
CORROSION POLICY AND OVERSIGHT

OFFICE OF THE UNDER SECRETARY OF DEFENSE
FOR ACQUISITION AND SUSTAINMENT (USD(A&S))

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2021 HASC/SASC Briefing on Domestically Sourced Corrosion Control

December, 2020

The estimated cost of this report or study for the Department of Defense is approximately \$12,000 in Fiscal Years 2020 - 2021. This includes \$8,600 in expenses and \$3,050 in DoD labor. Generated on 2020Dec02 RefID: 8-3CC8F80

Reference: [8-3CC8F80](#)



2021 NDAA Direction



CORROSION POLICY AND OVERSIGHT

House Report 116-442 to accompany the Fiscal Year (FY) 2021 National Defense Authorization Act (NDAA), page 88, reads:

Domestically Sourced Corrosion Control

“The impact of corrosion on the Department of Defense amounts to nearly \$20 billion per year. Unfortunately, many of the chemicals typically used to treat corrosion are harmful to the environment. In addition, most phosphates are produced in China, making the United States dependent on foreign producers to maintain vital weapons systems and military equipment. Through advancements in synthetic biology, cleaner alternatives exist and are in use by the oil and gas industry. Therefore, the committee directs the Secretary of Defense to provide a briefing to the House Committee on Armed Services by December 1, 2020, on bio-based corrosion control systems. At a minimum, the report shall contain:

- (1) historical cost data for the preceding 5 years on corrosion impact to military systems;
- (2) an assessment of the impact to military readiness from corrosion;
- (3) an assessment of the effectiveness of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments;
- (4) an assessment of the environmental impact of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments; and
- (5) a cost assessment of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments.”





2021 NDAA Direction



CORROSION POLICY AND OVERSIGHT

Senate Report 116-236, to accompany the FY 2021 NDAA, page 254, reads:

Domestic Sources for Corrosion Control Chemicals

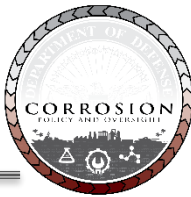
“The committee recognizes that the impact of corrosion on the Department of Defense (DOD) is nearly \$20.0 billion per year as it accounts for as much as 20 percent of maintenance costs and impacts military readiness. The committee notes that many of the current chemicals used to treat, mitigate, and control corrosion are produced in China and can be dangerous for workers and harmful to the environment. The committee believes that DoD should not be reliant on chemicals from China to maintain vital weapon systems and other military equipment. The committee understands that there are now bio-based solutions that are produced domestically that are safer, better performing, and more cost-effective than traditional solutions. The committee believes that the DoD should review whether these bio-based chemicals, which are already used in other domestic sections such as the oil and gas industry, could offer a better performing domestic corrosion control solution.

Accordingly, the committee directs the Assistant Secretary of Defense for Sustainment to review commercially-available, domestically-manufactured bio-based corrosion control and mitigation solutions used in other commercial sectors and to provide to the committee no later than November 1, 2020, a briefing that should include the Department’s findings and potential military applications.”





BLUF



CORROSION POLICY AND OVERSIGHT

- 1) The average annual cost of corrosion to the Department of Defense (DoD) for the last five years was approximately \$20.8B – Corrosion not only impacts costs but also negatively impacts asset availability.
- 2) “Bio-based Corrosion Control Solutions” generally fall into three categories – The DoD currently uses these categories of materials to protect its assets.
- 3) The DoD primarily uses performance-based military specifications to qualify these materials for use in DoD applications – There are no restrictions preventing bio-based materials from qualifying to these specifications.
- 4) It is DoD policy to require use of materials that limit negative effects on human health and the environment where possible – Sustainable goods are given procurement preference for use in Military Installation applications.
- 5) Scientific studies comparing conventional and bio-based corrosion control solutions are limited.
- 6) Bio-based materials, if shown to meet performance requirements, have the potential to reduce the environmental impacts of corrosion control solutions as compared to conventional materials, but the total life cycle environmental impact needs to also be considered.
- 7) Bio-based materials are not always more environmentally beneficial than conventionally produced materials.
- 8) An accurate cost assessment of bio-based corrosion control solutions is not possible without knowing both cost and performance relative to conventional materials.





