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# Corrosion Protective Coatings in Machines Design

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**Abstract :** During the last 50 years, the selection of materials is one of the main decisions in machine design for different industrial applications. It is due to numerous physical, chemical, mechanical and technological factors to consider in it. Corrosion effects are related with all of these factors and impact in the life cycle, machine incidences and the costs for the life of the machine. Corrosion affects the deterioration or destruction of metals due to the reaction with the environment, generally wet. In food industry, dewatering industry, concrete industry, paper industry, etc. corrosion is an unsolved problem and it might introduce some alterations of some characteristics in the final product. Nowadays, depending on the selected metal, its surface and its environment of work, corrosion prevention might be a change of metal, use a coating, cathodic protection, use of corrosion inhibitors, etc. In the vast majority of the situations, use of a corrosion resistant material or in its defect, a corrosion protection coating is the solution. Stainless steels are widely used in machine design, because of their strength, easily cleaned capacity, corrosion resistance and appearance. Typical used are AISI 304 and AISI 316. However, their benefits don't fit every application, and some coatings are required against corrosion such as some paintings, galvanizing, chrome plating, $SiO_2$, $TiO_2$ or $ZrO_2$ coatings, etc. In this work, some coatings based in a bilayer made of Titanium-Tantalum, Titanium-Niobium, Titanium-Hafnium or Titanium-Zirconium, have been developed used magnetron sputtering configuration by PVD (Physical Vapor Deposition) technology, for trying to reduce corrosion effects on AISI 304, AISI 316 and comparing it with Titanium alloy substrates. Ti alloy display exceptional corrosion resistance to chlorides, sour and oxidising acidic media and seawater. In this study, Ti alloy (99%) has been included for comparison with coated AISI 304 and AISI 316 stainless steel. Corrosion tests were conducted by a Gamry Instrument under ASTM G5-94 standard, using different electrolytes such as tomato salsa, wine, olive oil, wet compost, a mix of sand and concrete with water and NaCl for testing corrosion in different industrial environments. In general, in all tested environments, the results showed an improvement of corrosion resistance of all coated AISI 304 and AISI 316 stainless steel substrates when they were compared to uncoated stainless steel substrates. After that, comparing these results with corrosion studies on uncoated Ti alloy substrate, it was observed that in some cases, coated stainless steel substrates, reached similar current density that uncoated Ti alloy. Moreover, Titanium-Zirconium and Titanium-Tantalum coatings showed for all substrates in study including coated Ti alloy substrates, a reduction in current density more than two order in magnitude. As conclusion, Ti-Ta, Ti-Zr, Ti-Nb and Ti-Hf coatings have been developed for improving corrosion resistance of AISI 304 and AISI 316 materials. After corrosion tests in several industry environments, substrates have shown improvements on corrosion resistance. Similar processes have been carried out in Ti alloy (99%) substrates. Coated AISI 304 and AISI 316 stainless steel, might reach similar corrosion protection on the surface than uncoated Ti alloy (99%). Moreover, coated Ti Alloy (99%) might increase its corrosion resistance using these coatings.

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