Commentary

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Thermal Spray Technologies—An Integral Part of Modern Production Processes

The title is no overstatement. Indeed, thermal spray coating technologies have become indispensable in several high-tech areas, such as aircraft and automobile manufacturing, power engineering, heavy machinery manufacturing, electronics, the waste treatment industry, and medicine. The growing range of applications fields serves as an incentive for further studies of the deposition processes, for research on process modifications, and development of the deposition equipment. New coating systems are being investigated, with the main goal to obtain specific functional properties of machinery components or parts, and find application for the new methods in specified fields of industry.

Thermal spray technologies have bright prospects for the future as they have proved to be technically feasible and highly effective investments. The considerable research and development costs bring fast benefits in terms of market demand and profits from sales of the new production equipment. In many practical situations, thermal spray processes offer complex solutions to the challenges of modern technology, with ever higher requirements for quality, operational reliability, product life span and environment friendliness. The higher manufacturing costs associated with the deposition of functional coatings are well offset by the outstanding operational properties of the final product.

SKODA a.s., a Czech engineering company, has a nearly 140-year tradition of technical excellence and consistent effort toward product quality improvements. The company currently employs a staff of 30,000 in its 42 affiliates in the Czech Republic, other European countries, USA, and Asia. Its main product lines are metallurgy (large castings and forgings in particular), conventional and nuclear power engineering, heavy and special-purpose engineering, transport systems (including a wide range of rail and road vehicles), heavy trucks and ecological engineering. SKODA exports products to 90 countries around the world.

The R&D section of SKODA includes specialized laboratories and a workshop in thermal spray coating technologies, such as HP/HVOF, APS, WAS and FS technologies, PTA plasma facing and TIG/MIG welding. Among the most advanced equipment used at SKODA are HP/HVOF JP 5000 and WAS 9000 Arc Jet TAFA. The parts to be processed are sprayed in a spacious cabin with positioning devices. The maximum diameter of the processed part is 1m, by 4m in length and 2,000 kg. Larger parts (maximum 3m in diameter, up to 10m in length and a maximum weight of 30,000 kg) can be sprayed at other SKODA subsidiaries.

The application team at the R&D center have applied thermal spray technologies to the following manufacturing areas:

- HVOF extremely hard cermet coatings on rolling and unrolling equipment for rolling mills (rolls of diameter 0.6m, length 4m and weight 1 to 28 tons)
- as an alternative technology to two-phase crankshafts (length 4 to 10m. weight 1 to 28 tons)
- as an alternative technology to two-phase nitriding
- HVOF coatings on machine tool spindles
- HVOF, WAS, and APS functional coatings on 18 different parts of steam turbines (including holes of cylindrical shape)
- WAS coatings of composite materials and alloys of non-ferrous metals as a substitute technology to metal casting for parts of power generation equipment
- HVOF and WAS coatings as substitute for hard chromium plating and surfacing

Thermal spray coatings have a very successful application in equipment upgrading. For example, turbine rotor journals can be renovated using multi-layer WAS coating of total thickness 1 to 10mm, or complete overhaul of water turbine guide blades is possible using multiple or graded coatings of total thickness 5 to 30mm. Other standard upgrading or repair operations are performed on rolls, piston rods, sliding bearings, rotor journals, gearbox casings, etc.

It is expected that the newly developed deposited multicomponent coatings (metastable, mixed, multilayered or graded nitrides, carbides, oxides and cermets), self-reinforced ceramic coatings (ionic partially stabilized oxides, mixed ionic covalent whisker systems), special surface and coating structures (epitaxial, nanocrystalline, amorphous), thin-film materials for electronics, super-hard covalent materials, and polymer coatings will soon become standard items on the list of engineering materials. There is no doubt that thermal spray technologies will play an important role in the development and manufacturing of these new materials.

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