Corrosion Costs for Military Systems and Facilities



CORROSION POLICY AND OVERSIGHT

Impact of Corrosion on DoD Cost – Latest 5-Year Average[†]

Study Segment	5-year Period Studied (FY)	Average Annual Cost of Corrosion (Millions)	Cost of Corrosion as a Percentage of Total Maintenance Cost
Air Force Aviation	2015-19	\$5,348	22%
Army Aviation	2014-18	\$1,043	19%
Army Ground	2014-18	\$956	13%
Navy/Marine Corps Aviation	2015-19	\$3,791	30%
Navy Ships	2012-16	\$4,037	25%
Marine Corps Ground	2015-19	\$463	21%
Infrastructure	2012-16	\$2,658	17%
DoD Other*	2012-16	\$2,540	16%
Total		\$20,836	21%

[†] Data availability varies by service and segment

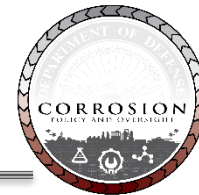
* The study segment “DoD Other” includes small arms, crew-served weapons, Army watercraft, ammunition, etc.

Reference: Assistant Secretary of Defense (Sustainment) Maintenance and Availability Date Warehouse





Impact of Corrosion on Availability of Military Systems



CORROSION POLICY AND OVERSIGHT

Impact of Corrosion on Availability (5-Year Average)

Study Segment	Average Annual Loss of Availability Due to Corrosion (hours)	Equivalent Loss of Asset Availability Due to Corrosion (# Assets)*
Air Force Aviation	2,485,112	286
Army Aviation	1,245,187	143
Army Ground	10,327,312	1,188
Navy/Marine Corps Aviation	4,518,677	520
Navy Ships	116,965	13.4
Maine Corps Ground	4,018,858	462

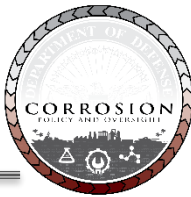
* The annual availability of an asset in hours is 362 days x 24 hrs/day = 8,688 hours of availability per year per asset

Reference: Assistant Secretary of Defense (Sustainment) Maintenance and Availability Data Warehouse





Bio-based Materials



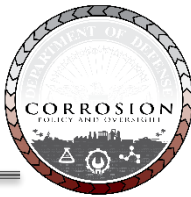
CORROSION POLICY AND OVERSIGHT

- As designated by the Secretary of Agriculture, bio-based products are commercial or industrial products that are composed in whole, or in significant part, of biological products or renewable domestic agricultural materials or forestry materials.
- Simply because a material is bio-based does not preclude it from containing compounds that pose a health risk resulting in disease or injury.
 - Biological Exposure Indices (BEI®) are published and updated by the American Conference of Governmental Industrial Hygienists (ACGIH) for the use by industrial hygienists to assess safe levels of exposure to various chemical substances and physical agents found in the workplace or within chemical products.
- A life cycle approach should be taken to determine whether or not bio-based materials have a lower or higher environmental impact as compared to non bio-based materials in a given application.
- DoD has sponsored research and development in the area of bio-based materials – A partial listing of research projects is provided in the “Additional Information” at the end of this brief.





USDA “Bio-Preferred” Program



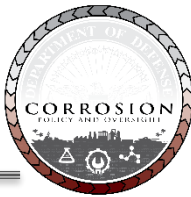
CORROSION POLICY AND OVERSIGHT

- Mandatory Federal purchasing requirements for bio-based products were established by Section 9002 of the Farm Security and Rural Investment Act (FSRIA) of 2002, Public Law 107-171, and later expanded in the 2008 and 2014 Farm Bills. This authorizes the United States Department of Agriculture (USDA) Bio-Preferred Program to designate bio-based products for Federal procurement. Federal Acquisition Regulation (FAR) Subpart 23.4 requires that Federal agencies give preference to bio-based products under the USDA Bio-Preferred Program.
- USDA has established a minimum bio-based material content of 53% for corrosion preventatives to be certified under the Bio-Preferred Program.
- The Bio-Preferred Program **does not** establish performance requirements for products and are not endorsed by USDA for their intended use.
- A list of USDA certified bio-based corrosion preventatives can be found in the “Additional Information” portion at the end of this brief. None are currently qualified for military applications.





