

***A Coating with Superior Chemical Resistance, with High Impact Resistance, and Elongation Virtually Equal to Steel, for Chemical and Product Tankers***



*The MarineLine<sup>®</sup> Enhanced cargo tank coating with nano technology has been engineered to provide both high chemical resistance, and high impact resistance, as requested by shipowners to withstand mechanical damages that may be incurred during cleaning, repairs, etc. Advanced Polymer Coatings' MarineLine<sup>®</sup> Enhanced is a tougher version of its previous coating system.*

*With this R&D breakthrough, several other features have also been realized, thus adding significantly to the overall performance of the coating. Key benefits of the enhanced formulation include:*

- ▶ **Increased Impact Resistance more than 50%** creating a tougher, more durable coating.
- ▶ **Increased Coating Elongation (flexibility) more than 100%**, to virtually match the carbon steel cargo tank.
- ▶ **Reduced Surface Energy almost 60%** for easier, faster tank cleaning.

## Description

MarineLine<sup>®</sup> Enhanced is a high functionality two component polymer coating having enhanced properties:

- ▶ Impact resistance
- ▶ Toughness
- ▶ Elongation virtually equal to steel
- ▶ Abrasion resistance
- ▶ Lower surface energy

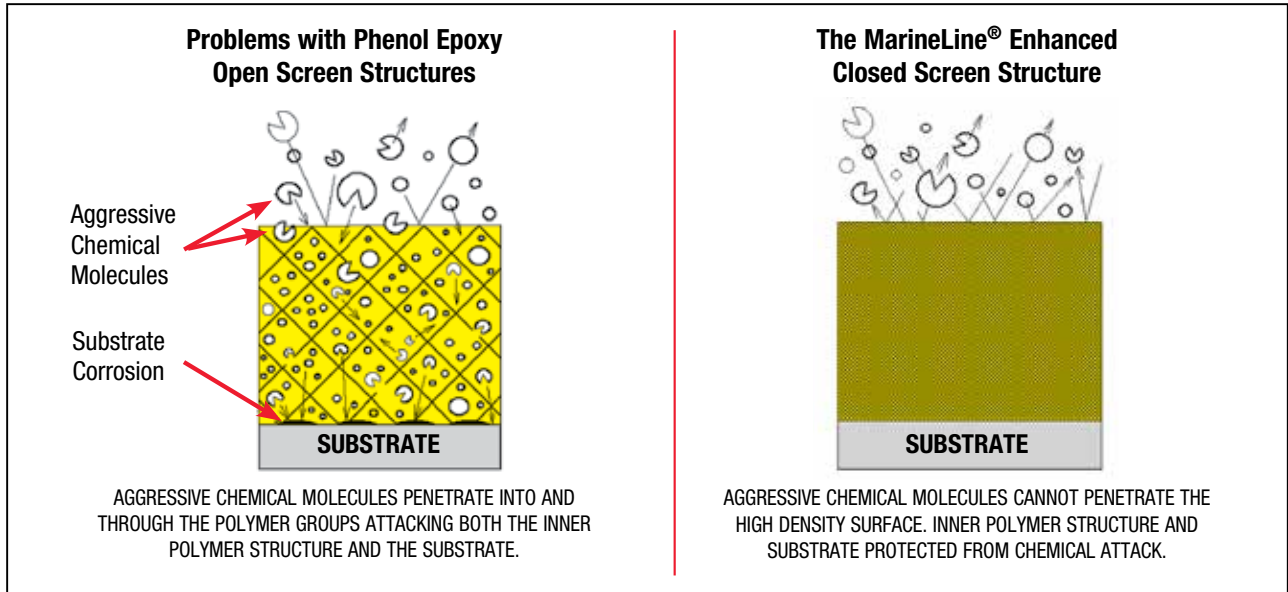
## Superior Chemical Resistance to:

- ▶ 1% to 98% Sulfuric Acid
- ▶ 1% to 80+% Phosphoric Acid
- ▶ 10% to 73% Sodium Hydroxide
- ▶ Methanol
- ▶ Methylene Chloride
- ▶ Acetic Acid
- ▶ Most Acids, Alkalis and Solvents
- ▶ Wine and Edible Oils (complies with all FDA regulations – GRAS)



