Abakan™

Tomorrow's Advanced Coatings. Today

Introduction

In nearly every area of heavy industry, wear and corrosion are phenomena of paramount concern.

In the pursuit to locate and produce greater quantities of oil and gas each year, energy companies are forced to operate farther away from the shore and in deeper waters, extracting and transporting increasingly abrasive, caustic fluids at high temperature and pressure.

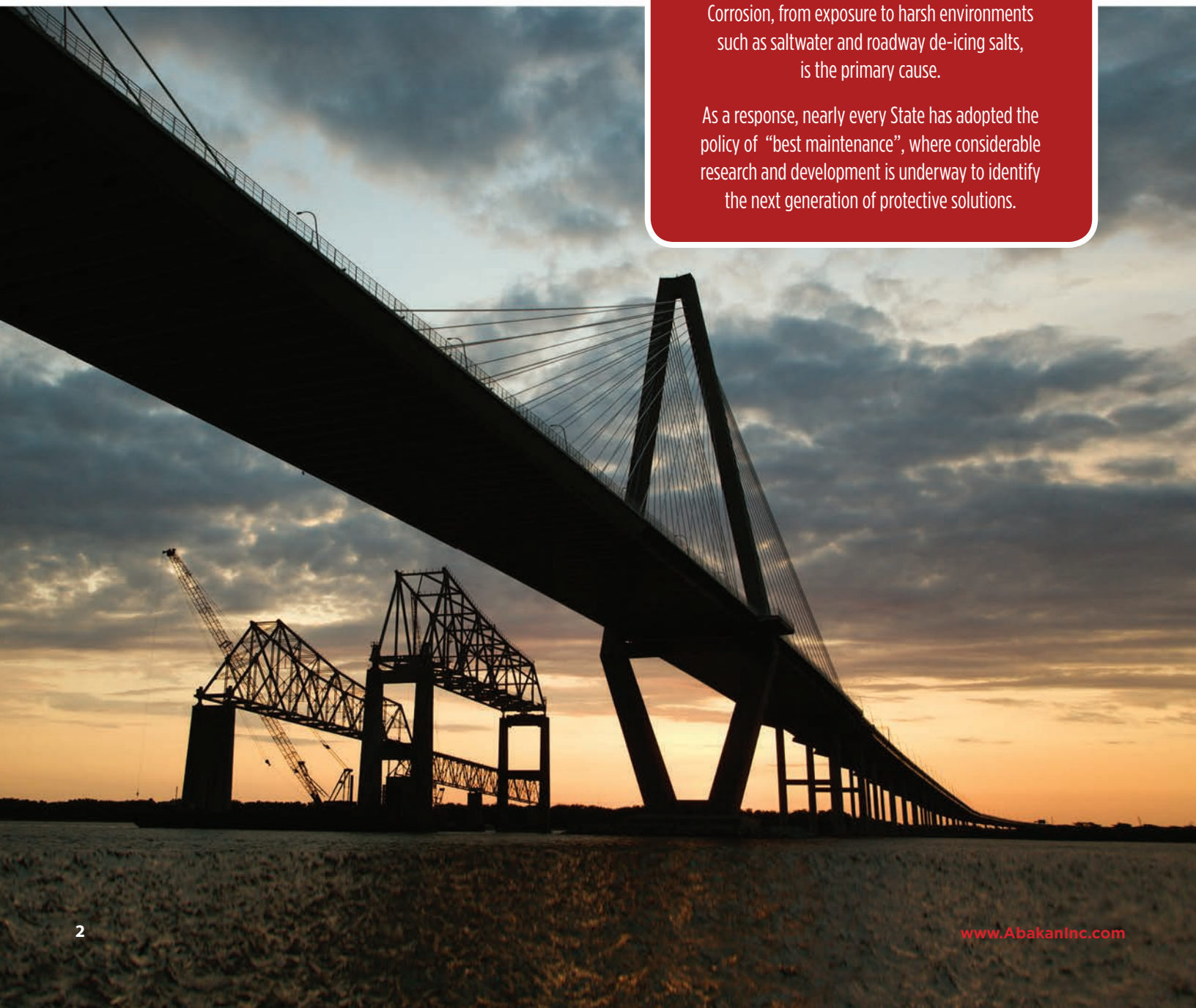
The extreme stress placed on pipelines and processing equipment, coupled with near unimaginable costs for repair, has caused the industry worldwide to redefine their standards for long term corrosion and wear protection.