DoD Policy



CORROSION POLICY AND OVERSIGHT

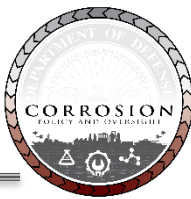
- DoDI* 4105.72 “Procurement of Sustainable Goods and Services”
 - Establishes DoD-wide policy for installations.
 - Does not apply to weapon systems.
 - “b. Give preference to procurement of sustainable goods and services using or supplying sustainable goods unless:
 - (1) The good or service cannot be acquired competitively within a reasonable performance schedule;
 - (2) The good or service cannot be acquired that meets reasonable performance requirements;
 - (3) The good or service cannot be acquired at a reasonable price consistent with Section 6962 of Title 42, U.S.C., and Section 9002 of PL 107-171...”
- Acquisition policy for weapon systems (DoDI 5000.02T, DoDI 5000.85, and DoDI 5000.81) require materials used to limit negative effects on human health and the environment where possible – Each acquisition program selects materials appropriate for a specific weapon system.

*DoDI – Department of Defense Instruction





Procurement of Corrosion Control Materials



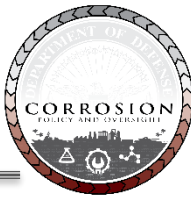
CORROSION POLICY AND OVERSIGHT

- DoD uses performance-based specifications (Military Performance Specification and Commercial Item Description (CID)) to the maximum extent possible.
 - Specify performance of the materials for their intended use.
 - Generally do not specify chemical composition of products – May exclude specific constituents known to be hazardous to human health or the environment (e.g., volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and heavy metals).
 - Also specify other properties such as:
 - Viscosity
 - Color
 - Shelf Life
 - Packaging Requirements
 - Flash Point
 - Products that qualify to the specification are eligible to be sold for use in applications where the corresponding specification is called out.





Bio-based Corrosion Control Solutions



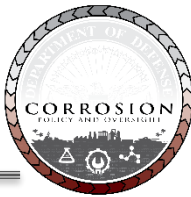
CORROSION POLICY AND OVERSIGHT

- “Bio-based Corrosion Control Solutions” generally fall into three categories:
 - Film forming corrosion preventive compounds (CPC) – Used to provide temporary corrosion protection for components that are difficult to access, have complex geometries, or for which other corrosion control solutions (e.g., conventional coatings) are not appropriate. Organic films formed by the products may be hard or soft and provide barrier protection from the environment. These materials are often added to lubricants.
 - Cleaners/rust removers – Used for removing contaminants and rust from components as part of a maintenance process. Residual films may also offer some corrosion protection.
 - Corrosion inhibitors – Chemical compounds added to a liquid or gas that decrease corrosion rates. Used in situations where it is impractical or undesired to use rust preventative liquids or other surface treatments. Vapor-Phase Corrosion Inhibitors (VPCIs) slowly release a corrosion preventative compound into a sealed air space to protect exposed metal surfaces.





Corrosion Solution Selection Considerations



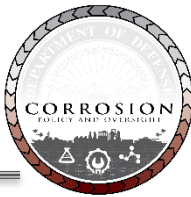
CORROSION POLICY AND OVERSIGHT

- Common considerations for selection corrosion solutions include:
 - Performance:
 - Type(s) of metal to be protected
 - Environment (immersion, atmospheric, etc.)
 - Complexity of structure to be protected
 - Operational temperature
 - Duration of protection required/desired
 - Compatibility with non-metallic materials
 - Potential to cause stress corrosion cracking
 - Application method (spray, brush, dip, etc.)
 - Removability (if required)
 - Maintainability
 - Usage:
 - Occupational safety and health (toxicity)
 - VOC content
 - Flammability (flash point)
 - Hazardous material content (e.g., heavy metals, ozone depleting substances, and HAPs)
 - Disposal
 - Cost
 - Storage and handling





