Corrosion Protection of Aluminum Alloy Skin for Long-Term Parking Aircraft

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Abstract. The previous research mainly focused on the corrosion protection of aircraft in service, rarely involved in the corrosion protection of long-term aircraft on ground in Colleges and universities. There are many similarities and differences between the aircraft in service and those AOG aircraft. In order to ensure the structural safety of the aircraft, corrosion protection must be carried out. However, because it no longer needs to fly to the blue sky, the requirements of corrosion protection are also different from the aircraft in service.

1. Introduction
At present, many aviation colleges and universities in China have many airplanes in order to meet the students' practical training requirements. Due to the long time of parking, these aircraft aluminum alloy skin will inevitably produce serious corrosion. Because of the great difference in service conditions and environment between these long-term parking aircraft and in-service aircraft, their corrosion conditions are also quite different. At the same time, in order to reduce the cost of corrosion protection as much as possible, the corrosion protection measures are also different.

2. Main Corrosion Types of Long-Term Parking Aircraft Skin

2.1. Surface Corrosion
When the aircraft surface is unprotected and the metal is exposed to the atmosphere containing corrosive medium, surface corrosion will occur. It is characterized by rough metal surface, etching and numerous spots, and often accompanied by powder corrosion products. Due to the influence of light, temperature, humidity, active anions and other factors, the paint layer on the skin surface of long-term parking aircraft is easy to cause aging, cracking, local shedding and other failure phenomena of the organic coating on the skin surface, which is prone to surface corrosion.

2.2. Pitting Corrosion
Pitting corrosion is a kind of local corrosion form like needles, dots or little holes. Corrosion holes usually grow along the direction of gravity, most common on the horizontal surface, a few on the vertical surface, and only a few holes grow upward from the bottom surface. Pitting corrosion often occurs on the metal with self passivation property, and often occurs in the passivation film with local defects, sulfide impurities in the interior, carbide deposition on the grain boundary and so on. In addition,
should be noted that the development of common surface corrosion or microbial erosion can cause pitting corrosion. It develops much faster than surface corrosion. If allowed to develop, it will lead to serious weakening of structure.

2.3. Crevice Corrosion
It's a special corrosion occurring in or around a crevice. It is one of the most common corrosion forms of aluminum structure. The main parts of the upper and lower parts of the aluminum hoop are the screw and the lower part of the pipe. The reason is that there is a narrow gap between metals or between metals and nonmetals, which limits the diffusion of solution in the crevice, thus forming concentration cell and causing local corrosion around the gap. The protection method is to isolate moisture, expel moisture inside the aircraft and prevent moisture from entering. Reasonable gasket should be used and nonhygroscopic material gasket or filler should be used as much as possible. Due to poor drainage holes of long-term parking aircraft, crevice corrosion can easily occur in low-lying areas such as cabin door area and fuselage abdomen; or due to water vapor accumulation, crevice corrosion can also occur at the floor guide rail and floor support in the cabin.

2.4. Filiform Corrosion
Filiform corrosion is a special crevice corrosion, most of which occurs under the protective film. This kind of corrosion is in the shape of wire groove, which develops in an unpredictable direction under the metal protective layer, and often occurs at the head of the fastener and the edge of the skin. The main reason is that the high atmosphere is relatively moderate, and the filamentous corrosion mainly occurs between 65% and 90%. For example, the annual average relative humidity in Guangzhou is 75%, so the aircraft in Guangzhou is prone to filiform corrosion.

2.5. Galvanic Corrosion
Due to different corrosion potentials, the local corrosion of dissimilar metals in the same medium is galvanic corrosion. Between different metals in contact, the anode with negative potential is corroded and the cathode with positive potential is protected. Alloy steel fasteners are used to connect many important structures in aircraft. Although alloy steel fasteners are coated with cadmium to isolate corrosive media, the oxide film of cadmium coating will be destroyed under the combined action of various corrosive media (such as industrial atmosphere, marine atmosphere and humid environment) for a long time, and the cadmium coating will be gradually produced Sacrificial corrosion, and gradually lead to the corrosion of fastener base metal and connected aluminum alloy components. The fundamental way to prevent galvanic corrosion is to isolate the anode and cathode metal and avoid the accumulation of electrolyte as much as possible.

3. Protection requirements
1) Most of the long-term parking aircraft in Colleges and universities are only used for ground teaching, so the protection requirements are lower than the aircraft in service. In the process of corrosion protection, you can refer to the maintenance manual, but the consumables used, such as lubricating grease, paint, etc., can be of a brand not specified in the manual of the model, as long as they can meet the basic anti-corrosion requirements.
2) The post-treatment and preventive measures after corrosion is an important part of corrosion protection for long-term aircraft in Colleges and universities.
3) Corrosion protection should be carried out regularly and corrosion protection plan should be made.