Wear and corrosion cost an estimated **$2.1 trillion annually worldwide** in early replacement, lost production, poor performance and damage.

The U.S. Federal Highway Administration estimates almost 200,000 bridges, or one of every three bridges in the U.S., is structurally deficient or functionally obsolete.

Corrosion, from exposure to harsh environments such as saltwater and roadway de-icing salts, is the primary cause.

As a response, nearly every State has adopted the policy of "best maintenance", where considerable research and development is underway to identify the next generation of protective solutions.



MesoCoat

Abakan's two subsidiaries MesoCoat, Inc. and Powdermet, Inc. are solution providers for metal wear and corrosion protection.

MesoCoat, Inc. is an advanced material science company that is fast becoming a world leader in metal protection and repair through their revolutionary 'long life' coating and 'high speed' cladding technologies. MesoCoat provides nanocomposite wear- and corrosion-resistant thermal spray coatings and metallurgical cladding services.

MesoCoat has developed high speed fusion cladding process for large areas; and high strength, high toughness ceramic-metallic materials providing unparalleled wear and corrosion resistance; and has verified performance, productivity, and cost benefits with industry leaders in Oil and Gas, Oil Sands, Mining, Aerospace and Defense, Shipbuilding, Infrastructure, and other Energy markets. MesoCoat's start-up phase includes over $30 million in sunk R&D, Product Development, Proof of Concept, and testing costs.

Significant advantages in base material protection, service life, application efficiency, and total cost of ownership provide an arsenal of market levers that will be difficult for competitors to match - The potential for global dominance is real and immediate for MesoCoat. MesoCoat is now commercializing several products and services that are a direct replacement for the toxic hard chrome plating, expensive tungsten carbide powders used in thermal spray applications, and the very slow weld or laser cladding processes to address the needs of both Original Equipment Manufacturers (OEM) and Maintenance and Repair Organizations (MRO).

www.AbakanInc.com

Partners & Customers

The core technologies being commercialized by MesoCoat have won multiple '**R&D 100**', '**Nortech Innovation Award**', and **Technology Innovation Award** from National Institute of Standards and Technology, along with grants exceeding USD 10 million to date.

Mesocoat is under contract with the **US Air Force**; with support from the **US Navy**, **DemVal Inc**, **General Dynamics Information Technologies**, **Goodrich Co**. and **Boeing Co**. to complete demonstration and validation stage testing and qualification of the company's microcomposite cermet coatings 'PComP' to replace hard chrome coatings on airframe and engine components. In the recently concluded joint testing program with the **US Air Force**, MesoCoat has cleared most of the qualification tests with flying colors.

In January 2011, MesoCoat signed a cooperative development agreement with **Petrobras**, one of the largest Oil and Gas companies across the globe; and recently completed Phase I of the Petrobras sponsored project where the CermaClad™ corrosion resistant samples were tested by the most respected risk management and qualification company, DNV. MesoCoat's CermaClad™ wear-resistant samples also recently cleared the qualification tests at one of the largest Oil Sands Producers in Canada, and have been approved for use in critical projects.

PComP™ coated mandrels, plungers, valves, and other components are currently under field testing with several Fortune 500 Oil and Gas companies, and OEM's in the Houston area, and all the results have been spectacular so far which have led to multiple test orders from several of these companies.

Some of Mesocoat's Partners & Customers:

Government

Corporate

Research

CermaClad™

Abakan

Participants in the Oil & Gas, Oil Sands, Mining, Shipbuilding, and Infrastructure industries face a constant onslaught from wear and corrosion. The downtime created by frequent part replacement and the use of expensive base materials and coatings increases operating costs. Industry participants have attempted various techniques to protect, strengthen or enhance the performance of their solutions, but each method has its limitations.

MesoCoat has developed a revolutionary high speed fusion cladding process - **CermaClad™** that provides exceptional levels of wear and corrosion resistance for large area applications such as pipes used in Oil and Gas and Oil Sands, wear plates and components used in Mining industries, ballast and cargo tankers in Shipbuilding, rebar and steel structures in Infrastructure; 15-100X faster, less expensive, and with better metallurgical properties than competing solutions.

CermaClad™ shows the promise to surpass the corrosion and wear standards of all existing coating and cladding processes at a lower cost and much faster output.

