

## RMB BIO-ARMOR™

BIOFOULING PREVENTION

# Shell Cuts Mars B Costs with RMB BIO-ARMOR™ Corrosion-Resistant Rotational Lining Solution



*Diameter changes, wall penetrations and gussets that spanned the ID had to be protected with a uniform and uninterrupted bonded liner of modified HDPE.*

The Mars production platform is located in the Gulf of Mexico about 130 miles southeast of New Orleans. It has been one of Shell's most important oil and gas platforms since the oil field's discovery in 1989. Shell initially developed the platform using the Mars A 24-tension leg platform. Given the platform's sizeable resources, the company assessed the need for additional infrastructure to boost production. The resulting Mars B project added new infrastructure to the Mars platform and is expected to extend its production life to at least 2050, producing more than 1 billion barrels of oil equivalent.

### Challenge: Tight Turnaround and Budget for Reliable Corrosion Resistance

The Mars B infrastructure includes an Olympus tension leg platform, with 24 well slots and a self-contained drilling rig. This production platform has 16 caissons installed in the tension legs to assist with stabilizing the platform by controlling and distributing seawater. Because offshore platforms are highly susceptible to the aggressively corrosive effects of seawater, Shell was determined to use [corrosion-resistant](#) materials whenever possible.

Shell invited RMB Products to participate in the Shell Oil Deepwater Caisson Project in 2008. Shell's main objective was to find a corrosion-resistant replacement for the super duplex 2507 stainless steel caissons the company used previously. Shell needed a fast turnaround on production and required the alternative components to demonstrate equivalent or superior long-term performance.

Finally, Shell stipulated that production costs had to meet—or beat—the budgeted cost targets.

## At a Glance

Client: Shell

Industry: Chemical Processing—Oil & Gas

Manufacturing solution: Rotational lining with custom-compounded polymer

### PROJECT GOALS

- Find an alternative to super duplex 2507 stainless steel components
- Decrease production turnaround time
- Maintain or improve component performance/life
- Meet or beat budget cost targets

### REQUIREMENTS

- Provide exceptional resistance to seawater corrosion
- Address high mechanical-property demands
- Provide a turnkey solution
- Ensure uniform wall thickness in lining complex shapes
- Custom-compound polymer (HDPE) with antimicrobial additive

### HIGHLIGHTS

- Delivered BIO-ARMOR solution in 18 weeks vs. 50 weeks for super duplex stainless steel
- Tested and validated all materials to ensure design-life requirements met for maintenance-free performance
- Saved Shell \$5 million in manufacturing costs
- On track for improved service life, reducing future maintenance costs and capital expenses



Rotatorially lined caissons (20' length by 30" diameter) readied for inspection and delivery.

### Solution: BIO-ARMOR Formulation, Rotational Lining, and Finishing

RMB Products consulted with Shell for more than two years during the [design phase of engineering](#). The scope of the project included:

- Design and engineering
- Custom BIO-ARMOR material formulation and compounding ([high-density polyethylene](#) [HDPE] with added antimicrobial agent)
- Testing and validation
- Fabrication
- Preparation of the host structure
- [Rotational lining](#) with complex geometry
- Finishing, painting, and delivery for inspection and acceptance

RMB Products provided in-house services throughout all phases of the project and delivered product in about one-third of the time required for stainless steel components.

### Results: BIO-ARMOR Solution Saves \$5 Million in 18 Weeks

All aspects of the project ran smoothly and all project requirements were successfully met.

**Project turnaround.** RMB Products delivered the BIO-ARMOR solution 18 weeks after Shell released the order for production, compared with the anticipated 50-week lead time for super duplex stainless steel. Both lead times included fabrication, preparation, finishing, painting, and delivery for inspection and acceptance.

**Product performance.** Several parts of the project required rounds of testing and validation to meet Shell's stringent design-life specifications for maintenance-free performance.

- RMB Products used standard and proprietary preparation processes to enhance the receiving surface of the host material and better condition it for a successful coating application.
- RMB Products determined the manufacturing methodology to assure uniform wall thickness throughout the interior of the host structure. The complex shape varied in diameter, included multiple outlets, and contained an internal component that transversed the interior of the caisson with four interlocking steel rectangular ribs.

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- RMB Products and Shell collaborated to select HDPE for the lining material. Shell requested the addition of an antimicrobial element, requiring RMB Products to test modified batches of material until it achieved the design requirements without affecting established mechanical properties.

**Cost reduction.** RMB Products satisfied Shell's budget requirements. The rotational lining technology saved Shell \$5 million on the caisson portion of the Mars B project. Relative to the overall project costs approximating \$1 billion, the cost-savings contribution was a modest amount. However, meeting or exceeding all other project requirements while generating significant savings was a winning combination for Shell. As Mars B moves ahead, the use of corrosion-resistant HDPE will increase operational life, reducing maintenance costs and long-term capital expenses for Shell.

**Customer satisfaction.** The overall project went smoothly due to the ongoing successful collaboration of Shell and RMB Products. Shell engineers were highly satisfied with the value the alternative manufacturing materials and technologies provided for the project. Going forward, Shell has an additional arsenal of manufacturing options—with demonstrated advantages—that it can consider for future projects.

### Partnering with United Pipeline

The Mars B project also utilized numerous long, straight sections of pipe with no complex geometry. For internal [corrosion protection](#) in these sections, Shell contracted with United Pipeline to install its HDPE Tite Liner® product. Tite Liner® is pulled through long pipe sections that are straight or contain gradual bends, and fits tightly against the inside of the host pipe. Rotational lining and Tite Liner® work well as complementary technologies in many HDPE projects. RMB Products and United Pipeline have partnered on such projects for more than 20 years. For more information about Tite Liner®, visit [unitedpipeline.com](http://unitedpipeline.com).

### About Shell

Shell is a global group of energy and petrochemical companies and one of the largest energy companies in the world. Houston-based Shell Exploration & Production Company focuses its exploration on the deepwater plays in the Gulf of Mexico. Visit [shell.com](http://shell.com) to learn more about the company and the Mars B project.

### About RMB Products

RMB Products is a leading supplier of engineered polymer products for critical applications in the aerospace, chemical processing, semiconductor and biopharmaceutical industries. Our success is based on helping customers lower capital cost and operating expenses through innovative manufacturing processes and high-performance materials.



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