Metal flame spray

Description

Process schematic

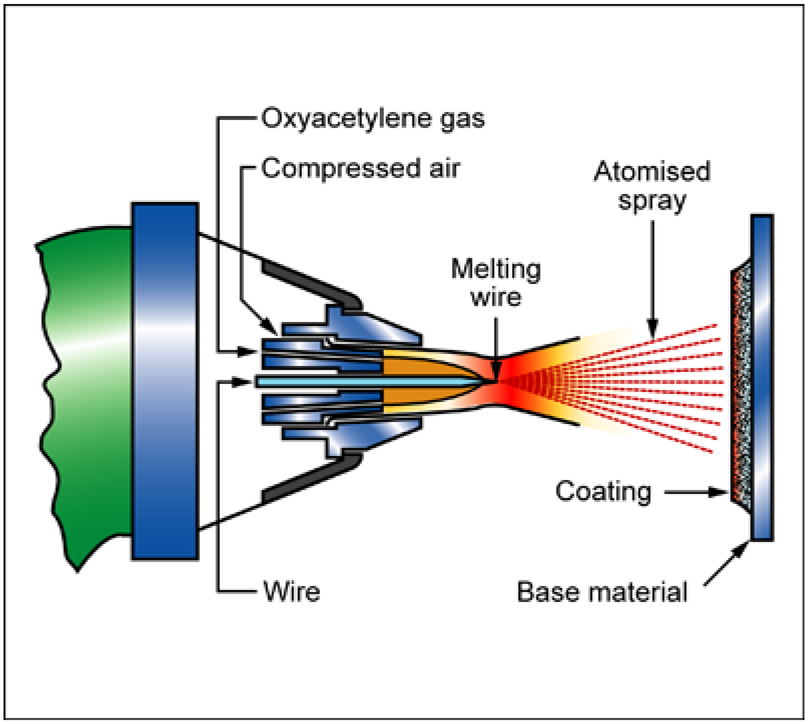

Figure caption

Flame spraying

The process

Wire flame spraying is one of a family of processes for spraying metal - others are arc wire thermal spraying, plasma arc spraying, and powder flame spraying. All use a heat source to melt the coating material and a high velocity gas jet to break it into small droplets and propel them to the surface to be coated.
In wire flame spraying, a continuous wire or rod is fed into an oxyacetylene flame, which melts it and disperses it into droplets 10 to 100 microns in diameter. The gas stream accelerates them to 90 to 25 m/s and propels them towards the surface at a distance 100 to 250 mm from the gun. The molten particles strike the surface and flow into thin, flat droplets that overlap, interlock and bond as they solidify. Multiple passes allow thick coatings to be built up.

Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓

Function of treatment

Corrosion protection (aqueous)	✓
Corrosion protection (gases)	✓
Hardness	✓
Wear resistance	✓
Friction control	✓
Thermal conduction	✓
Electrical conduction	✓

Magnetic properties	✔

Economic compatibility

Relative tooling cost	medium
Relative equipment cost	medium
Labor intensity	medium

Physical and quality attributes

Surface roughness (A=v. smooth)	C			
Curved surface coverage	Poor			
Coating thickness	0.591	-	118	mil
Surface hardness	25	-	100	Vickers
Processing temperature	2.73e3	-	4.53e3	°F

Process characteristics

Discrete	✔

Supporting information

Design guidelines

Applicable for thick or thin sections. Unsuitable for thick coatings. Large area covered easily with thin coatings. Very applicable for site-work and machined components.
Non-metallic coating processes: from a practical standpoint, the maximum size limits for coating the outside and inside surfaces of workpieces depend only on the preparation and handling equipment. In general, the minimum size of the internal diameter is limited to 50 mm and the length should not exceed 3.7 m unless the diameter is large enough to accommodate the entire gun and the supply lines. The coating of curved passages is limited to sizes and shapes that permit distances already prescribed.
May show useful porosity.
Flame spraying prolongs the life of new parts and repairs worn parts, and it allows the use of inexpensive substrate materials with thin layers of a more costly coatings.

Technical notes

In general, flame spray coatings exhibit lower bond strengths, higher porosity, a narrower working temperature range, and higher heat transmittal to the substrate than plasma-arc and electric-arc spray.
Flame temperature and characteristics depend on the oxygen-to-fuel gas ratios (3273 to 3623 K).
Wire feed generally gives better coating than powder. Spray and fuse is more expensive because of the extra operations, and it is limited to self-fluxing alloys which tend to be low in ductility.
The base material is usually metal but can be ceramic, glass, concrete, plaster, carbon or even wood can be coated. The cooling effect of the airstream prevents heat damage to temperature-sensitive materials. Both non-ferrous and ferrous metals are spray-coated. Low carbon steels are generally preferable to high-carbon steels as substrate materials. Coating materials with a melting point below 2000 C can be sprayed, which includes most metals and ceramics. The most commonly used are low-melting alloys such as steel, bronze, aluminum, nickel, aluminum oxide, chromium oxide, nickel graphite. The flame spray and fuse process permits coating with nickel and cobalt-base alloys. The coating rate is higher for metals (3.2-9.1 kg/h) than for ceramics (1.4-2.3 kg/h). The coating is relatively porous (10-15%). Some layers can be sintered at 1000C after coating, causing them to diffuse and produce a dense film with good adhesion.

Typical uses

Metal flame spraying is most commonly used to enhance wear resistance. It is also used in the foods industry to modify surfaces of food processing equipment and in the oil/gas industry for protection against corrosion and wear.

The economics

The process has low capital investment, high deposition rates and efficiencies, relative ease of use and low cost of maintenance.

The environment

No particular hazards.

Links

MaterialUniverse

Reference