## MarineLine® Enhanced Technology Has Higher Functionality, Producing Higher Crosslink Density with High Flexibility

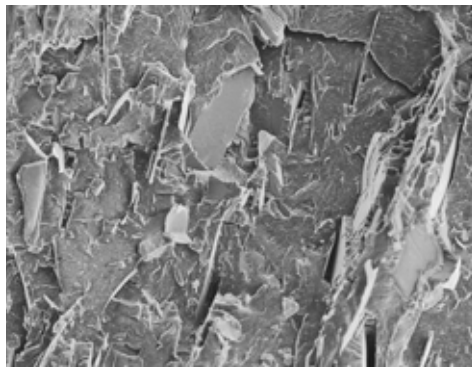
- Higher chemical resistance
- Higher temperature resistance
- Resistance to permeation (absorption)



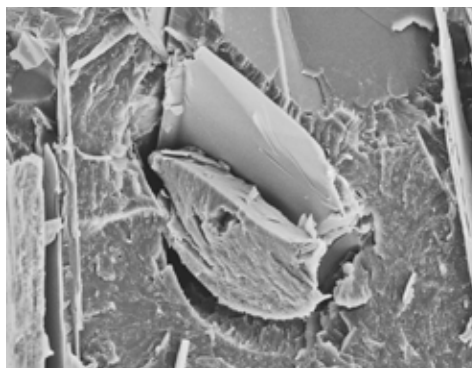
## High Crosslink Density Shown at Microscopic Level

Microscopic coating surface images taken at TUBITAK, in Ankara, Turkey, compare the differences of Advanced Polymer Coatings' MarineLine® versus standard Phenol Novolac epoxy coatings. LEFT, a Phenol Novolac Epoxy coating at various magnifications, compared to RIGHT, the MarineLine® coating. Higher crosslinking leads to a more dense structure, that enhances high chemical and high temperature resistance.

### Phenol Novolac Epoxy

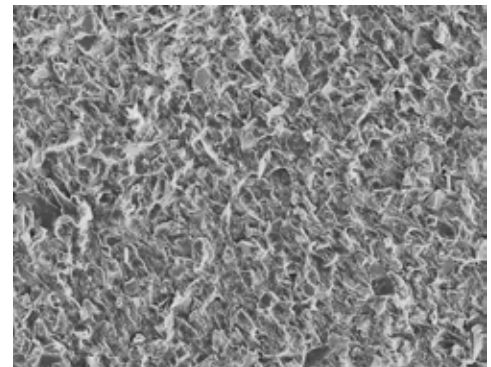


*x250 Magnification*

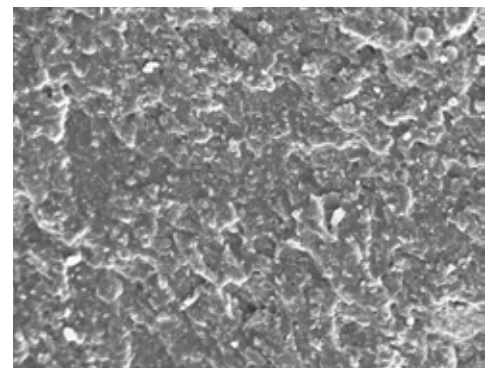


*x1000 Magnification*

### MarineLine®



*x250 Magnification*

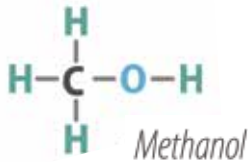


*x1000 Magnification*

# ▶ Operational Efficiencies of MarineLine®

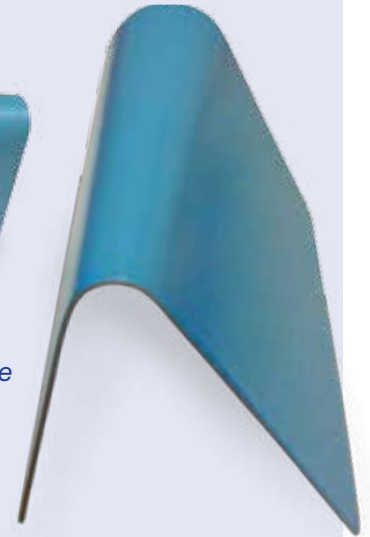
## Product Highlights

- ▶ Can load and carry Methanol continuously at up to 50°C (131°F)



