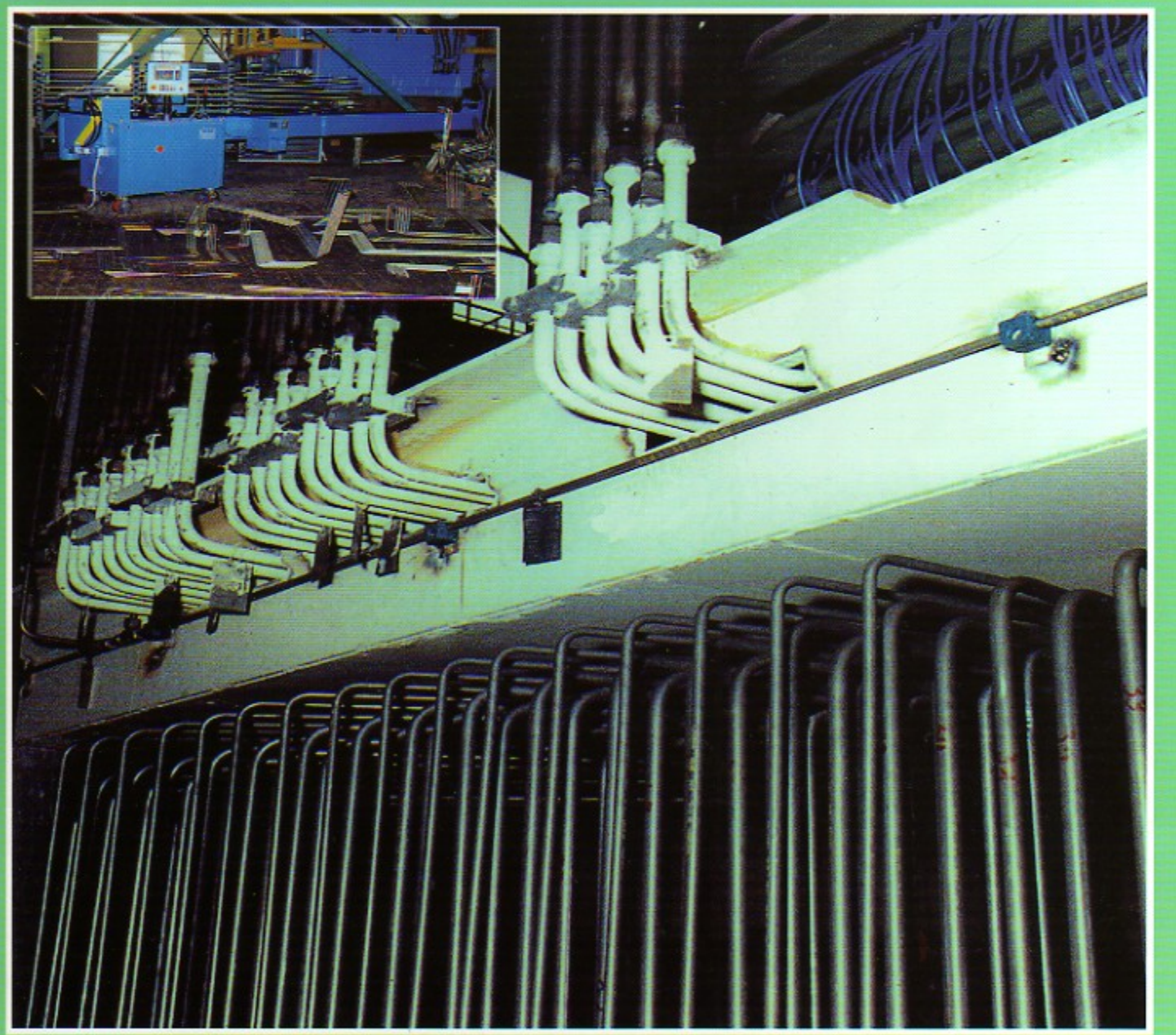
MARINE EQUIPMENT NEWS

The Business Magazine for the Marine Equipment Industry

DECEMBER/JANUARY 2000



New Amorphous Metallic Coating Delivers Engineered Wear Surface

By Gerald A. Croopnick, Director, Research & Development, Amorphous Technologies, Inc.

A new amorphous metallic coating is delivering an intriguing triangle of corrosion protection, hardness and reduced friction. This coating's unique molecular microstructure and associated properties can potentially reduce exorbitant marine equipment replacement, labour maintenance and downtime costs caused by corrosion.

