CORROSION PROTECTION BY LASER CLADDING OF PURE TITANIUM

Task

The corrosion resistance of materials is of particular interest to the chemical engineering industry, where highly corrosive media are processed and stored. The most demanding applications often require the use of metals such as tantalum or titanium in their pure form. The high price of these commodities on the world market often prohibits their use in the manufacture of large components such as heat exchangers. The aim of this project is to provide the required corrosion resistance by coating low-cost steel materials with a protective layer of these more resistant metals.

Method

The laser cladding process used to deposit a titanium layer on a steel substrate results in the formation of brittle intermetallic phases in the dilution zone. By adapting the process parameters, the size of this zone can be minimized. It is also important to limit iron dilution in the layer, so as to ensure a sufficiently pure coating with high corrosion resistance properties. Another essential requirement is that the melt pool must be adequately shielded against oxygen in the surrounding air, to avoid oxidation reactions with the titanium.

Result

Dense layers of grade-2 titanium with a thickness of 350 μm were deposited on a CK45 steel substrate without crack formation. The zone containing intermetallic phases was reduced to a thickness of only a few micrometers. No significant oxidation of the titanium coating occurred. The purity of a single-layer titanium coating was 99.8 percent which can be increased by multilayer cladding.

Applications

The chemical engineering sector represents the largest market for coating applications based on this technique, because it allows corrosion-proof components to be manufactured that would not otherwise be economically viable. Medical technology is another area in which titanium coatings could be of interest, given the material’s high biocompatibility.

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1 Cross-section through a single-layer coating of grade-2 titanium on CK45 steel.
2 Cladding process.