Building on 15 years of research, MesoCoat has developed a novel coating technology, **PComP™**, and a game-changing cladding application system, **CermaClad™**, that combines breakthrough nanocomposite materials with a cost-effective, high speed fusion cladding technology.

These core technologies include over $30M in sunk product development and testing at the Department of Energy (DOE) National labs, and leading nanoengineering R&D centers.

CermaClad™

The CermaClad™ high energy density fusion cladding technology is a high production rate organic and inorganic coating and cladding process. CermaClad uses a high density infrared (HDIR) arc lamp to fuse a uniform layer of metal powder such as a nickel based alloy, (625, 825, Monel), stainless steel, metallic glass, aluminum-zinc, or polymer/fusion bond epoxy to steel surfaces.

CermaClad™ has the potential to allow users to obtain the benefits of cladding with a corrosion resistant alloy at costs that are less expensive than weld overlay and laser cladding. This opens up tremendous opportunities in the oil and gas, oil sands, mining, shipbuilding, and infrastructure industries.

CermaClad™ offers the promise of **FASTER**, **LESS EXPENSIVE** and **BETTER** cladding for large area applications.

Unparalleled Benefits

Metallurgical bond

- True metallurgical bond (> 70,000 psi) with a smooth, pinhole free cladding layer
- 15 to 100 times faster than current cladding technologies
- Very Cost Competitive

Performance and Reliability

- Refined grain size and controlled uniform fusion process
- Little to no substrate back mixing
- Low thermal impact, does not degrade high strength pipe
- Uniform, smooth finish - does not require post processing

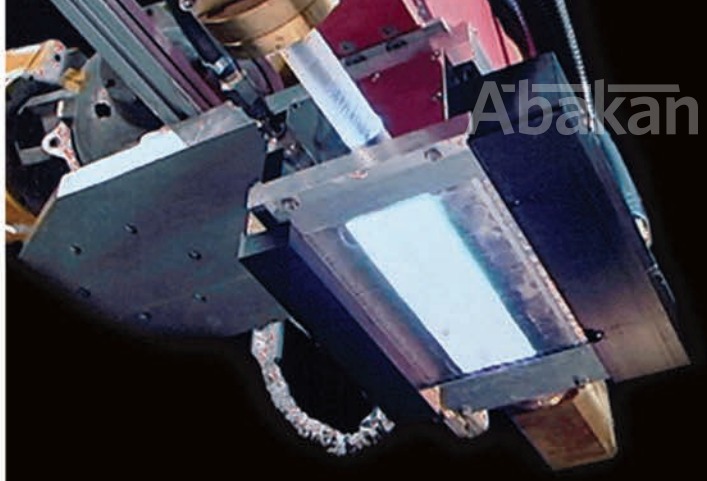
Large scale application process

- Pipe plant or mill production cladding capability

Low environmental risk and compliance

Wide range of material compositions

- High corrosion, wear, and temperature resistance
- Application thickness from 0.1 to 15 mm
- Application of multi layer compositions



CermaClad™
High Energy Density Fusion Cladding

Finish surface using CermaClad process.

Cross cut sample etched in 50% HCL @ 200X

Cross cut sample etched in 50% HCL @ 800X

CermaClad™ is Faster

With its revolutionary cladding application system MesoCoat is ushering in a new paradigm in the corrosion prevention world to replace current band-aid maintenance and painting practices with next generation solutions and technologies that offers a higher level of protection than weld overlay or laser cladding, but can be applied at rates up to 100 times faster, utilizing significantly less corrosion resistant alloy (CRA) than is needed by the weld overlay or laser cladding process.

The CermaClad™ process has a 15-30 times wider application area, as compared with the narrow focal point application area for laser cladding. A single laser head fuses a track of .7 cm per pass, whereas the CermaClad™ system fuses a track of 25-30 cm in one pass. This would allow a single CermaClad™ system to clad 28 miles of pipe in a year versus 2 miles for a single laser cladding system.

The **CermaClad™** application process is very controllable. By scaling lamp power, area density, and line speed; applied material properties and subsequent performance can be optimized.