- ▶ Superior corrosion resistance with outstanding flexibility
- ▶ Superior bonding qualities
- ▶ Maximum product (chemical) versatility, product cycling
- ▶ Virtually non-permeable and steam cleanable
- ▶ Field repairable
- ▶ Complies with all FDA regulations (GRAS) for food grade products
- ▶ High impact resistance
- ▶ Dry heat resistance to 177°C (350°F), immersion temperature depending on chemical

## Enhanced Elongation & Physical Properties



*The increase in elongation virtually matches carbon steel as shown in these actual bend photographs. MarineLine® Enhanced elongates and 'flexes' with the severe bend.*

- ▶ Elongation Comparison
 

Carbon Steel (AISI 1040)	_____	12-18%
MarineLine® Enhanced (ASTM D522)	_____	12-15%
Phenol Epoxy (ASTM D522)	_____	1-2%
- ▶ Impact Resistance (ASTM D2794) \_\_\_\_\_ 200in/lbs
- ▶ Pull Off Strength (ASTM D4541) \_\_\_\_\_ 2800-3100 PSI
- ▶ Tabor Abrasion Resistance \_\_\_\_\_ 4.2mg/1000 cycles (ASTM 4060) \_\_\_\_\_ (CS-17, 1000g Load, 1000 cycles)

*MarineLine® Enhanced surface energy has also been reduced +57% for easier cleaning.*

## Long Service Life Potential of MarineLine®

Taking care of your MarineLine® cargo tank coating with proper cleaning and regular maintenance can provide years of profitable service. Well maintained MarineLine® tanks have been in service 10+ years, and are still performing well. The following UNRETOUCHED photos of tankers at various inspection intervals provide some insight into the performance of MarineLine®.



