

Sustainable use of energy and resources thanks to modern surface technology

Functional surfaces support the energy transition

Sulzer Metco holds leading market positions in surface engineering. With its tailor-made solutions, customers can save energy and resources, which increases the competitiveness of their products and processes. Modern coatings make it possible to significantly increase energy efficiency and to make sustainable use of renewable energy.

Ambitious targets for emission control and the reduction of CO₂ emissions have already been introduced as binding standards in many countries. In the US state of California, for example, the goal is to reduce the emission of greenhouse gases to 20 % of 1990 levels by 2050. Goals of this kind define the scope and the speed of the development of energy

technologies¹, and they can only be achieved in the medium and long term through the introduction and further development of new technologies (such as biogas, wind energy, solar energy, hydropower, and hydrogen technology). In the short term, however, great success can be achieved by increasing the efficiency of energy generation, as well as in the use of energy, particularly

in residential applications and the transport sector.

Coatings ensure optimal use of fuel

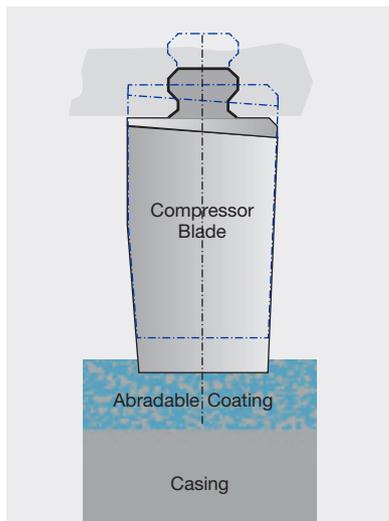
Efforts to make the best possible use of fuel in stationary gas turbines and aircraft engines basically concentrate on further increasing the gas temperatures and the pressure differences between the stages of the turbine. A very effective measure

Sulzer Metco is the world leader in the development of coating solutions for energy-efficient gas turbines.

Metco has left the Sulzer Group and is now part of the Oerlikon Group.

oerlikon
metco





1 Principle of thermally sprayed abrasion-resistant coatings (example: compressor blade).

that is also cost-effective is the use of thermally sprayed abrasion-resistant coatings as a sealing system between the rotating and stationary components of individual turbine stages 1. Savings in operating costs of USD 1 million per year have been achieved for a modern gas turbine through the reduction of the sealing gap by 1 mm in stages 1 and 2, whereby the hotter first stage provides two-thirds of the total savings.² Along with energy use, greenhouse gas emissions are also reduced.

Sulzer Metco holds leading positions in the development and introduction of modern high-temperature resistant materials for abrasion-resistant coatings in accordance with the efficiency goals set by original equipment manufacturers (OEMs).

A major contribution was the development of the material Durabrade™ 2192, which is suitable for use as a turbine sealant up to temperatures of 1200 °C.² Coatings made from this material exhibit excellent abrasion-resistant behavior combined with excellent thermal-shock resistance, which is twice that of yttrium-stabilized zirconium oxide coatings with comparable porosity. Further development programs are currently running to meet the requirements of the turbine manufacturers for additional increases in temperature and energy efficiency.

Functional surfaces for high-performance fuel cells

Solid oxide fuel cells (SOFC) have an equally great potential to make an important contribution to energy savings.³ The highest efficiency for the production of electrical energy is achievable with an SOFC having a power range between one and several hundred megawatts. Due to its thermal spray and material engineering experience, Sulzer Metco has become an important partner of leading SOFC manufacturers.

Like that of gas turbines, the success of SOFCs with regard to performance and service life largely depends on surface coatings, some of which can be very efficiently produced by thermal spraying. Currently, several hundred

Sulzer offers efficient coating solutions for fuel cells.

thousand SOFC interconnectors are coated annually with a layer of lanthanum-strontium manganate (LSM) to prevent chromium evaporation from the metal interconnectors. Metco 6800 and Metco 6801 spray materials, as well as the new TriplexPro™-210 plasma spray gun, are used for this purpose.

The plasma spray thin film process (PS-TF) provides another coating solution

for SOFC components. This technology has a chamber pressure of approximately 1 mbar (the ambient pressure for plasma flame and component) and creates a very long, wide plasma jet, through which the coating material is evenly distributed over a comparably large area (diameter of approximately 200 mm).³ Sulzer Metco has continually developed the PS-TF process further and offers a wide range of solutions for the effective application of thin and thick layers of ceramic and metallic materials onto large surface areas.

