Thermal Spray for Corrosion Protection
Metallisation
Thermal spray equipment and consumables

Metal Spray Equipment, Consumables
Excellence and support since 1922

Established in 1922, Metallisation Ltd is the leading manufacturer of Thermal Spray equipment such as Arcspray, Flamespray, Plasma, HVOF, Laser Cladding and Automated Spraying Systems.

We have the expertise to not only bring you the most advanced metal spraying technology, but also extensive knowledge in surface engineering and excellent customer service.

Our equipment has been designed for a wide range of uses - from universal corrosion protection of steel fabrications to engineering coating applications within the automotive, aerospace, oil/gas and manufacturing industries.
History of the process

- Pioneered by Dr M U Schoop of Zurich in the early 1900’s (1st patent 1909)
- Started out by pouring molten metal into a high pressure gas stream
- Developed to depositing coatings from solid wires (1916)
- Introduced in the UK in 1922 (foundation year of Metallisation)
How does thermal spray work?

- It is a process that converts solid wires to a molten spray.

- Wire is melted then atomised & projected onto the substrate.

- The material hits the substrate, deforms, flattens & freezes, gripping it onto the substrate surface.

- Successive layers of coating can be applied to achieve the required coating thickness (can be 10’s of microns up to several mm thick).
Thermal Spray Highlights

- Instant curing
  - No drying or curing time – can be handled straight after application

- Metallurgically cold process
  - Virtually no heat input to the substrate (<80°C typically)

- Typically mechanical bonding process
  - Normally requires grit blasting to prepare the surface

- Can be applied at various thicknesses
  - Typically 150-350 microns for corrosion applications

- Long life corrosion protection
  - >20 years life to first maintenance in splash zone

- Line of sight process
Material choices for corrosion protection

Zinc (TSZ)
- Acts sacrificially with ferrous substrates
- Forms an oxide
- Predictable life under known localised environmental conditions
- pH range 6-12.5
- Used
  - Wide range of atmospheric and immersed environments, ambient temperatures

Aluminium (TSA)
- Acts less sacrificially with ferrous substrates than zinc
- Produces adherent oxide / hydroxide insoluble corrosion product
- Finite life difficult to predict
- pH 4-7
- Used
  - Coastal, offshore, chloride (salt) environments and elevated temperatures

Other alloys used – Zn/Al, Al/Mg
Refer to EN ISO 2063
Spray processes

Flamespray Systems:

Diagram showing the components of a Flamespray system:
- Wire Drive Mechanism
- Compressed Air
- Wire Drive Rollers
- Mixed Fuel Gas & Oxygen
- Spray Stream

Image of a worker applying TSA onto an offshore platform.
Flamespray Systems – WIRE

MK73 - Propane Fuelled Pistol

Primary use:
- Anti-corrosion coatings:
  - Zinc, Aluminium, Zinc/Aluminium alloy

Can be used for
- Decorative coatings:
  - Cu, AlB², PhB²

Very flexible for site applications
- 60m+ supplies pack lengths
Spray processes

Arcspray Systems:
Arcspray Systems

ARC145, ARC150

- Most flexible Arcspray systems available – manual or automated, push/pull spray systems

- Spray small or large structures with ease:
  Up to 50m supplies Energiser to Pistol.
  Up to 20m supplies Wire to Pistol

- Spray metallic wire of Ø 1.6, 2.0, 2.3 & 2.5mm. MIG reel or drum dispense

- Used for Anti-Corrosion applications i.e. spraying Zn, Al and Alloys and engineering applications, i.e. steels, bronzes, molybdenum, FeCrBSi etc.

- Suitable for robot mounting or hand spraying.
Arcspray Systems

ARC528E-ACD

• Semi-automated or fully-automated spray system.

• Can be fully integrated into auxiliary control system.

• High throughput applications where high coating deposits are required.

