Response Technologies
3350 Pawtucket Ave
Riverside, RI 02915
www.responsetechs.com
POC: Ed Bard
401-585-5918
ebard@responsetechs.com

Technology Description

Additively Manufactured Textile Reinforced Composite Fuel Bladders and Tanks

Business Opportunity: Response Technologies (RT) expects to improve the total cost of ownership [TOC] of textile reinforced, composite fuel tanks. These tanks can be rigid or flexible and can integrate: self-sealing, crashworthy and ballistically tolerant features. RT uses proprietary additive manufacturing processes and trade secret materials, that it anticipates will result in:

1) Fuel cells that have seamless constructions, which will extend service lives by eliminating seam failures
2) Fuel cells that are 20% lighter through additive manufacturing and the elimination of overlapped seams
3) Fuel cells that have superior chemically resistant inner barriers, reducing the likelihood of product obsolescence
4) Fuel cells that are 20% lower in purchase price, through the reduction in manufacturing costs
5) Fuel cells that are not made of rubber, so do not need to be routinely oiled

RT has SBIR funding and a follow-on contract to deliver four rotorcraft fuel tanks in 2019. RT is seeking DoD and OEM textile reinforced composite fuel tank partners for: land, marine, missile defense, and fixed wing platforms.

Company Background: Response Technologies, a certified small business, was founded in 2015 as a product development company utilizing material science and advanced manufacturing processes to deliver breakthrough product and process solutions. The company, which is in Riverside RI, has its own: engineering, product design, prototype manufacturing, testing, and development facilities.

Industry Problem: The current subtractive process employed for manufacturing textile reinforced composite fuel tanks, predates WWII.

Current Methods	Process	Product Examples	Problems
Sacrificial Form: Build Layers atop 3D Form, Break and Remove Forms			Form Cost Form Removal Cost Master Form Storage Labor – Building Layers Overlap Added **Weight**
Split – Molding: Build Layers atop Partial Forms, Peel Composite from Form, and Connect Parts			Seams – Cost & **Weight** Seam Strength Forms Storage Labor Building Layers Defects at Form Interface
Welded Seams: Cut and Seam 2D Membranes Into 3D Shapes			Design Limitations Overengineered Membrane Seams – Cost & **Weight** Hi Scrap Rate

Along with the processing challenges, the current protective coating chemistries are no longer compatible with many of today's mandated bio-fuel. The increased use of these new blends has resulted in shortened operational life, increased maintenance costs, and unsafe hazards for the technicians servicing them.

Technology: RT's patent-pending innovation is threefold. First, RT eliminates the cutting, seaming, welding and sacrificial mold operations via its additive manufacturing process. This process eliminates the primary failure mode of these tanks, which is catastrophic seam failures. These failures are a result of: variation in workmanship, contamination between the seams, and the inevitable wicking of fuel from the inside seams through to the outside seams, which slowly erodes the tank from the inside, to the outside. Response Technologies' additive manufacturing process also greatly decreases the costs by reducing labor, material and scrap levels. Finally, the agile nature of the additive manufacturing process, translates to significantly reduced development and manufacturing lead times.

The novel process can also use superior coating chemistries, such as thermoplastic fluorinated polymers and other highly chemical resistant polymeric coatings. Since there is no seaming required in the formation of these tanks, Response Technologies can uniquely apply dissimilar chemistries that will best suit the unique operational environments of the inside versus the outside of these tanks. Combining superior fuel resistant and operating environmental chemistries, along with the elimination of seams, is expected to dramatically increase the life span of these tanks.

Finally, Response Technologies' additively manufactured 3D textile process allows dissimilar yarns or quantities of yarn to be placed in specific areas requiring different: flexibility, tear, tensile, etc. performance properties. Corners and the area around fittings are the primary failure spots during crashes. Response Technologies can uniquely engineer these specific areas without having to add weight or cost to the other areas of the tank. This capability allows tanks to be designed and manufactured at minimum weights while fully meeting performance requirements.

Advantages: Response Technologies' additive manufacturing process affords a massive expected advantage compared to current textile reinforced composite fuel tank manufacturing processes, by reducing: processing steps, lead times, cycle times, materials, labor, and utilities. The resulting value proposition is lighter, less expensive and longer lasting fuel tanks.

Stage of Development: Response Technologies has manufactured an 8-gallon working prototype and is in the process of phase I qualifying a 30"x27"x27" test tank designed to meet MIL-DTL-27422F Class B Semi-Rigid and Type 1 Self-Sealing. Response Technologies inside fuel barrier has passed ASTM D471 test for Fuel Resistance.

Process Capabilities: RT's current process capabilities are:

Dimensions: Combined 180 inches in X and Y and effectively infinite in the Z direction
Fiber types: Singular fiber or mixed constructions using: Basalt, Kevlar - Aramids, Carbon Fiber, Zylon - PBOs, Ballistic Nylon, Polyester, Vectran, Spectra – Dyneema - UHMWPEs
Coating Types: Urethane – Ester or Ether, PVDF, Nylon, PTFE, Urea, CNT/PE Blends