Case Study – Resort Corais de Búzios (RN)

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Abstract

The characteristic properties of aluminum, high strength stiffness to weight ratio and good corrosion resistance make it a material highly used in civil construction. Currently, the heat-treatable 6000 alloys are preferred, films and coatings are applied for decorative and protective purposes and adhesion between the substrate and the coating must adhere satisfactorily. In this paper, we investigated corrosion in a construction, specifically in doors and windows frames produced through AA6063 alloy, and the use of titanium as an alternative presented to increase corrosion resistance. A case study of a resort located in Rio Grande do Norte (Brazil) is presented, which involves an area of high exposure to the sea with some pieces coming from doors and windows with oxidation problems, such as identification of the type of corrosion and the solutions treatments adopted including electrostatic paintings with titanium, a technological innovation to replace the current process with chromium. In addition to providing esthetic effect, electrostatic painting with titanium present itself as an alternative to the current process, providing paint adhesion to frames with greater corrosion resistance to the metal.

1 Introduction

To maintain the self-protection of aluminum and its alloys in specific applications, supplementary protective measures are required, applying surface treatments involving appropriate technologies. Over the years, environmental sustainability has become increasingly stringent due to specific environmental legislation. As aluminum surface treatment processes are polluters, mainly because of the use of hexavalent chromium in the electrostatic painting process, special attention has been giving to replace these processes with environmentally sustainable ones. The case study presented involves an investigation the corrosion in aluminum frames based in a AA6063 alloy pre-treated an electrostatic painting with hexavalent chromium, the present work also looks at another alloy as AA6060 alloy, both alloys present excellent natural corrosion resistance. The conditions of the pieces in situ showed to be filiform corrosion, the attack was superficial but aesthetic unpleasant and hence undesirable, an alternative system to current practice which represents a technological innovation in the surface treatment with titanium shows itself as a solution for the treatment enhance the adhesion. The objective is generate knowledge that contributes to practical applications without generating pollutants as in the current process (with chromium). Filiform corrosion occurs in humid, although not saturated atmospheres: between 70% and 95% for aluminum, at temperatures between 20oC and 40oC. Water saturated atmospheres produce blisters rather than filiform corrosion (DELPLANCKE et al., 2001). Usually, this type of corrosion is associated with failures in the adhesion of the surface treatment or breaks in the coating and the solution is the replacement the piece. This type of corrosion takes the form of filaments which do not cross each other and propagate from the ends of the pieces. The corrosion products cause surface peel off and you may, eventually, note a white powder coming off the frames.

2 Methodology

*The case study presented is aimed at analyzing the corrosion in windows and doors frames from Resort Corais de Búzios located in Nísia Floresta (Northeast Brazil Coast) in the state of Rio Grande do Norte in Brazil (**Figure 1**). Five years after finished the installation service in September 2014 pitting corrosion appeared at the aluminum pieces which, were treated with electrostatic painting with hexavalent chromium. The resort is located a few meters from sea with moderate incidence of winds (important feature due to the deposition of salt air on the frames).*