• Typical applications:
  Corrosion protection for wind turbines.
  Ductile iron pipes, subsea pipes/risers.
  Robot mounted systems.
  LPG bottle plants.

• Typically Zn, Al or Alloys Ø 1/8”, 4mm or 3/16”.
• 700A, 1000A or 1500A.
Sealing of coatings

Sealers

- Many coatings benefit from being sealed but not always essential (especially for larger coating thicknesses)

- Sealers are low viscosity materials used to **penetrate** the natural porosity of the thermally sprayed coating

- Sealers enhance life expectancy by reducing exposed surface area & can offer a more desirable coloured appearance

- Sealers smooth the sprayed surface thus remaining cleaner longer and reducing paint consumption for duplex coating systems
Common corrosion applications
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Future for Foundations – CROWN Project

Developers/Owners
- DONG Energy (now Orsted)
- EDF Energy

Designer
- LIC Energy

Foundation Fabricators
- Wilton Engineering

Coating Supplier
- Universal Coatings

Research Organisations
- TWI
- ORE Catapult

CROWN – Cost Reduction for Offshore Wind Now – slides for CROWN courtesy of TWI
Foundation corrosion protection

What’s used at the moment?

Galvanic Anodes

- Lengthy cure times
- Complex specifications
- No protection if damaged
- Limited lifetimes

Paint

- Large mass of aluminium alloy
- Secondary steelwork needed
- Needs connecting to the structure

What’s used at the moment?
Project objectives

To reduce the cost of offshore wind foundations

**HOW?**
- Investigate the replacement of paint and anodes with TSA

**CAPEX**
- Reduce manufacturing costs by altering fabrication sequence

**OPEX**
- Longer coating lifetime that requires less maintenance

**INSTALLATION**
- No need to fabricate and install anodes cages

Provide data needed to address current knowledge gaps and enable developers to make informed decision on TSA use.
Project scope

**Corrosion**
- Laboratory (damage, CP, internal)
- In-situ (offshore trials)
- Long standing empirical data

**Manufacture**
- Jackets
- Monopiles
- Spray productivity
  - ‘Yellow TSA’

**Installation**
- Mechanical piling damage
- Initial mudline corrosion assessment

**Modelling**
- Numerical design modelling incorporating TSA
- Life-cycle cost modelling

**Project Management / Dissemination / Liaison with standards bodies**
Manufacture with TSA

Quick wins on offer?

+ **Zero cure time**
  - Removes significant manufacturing bottleneck

+ **Lower material costs**
  - Less Al needed to protect structure

+ **Less secondary steelwork**
  - Labour intensive manual welding operations reduced

**Quicker installation?**

- No requirement to electrically connect anode cages following piling.
Manufacture with TSA

Change of process

Traditional - monopiles
- Roll, weld, paint, anode cage

New concept - monopiles
- Coat flat place, roll, weld, repair welds

Traditional - jackets
- Fab, coat completed structure, anodes

New concept - jackets
- Coat tubulars (easier), fab, repair welds
Trials – pre coated plate rolling
CROWN - Summary

Manufacture - CAPEX
- New production principles proven, high throughput spraying proven

Installation – CAPEX
- Easier installation, robust coating, estimate saving ~£100k/foundation

Corrosion protection / OPEX
- Good levels of corrosion protection proven and supporting empirical data

Next steps - CROWN 2
- Approved April 2018 to start July 2018 – 3 years
- Aims – continue corrosion analysis, up-scale new production principles, develop large scale automated spraying principles, further reduction in costs, achieving ‘yellow TSA’
Concluding points

 Thermal spray is…
 - An independently proven, long term corrosion protection process
 - Not as complex to apply as some consider
 - Fast process overall

 Common corrosion coatings
 - Applied by flame spray and arc spray
 - Aluminium, Zinc or Zinc/Aluminium alloys

 Research
 - Looking at innovative manufacturing approach
 - Clarifying reduced LCC