Applicable Military Specifications



CORROSION POLICY AND OVERSIGHT

- A partial listing of military specifications for the categories of corrosion solutions, noted on Slide 11, is provided below:
 - Film forming CPCs:
 - MIL-PRF-16173 – Corrosion Preventive Compound, Solvent Cutback, Cold-Application
 - MIL-DTL-85054 – Corrosion Preventive Compound, Water-Displacing, Transparent
 - MIL-PRF-81309 – Corrosion Preventive Compounds, Water Displacing, Ultra-Thin Film
 - MIL-C-40084 – Corrosion Preventive Compound, Water-Emulsifiable, Oil Type
 - MIL-PRF-25017 – Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble
 - MIL-PRF-3150 – Lubricating Oil, Preservative, Medium
 - Cleaners/rust removers:
 - Commercial Item Description A-A-59261 – Corrosion Removing Compound, Sodium Hydroxide Base; for Immersion Application
 - MIL-PRF-63460F – Cleaner, Lubricant, and Preservative for Weapons and Weapons Systems
 - Corrosion inhibitors:
 - MIL-PRF-3420H – Wrapping Materials, Volatile Corrosion, Inhibitor Treated, Opaque
 - MIL-PRF-22019E – Barrier Materials, Transparent, Flexible, Sealable, Volatile Corrosion Inhibitor Treated

Bio-based material suppliers can pursue qualification to current military specifications.





Effectiveness of Bio-based Corrosion Control Solutions



CORROSION POLICY AND OVERSIGHT

- Very few scientific studies comparing conventional and bio-based corrosion control solutions are available in the literature.
- A National Aeronautics and Space Administration (NASA) study compared conventional and “environmentally friendly” (organic oil- or wax-based) soft film CPCs for protecting flight hardware and ground support equipment from atmospheric corrosion. Results varied depending on the specific CPC, but some of the environmentally friendly CPCs performed as well as conventional CPCs.

Eliza L. Montgomery, et al., “*The Behavior of Environmentally Friendly Corrosion Preventative Compounds in an Aggressive Coastal Marine Environment*”, NACE International, CORROSION 2013 Conference and Expo, 2013.

- Results from a paper published by the European Corrosion Congress (EUROCORR) compared the rust prevention performance of one bio-based and four petroleum-based rust preventatives on carbon steel in a laboratory humidity chamber. The bio-based rust preventative performed better than the petroleum-based rust preventative under these conditions.

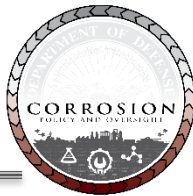
Boris A. Miksic, et al., “*Economic and Environmental Impact of Traditional Rust Preventives as Compared to Novel Bio-based Temporary Coatings*,” EUROCORR, Prague, September, 2017

The corrosion performance of any corrosion control solution is dependent on the materials being treated and the test conditions – Bio-based corrosion control solutions may have acceptable performance.





Technology Development Opportunities



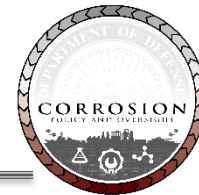
CORROSION POLICY AND OVERSIGHT

- Corrosion Policy and Oversight (CPO) Office Technology Demonstration/Validation Projects
- Strategic Environmental Research and Development Program
- Environmental Security Technology Certification Program
- Sustainable Technology Evaluation and Demonstration Program





Corrosion Policy and Oversight Office Technology Demonstration Projects



CORROSION POLICY AND OVERSIGHT

- CPO invests in Technology Demonstration Projects to further development and implementation of technology to improve operational availability and reduce sustainment costs:
 - The objective of the projects is to develop, test, and implement new corrosion prevention and control technologies for DoD equipment and facilities.
 - Projects executed by the DoD laboratories – partnering with industrial suppliers of corrosion control materials is encouraged where appropriate.
 - 326 projects funded between FY 2005 and FY 2019 – Four projects focused on advanced Corrosion Preventative Compounds funded since FY 2007.
 - Additional information on projects can be found at <https://www.dau.edu/cop/cpc/Pages/Default.aspx>.
 - The funding profile for technology demonstration projects is provided below:*

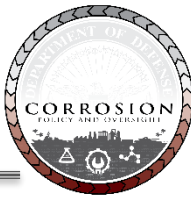
	FY 2020 Budget Allocation (\$K)	FY 2020 Actual Budget (\$K)	FY 2021 Budget Allocation (\$K)
Technology Development and Implementation	3,780	3,780	1,662

