OFFICE OF THE CHIEF TECHNOLOGIST

TechPort

TECHNOLOGY FACT SHEET

General Information

Title of Technology Development: Citric Acid Alternative to Nitric Acid Passivation

Responsible NASA Mission Directorate or Office: Human Exploration and Operations Mission Directorate

NASA Lead Center or Facility: Kennedy Space Center

NASA Supporting Centers and Facilities: No data provided

NASA Program: Ground Systems Development and Operations

NASA Project: 11711

NASA Program Executive: No data provided

NASA Program Manager: No data provided

NASA Project Manager: William Simmonds

Principal Investigator: Charles Griffin

States with Work: No data provided

Contractors Performing Work: No data provided

Sources of Funding

NASA Mission Directorates or Offices Providing Funding/Resources: No data provided

NASA Centers and Facilities Providing Funding/Resources: No data provided

Other U.S. Government Agencies Providing Funding/Resources: No data provided

U.S. External Partners Providing Funding, Academia or Commercial: No data provided

International Partners Providing Funding/Resources: No data provided

Technology Project's Mappings

Primary Space Technology Roadmap - Technology Area: TA 13: Ground & Launch Systems Processing – Detailed Primary Space Technology Roadmap - Technology Area: No data provided

Secondary Space Technology Roadmap - Technology Area: No data provided

Additional Space Technology Roadmap - Technology Area: No data provided

Project Details

Project Start Date: Sep-01-2011	Project End Date:Sep-01-2016
Project Start TRL: 7	Project End TRL: 9

Brief Description (abstract) of Technology Project: The Ground Systems Development and Operations GSDO) Program at NASA John F. Kennedy Space Center (KSC) has the primary objective of modernizing and transforming the launch and range complex at KSC to benefit current and future NASA programs along with other emerging users. Described as the "launch support and infrastructure modernization program" in the NASA Authorization Act of 2010, the GSDO Program will develop and implement shared infrastructure and process improvements to provide more flexible, affordable, and responsive capabilities to a multi-user community. In support of the GSDO Program, the purpose of this project is to demonstrate/validate citric acid as a passivation agent for stainless steel. Successful completion of this project will result in citric acid being qualified for use as an environmentally preferable alternative to nitric acid for passivation of stainless steel alloys in NASA and DoD applications.

Technical Performance Measures:

Measure	Unit	Quantity

Description of Capability This Technology Provides: Citric acid can provide corrosion protection in an environmentally preferable manner.

Anticipated Benefit to NASA for Funded Missions: 1. Citric acid reduces environmental, safety, and health risks and costs associated with the use of nitric acid. 2. Citric acid is a sustainable alternative that reduces material obsolescence risks. 3. Citric acid does not remove beneficial heavy metals from the passivated surface like nitric acid does. 4. Elimination of nitric acid (NOx) emissions considered greenhouse gases that contribute to smog and nitrogen loading (oxygen depletion) in bodies of water.

Anticipated Benefit to NASA for Unfunded/Planned Missions: 1. Citric acid reduces environmental, safety, and health risks and costs associated with the use of nitric acid. 2. Citric acid is a sustainable alternative that reduces material obsolescence risks. 3. Citric acid does not remove beneficial heavy metals from the passivated surface like nitric acid does. 4. Elimination of nitric acid (NOx) emissions considered greenhouse gases that contribute to smog and nitrogen loading (oxygen depletion) in bodies of water.

Anticipated Benefit to Commercial Space Industry or Other Government Agencies: 1. Citric acid reduces environmental, safety, and health risks and costs associated with the use of nitric acid. 2. Citric acid is a sustainable alternative that reduces material obsolescence risks. 3. Citric acid does not remove beneficial heavy metals from the passivated surface like nitric acid does. 4. Elimination of nitric acid (NOx) emissions considered greenhouse gases that contribute to smog and nitrogen loading (oxygen depletion) in bodies of water.

Detailed Description of Technology Project

Corrosion is an extensive problem that impacts National Aeronautics and Space Administration (NASA) and Department of Defense (DoD). The deleterious effects of corrosion result in steep costs, asset down-time affecting mission readiness, and safety risks to personnel. Consequently, it is vital to reduce corrosion costs and risks in a sustainable manner. NASA and DoD have numerous structures and equipment that are fabricated from stainless steel. The standard practice for protection of stainless steel is a process called passivation which removes free iron contamination from the surface and forms a metal oxide layer to prevent corrosion. Typical passivation procedures call for the use of nitric acid which exhibits excellent corrosion performance; however, there are a number of environmental, worker safety, and operational issues associated with its use. The longtime military specification (QQ-P-35C) for the passivation of stainless steel was cancelled in favor of newer specifications which allow for the use of citric acid in place of nitric acid. Citric acid offers a variety of benefits that include increased safety for personnel, reduced environmental impact, and reduced operational cost. There have been few studies, however, to determine whether citric acid is an acceptable alternative for NASA and DoD applications; therefore, NASA and DoD agreed to collaborate on an effort to validate citric acid as an acceptable passivating agent for stainless steel.