



2019 Award Nomination

Title of Innovation:

(insert title here—no more than five words)

Nano-Clear® Industrial Coating Solutions

Nominee(s):

(insert Name[s] and Organization[s])

Tilo Kunz (CEO) - Assero Industrial Coatings

Thomas Choate (CEO) - Nanovere Technologies, LLC

Category:

(select one below)

Coatings and Linings

Cathodic Protection

Materials Design

Chemical Treatment

Instrumentation

Testing

Integrity Assessment

Other—fill in

Dates of Innovation Development:

(from [month, year] to [month, year])

Nano-Clear® was first introduced to the industrial market in late 2014

Web site:

www.assero.co , www.nanovere.com

Summary Description:

Nano-Clear® (NCI) is manufactured using proprietary 3D nano-structured polymers producing extreme crosslink density. Nano-Clear® is a one-component (1K), humidity cured, polyurethane / polyurea hybrid nano-coating that penetrates deep into the pores and voids of new or highly oxidized paint systems to form a hard, protective, clear, topcoat surface.

Nano-Clear® protects against corrosion, restores existing colour and gloss, and provides strong resistance to UV degradation, extreme weathering, and chemical attack, as well as abrasion, chipping, marring, gouging, impact and scratching. Nano-Clear® also features repellency properties for oil & dirt, water & ice, brake dust, algae and other environmental and biological contaminants. NCI is a flexible, solvent based solution with low VOC values.

NCI can be applied to 2K epoxies, 2K polyurethanes, powder coatings, polyesters, gel coats, eCoats, latexes, fiberglass, and anodized aluminum (to prevent filiform corrosion, etc.).

NCI is engineered to exceed the functional specifications required by industrial, marine, fleet, aerospace, and oil & gas markets.

NCI is designed to protect industrial & commercial equipment such as: rail tank cars, locomotives, fuel tanks, chemical storage tanks, earth moving equipment, ocean going vessels, fleet vehicles and support equipment, painted building structures, light posts, utility enclosures, emergency response vehicles and equipment, oil & gas platforms, pipelines, shipping containers, military vehicles & support equipment, mass transit vehicles & equipment, and much more.

Nano-Clear® reduces maintenance frequency, recoating cycles, chemical costs (mixing, repair, cleaning), the length & frequency of repair & maintenance downtime, the volume of coating material shipped/stored/applied to project surfaces and, thus, reduces expenses.

Customized "first-to-market" functional additives have also been developed that enhance the multi-functional attributes of NCI to record setting levels of performance.

Nano-Clear® is a reliable, long-term, eco-responsible, industrial solution that extends the surface life of an asset's coating system, and is backed by an industry leading 10 Year Warranty.



Full Description:

(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

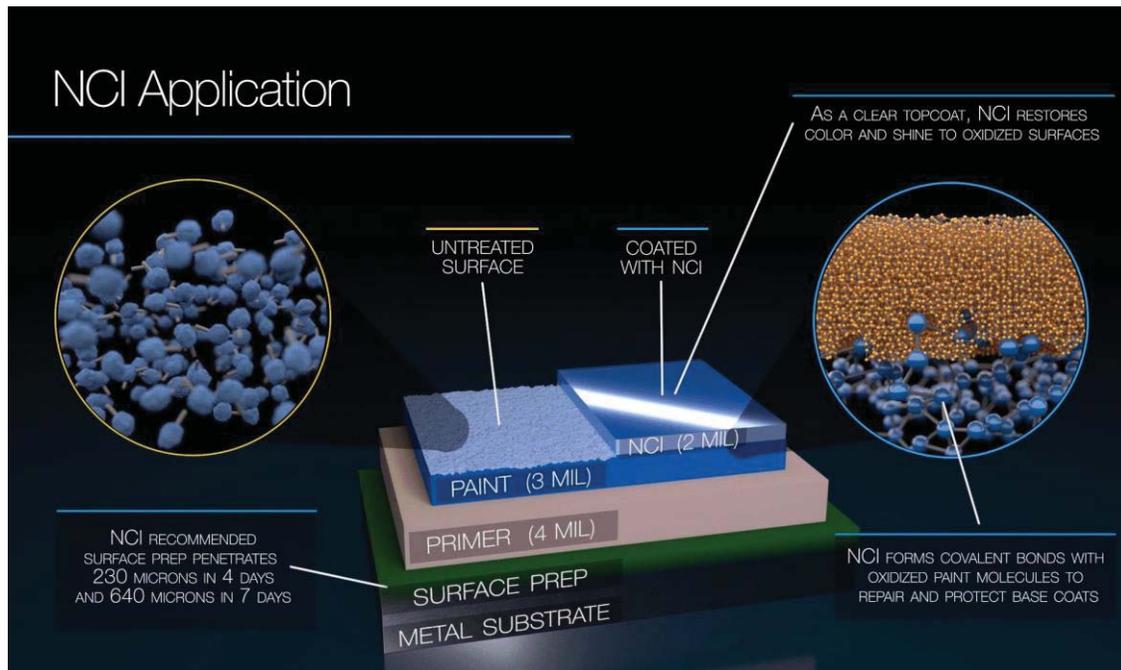
Nano-Clear® Industrial Coating (NCI) and Nano-Clear® Functional Materials are specifically designed to expand the application potential of Nano-Clear® NCI to include military assets, aluminum, direct-to-metal, etc. as well as to enhance product features such as accelerated curing, adhesion promotion and matte finishing.

