Guest Editorial

The JEMT reader will find eleven papers in this issue devoted to technological developments that can be used to enhance the structural integrity of adhesively bonded structures. The bonded structural concept is in itself an innovation for imparting a structural framework with crack growth damage tolerance since crack growth damage will, in general, be contained within single elements of the multiple load path structure. Until the recent past, however, longtime adhesive bonding durability was sufficiently lacking that the above noted innovation could not be utilized with confidence in primary structures designed for long service lifetimes.

The Boeing Commercial Airplane Company (Seattle, WA) achieved a major breakthrough for increasing the durability of adhesively bonded joints made from aluminum alloys in the early 1970's by developing a surface preparation procedure (BAC 5555) that produced environmentally resistant (and therefore durable) interfacial oxide layers during the bonding process. This advancement led the U.S. Air Force in 1974 to request proposals and bids from industry on conducting an advanced development study now known as the PABST program. (PABST = Primary Adhesively Bonded Structures Technology). The PABST program objective is to demonstrate and validate that applications of adhesive bonding to primary aircraft structure can result in at least a twenty (20) percent cost savings and a concurrent fifteen (15) percent weight reduction for the participating structure when compared with existing fabrication techniques, while providing significant improvements in structural safety and durability.

The fifty-three (53) month contractual portion of PABST was awarded to McDonnell-Douglas, Long Beach, CA, on February, 1975 in the amount of 17.7 million dollars. More detail on the results of the PABST program can be found in L. J. Hart-Smith's paper and his cited references. The PABST program has spawned other Air Force and industrially sponsored research activities for adhesively bonded structures, some of which are reported in this issue.

The eleven papers devoted to adhesively bonded structures were presented at the 1977 Winter Annual Meeting held in Atlanta, Georgia during two sessions that were jointly sponsored by the Materials Division/Structural Integrity Committee and the Aerospace Division/Structures and Materials Committee. In developing these sessions, the emphasis was on selecting papers which (*a*) could improve understanding of crack growth behavior and of life-estimating procedures, as well as (*b*) increase the analytical capability for establishing the residual strength of cracked adhesively bonded structures. The reader will find that each paper provides a unique focus on important ingredients used to establish the structural integrity of adhesively bonded structures. While attention is directed at aerospace applications, the technological developments reported herein should be generally applicable.

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Conference Report

Material Substitution: Availability, Energy and Environmental Factors

A conference on materials substitution was held on September 27, 28, 1977 at Water Tower Hyatt House, Chicago. The conference was sponsored by the American Society for Metals with the cooperation of the office of Technology Assessment and cosponsored by the member and observer societies of the Federation of Material Societies, including ASME, who was represented by a member of the Executive Committee of the Materials Division on the organizing committee.

The conference was aimed at design, research, and purchasing engineers with responsibility for the selection of materials. It tried to provide a description of the pressures leading to materials substitution and constraints within which they are made, as well as case studies of actual substitutions made or under development.

The keynote address was by W. Dale Compton, Vice-President, Research and Development, Ford Motor Company, who set the tone of the whole meeting by describing how the mandated fuel consumption standards for 1985 are forcing Ford to reduce the average weight of a car from 4,200 lb to 2,750 lb, leading to massive substitution of heavy materials by light materials. The use of aluminum, plastics, and high strength steel are all expected to increase by a factor of two or more by 1985. The method by which Ford analyzed the physical requirement of each component and compared them to the properties of each material in a matrix was demonstrated. When the huge consumption of materials by the automobile industry is considered, the impacts of these changes can be gauged. In reply to a question Mr. Compton unequivocably stated that the energy impacts of these substitutions had not been considered, but only the requirement to meet the mandatory fuel economy standard and thus illustrated the paradox between the aims and effects of government policy. In fact, weight reduction had replaced cost as the main criteria in material selection at Ford.

One series of papers covered government and industry concerns in pressing material substitution both in a historical and present day perspective. Another series described the energy and environmental impacts of changes in material uses, and some of the studies and tools being developed to measure them. One lecture covered the requirements of the Toxic Substances Control Act. Another described the effect of materials substitution on the recycling industry, and how relatively small changes in the composition of an automobile could make it uneconomic to process old vehicles and sell the steel scrap.

The remaining papers covered a series of materials substitutions now being made, or under various stages of development covering metals, plastics, ceramics and construction materials used in a wide range of industries ranging from electronics to highway construction. Some papers were informative and of wide interest, others promotional and with specialized applications.

The conference was highly successful in its aim of putting the problems of material substitition into perspective.

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