Overview Of In-Situ Environmental Monitoring And Corrosion Sensing Systems For Aircraft Environmental Degradation Management

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Abstract

In military aircraft, corrosion is responsible for a large proportion of maintenance time and expenditure. A study undertaken in 2000 indicated that the United States Navy (USN) spends more that $US1.5 billion annually on aircraft systems on repair and maintenance due to corrosion. In fact a significant proportion of the corrosion effort arises from the cost of looking for corrosion. For example, the US Naval Air Systems Command noted that about 50% of the corrosion items processed were scheduled corrosion inspections whereas corrosion repair accounted for about 20% of items processed. Clearly there are significant incentives to reduce the number of inspections. While these maintenance costs may be readily identified, it is the costs associated with not having the aircraft capability available for operational purposes that are harder to quantify, and which may be orders of magnitude greater. Inspections for corrosion damage are usually time consuming, complex, require aircraft disassembly, and quite often reveal no corrosion damage. These inspections may also introduce additional costs resulting from incidental damage to the structure or increased likelihood of corrosion due to the replacement of factory seals by possibly inferior less durable seals. In an effort to reduce maintenance costs and to increase aircraft availability, aircraft maintainers are considering condition-based maintenance centred on a SHM system (with a prognostic capability) for aircraft structures, which will enable maintainers and operators to manage the prevention and control of corrosion in structural aircraft components on a condition basis, rather than inspections on the basis of elapsed flying hours. As a first step, SHM systems also provide information to allow the prediction of corrosion levels in structural components, thus enabling the maintainer to estimate the time required for scheduled deep level maintenance, thus overcoming unexpected maintenance overruns.

The philosophy of SHM of structures prone to corrosion damage is based on the concept of continually monitoring a structure in order to (i) characterise the nature of the environment in a particular area of structure, (ii) identify when coatings have broken down, and (iii) identify when corrosion has commenced and predict the corrosion rates. The system is based on the concept of locating corrosion sensors and environment monitors in areas of aircraft structure which are generally difficult to inspect and/or are only inspected at major servicings, i.e. at 3 to 5 year periods for military aircraft. Some of the basic tools for effective SHM are (i) the application of in situ corrosion sensors and environment monitors, (ii) corrosion prediction (and paint degradation) models, and (iii) maintenance decision making approaches.

The presentation gives an overview of environmental monitor systems previous installed on P3-C, F-111, Seahawk and B707, currently planned for C-130J (CSIRO IHMAV program) and Hawk (BAES CTD program), and proposed for P-3 and F/A-18. The information from these systems gives a better understanding of the influence of different aircraft types, missions and locations on the corrosion activity within an aircraft structure. An example is presented on how this information has been used in the development of an index used to rank the corrosion condition of the P3-C fleet. Finally we discuss how the outputs from such systems can be integrated into the Environmental Degradation Management System of the Australian Defence Force.