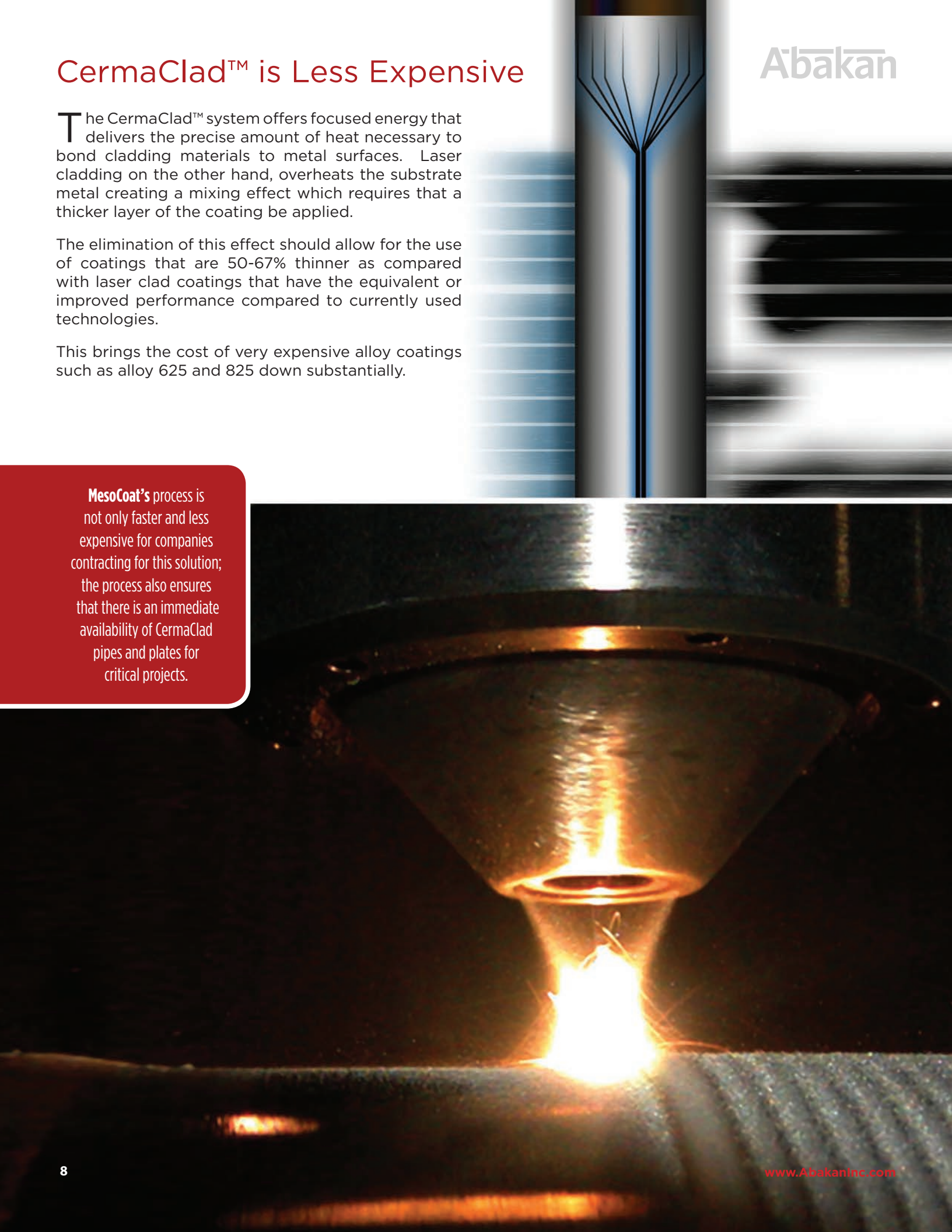
With an application rate **15 to 100 times faster** than advanced weld overlay and laser cladding, **CermaClad™** offers superior uniformity and reliability.

CermaClad™ is Less Expensive

The CermaClad™ system offers focused energy that delivers the precise amount of heat necessary to bond cladding materials to metal surfaces. Laser cladding on the other hand, overheats the substrate metal creating a mixing effect which requires that a thicker layer of the coating be applied.

The elimination of this effect should allow for the use of coatings that are 50-67% thinner as compared with laser clad coatings that have the equivalent or improved performance compared to currently used technologies.

This brings the cost of very expensive alloy coatings such as alloy 625 and 825 down substantially.



MesoCoat's process is not only faster and less expensive for companies contracting for this solution; the process also ensures that there is an immediate availability of CermaClad pipes and plates for critical projects.