Nanovere Technologies is the first company ever to utilize 3D nanostructured polymers within an industrial coating system to achieve high crosslink density (as measured with DMTA) with remarkable flexibility. Our 3D polymers provide extreme corrosion, scratch, chemical and UV resistance (see following data).

2. How does the innovation work?

Unlike conventional metal coatings which are subject to scratching & chipping, water absorption, chemical attack, chipping and UV degradation, Nano-Clear® Coatings penetrate deep into the pores of newly painted or highly oxidized paints to dramatically improve corrosion resistance, scratch &

chipping resistance, chemical and long-term UV resistance. Nano-Clear® Coatings, which are designed to be applied “over” conventional paints, are impervious to water and oxygen and protect painted metal surfaces using a proprietary, 3D nano-structured, high cross-link density polymer coating. (<http://www.assero.co/video-gallery>).



3. Describe the corrosion problem or technological gap that sparked the development of the innovation? How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

As described by a NACE study released in 2016, the problem of corrosion costs the global economy upwards of US \$2.5 trillion every year. The impact of this issue is not just financial; it also affects the health of the environment and the eco-systems and populations that are dependent on and interconnected with it. The innovation that Nano-Clear® Coatings provide are designed to tackle these issues head on by significantly preventing the problems of corrosion and by reducing the costs associated with proper maintenance programs.

UV rays cause conventional coatings to quickly degrade, thereby causing underlying corrosion. Surface scratching exposes the steel to the environment, thereby causing corrosion. Chemical attack on conventional steel paints also cause underlying corrosion issues. Painted surfaces exposed to the environment are highly susceptible to environmental damage from factors including water, humidity, salts, ice, heat, dirt, smog, oils, chemical attack, acid precipitation, and unrelenting UV rays. This damage is of particular concern with regards to high value assets such as trans-oceanic ships, chemical tank cars, offshore oil rigs, heavy duty machinery and fleet vehicles. These assets are exposed to the harshest of environments on a regular basis and their painted surfaces are constantly subject to UV degradation due to long-term exposure to sunlight, and from loss-of-gloss from chemical attack or micro-scratching due to repeated surface cleaning.

Normally, high value industrial assets such as bridges, ships, aboveground storage tanks, cranes, tank cars and heavy duty machinery utilize conventional one or two-component pigmented epoxy and polyurethane coatings for metal protection. Epoxy based coatings have excellent adhesion to metal

with good “initial” corrosion resistance and “initial” surface hardness. Unfortunately epoxy based coatings fall-short in areas of long-term UV and chemical resistance due to “poor cross-link density” (linear chain molecules).

The screenshot shows the Inspectioneering website header with navigation links: Home, Topics, Journal Archives, Company Directory, Jobs, Resources, a search bar, Log in, and Subscribe. The main content area features a news article titled "NACE study estimates global cost of corrosion at \$2.5 trillion annually" dated March 8, 2016. The article text states that NACE International released the "International Measures of Prevention, Application and Economics of Corrosion Technology (IMPACT)" study, estimating the global cost of corrosion at US\$2.5 trillion, or 3.4% of GDP. A quote from Bob Chalker, CEO of NACE International, emphasizes the need for change in corrosion decisions. The article also mentions that the study examined corrosion management practices across various industries, including oil and gas, pipeline, and drinking and wastewater industries.