Coated glass saves energy in buildings

Saving energy is not only important in industrial production, but also in the home, in building technology, and in daily life. Thermal spray coatings from Sulzer Metco also make an indirect contribution in these areas, for example, in coated architectural glass. Coating of the glass is carried out using a PVD process (magnetron sputtering), in which rotating tube targets are becoming common. These are often manufactured by thermal spray (e.g., TiO_x targets). The large area of the targets and the required coating thickness of up to 11 mm require maximum deposition rates, which can only be achieved by the latest plasma spray

New TriplexPro™-210 plasma spray gun

The new version of the TriplexPro-210 plasma spray gun is based on the successful Sulzer Metco TriplexPro product line, with simplified maintenance and more robust performance.

Simplified consumable parts

- Quicker, easier gun maintenance
- Significantly reduced potential for assembly errors

Keyed and numbered electrode power connectors

- Simplified data logging and quality management

Helium-free operation

- Reduced spray process costs using low helium or helium-free parameters (examples: Ar only, Ar/N₂, or Ar/H₂)

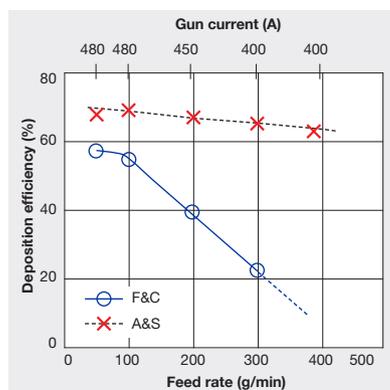
Robust design

- Stands up to harsh thermal spray environments
- Trouble-free long spray runs



gun technology, high powder feed rates, and high application efficiency.

Sulzer Metco has developed a special TiO_x powder (agglomerated and sintered) for this application. The powder is significantly different from conventional powder (fused and crushed) with regard to morphology and density.⁴ When this powder is sprayed using the Triplex-Pro-210 high-performance plasma spray gun, the application efficiency is doubled with the same or improved coating properties and with a powder feed rate up to three times higher.



2 Comparison of the deposition efficiency and the delivery rate of the conventional powder (fused and crushed F&C) with the newly developed powder (agglomerated and sintered A&S).

The advantages of this new powder can be clearly seen in Fig. 2. With very high feed rates, high deposition efficiencies in the range of 70% are achievable. The abovementioned measures save considerable amounts of powder and coating time, which translates into a greater saving of energy and resources and provides a decisive competitive advantage.

Fuel-saving coatings in the engine

Coatings that improve the friction and wear properties of components in the vehicle drivetrains can also lead to a remarkable increase in energy efficiency. For example, diamond-like carbon (DLC) coatings can considerably improve the friction and wear characteristics of bucket tappets. The smooth surface and the low frictional properties are retained

DLC offers great hardness combined with low friction values

Diamond-like carbon coatings (DLC) are characterized by extremely low friction resistance and extreme hardness. The coatings are used to reduce wear and friction in a series of industrial applications; for example, for machine components for the automobile industry and molds for the processing of plastics and metals. In 2010, Sulzer acquired the DLC coating division of Bekaert and thereby complemented the technology range offered by Sulzer Metco in thin-film technologies.

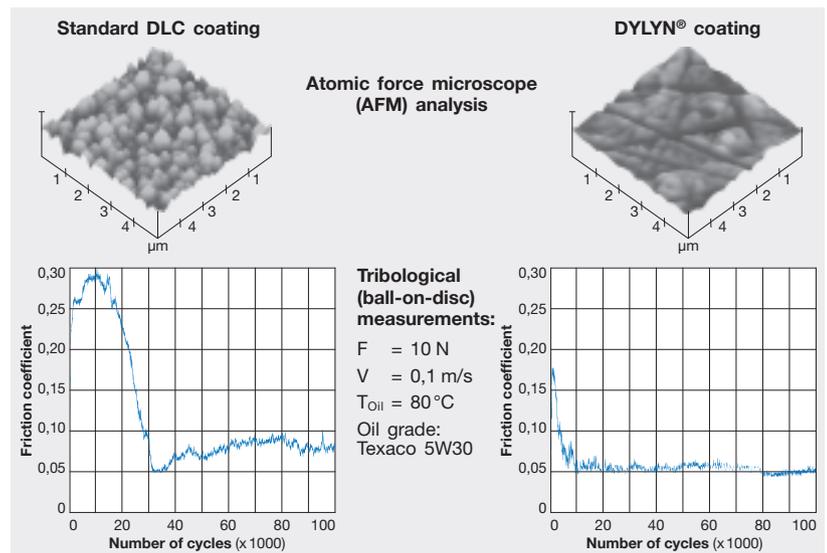
The illustration shows a selection of DLC-coated components from the drivetrain of a motor vehicle.



while exhibiting high wear resistance and very good oil wetting, even while running 3.