CermaClad™ is Better

The CermaClad™ system can be used to extend the useful life of large structures such as pipelines, bridges, ships, chemical plants, and ballast and cargo tanks by cladding them in a protective corrosion resistant metal. This would afford substantially better protection than epoxy paints which are commonly utilized today.

When used to coat oil and gas pipelines, this wide application area results in a smoother surface finish which reduces or eliminates the need for post-finishing, resulting in additional savings. The smoother coating should also lead to longtime operational cost savings for the pipeline operators by reducing the cost required for compressing the oil and gas.

Companies seeking wear and corrosion solutions will buy these new products because they can:

1. improve their own products position in the marketplace,
2. limit their warranty payouts,
3. comply with newly passed environmental laws and not have to redesign their products manufacturing processes, and lastly,
4. not worry about downtime and resulting revenue loss due to lost production efficiency.

Pipe interior surface finish with traditional laser cladding.

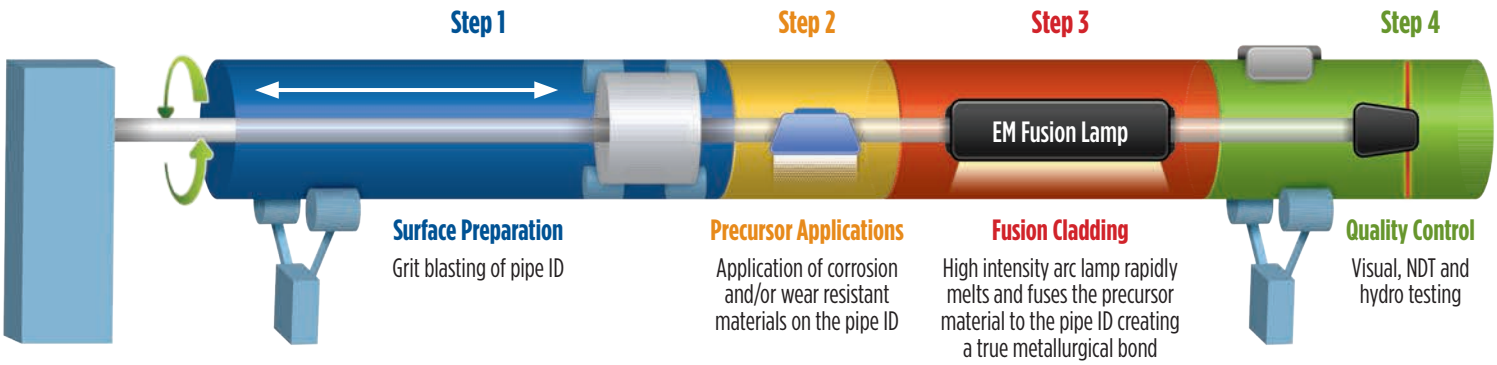
Pipe interior surface finish with **CermaClad™**

The Meso and Nano scale engineered structure of the CermaClad consumable controls the wetting and viscosity of the cladding, to enable a pinhole-free, smooth, uniform cladding/coating to be applied.

Due to input controllability and the scalable application rate, a full range of metallurgically bonded alloys can be applied.

CermaClad™
Seamless, Metallurgically Clad CRA Pipes

Application to Pipe Interior Surface



Internal rough surface of a steel pipe is replaced with a smooth wear- and corrosion-resistant alloy clad finish. This results in a reduction in friction and turbulence which increases flow efficiency. This may allow for the use of a smaller diameter pipe or lower compression requirements resulting in reduced capital and operating costs respectively.

PComP™

Micro / Nanocomposite Ceramic Metallic Composites

PComP™ metal-ceramic coatings replace electrolytic hard chrome, electroplating, spray and fuse, and thermal spray carbides; to impart wear and corrosion resistance, and reduce friction in sliding wear applications. Cermet coatings are easy and fast to apply, and machine to tight tolerances for dimensional restoration of OEM or worn E&P components.

PComP™ nanocomposite thermal spray powders offer an unparalleled combination of toughness, hardness, low friction, and affordability that provide a unique, patented coating microstructure that combines high hardness zones of a ductile metal in an optimum geometry.

Recent changes in federal acquisition regulations have banned the purchase of systems and components which have been treated using hexavalent chrome plating techniques, creating a burgeoning demand for cost-effective, rapidly deployable alternatives such as thermal spray cermets within the military procurement system. PcomP ST is an ideal chrome replacement in aerospace and other weight critical applications.