NEWS

NACE study estimates global cost of corrosion at \$2.5 trillion annually

NACE International, March 8, 2016

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NACE International today released the "International Measures of Prevention, Application and Economics of Corrosion Technology (IMPACT)" study, in which it estimates the global cost of corrosion to be US\$2.5 trillion, equivalent to roughly 3.4 percent of the global Gross Domestic Product (GDP). The two-year global study released at the CORROSION 2016 conference in Vancouver, B.C., examined the economics of corrosion and the role of corrosion management in establishing industry best practices. The study found that implementing corrosion prevention best practices could result in global savings of between 15-35 percent of the cost of damage, or between \$375-875 billion (USD).

"The IMPACT study reinforces what recent news headlines have made all too clear: there needs to be a change in how corrosion decisions are made," said Bob Chalker, CEO of NACE International. *"Whether it is a pipeline, an airplane, a water treatment plant or highway bridge, corrosion prevention and control is essential to avoiding catastrophic events before it's too late."*

Looking beyond corrosion's cost to businesses and industries worldwide, IMPACT assessed corrosion management practices across various industries and regions. Specifically, the study examined the oil and gas, pipeline, and drinking and wastewater industries, as well as the U.S. Department of Defense.

Latest Industry News

- U.S. Oil Output Jumps to Record 10.47 Million BPD in March: EIA
- Petrobrazi Refinery Completes 6 Week Turnaround, Resumes Operations
- Workers Sue Valero Over April Refinery Explosion
- Enterprise and Navigator Begin Construction on Ethylene Export Terminal in Houston Ship Channel
- Domo Chemicals and Total Inaugurate Joint Project at Leuna Refinery in Germany

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The high cross-link density and multi-functional aspects of Nano-Clear® Coatings provide much higher levels of protection compared with conventional coating methods by shielding an underlying painted steel asset from the corrosive culprits of water, oxygen, and UV rays. Nano-Clear® also provides extreme resistance to chemical attack as well as from scratching, chipping, marring and abrasion.

Such innovation improves upon the status quo by greatly raising the levels of corrosion resistance performance for protective coatings that are required to withstand harsh corrosive forces and extreme weather conditions. Nano-Clear® and its enhancement additives also benefit the planet by preventing and reducing the amount of metals that leech into the ground and ground water reservoirs every year. Nano-Clear® provides superior protection as well as multi-functional protective features in a low VOC (150 g/L), single component (1K) solution that is easily applied using conventional methods.

Nano-Clear® is the only industrial coating in the global marketplace to enhance, restore, and extend the service life of freshly coated and oxidized painted surfaces by 10 years. Nano-Clear® sets new benchmarks by extending the potential service lifetime of assets and reducing the costs associated with maintaining assets in a state of repair, thus improving the ROI associated with their operation. Nano-Clear® Coatings are a long term solution designed to reduce surface cleaning of painted assets by 50%.

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

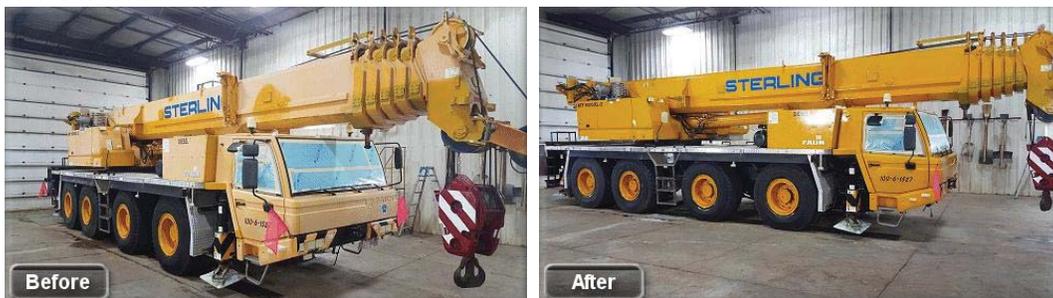
Yes ... we have years of intensive research & development supported by field, in-house and third-party laboratory tests, joint development initiatives, licensing agreements, and documentation to support its ability to exceed global industrial and military specifications. Nano-Clear® has been tested by many third party organizations including Nippon Paint, BASF, Henkel Corporation, Alcoa, StoneBridge Technical Services, Saudi Standards, Metrology and Quality Organization, General Dynamics and many others. See test reports including 4000 hr. corrosion resistance test data at <http://www.nanocoatings.com/ncitestdata.pdf>.

