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Intriguing Cortec® White Paper Details Saturn V Rocket Engine Conservation

Cortec's notable history with the aerospace industry has continued, as seen in a new white paper published by Cortec® Corporation! The white paper details the use of two VpCI® products in the conservation of Saturn V rocket engines recovered from bottom of the Atlantic Ocean.

The rocket engines were critical to the 1960's and 70's Apollo manned missions to the moon, with enough thrust to launch more than 1,000,000 pounds (453.59 metric tons) of mass out of earth's atmosphere. In flight, the engines were released and dropped into the Atlantic Ocean, where they rested until recent efforts to recover and preserve these significant historical artifacts.

The white paper explains how conservators used Cortec's FlashCorr® VpCI® during restoration to help remove chlorides and rust staining after over 40 years of exposure to incredibly corrosive seawater. After cleaning, a dilute solution of VpCI®-377 was applied to the surface of certain parts to preserve them during storage without affecting their appearance.

Please continue to read the full white paper!

Saturn V Rocket Engine Conservation

Introduction

Cortec® Corporation has a notable history with the aerospace industry. From cleaning and preserving meteorites that land on our planet to protecting integral components of NASA's rockets that leave it, Cortec® is dedicated to combating corrosion wherever it is and to whatever planet it is going. For this reason, Cortec® is honored to have been called upon by lead conservation firm Terra Mare Conservation, LLC to aid them in their endeavor to clean and preserve 25,000 pounds (11.34 metric tons) of Apollo-era Saturn V rocket engine parts that were recovered from the bottom of the Atlantic Ocean.

To date, the Saturn V rocket engine is the most powerful liquid-fueled space-faring rocket ever built. With the thrust to deliver over 1,000,000 pounds (453.59 metric tons) of mass to the moon, this engine served as the backbone of the manned Apollo missions to the moon in the 1960's and 70's. In flight, the Saturn V engine would shed its depleted engine components as dead weight, which then fell back to earth and crashed into the Atlantic Ocean. Recovering and preserving these forgotten engine components were the primary objectives of a recent effort supported by NASA; Jeff Bezos, Amazon's founder and chief executive; and the Cosmosphere (formerly known as the Kansas Cosmosphere and Space Center) based in Hutchinson, Kansas, where the work took place in collaboration with the Cosmosphere team.

Locating the engine components was difficult considering that their likely resting place spanned an area of 300 square miles (776.996 km^2) and lay at a depth of over 2.6 miles (4.2 km) below the ocean surface. Furthermore, these engines were developed over 40 years ago during the Cold War, resulting in a large amount of identifying information becoming lost to time. Because of this, significant effort was required to match individual components with their specific Apollo mission number. Even just determining the particular metal alloys used to construct the engines proved to be a challenge, further complicating the preservation process. The project involved over two years of careful preparation and delicate operation and is detailed in the peer-reviewed article, "One Small Step for Man, One Giant Leap for Conservation," authored by Paul Mardikian, Claudia Chemello, and Jerrad Alexander and published in 2016 by the American Institute for Conservation.

Figure 1: View of the lab with recently recovered artifacts in treatment. Photo credit: Terra Mare Conservation, LLC

High Level Solution

The pieces were collected from the floor of the Atlantic Ocean after exposure to over 40 years of incredibly corrosive, saline water. To aid the chloride removal process, Cortec's FlashCorr® VpCI® was incorporated into a showering system used to keep the artifacts wet until they could be immersed in large basins filled with the same FlashCorr® VpCI® solution. This immersion process removed the majority of the free chloride ions and rust staining, greatly reducing the time required for this phase of the conservation. Once conservators finished removing the remainder of the sediment and other deposits, some of the parts required further corrosion protection. In order to preserve these parts for storage, a dilute solution of VpCI®-377 was applied to their surface. This allowed the surface appearance and texture to remain unchanged while still offering corrosion protection.

Solution Details

As with almost all artifacts retrieved from marine environments, the artifacts had to be kept wet at all times prior to cleaning and stabilization to prevent damage resulting from precipitation of chlorides and other contaminants. By showering the artifacts daily with a 0.1% solution of FlashCorr® VpCI®, conservators were able to store the heavily corroded engine components for up to five months in open air without the need to submerge each one. The flexibility offered by this method simplified the conservation effort and saved conservators time in the planning phase of the project.

Chemically stabilizing the components by removing chlorides and rust stains took place in separate basins filled with a 0.1% solution of FlashCorr® VpCI®. Due to the large affinity FlashCorr® VpCI® has for metal, it can preferentially displace chlorides from metal allowing for their capture in an aqueous solution. This system allowed the conservators to easily remove the most severe rust stains and extract the majority of the chlorides from the metal surface by periodically refreshing the solution and manually washing the metal surface.

Figure 2: A conservator works in a treatment tank to remove loosely adhered residue between soakings in dilute FlashCorr® solution (pictured in background). Photo credit: Terra Mare Conservation, LLC

Once the metal surfaces were completely cleaned and stabilized by the many methods employed by the conservators, a 2.5% solution of VpCI®-377 was used on selected objects to ensure that the artifacts did not suffer further corrosion while at the same time not affecting the appearance of the artifact. VpCI®-377 protects ferrous and yellow metals as well as aluminum, so it offers a one-size-fits-all solution to thin-film protection, and due to its wide dilution range, it is not difficult to adapt a solution to specific visual or protection requirements.

Figure 3: The final cleaned and reassembled engine parts awaiting shipment for museum display and storage. Photo credit: Terra Mare Conservation, LLC

Summary

Cortec's products proved beneficial to the preparation and preservation of heavily corroded, Apollo-era, Saturn V engine components recovered from the

ocean floor after 40 years of exposure to excessively corrosive conditions. The ability to quickly remove chloride contamination from the recovered artifacts with a dilute FlashCorr® VpCI® solution accelerated the project by reducing downtime typically spent waiting for chlorides to extract into deionized water. Furthermore, showering the artifacts with the same FlashCorr® VpCI® solution provided a novel method to stabilize the engines outside of the extraction baths. This saved space and money by reducing the number of baths necessary, and consequently the area needed to house them. Finally, a dilute solution of VpCI®-377 was used on specific objects to apply lasting protection to the engines without affecting their appearance, the most important trait for public viewing.