PComP™ Product Line

PComP™ T-HT: High Toughness, corrosion resistant Nanostructured Titanium cermet. It is highly resilient, machines quickly, has very low friction and replaces chrome and carbides in shaft, seal, plunger, and valve applications. PComP™ T-HH can be machined with alumina or SiC wheels, and has build-up rates 3-5X that of carbides (cuts spray time up to 80%); and with its high build rate and low stress can be readily used to repair worn components up to 0.025 inches.

PComP™ S: Lower density, spallation-resistant nanocomposite thermal spray coating for chrome replacement in aerospace and other weight critical applications.

PComP™ T-HH: Higher hardness wear resistant nanocomposite cermet with cobalt-based matrix. It provides higher wear resistance than T-HT when in contact with drilling mud, with good corrosion resistance. It is primarily used in sliding wear with environments that contain suspended solids.

PComP™ W: Premium High toughness nanoengineered WC-Co system. High deposition efficiency, and 4-7X the toughness of conventional carbide at 1400-1600VHN. It is ideal for use in valve trim and seats on gate valves, and in sand erosion and three body wear environments. Shows 3-7X life in downhole applications.

PComP™ Applications

- Hard Chrome replacement
- Aerospace and Defense
- Oil and Gas
- Energy Generation
- Processing and Refining
- Chemical and Petrochemical
- Pulp and Papers
- Other applications to replace tungsten carbide cobalt

Powdermet

Abakan

Powdermet, Inc., is committed to maturing and transitioning clean, sustainable, energy and life-saving advanced materials solutions to the marketplace through the production of nanoengineered metallic composites.

Powdermet develops, matures and transitions breakthrough materials innovations that enable reduced weight, reduced resource consumption, reduced environmental footprint, reduced life-cycle costs and increase energy efficiency based on value creation gained through engineered nano-scale features and hierarchically structures of metal and/or ceramic phases in a structure.

SComP™

A family of light-weight, energy absorbing syntactic metal and ceramic matrix composites 30-85% lighter than their parent material. Currently in the prototype phase for next generation rocket motors and panel protection against IED's and ballistics.

MComP™

A family of nanocomposite metals with extreme strength and hardness properties compared to conventional metal alloys that does not rely on the use of expensive or exotic and rare alloy elements. Ideal for light weight ballistic protection.

EnComP™

A diverse family of energetic composites - alternatives to red phosphorous smoke generators with low toxicity and high output volume. Currently in advanced qualification for replacement of red phosphorous for select types of mortar rounds.

Addressable Market

Wear and corrosion cost an estimated $2.1 trillion annually worldwide in early replacement, lost production, poor performance and damage to metal structures, vessels and machinery.

The combined clad pipe and clad plate markets in which steel plates and tubes are clad with corrosion resistant alloys is worth $3.8 Billion dollars worldwide and $1.5 Billion dollars in the US. According to experts, a better alternative that can reduce the life cycle cost of final products would double the market size for metal cladding over the next 3 years to $3 Billion dollars in the US.

Today, the most common solution to mitigate extremely corrosive elements is a process known as laser cladding where a coating is fused to a surface by the use of a laser. This process is expensive and time-consuming. In the case of pipelines, it creates multi-year lead times for purchasing pipeline, as the laser cladding can't match the line speed of the steel mills.

Each year the Federal Government and State departments of transportation spend billions of dollars on bridge rehabilitation and maintenance due to corrosion.

For bridges and ships, wear and corrosion are currently combated using multilayered epoxy coatings. The useful life of these structures and vessels would be extended significantly if they could be clad rather than painted, however, the existing cladding methods are too time consuming and expensive.

CermaClad™ and PComP™ address the needs of the $3.8 B global cladding market, and the $7 billion thermally sprayed coatings market. The performance and extended useful life advantages offered by both these products make them viable replacements for current, less cost efficient applications such as paints and metal coatings.

Experts estimate that a less expensive cladding process will increase the global metal cladding market by 100% in the next 3 years to $7.6 B driven by significant investments being made by oil and gas companies in deep water projects. For example, Petrobras who has signed a cooperative development agreement with MesoCoat; have announced deepwater projects worth $225 B for the next 5 years.

There is a multi-billion dollar market opportunity for providing a cladding solution that is cost competitive and, can reduce lead time and provides better performance in the ongoing battle against corrosion.

Contact

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