*Corrosion Policy and Oversight Budget Materials Report – Fiscal Year 2021





DoD's Environmental Research Programs



CORROSION POLICY AND OVERSIGHT

- DoD organizations focused on improving DoD environmental performance and reducing environmental liabilities:
 - Strategic Environmental Research and Development Program (SERDP)
 - DoD's environmental science and technology program.
 - Partnership with the Department of Energy (DOE) and the Environmental Protection Agency (EPA), with participation by numerous other federal and non-federal organizations.
 - Broad spectrum investment in basic and applied research as well as advanced development.
 - Environmental Security Technology Certification Program (ESTCP)
 - DoD's environmental technology demonstration and validation program.
 - Transfer of innovative technologies that have successfully established proof of concept to field or production use.
- Information on recent investments by SERDP and ESTCP in bio-based materials is provided in the “Additional Information” at the end of this brief.





Sustainable Technology Evaluation and Demonstration Program



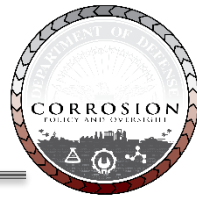
CORROSION POLICY AND OVERSIGHT

- Congress directed the Assistant Secretary of Defense for Sustainment (ASD(S)) to establish the Sustainable Technology Evaluation and Demonstration (STED) Program.
 - Identifies and evaluates emerging, commercially available, sustainable technologies and products.
 - Initially focused on Defense Logistics Agency (DLA) Aviation managed items.
 - Early evaluation of bio-based products because of Farm Bill and Congressional intent.
 - Currently evaluating broad range of technology including light-emitting diodes (LEDs), installation doors for improved thermal management, as well as oils, greases, and hydraulic fluids.
 - Enhances and sustains mission readiness through reduced life-cycle costs, increased operational performance, and minimized impacts to human health and the environment.
 - Ensures DoD end users performance requirements are met in operational environments and in a range of climate regions.
 - Can take up to 24 months for completion.
 - Currently (FYs 2018, 2019, & 2020) funded at \$2M/year in Congressional adds.





STED Case Study: Cleaner, Lubricant, and Preservative



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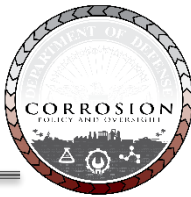
- Cleaner, Lubricant, and Preservative (CLP) products are used for cleaning, lubricating and short-term preservation of small and large caliber weapons.
 - CLP products are used at practically all DoD installations.
 - Multiple Federal agencies maintain security and law enforcement forces that use and maintain weapons.
 - CLP qualifies as a “corrosion control solution.”
- CLP products must meet the requirements of MIL-PRF-63460F.
 - Type B – Bio-based (minimum 33% bio-based content).
 - Have the potential for increased performance characteristics over petroleum-based products, including:
 - Carbon residue removal
 - Improved weapon performance
 - Reduced duration of cleaning and disposal of associated cleaning materials
 - Increased lubrication
 - Reduced wear

The U.S. Army Combat Capabilities Development Command Armaments Center qualified two bio-based CLPs to MIL-PRF-63460F.





Environmental Impacts



CORROSION POLICY AND OVERSIGHT

- The exact composition of conventional corrosion control solutions of the types, noted on Slide 11, are proprietary but generally contain petroleum or wax compounds, volatile solvents, and organic or inorganic corrosion inhibiting compounds.
- Bio-based corrosion control solutions reduce or replace petroleum compounds with organic compounds derived from natural sources such as:
 - Corn
 - Soybean
 - Oranges
 - Sugar beets
- Bio-based solutions often are blended with petroleum compounds as a necessity to meet performance requirements.
- Some bio-based corrosion control solutions may also reduce or eliminate the use of VOC's.
- The environmental benefits of bio-based solutions should be assessed on a life cycle basis (see next slide). Potential benefits compared to conventional solutions may include:
 - Reduced dependence on non-renewable resources
 - Biodegradability – reduced hazardous waste
 - Reduced release of VOC's
 - Reduced use of phosphates in cleaner/rust remover products





Environmental Impacts (cont.)



