Metal spray coatings for protection of steel in extreme environments

Applications in New Zealand
Metal Spray Suppliers

• Established 35 years ago by Mr Jacques De Reuck

• We are a small company of highly trained and unusually good looking individuals

• We have been involved in designing coatings sometimes internationally for mining, drilling, power generation, oil and gas, Hamilton jet, pulp and paper mills, even rockets to deliver satellites into orbit and of course anodic coatings for infrastructure

• We help Auckland University and students doing their PHD with HVOF and plasma coatings due to Jacques experience working with the inventor and being the first in the southern hemisphere to introduce HVOF and first in the world to introduce HVAF
Introduction to metal spray

- The Swiss inventor Max Ulrich Schoop is believed to be the "father" of thermal spray technology, as he submitted the first two patents in Germany and Switzerland for a metal spraying process delivering "dense metallic coatings" in the year 1909. This invention was based on the well known observation of his children shooting with Flobert guns in the garden, where the lead bullets formed splats when hitting the wall.
Flobert gun
Responsible for metal spray as we know it
Structure of an arc spray coating
Sealing arc sprayed coatings

Penetrating/capillary sealers
Volume solids in sealers
Pore size and pigments
Operating conditions

No sealer?
Aluminium as high temp sealer
Wine racks at Villa Maria
Wine racks at Montana

100 microns of zinc
with Vinyl sealer
Both over 20 years ago
Centennial Pool

85/15 zinc/aluminium was applied at 150 microns with a paint system on top over 15 years ago
AIR LIQUIDE

Liquid argon cryogenic vessels transported by boat as deck cargo, were being painted every year and came back looking like this.

With 85/15 zinc aluminium, a penetrating epoxy sealer and aesthetic top coat and urethane 5 years on they still look great.
Taupo arterial road
Pure aluminium with an aesthetic sealer for a sulphur rich environment
Unimog chassis

NZ defence force looking for a durable coating to last 20+ years
Zinc metal spray with a paint system
25 years on and we still see them on our roads looking tidy
Nominal 60 microns of zinc with penetrating epoxy sealer and paint system

Nominal 50 microns of zinc with penetrating epoxy sealer and paint system
This South Island rail bridge was coated with 350 microns of zinc/aluminium and an aesthetic sealer to achieve a coating life of 100 years Before first major maintenance!
A 40 foot statue (Shiva) in Delhi, made with concrete and coated with copper to appear as if the structure was metal.
Corrosion under insulation

• Aluminium outperforms any alternative in temperature range and coating longevity

• Shell D.E.P rates grade 1100 aluminium up to 590°C working temperature with a service life before first maintenance of 25 years for on shore and off shore structures
Column C451 at Refining NZ

Externally Aluminium Arc sprayed and Flame sprayed at the same time to 250 microns as per Shell D.E.P

Arc spray Vs Flame spray in the refineries eyes
NZ Steel

Water pump sprayed with aluminium
Turbine shaft for hydroelectric power generation

Sprayed with stainless steel using a special alloy with low stress but hard wearing properties for a seal surface

Significantly cheaper than replacement and the material applied will last better than a new shaft too
Shenandoah
schooner built in 1902

Propellor shaft reclaimed

To resist continuous salt water immersion a stainless steel with boron and silicone for the was needed for the gland seal area

Again cheaper than replacement and “better than new” performance
GEOTHERMAL POWER GENERATION

corrosion/erosion inside larger diameter steam pipes. A high chrome nickel alloy with moly was applied to repair and protect transitions and elbows.
Steam separator

• LP Steam Separator at Mercury Energy in Kawerau

• Erosion was the main issue, but the steam is corrosive too.

• 140ºC steam at 3 Bar up to 100 M/s velocity to drive the turbines

• Contains Hydrogen Sulphide, Hydrogen Sulphide (H2s) and various small particles from the subterranean steam

• Applied 500 microns of Nickel Alloy in 2011. Re-inspected in 2018 with no measurable coating loss
KRAFT PULP DIGESTER

Originally weld overlaid with 309 stainless, the welding cracked over time causing the substrate to corrode at 1mm per year in thickness

In 1985 it was plasma sprayed to last an expected two more years with replacement costings estimated at $40 million

The coating lasted 6 years and has been reapplied several times and kept the vessel in service more than 20 years longer than expected
COLUMNS C6101 AT REFINING NZ

Product
Napthenic acid and crude oil at 300°C

The refinery considers this a critical vessel because over 80% of everything produced there passes through it at some point during production.

Extensive testing was carried out overseas because no laboratory in Nz could reproduce the process environment.

Our coating specification was chosen over options from large multinational corporations in America.
Aluminium coating inside hot gas filter

430ºC Sulphur dioxide gas from liquid sulphur combustion
Boiler tubes

1000°C or more
Fuel is often high in Sulphur
Flames are in direct contact

Bond coat of Ni, Al, Mo
Corrosion resistance Ni, Cr, Fe
Erosion resistance Fe, Cr, B
Sealed with Al
Alternative coating Ni, Cr, Ti