Research on manufacturing technology and corrosion causes of rudder iron components of Dingwei island Junk in Rongcheng, Shandong Province

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Abstract: In 2016, a relatively complete rudder of an ancient sand ship came out of the water near Rongcheng, Shandong Province. On the basis of using wood technology, the rudder stock, tiller, lap head and rudder blade are organically connected as a whole through a variety of iron components such as iron pin (round and flat) and iron hoop. Through metallographic analysis, SEM EDS, X-ray diffraction, ion chromatography and other analysis, the metallographic structure of iron matrix of iron components such as iron pin and iron hoop was determined, and the stratification of corrosion section, elements and phase distribution of rust were analyzed. The results show that the flat iron and round iron are ferrite structure, which are typical wrought iron. The ferrule has at least two kinds of structures, ferrite and ferrite+pearlite. It can be judged that it contains wrought iron and hypoeutectoid steel, which have been forged. The structure and chlorine content of the rust layer of iron components are in line with the corrosion characteristics of iron relics in marine water. The rust of iron components generally consists of 2-4 layers, the outermost layer is a calcium and siliceous condensate layer, the second layer is a mixed layer of condensate and yellow rust, the third layer is a dense rust layer alternating black and yellow, and the innermost layer is a yellow rust layer close to the substrate. The corrosion products of iron components are mainly iron hydroxide and oxide, including magnetite(Fe_3O_4), goethite(α-FeOOH), lepidocrocite(γ-FeOOH) and akaganeite (β-FeOOH). It is worth noting that through the analysis of iron sulfide compounds, element S does not completely exist in the form of iron sulfide compounds, and the Raman spectrum surface scan results show that part of S exists in the form of elemental sulfur (S_8). This study provides a scientific basis for the further protection and restoration of the rudder, and has an important reference value for the protection of wooden and iron cultural relics in marine water.

Keywords: Ancient junk rudder; Marine water ironware; Iron corrosion; Iron sulfides

Reference

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