CORROSION POLICY AND OVERSIGHT

- “.... as useful as the environmental characteristics in the product itself were, it was much more important to understand the life-cycle environmental impact of producing and using a bio-product. For example, a product itself may appear environmentally benign, but the production of the feedstock from which it is made, the manufacturing process itself, or the final disposal of the product could have a significantly adverse effect on the environment. Thus, a clear understanding of the environmental and health effects of a product required knowledge about its environmental and health effects profile on a cradle-to-grave basis.”

Organisation for Economic Co-operation and Development, “*Metrics to Support Informed Decision-making for Consumers of Bio-based Products*”, 2009.

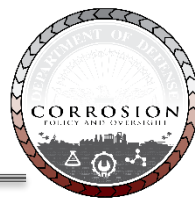
- ASTM is in the process of reinstating ASTM D7075 “Standard Practice for Evaluating and Reporting Environmental Performance of Bio-based Products” through Work Item WK40441.
 - Once the standard is reactivated, it will provide a life cycle assessment approach for determining the environmental impact of the use of bio-based products.

Bio-based materials are not always more environmentally beneficial than conventionally produced materials.





Cost Assessment of Bio-based Corrosion Control Solutions



CORROSION POLICY AND OVERSIGHT

- An accurate cost assessment requires knowledge of both the price of the material and its performance characteristics.
 - “...while a given product might be either less or more costly than its non bio-based competitor when purchased, what really mattered was the cost comparison over the life of the product. Though more expensive to purchase, a bio-based product might well have a longer useful life and have lower final disposal costs than a non bio-based product, thus offsetting a higher initial purchase price. Hence, product costs measured over a product’s useful life provide the most appropriate measure of a product’s relative economic worth.”

Organisation for Economic Co-operation and Development, “*Metrics to Support Informed Decision-making for Consumers of Bio-based Products*”, 2009.

- The DoD does not centrally manage procurements of all of the products meeting the specifications on Slide 11 of this brief so the total quantities used and corresponding prices are not known.
- Price of a unit quantity of a material is also dependent on the quantity ordered and the type of packaging (e.g., five gallon can versus 16 oz. aerosol can).
- The range of purchase prices for products listed in the USDA Bio-Preferred Program is similar conventional products.





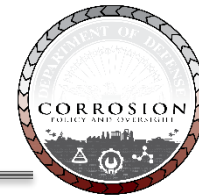
Conclusions

CORROSION POLICY AND OVERSIGHT



- Corrosion accounts for 21% of all maintenance costs and negatively impacts availability of DoD assets.
- DoD policy is to utilize materials, for corrosion control, that minimize the impact on human health and the environment.
- Bio-based corrosion control solutions may have the potential to meet some of DoD's corrosion control requirements and reduce environmental and human health impacts compared to conventional corrosion control solutions.
- The performance of corrosion control solutions required by DoD is established in performance-based military specifications and CIDs.
- Suppliers of bio-based corrosion control solutions are encouraged to qualify their materials to the appropriate specifications and CIDs in order to make them available for use by the DoD.
- CPO Office Technology Demonstration Projects, SERDP/ESTCP, and the STED Program provide potential funding opportunities for development, demonstration, and qualification of bio-based products in DoD applications.
- Bio-based materials are not always more environmentally beneficial than conventionally produced materials.
- An accurate cost assessment of bio-based corrosion control solutions is not possible without knowing both cost and performance relative to conventional materials.



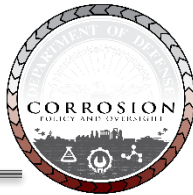


Additional Information





Compliance Matrix - HASC



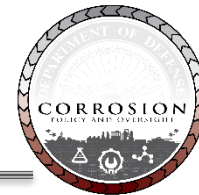
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Requirement	Slide Number(s)
Historical cost data for the preceding 5 years on corrosion impact to military systems	5
An assessment of the impact to military readiness from corrosion	6
An assessment of the effectiveness of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments;	14, 19
An assessment of the environmental impact of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments	20-21
A cost assessment of commercially available bio-based corrosion control solutions compared to solutions currently in use by the military departments.	22