4 Years



5 Years



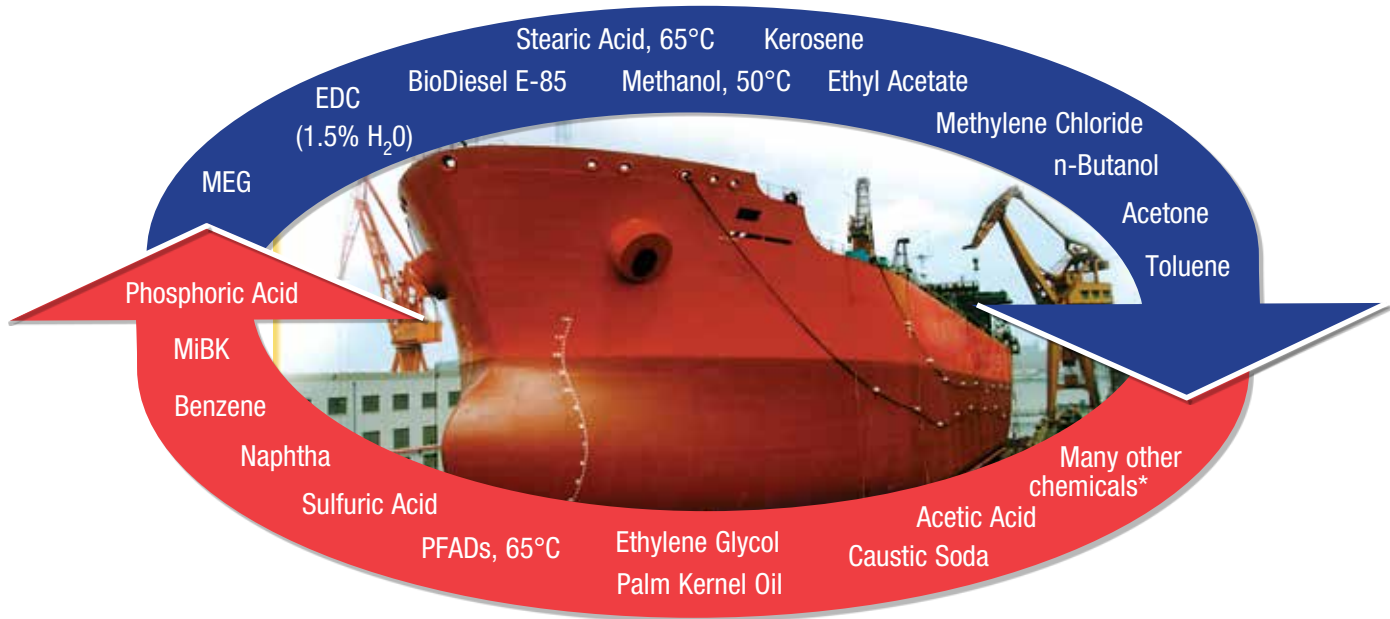
6 Years



11 Years

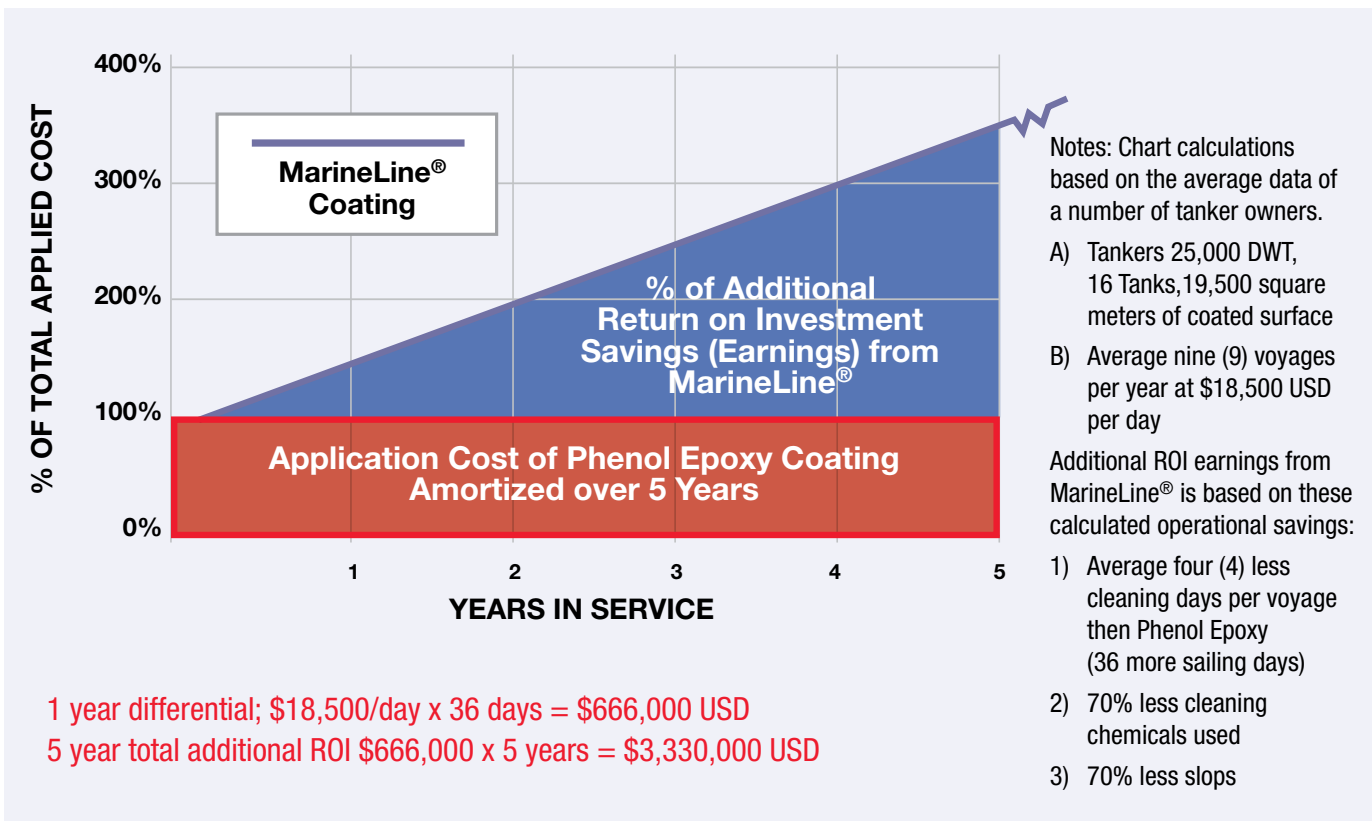
## Protecting Your Assets

- ▶ MarineLine® Enhanced Solves Your Corrosion Problems.
- ▶ MarineLine® Enhanced Gives You Corrosion Resistance with Toughness, and Versatility to Change from One Chemical to Another with Easier Cleaning.



\* See Advanced Polymer Coatings  
MarineLine® Chemical Resistance Brochure.

## MarineLine® Delivers Additional Return on Investment (ROI)



# ▶ MarineLine® Enhanced Coating Success Story



*M/T Sveva.*

**WHO:** Italian shipping company Mediterranea di Navigazione SpA (Medimar), founded in 1908, operates a fleet of 10 specialty ships and tankers serving in

niche markets including the chemical trade, operating in the Mediterranean Sea, the Black Sea, the North Sea, the Baltic Sea, the Atlantic, South America, and Central America regions.

**SERVICE:** Carriage of various chemicals, Methanol, petroleum products, lubricants, and vegetable oils.

**HISTORY:** In 1998 Medimar started a year-long testing of MarineLine® for a newbuild chemical tanker application mostly focused on Methanol storage. MarineLine® passed the tests and was applied to the 15,200 chemical tanker *M/T Sveva* launched in 1999. For years, the *M/T Sveva* carried a range of

cargoes including: 100% Acetic Acid, Caustics, Methanol, MTBE and Fatty Acids. In 2015, the company decided to re-coat the ship's cargo tanks and contacted APC for a recommendation on the latest MarineLine® innovation.

**THE SOLUTION:** APC recommended the new MarineLine® Enhanced coating which was applied to the *M/T Sveva* in Turkey that year and has been in service since then. In 2017 another tanker in the Medimar fleet, the *M/T Cosmo* was also coated MarineLine® Enhanced, thus becoming the first and second ships now using the new coating system.