Ferrous Metal Components subject to Substrate Corrosion

The sea, fog and saltwater offshore environment is aggressively damaging to ferrous metal components. To protect these surfaces from corrosion, the industry historically has employed barrier coatings of paint and polymeric materials on surfaces not subject to mechanical wear, damage or abrasion. However, any breaches of these coatings can accelerate corrosive attacks. Frequently, the corrosion insidiously spreads under the surface coating producing damage areas not readily visible to the naked eye While galvanic protective coatings, such as zinc or aluminium, also have been useful as corrosion-inhibiting options, they tend to be rather soft and susceptible to mechanical damage.

Electroplated Chromium Vulnerable to Corrosion and Impact Damage

Electroplated chromium traditionally has been the protective coating of choice in applications where equipment is subject not only to corrosion, but extreme wear and/or abrasion. However, hard chrome coatings also exhibit several drawbacks. The surface morphology of electroplated chrome inherently incorporates a fine network of micro-cracks, which similarly predispose electroplated equipment to substrate attacks. In addition, the brittle nature of hard chrome makes this material vulnerable to impact damage and resultant delamination and peeling. These problems, along with the environmental regulatory compliance issues associated with hexavalent chrome plating effluent, provide an opportunity to substitute an improved

Amorphous Metallic Coatings prove Corrosion Resistant and Tough

A family of proprietary amorphous nanocrystalline metallic coatings, known as ARMACOR™ and developed in the United States by Amorphous Technologies, Inc., provide wide-ranging corrosion protection. Amorphous metallic coatings are further enhanced by their ability to resist abrasion wear and impact damage. These materials are applied using a thermal spray technique known as high-velocity-oxygen-fuel (HVOF) which produces dense, pore-free, hard, and tough coatings (see Figure 1).

The ARMACOR materials are transformed into an amorphous nanocrystalline structure upon finishing – or once they are put into service When ARMACOR coatings are subjected to wear, once they have been put in service, they undergo the unique transformation that causes further hardening. Contrary to the traditional concept of wear resulting from usage, amorphous metallic coatings get harder, slicker, and more wear resistant as they are put into service. In addition, the surface hardness of ARMACOR, after being transformed by service, has proven to by 10 to 20 percent harder than a hard chrome surface when compared and measured on a Vickers hardness rating scale.

Amorphous Coatings outperformed Hard Chrome in Marine Setting

Amorphous metallic coatings subjected to laboratory-simulated corrosive marine variables, such as fog and sea water spray, have outperformed hard chrome coatings. Seven-day tests conducted in a saturated sea water mist environment by Amorphous Technologies, Inc. Demonstrate the superior performance of amorphous coatings. Samples of 'as sprayed' and ground and polished amorphous coatings on steel and aluminium substrates were tested alongside samples of hard chrome-plated hydraulic rod and shafts (see Figure 2). Post test examinations, using optical and scanning electron microscope (SEM) techniques, showed no indication of corrosive attack on the ARMACOR-coated samples. Furthermore, a manufacturer of offshore value equipment documented the corrosion resistance of

Testing and Materials) Salt Fog Spray Test. An HVOF-applied amorphous coating of only three mils in thickness totally protected the substrate from corrosion during a six-day salt spray test by producing a barrier coating.

HVOF Coating Methodology proven viable

A government program currently being implemented by a US and Canadian team of companies and research institutes has been evaluating alternatives to hard chrome plating to solve a variety of problems. The primary objective of the program has been to identify a coating process capable of replacing hard chrome plating. In effect, the group has been looking for a technology that produces a finished surface matching or improving on the engineering usefulness of hard chrome itself – while eliminating environmental problems associated with hexavalent chromium. As a result of this study, the HVOF coating process has been evaluated as an environmentally viable methodology, allowing coatings other than hard chrome to be applied to metal.

ARMACOR powders are well suited to HVOF application, as well as the hardness criteria established by this study. They therefore constitute an environmentally acceptable alternative to hard chrome plating. In addition, HVOF technology has gained acceptance in several industries during recent years. Commercial airlines, for example, have adopted HVOF-applied coatings as a replacement for hard chrome on landing gears. Industrial acceptance of the HVOF process, combined with the advent of amorphous materials, provides the marine industry with new tools to help solve old problems.

Seven-day ASTM B117 Salt Fog Spray Corrosion Test after seven days readily shows chrome and steel corrosion, as compared to the three ARMACOR-coated samples with no signs of corrosion