Department of the Navy SBIR/STTR Transition Program

NAVAIR SPR Number: 2022-844

Topic # N181-019
Innovative Material (and Application Method) for a Hydrophobic/Oleophobic Coating to an Aluminum-Bodied Heat Exchanger
TDA Research, Inc.

WHO

SYSCOM: NAVAIR

Sponsoring Program: NAVAIR PMA-275

Transition Target: V-22 Osprey

TPOC: (301) 342-0865

Other Transition Opportunities: Parties interested in licensing this product would include Off-Highway vehicles, mining equipment, and automotive applications intended for off-road use. Devices that use heat exchangers in austere and also wet or dry environments would benefit.

U.S. Marine Corps photo, Photo ID 360939, VIRIN 110112-M-#####-216.

Notes: TDA Research, Inc. (TDA) has a history of commercializing SBIR projects. TDA develops and manufactures advanced materials, chemical processes and aerospace and military hardware. Privately owned and founded in 1987, TDA has annual revenues of $26.6 million, with a staff of 104, mainly engineers and chemists, 26 of whom have Ph.D. degrees. We have licensed three major processes and manufacture ton quantities of sorbents; all with multi-million dollars of sales. We manufacture specialty chemicals and build flight-qualified hardware for the DoD and NASA. TDA and its partners have sold $100,984,644 of products based on our SBIR work, and Phase III investments (which drive future sales) total $261,855,223.

WHAT

Operational Need and Improvement: Optimal heat exchanger (HX) performance in mechanical systems is achieved when the thermal transfer surfaces are maintained free of dirt and debris. Developing a cost-effective, innovative technology for a coating material and application method, designed to reduce the build-up of organic material on the thermal transfer surfaces of the heat exchanger and/or increase the surface cleanability, will increase the available usage time of a mechanical system. This would result in a decrease in cost to the Government by reducing the need to clean or remove components that have diminished heat-rejection capability. Longer periods of trouble-free use could also provide more remote usage of a device. Heat exchanger size could be reduced to account for higher resulting efficiency.

Specifications Required: The desired coating must be cost-effective and reduce the build-up of organic material on the thermal transfer surfaces of the heat exchanger, without affecting the efficiency of the HX. The application method of the coating material must provide even distribution coverage of the coating to the external surfaces that provide the thermal transfer capability. Specified performance should be maintained during and following exposure to a high/low temperature (-65F to 420F), a range of relative humidities (up to 95%), fresh and salt water immersion, and sea salt fallout of 200 parts per billion. The coating should be erosion resistant and durable to 40 mile per hour air flow with sand and dust concentrations up to 1.32 x 10e-4 pounds of sand and dust per cubic foot.

Technology Developed: TDA Research has developed a hydrophobic and oleophobic coating for the V-22 Osprey Nacelle Oil Cooler Assembly heat exchanger (HX). The coating is composed of commercial, off the shelf, products and is applied to the HX via electrodeposition, a commonly used industrial coating technique. This results in a thin, conformal coating that can evenly coat the complicated HX fin geometry and does not impede heat transfer. Compared to an uncoated aluminum body HX, our coated HX has a 50% reduction in initial soiling. When the HX is cleaned with a simple low pressure, high flow, water rinse, the coated HX has a better cleaning efficiency (72%) compared to only 47% for the uncoated HX. We have verified that our coating is abrasion resistant and can endure the environmental conditions that the HX is expected to encounter (high/low temperatures, thermal cycling, thermal shock, high humidity, water and salt water immersion).

Warfighter Value: An effective hydrophobic/oleophobic coating will increase the maintenance intervals and decrease time spent cleaning the heat exchanger, thus decreasing the burden on the warfighter. Additionally, our coating will prevent overheating and ensure safe HX operation. Finally, this technology will save money by reducing maintenance currently required to clean heat exchangers surfaces.

WHEN

Contract Number: N68335-20-C-0089 **Ending on:** Jul 11, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Down select to lead coating candidate and demonstrate coating performance on flat coupon	Low	Coating passes physical property and performance requirements	3	3rd QTR FY22
Demonstrate small scale application on heat exchanger geometry	Low	Coating is uniform, conformal, and passes physical property testing	4	4th QTR FY22
Demonstrate application on representative heat exchanger	Medium	Coating is uniform, conformal, and passes physical property testing	4	3rd QTR FY23
If Option exercised, validation testing of coated HX by NAVAIR	Medium	Coated HX passes NAVAIR testing	6	3rd QTR FY24

HOW

Projected Business Model: This coating would be commercialized via licensing of the coating formulation and application technologies to the prime contractors. Our solution is composed of commercial, off-the-shelf products, but TDA has developed unique expertise in the formulation and application of the coating.

Company Objectives: We are interested in identifying a prime contractor that would apply this coating to heat exchangers during manufacture. This could either be a prime contractor specifically for the V-22 Osprey heat exchanger, or another heat exchanger manufacturer that is interested in our coating solution. Alternatively, a maintenance contractor could apply our coating during routine heat exchanger maintenance.

Potential Commercial Applications: TDA's coating could be used to reduce heat exchanger fouling for a variety of applications. In particular, our solution is well suited to any environment in which the heat exchanger would encounter abrasive/erosive conditions. Due to our unique application method, our coating is ideal for complicated parts and geometries. The coating could be applied to any metal surface for which a self-cleaning functionality is desired.

Contact: Dr. Lauryn Baranowski, Senior Engineer
lbaranowski@tda.com (303) 261-1167