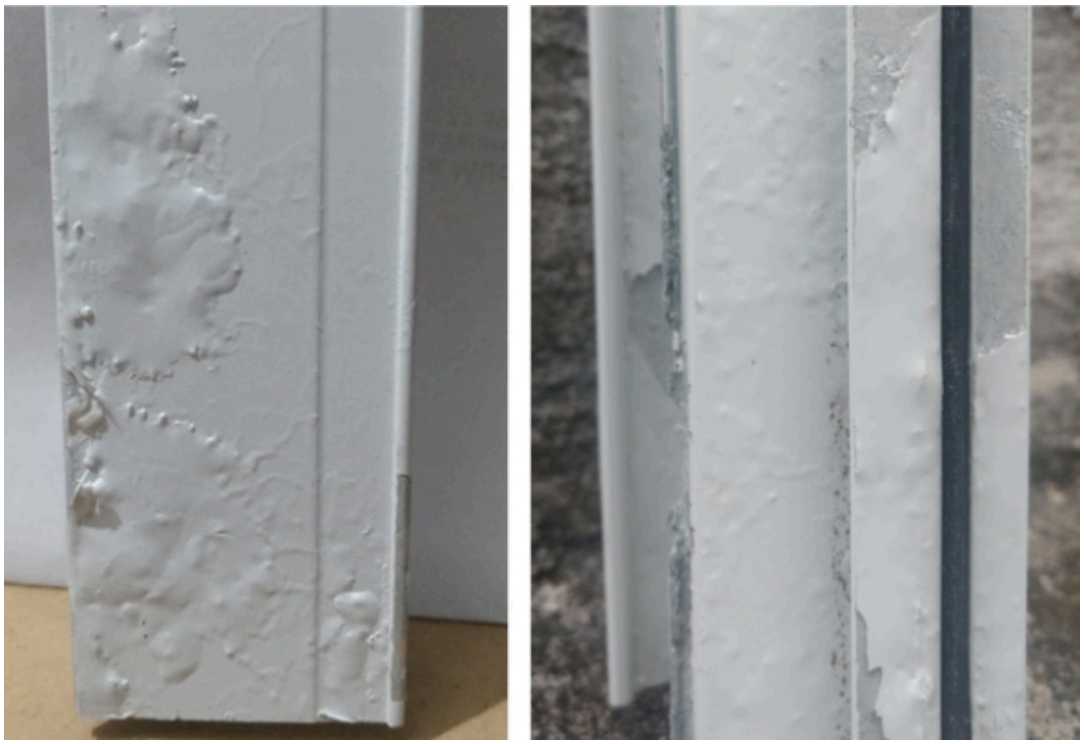
Figure 1 – Resort Corais de Búzios

Source: Centro Nacional de Estudos Espaciais (2020)

The resort is not used as a residence by owners, they use it for season and for this reason doors and windows are not submitted to regular cleaning and maintenance, therefore, they are directly subject to weather conditions. Cleaning and maintenance are essentials to keep pieces in terms of use and avoid the accumulation of salt on the frames, technical standards establishes minimum and periodic times for the maintenance of these products as ABNT NBR 14125:2016: Aluminum and its alloys – Surface treatment – Requirements for organic coating for architectonic purposes (ABNT, 2016), which recommends that the profiles be cleaned every 12 months in urban or rural regions and every 3 months when in industrial or maritime environment. We visited the local to evaluate and to monitor the pathology where samples were collected. The visual inspection evidenced clear characteristics of

*filiform corrosion, pitting corrosion appeared specially at the cut edges and machining parts of the pieces (**Figure 2**). It is important to mention that aluminum bars were painted before cutting and assembling so these regions remained unprotected which reinforces the filiform corrosion.*

Figure 2 – Filiform corrosion in aluminum profiles



Source: Own authorship, 2019

The corrosion caused aesthetic effect and not structural damage, a detailed inspection showed that the pieces underwent severe filiform corrosion which caused the detachment of the paint layer, in some cases it appeared in form of trails at one or more points. Filiform corrosion is associated with mechanical impair of the coating which exposes the coating and metal interfaces, such as cut edges. Filiform corrosion occurs on some metallic materials covered with an organic coating. It shows up as lifting of the coating, in the shape of narrow and possibly long filaments, initiating from defects of the coatings (DELPLANCKE et al., 2001).

3 Results and discussion

At the resort the aluminum alloy used is AA6063 (composition: 0.2%-0.6% Si, 0.35% Fe, 0.1% Cu, 0.1% Mn, 0.45%-0.9% Mg, 0.1% Cr, 0.1% Zn, 0.1% Ti, 0.15% others) used in Brazil for aluminum doors, windows and facades, recommended by Brazilian Aluminum Association Guide (ABAL, 2014). The alloy has little influence on filiform corrosion which is more oriented to substrate adhesion. During the case study we observed a few companies that work with titanium for aluminum coatings in civil construction, most companies still use hexavalent chromium in processes. In December 2019 all the frames were replaced for new ones which received titanium treatment, the end of the pieces and cutting and machining parts had been protected for a layer of neutral sealant. Since the pieces were replaced, no points of filiform corrosion were evidenced in the new pieces.

4 Conclusions

We attempted to identify the factors who influenced the appearance of filiform corrosion at the resort, the short distance from the sea must be the main reason. In the case study it was possible to show as a preventive measure to improve the quality of coatings in civil works, protect the ends of pieces and the places that were subjected to the processes machining (drilling, cutting, etc.) or any parts where stay unprotected and confirmed the importance of a coating with better adhesion. Titanium in painting process for aluminum coating can replace chromium used today due to the disposal problems involving chromium, a material considered carcinogenic with controlled disposal. According to the authors it is necessary to research more about titanium in electrostatic painting for aluminum frames in civil construction.

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