Compliance Matrix - SASC



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Requirement	Slide Number(s)
Review commercially-available, domestically-manufactured bio-based corrosion control and mitigation solutions used in other commercial sectors	7-8, 14, 29
The Department's findings	11-13, 20-22
Potential military applications	13, 19





DoD-Sponsored Research & Development Efforts on Bio-based Materials



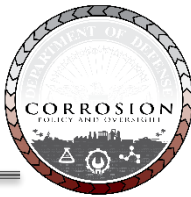
CORROSION POLICY AND OVERSIGHT

- Sustainable Alternative Bio-based Cleaner, Lubricant, and Preservative for Weapons Systems
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-201622>
- Bio-based Carbon Fibers and Thermosetting Resins for Use in DoD Composites Applications
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-1758>
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-201711>
- Soy Methyl Ester Bio-based Solvent Demonstration
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Surface-Engineering-and-Structural-Materials/Surface-Cleaning/WP-200305>
- Novel Chemistries for Replacement of Methylene Dianiline in Polyimide Composites
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-2402>
- Cyanate Ester Composite Resins Derived from Renewable Polyphenol Sources
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-2214>
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Surface-Engineering-and-Structural-Materials/Composites-Alloys-and-Ceramics/WP-1759>





DoD-Sponsored Research & Development Efforts on Bio-based Materials (cont.)



CORROSION POLICY AND OVERSIGHT

- Aqueous Film Forming Foams Based on Biodegradable Natural Surfactants and Additives
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP20-1535> (fire-fighting)
- A Fluorine-Free, 100% Bio-based Fire-fighting Material
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Noise-and-Emissions/WP19-5348> (fire-fighting)
- Environmentally Benign Aircraft Anti-Icing and Deicing Fluids Based on Cost-Effective, Bio-based Ingredients
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-1678> (anti-icing)
- Isocyanate-Free Solid Rocket Motor Propellant Binders Inspired by Nature
 - <https://www.serdp-estcp.org/Program-Areas/Weapons-Systems-and-Platforms/Energetic-Materials-and-Munitions/Rocket-and-Missile-Propellants/WP-2406>





List of USDA Certified Bio-based Corrosion Preventatives



CORROSION POLICY AND OVERSIGHT

Product	Manufacturer
EcoLine All-Purpose Lubricant	Cortec Corporation
BioCorr Rust Preventative	Cortec Corporation
EcoLine Long Term Rust Preventative	Cortec Corporation
MCI-2005	Cortec Corporation
EcoLine 3690	Cortec Corporation
EcoLine 3220	Cortec Corporation
EcoLine CLP	Cortec Corporation
BioCorr SC	Cortec Corporation
M605 PS	Cortec Corporation
Ecoline Metalworking Fluid	Cortec Corporation
EcoLine 3680	Cortec Corporation
RUSTECO Corrosion Treatment R-200-3 (Liquid)	RUSTECO LLC
RUSTECO Corrosion Treatment R-200-G (Gel)	RUSTECO LLC
RUSTECO Tank Cleaner	RUSTECO LLC
Metcor 52	Metalloid Corporation
ADVANCE 6110K	Metalloid Corporation
DuraShield 310	LifeLast, Inc.

Product	Manufacturer
Sauereisen ConoFlex No. 381	Sauereisen, Inc.
Metcor 71	Metalloid Corporation
Duck Hunters Delight	Metalloid Corporation
ZEBRON® 386	ZEBRON
ZEBRON® 486	ZEBRON
ZEBRON® 385	ZEBRON
VpCI®-645 Marine Use Corrosion Inhibitor	Cortec Corporation
EcoLine® VpCI®-642	Cortec Corporation
BioCorr® ATF Rust Preventative	Cortec Corporation
FlashCorr® VpCI®	Cortec Corporation
VpCI®-705 Bio	Cortec Corporation
Zero Thermal™ (ZT) Industrial	OneOceans Technology Group
StranCore	Grignard Company LLC
Zero Thermal™ (ZT) MarineOne Antifouling ClearCoat Coatings	Oceans Technology Group
CorShield® VpCI®-146	Cortec Corporation
EcoShield® VpCI®-144	Cortec Corporation
BioPad®	Cortec Corporation

