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guest editorial

Stress-Corrosion Cracking

Corrosion is one of the most formidable technological problems in the United States; the cost to the nation has been estimated at $15 billion per year. The figures encompass all forms of corrosion, including stress-corrosion cracking (SCC), with the latter not only exceedingly costly but particularly dangerous. The term *stress-corrosion cracking*, as we use it here, covers many important aspects of stress corrosion including corrosion fatigue, hydrogen embrittlement, and liquid-metal embrittlement. SCC has become a limiting factor in several advanced technologies, such as deep submergence vehicles, critical members of the F-111 aircraft, and deep-well drilling. Recently, S. H. Bush documented 88 episodes of SCC failures in nuclear power plants. This pervasive problem has delayed certification of several new nuclear installations. The near-disastrous SCC failure of titanium-alloy tanks in contact with methanol and N_2O_4, imposed critical limitations on the Apollo Project. In a tabulation of materials problems encountered by an aerospace industry (compiled by H. Reiss in 1968), over one-third could be classed as stress corrosion

It is clear that existing knowledge on SCC is not adequately appreciated by the engineering and design community, even when preventive measures have been reported in the technical literature. As a consequence, structures are frequently designed, fabricated and operated in ignorance of the stress-corrosion hazards; at least some of the resulting catastrophies could have been avoided if the lessons of experience were more readily accessible. It has been pointed out that SCC "emidemics" appear to follow a cycle of seven years, due to the circumstances that practical information on preventive measures arising from a series of SCC failures tends to be lost when the problems subside and the knowledgeable personnel move on to other jobs.

It has often been assumed, usually erroneously, that SCC is not a design constraint for many applications; this is usually traceable to the fact that, intentionally or not, ultraconservative designs are adopted. However, as the performance requirements become more stringent, it is anticipated that the growing danger of SCC will pose new constraints, particularly in view of the potentially high cost per incident. These disconcerting considerations have been increasingly recognized by industry and federal agencies. We estimate that, over the past 10–15 years, about $50 million has been spent on stress-corrosion research and development, with some $28 million of this coming from the government. One manifestation of such support is a voluminous literature on the subject. And yet this available body of knowledge on SCC and its control, has neither been digested authoritatively nor made available in a tractable form, that could help eliminate many costly failures.

The authors of this note are involved in an effort to ameliorate this situation. Under the sponsorship of ARPA, we are preparing two publications of distinctly different types. The first will be a practical manual outlining engineering situations in which SCC has occurred or may be expected to occur and presenting control measures based on experience. This book, which is being compiled by B. F. Brown of The American University, will be sufficiently brief and inexpensive that all engineers responsible for design, fabrication and maintenance can afford to have a copy and will hopefully read it at a stage when SCC is preventable.

The second volume will provide more quantitative and complete data summarizing both published and unpublished work. Where possible and appropriate, data for crack propagation rates versus stress intensity factor will be presented for well-characterized materials in specific environments. However, in many cases, much less definitive data will be the best available. It is for this latter effort that we require the cooperation and input from the many people actively working on SCC problems.

We are presently collecting and compiling all recent and relevant data on stress-corrosion cracking and corrosion fatigue, and we would like to solicit your contribution on such data. We are particularly interested to hear of documented cases of stress-corrosion cracking, as well as efforts to ameliorate its occurrence and their consequences. If you have such cases or are aware of others who do, please contact Professor R. W. Staehle, Department of Metallurgical Engineering, Ohio State University, Columbus, Ohio. Evidence relating service behavior to laboratory testing is especially welcome.

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