4. Protective measures

4.1. Wash the Aircraft Surface Regularly
Aircraft with long parking time will accumulate dust, chloride ions and sulfate ions on the surface after a long time. Principles for aircraft cleaning:
1) Clean the aircraft surface with special cleaning agent of appropriate concentration specified in the aircraft maintenance manual, and wash it with clean water to avoid residual cleaning agent on the aircraft. For colleges and universities, the number of aircraft parking is relatively large, and the use conditions are relatively simple, so only high-pressure water can be used for flushing.

2) Some lubricating oil, oil, sealant and corrosion inhibitor will be washed out during flushing. Therefore, lubricating oil, grease and corrosion inhibitor shall be added again after flushing, and special attention shall be paid to thorough cleaning and drying of gaps and overlapping areas.

3) The frequency of flushing depends on the actual aircraft usage. The aircraft of Beiya branch company in Sanya, Hainan Province, is in the marine atmosphere with high relative humidity, so the environmental corrosion is very serious. Therefore, the cleaning cycle of the aircraft should be 15 days; for the aircraft of China Southern Airlines Dalian Branch, the marine atmospheric environment is strong corrosive, but the relative humidity of the atmosphere is low. Therefore, the aircraft cleaning cycle can be 1 calendar month; for Shenyang, Changchun, Harbin aircraft, due to the relatively good corrosion environment, the aircraft is cleaned once every a inspection. The aircraft use environment of colleges and universities is relatively simple, which can be determined by the local climate. Because our school is located in the southern tropical humid climate, less wind and sand, so we can wash the plane every three months.

4.2. Drainage, Moisture-Proof and Ventilation

1) Drainage. Regularly check the drain holes or orifices of the aircraft and check whether the drainage devices are unblocked. For rainy season, the inspection period can be shortened. The filling agent can be used to fill the low concave area of the structure which is easy to accumulate water, such as ditches and troughs, and the drainage holes should be increased and expanded according to the situation.

2) Moisture proof and ventilation. It is impossible for a long-term parked aircraft to wash the aircraft as frequently as the aircraft in service. However, in order to prevent rain, snow, frost, humid air, etc. staying in the aircraft for a long time, after rain or after cleaning the aircraft with high-pressure water, the cabin door and hatch cover should be opened in time for ventilation, and the ponding should be removed. Blower can be used to strengthen convection in places with serious water accumulation. Special attention should be paid to the gullies and grooves in the aircraft structure, the underfloor area and the lap joints of structural components, as well as the metals that are in contact with organic moisture absorption materials such as sponge rubber, sound insulation materials and insulation materials with high possibility of corrosion, so as to check whether there is water accumulation or moisture absorption, and whether there is corrosion.

4.3. Maintenance of Aircraft Coating System and Sealing structure

1) Maintenance of aircraft coating system. The protective coating on the surface of aircraft is thin and has low hardness, which is easy to be damaged by collision and friction. Therefore, in order to prevent the coating from mechanical damage, students should try to avoid direct collision and friction between hard objects and aircraft surface coating. If the coating has been damaged, it should be repaired in time or sprayed with dehydration antirust agent for temporary protection.

2) The sealing materials on aircraft are often used in the areas of ditch, groove and joint gap, which can prevent the entry of corrosive media such as rain water. However, due to the long parking time, many sealants and sealing belts have been aged. Therefore, it is necessary to regularly check the important sealing areas and use the relevant training courses of students for replacement, filling and repair.

4.4. Anti-Corrosion Treatment of Fasteners

Due to the aircraft parking on the apron for a long time, many fasteners on the aircraft will suffer from different degrees of corrosion, especially the fasteners outside the fuselage. The corrosion parts of fasteners are mainly the slot of screw, tightening edge of bolt and nut, and thread section. Due to the large number of aircraft and fasteners, it is impossible to rely on one or two teachers to carry out
maintenance. Therefore, the maintenance can be carried out with the help of practical training courses on the use of relevant tools by students. Let the students apply a layer of grease to remove the fasteners with screw cutters and spanners, so as to isolate the air and prevent corrosion.

4.5. **Painting of Corroded Parts**

The long-term parking aircraft skin surface will be more or less paint peeling off, resulting in corrosion of aluminum alloy skin. In view of the serious corrosion area, we need to deal with it in time. In the relevant training courses of students, students can carry out anti-corrosion treatment on real aircraft. The main steps are: grinding, ultrasonic thickness measurement, application of alodin, cleaning, primer coating, topcoat. The paint used can use the expired paint of the repair enterprise, so as to reduce the maintenance cost.

5. **Conclusion**

Although there are great differences between the long-term parking aircraft and the in-service aircraft in terms of service conditions and uses, there are still many similarities. Of course, in the specific use of materials, implementation methods and other aspects, combined with the characteristics of college teaching, corrosion protection task will be integrated into the training course. This can not only reduce the pressure on Aircraft Corrosion Protection in Colleges and universities, but also enable students to learn basic aircraft corrosion protection methods and skills, which can be described as killing two birds with one stone.

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