Spinoff Technology: # 632

On-Demand Releasable Corrosion Inhibitors
TDA Research, Inc. (Wheat Ridge, CO)

TDA Research, Inc. (TDA; Wheat Ridge, CO), designed a chromate-free corrosion-inhibiting additive in which tailored nanoparticles are used to release the corrosion inhibitors only when they are needed. The additive can be used in a protective coating that would provide longer-term and more environmentally friendly corrosion protection for commercial and military aircraft. In addition to certain types of aluminum, TDA is exploring the potential of the technology to protect other metals, including iron and steel.

Technology Description:

TDA Research has developed a corrosion-inhibiting additive in which organic corrosion inhibitors are anchored to nanoparticles with high surface areas. These corrosion inhibitors are released to the metal surface on-demand, that is when they are needed, to stop corrosion.

One of the key advantages of this technology is that the corrosion inhibitors are nonleachable, meaning that the rate at which the corrosion inhibitors are released is greatly reduced. A high concentration, or loading, of corrosion inhibitors extends the lifetime of the corrosion inhibiting coating, leading to improved levels of corrosion protection for metals. When corrosion begins, the corrosion inhibitors are released and can migrate to stop corrosion at the metal surface.

Although there are many excellent organic corrosion inhibitors available, most contain functional groups that react with the protective coating's polymer resin, locking them into the polymer chain and rendering them unavailable and ineffective. TDA's corrosion inhibitors are protected from reaction with polymer resin while the coating cures, but are released when corrosion occurs.

TDA's additive is chromate free. Chromates are the most widely used and effective corrosion inhibitors, but are toxic and heavily regulated. They also require additional handling and disposal costs. Chromate leaching can contaminate the environment.

To make the additive, TDA purchases agglomerated metal oxyhydroxide from a bulk material supplier. The metal oxyhydroxide is then chemically treated to modify the surface of the particles, reduce the particle sizes down to 20 to 70 nanometers, and anchor the organic corrosion inhibitors on the outside surface of the particles.

Spinoff Applications:

According to a 2001 Federal Highway Administration report, corrosion is very costly and has a significant impact on the U.S. economy, including infrastructure, transportation, utilities, production and manufacturing, and government. In 1998, the total direct cost of corrosion was estimated at $276 billion, or 3.1 percent of the U.S. gross domestic product. Sectors having the largest direct corrosion impact include drinking water and sewer systems, motor vehicles, and defense. Within the total cost of corrosion, a total of $121 billion per year is spent on corrosion control methods and services.

In the near term, TDA's organic coating technology could replace conventional corrosion protective coatings made of chromates and heavy metals in applications where high-strength and lightweight materials are required. For example, it matches the performance of chromate corrosion inhibitors in protecting Al 2024 and Al 7075, which are primarily used in the wings and bodies of military and commercial aircraft. Cost isn't a factor as chromate-free coatings ($2 to $4 per pound) can be manufactured more cheaply than chromate coatings ($3 to $5 per pound), and there are no additional costs required for handling and disposal. One of the biggest commercial markets for the organic coatings is in paint.

Extruded aluminum window frames could benefit from TDA's organic coatings. TDA says that in the south, home windows are often made with coated extruded aluminum. However, if the coating is scratched, corrosion appears more quickly in the scratched area and eventually causes enough metal damage to warrant replacement. TDA's technology would greatly extend the service life of these frames.

Another potential application is microbial-induced corrosion protective coatings. In gas pipelines, moisture tends to collect in certain parts. This causes bacteria build-up, leading to corrosion. Corroding gas lines can cause explosions. TDA believes its technology could make an excellent antimicrobial, antifungal coating.

Additionally, TDA is exploring the possibility of extending the technology to other metals, including steel, iron, copper, magnesium, brass, and tin.

Commercialization:

TDA is very interested in commercializing its corrosion inhibiting additive. Perhaps the most significant commercial activity to report has been the company's relationship with Sherwin Williams, the largest U.S. paint and coatings manufacturer. Sherwin Williams conducted 1000-hour filliform corrosion and 3,000-hour salt fog tests using TDA's additive. The company continues to work with TDA to bring the technology to market.

Unisphere, which has recently been purchased and absorbed by Concurrent Technologies, is currently evaluating a proposal from TDA to use the chromate-free corrosion-inhibiting compositions for use on steel. Unisphere seeks pollution reduction technologies for the U.S. Army.

While seeking licensees for its corrosion-inhibiting additive, TDA continues its research and development activities.

Company Profile:

TDA was formed in 1987 by two staff from the Solar Energy Research Institute. Since that time, the company has grown to a staff of 65 with annual revenues of approximately $10 million, of which about 70 percent comes from SBIR contracts. TDA is a privately held R&D company that develops new materials (polymers, carbons, and ceramics), catalytic and sorbent-based chemical processes, and military and aerospace components. Commercial revenues come from its direct oxidation technology to remove sulfur from hydrocarbon streams, which is available from Sulfatreat; its fullerene production technology, which is used by Frontier Carbon to manufacture up to 40 tons per year of fullerenes, and its processable conducting polymers, which are available from Sigma-Aldrich.

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