*"I am extremely pleased with the performance of MarineLine® Enhanced for the M/T Sveva and choose this same tank lining again for the M/T Cosmo and our newbuild." - Signore Paolo Cagnoni, Chairman & CEO of Medimar*

*The following photos show various cargo tanks of the M/T Sveva with MarineLine® Enhanced, including a slop tank, that were coated in Turkey.*



# MarineLINE<sup>®</sup> Enhanced

## A History of Performance

MarineLine<sup>®</sup> Enhanced is based on APC's MarineLine<sup>®</sup> cargo tank coating that has been applied to hundreds of maritime chemical and product tankers, covering millions of square meters of surface.

- The majority of ships coated are over 7 years old with some over 15 years old.
- MarineLine<sup>®</sup> has been applied successfully in major shipyards around the world.
- These tankers have carried thousands of different chemicals, including Acids, Caustics, Solvents, Inorganic Chemicals, and Edible Oils, with some tankers changing their chemical cargoes up to 85 voyages a year.
- APC's MarineLine<sup>®</sup> coating withstands the stresses of twisting and bending in rough seas while resisting temperature extremes of the cold Baltic winters to the hot Middle East summers.

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*The information, evaluations and statements herein pertain to the material currently offered and represent the tests believed to be dependable. Published technical data and instructions are subject to change. Consult your Advanced Polymer Coatings representative*

*for coating recommendations. Product covered under one or more of the following Patents or Patents Pending. 5,169,912, 5,658,966, or 5,874,501*

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