The finishing of the bucket tappets with DYLYN™ Plus in small- and medium-sized gas engines (for example, a 1.6 liter four-cylinder Otto engine) can reduce the torque by up to 33%, depending on engine temperature and speed, without having to carry out any design or production engineering changes to the engine. This improvement translates into a fuel consumption reduction in the low single-digit percentage range.

3 Friction coefficient as a function of loading. Comparison between a standard DLC coating and the optimized coating from Sulzer Metaplas DYLYN®.



Furthermore, it produces a CO_2 emissions reduction of around 2 to 3 grams per kilometer—a decisive amount for compliance with increasingly stringent requirements, such as Euro 5 and Euro 6. It seems that there is still a great deal of potential in the reduction of friction losses in the future.

Coating solutions for hydropower turbines

Wear- and corrosion-resistant coatings have proved their worth over decades in various hydropower turbines.⁵ The

primary goal here is to extend the service life of the individual components and to thereby reduce the life cycle costs of the turbine. At the same time, suitable coatings can also considerably increase energy efficiency, as heavily worn key components [4] have a negative effect on the energy efficiency of a turbine.

installations, new and more efficient plants will replace a large number of older installations. The materials used

Sulzer Metco makes a contribution to the use of renewable energy.

must be able to withstand very high loads, as well as continually varying forces, such as the forces wind turbine gearboxes are subject to during service. To achieve a good level of electric generation efficiency, the relatively slow rotor speed in most wind turbine installations will be translated into a considerably higher generator speed, whereby the gearbox gears will be subjected to enormously high wear and fatigue resistance requirements for the steel construction. High-toughness steel is also a precondition for withstanding the sudden stress caused by gusty winds.

Sulzer Metaplas has developed solutions that meet these boundary conditions to ensure optimized wear protection for the gear wheel. These solutions have already been installed in many wind turbines: DLC coatings of type a-C:H:Me for carburized gear wheels. This coating significantly improves gear wheel dry-running and running-in characteristics, as well as the wear behavior.

Today's wind turbine construction uses large amounts of steel (even more

than the shipbuilding industry), therefore corrosion protection is a clear necessity. Thermally sprayed coatings offer a cost-effective solution here—one that is aimed at ensuring a long service life. Nowadays, arc-sprayed zinc or zinc-aluminum coatings are largely used for corrosion protection, in both offshore and onshore installations. For example, they are used for corrosion protection of the (steel) towers (inside and outside before painting), the foundation plates, the slewing rings [5], and for protection of the complete machine housing and the hub.

Tailor-made coatings contribute to energy transition

In summary, it can be concluded that surface technologies are already making a great contribution to energy transition today—on the one hand, with renewable energies, and on the other hand, with energy-saving measures that improve energy efficiency. In both cases, specially developed, tailor-made, functional coatings and surfaces are used. In close cooperation with the customer, Sulzer Metco continually develops new solutions that will contribute to the use of renewable energy and energy and resource savings.

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- According to World Wind Energy Association (www.windea.org)



[4] Wear on the cups of a Pelton turbine.
(Source: Wikipedia)

When discussing energy efficiency, the use of resources must also be considered. As large quantities of mainly tungsten-carbide-based materials are used in the hydropower applications described here, the recycling of these materials, such as the overspray wastes, are increasingly a matter of discussion. Sulzer Metco has accepted this challenge and is currently drawing up suitable concepts for customers. An overview of coatings for hydropower applications is given in *STR 3/2011*.⁵

Protecting wind power systems against wear

At the end of 2011, there were 22 297 wind turbines in Germany, with a total installed capacity of 29 075 MW.⁶ According to the Dena forecast, there will be an installed capacity of 51 GW in the year 2020, of which 14 GW will be offshore installations. In addition to new

[5] Arc spraying a slewing ring with EcoArc 350.



Photo: © OGRAMAC Engenharia de Superfície