As another example: in an ICL study based in Israel ([IMI TAMI Institute for R&D Ltd.](#)), Nano-Clear® "was tested in a salt spray chamber for up to 5000 hours and then put through an in-field test for 1 full year at ICL plants; Dead Sea Works and Rotem, in different locations with severe corrosion conditions. The results show high corrosion resistance of the Nano-Clear® NCI coating during 5000 hours in a salt chamber. In addition, an abrasion test, adhesion and thickness measurements were performed before and after the salt spray exposure. The results of the field tests are summarized below."

Summary	Overall Performance	V Cut	Change in thickness	Location
Good	✓	✓	✓	Rotem plant area #4
Good	✓	✓	✓	DSW area #1
Good	✓	✓	✓	DSW area #2

- Summary Legend: Bad, Medium or Good
- Adhesion results are between 7-10 MPa with adhesive failure.
- Abrasion results are: Average Wear Index 40 [mg/cycle] and Wear Cycles 1337 [cycle/mil].

In field and real world results:



According to Al MacDonell, Manager with Sterling Crane, "We initially heard of Nano-Clear® NCI Industrial Coating from one of our Berkshire Hathaway sister companies and how much they liked it. By using the Nano-Clear® product we've saved thousands of dollars restoring vs. repainting our cranes. One of the things I am most impressed with is how easy it is to use. Nano-Clear® has performed as advertised as these crane units continue to look as good as the day we applied Nano-Clear® (2 years ago)."

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

Nano-Clear® can be easily incorporated into existing prevention and control activities as it uses the same methods and techniques that are currently used by industries around the world. Nano-Clear® uses conventional paint application techniques including airless HVLP or LVLP spray equipment. Nano-Clear® is easy to use and comes in a convenient one-component coating. Nano-Clear® is humidity cured and requires less product to be applied (2 - 3 mils) when compared with other conventional protective coating products.

Benefits to the industries served:

Nano-Clear® significantly reduces maintenance frequency, recoating cycles, chemical costs (mixing, repair, cleaning), and reduces the length & frequency of repair & maintenance downtime, the volume of coating material that is shipped/stored/applied to project surfaces and, thus, also reduces expenses. Nano-Clear® greatly extends the lifetime of painted assets and the ROI obtained from such assets.

Cost and time saving sample:

Leading US Tank Car Manufacture / Leasing Company

Technical Challenge

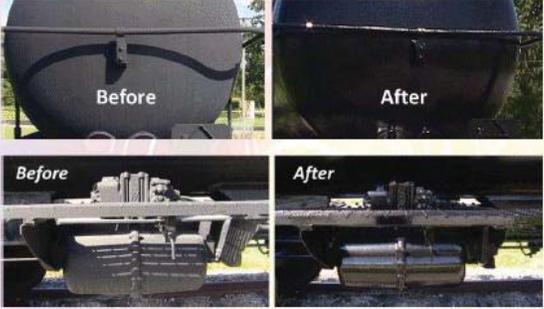
- Reduce Material Cost
- Reduce Labor Cost
- Reduce Energy Cost
- Extend In-Service Life
- Reduce VOC
- Improve UV Resistance

Technical Solution:

Nano-Clear for Industrial Applications was chosen to replace epoxy 2K black. Nano-Clear 1K restores oxidized paint, enhances underlying black color, dramatically improves surface hardness and prevent further UV degradation of underlying paints.

Nano-Clear Coating Benefits:

- Material Savings - 5 gal of Nano-Clear vs. 30 gal of Epoxy
- Energy Savings - No Heat Required to Cure
- Environmental - Lower VOC per Facility
- Higher Production Throughput with Nano-Clear
- 2X Extended Service Life of Tank Car
- Savings - \$925 per Tank Car using Nano-Clear



6. Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

Yes. Nano-Clear® was first introduced to the industrial market in late 2014. Innovative nano-coating developments continue each year. Our latest nano-coating technology includes ice-repellency and anti-barnacle prevention.

Further development challenges will be overcome by allowing Thomas Choate to work fulltime on R&D activities, and by providing the necessary funding to permit disruptive product development to continue with more advanced experimentation, equipment and processes.

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

Nanovere has built a vast portfolio of coating polymers and coating formulations which are held as trade-secrets using in-house "know-how" (details available upon request). The Nanovere "know-how" includes proprietary and newly synthesized materials, proprietary processes that require specific sequencing which are novel and not known in the field.

For maximum security, Nanovere engaged an independent laboratory to determine the strength of the IP in the marketplace. This laboratory has validated that the Nano-Clear® polymer-based coating system and dendrimer-based polymers cannot be reverse engineered as "new" polymer molecules have been synthesized.