbon and glass fibres reinforced by epoxy resin onto metal surface.
- Epoxy resin hardens and permanently bonds the fibres to the metal, resulting in a new layer of watertight and hard (strong) material.
## Composition of COMPA repair

<table>
<thead>
<tr>
<th>Sub-system</th>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Damaged material</strong></td>
<td>Substrate (metal or FRP)</td>
<td>Parent damaged material that is being repaired</td>
</tr>
<tr>
<td><strong>Substrate-to-composite interface</strong></td>
<td>Adhesive</td>
<td>Interface layer required for bonding of composite patch to the metal substrate</td>
</tr>
<tr>
<td><strong>Composite patch</strong></td>
<td>Glass fibres</td>
<td>Fabric of first layer of patch laminate; for prevention of galvanic corrosion</td>
</tr>
<tr>
<td></td>
<td>Carbon fibres</td>
<td>Fabric of other layers; for achieving strength and stiffness</td>
</tr>
<tr>
<td></td>
<td>Epoxy resin</td>
<td>Matrix material of patch laminate</td>
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COMPA Repairs process: design and engineering prior to repair application

**STEP 1**
Definition of the damaged area as provided by the client

**STEP 2**
Patch design involving numerical calculations

**STEP 3**
Preparation of the guidelines for a patch application

**STEP 4**
Report for the approval of a classification society
Numerical calculations for repair design

- Optimal patch design obtained using FE analysis
- Checking the structure behaviour
Steps of repair application process

• Surface preparation
• Application of the resin
• Application of the fibres (glass)
• Application of fibres (carbon) and corrosion protection (painting)
Approvals

• The company has received ISO 9001:2015 certificate for quality of management by Bureau Veritas BV.

• COMPA Repairs is in the process of technology qualification with DNV-GL.

• The company is certified by an IACS member, Croatian Register of Shipping (CRS), for repairs of marine piping using COMPA Repairs.
Clients

- Grimaldi Group
- Grand Circle Cruise Line
- Tankerska Plovidba
- Intersee
- Jadrolinija
COMPA Repairs cases of completed repairs
Problem: 500m of corroded piping was leaking sea water.

Solution: The repair was conducted during the vessel’s dry docking.

Repair Duration: 12 days

Class: BV and CRS
Problem: Corroded flange was leaking sea water.

Solution: COMPA repair was conducted during the vessel’s stay in port of Valencia.

Repair Duration: 4h

Class: RINA
SEWAGE TANK

**Problem:** Sewage tanks’ plating and profiles have undergone extensive corrosion.

**Solution:** The repair of the 300m2 was conducted during the vessel’s dry docking in Luxor, Egypt.

**Repair Duration:** 3 days
AIR-CONDITIONING UNIT SPACE

Problem: Air-conditioning unit’s steel flange and floor exhibited heavy corrosion.

Solution: The repair was conducted during the vessel’s dry docking.

Repair Duration: 1 day
Class: GL
**CLAPET VALVE**

**Problem:** Two clapet valves have undergone extensive corrosion.

**Solution:** The repair was conducted during the vessel’s dry docking.

**Repair Duration:** 1 day

**Class:** CRS
Problem: The damage on the garage floor was caused by severe corrosion in the corners where the water collects due to floor inclination.

Solution: The repair was conducted during the vessel’s dry docking.

Repair Duration: 1 day

Class: CRS
BOW THRUSTER TUNNEL

Problem: Bow thruster tunnel surface damage.

Solution: The repair was conducted during the vessel’s dry docking.

Repair Duration: 1 day

Class: GL
20m OF THERMAL OIL PIPING IN KEEL TUNNEL

**Problem:** The mineral-oil pipes, located in keel tunnel, were heavily corroded.

**Solution:** The repair was conducted during the vessel’s dry docking.

**Repair Duration:** 4 days

**Class:** GL
DECK UNDER AC STATION

Problem: Deck under AC station was leaking sea water.

Solution: The repair was conducted during the vessel’s stay in port.

Repair Duration: 7h

Class: RINA
BULKHEAD OF THE BALLAST TANK

**Problem:** Heavily corroded bulkhead was leaking HFO.

**Solution:** The repair was conducted during the vessel’s stay in Savona port.

**Repair Duration:** 7h

**Class:** RINA
Y-JUNCTION BALLAST INTAKE PIPE

**Problem:** Heavily corroded Y-junction was leaking sea water.

**Solution:** Conducted during the vessel’s stay in Salerno port.

**Repair Duration:** 6h

**Class:** RINA
HFO TANK TOP

Problem: Cracked tank top was leaking HFO in rough seas.

Solution: Conducted during the vessel’s stay in Savona port.

Repair Duration: 4h + 12h vacuuming

Class: RINA
BULKHEAD OF THE MDO FUEL TANK

Problem: Cracked bulkhead was leaking MDO.

Solution: Repair was conducted during the vessel’s stay in Antwerp port.

Repair Duration: 3h

Class: RINA
BULKHEAD OF THE HFO FUEL TANK

Problem: A heavily corroded bulkhead was leaking HFO.

Solution: Repair was conducted during the vessel’s voyage from Le Havre to Antwerp.

Repair Duration: 1 day

Class: RINA
HFO TANK TOP

Problem: A heavily corroded bulkhead was leaking HFO.

Solution: Repair of 5 cracks was conducted during the vessel’s stay in Antwerp port.

Repair Duration: 2 days

Class: RINA
Problem: Corrosion on the inner side caused leakage of the sea water.

Solution: Repair was conducted during the vessel’s stay in Antwerp port.

Repair Duration: 5h

Class: RINA
BALLAST TANK IN DOUBLE BOTTOM

Problem: Multiple bulkheads and the tank top were corroded and leaking sea water.

Solution: Repair was conducted during the vessel’s voyage from Hamburg to Antwerp.

Repair Duration: 2 days

Class: RINA
BALLAST PIPE IN HEELING TANK

Problem: Flange connecting steel and fibreglass pipe was corroded and leaking sea water.

Solution: Repair was conducted during the vessel’s stay in Antwerp port.

Repair Duration: 6h

Class: RINA
BULKHEAD BETWEEN BALLAST AND HFO TANK

Problem: The bulkhead was corroded and it was leaking HFO into the ballast tank.

Solution: Repair’s conducted during the vessel’s stay in Antwerp port.

Repair Duration: 8h

Class: RINA
Problem: Multiple pipe were corroded and leaking sea water.

Solution: Repair was conducted during the vessel’s stay in Antwerp port.

Repair Duration: 14h

Class: RINA
HEELING TANK FLOOR, AND BALLAST TANK BULKHEAD

Problem: The ballast tank floor and bulkhead were corroded and HFO was leaking into the ballast and heeling tanks from adjacent tank.

Solution: Repair was conducted during the vessel’s sail.

Repair Duration: 3 days

Class: RINA
Problem: Sea water pipe was corroded and leaking water.

Solution: Repair was conducted during the vessel’s stay in Rotterdam port.

Repair Duration: 10h

Class: LR
Thank You!

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