

Introduction

The problems presented by temper embrittlement in the use of alloy steels in heavy sections are much the same in 1971 as they were at the time of the 1967 ASTM Symposium on Temper Embrittlement. Trends toward thicker sections and higher operating stresses have continued in heavy structural components such as large pressure vessels and turbine generator rotors. These trends in size and severity require steel with higher hardenability to provide for the higher through-section strength and fracture toughness needed in such components.

The 1971 Symposium on Temper Embrittlement was convened to present the results of work which has been done in the field of temper embrittlement since the 1967 symposium, the proceedings of which have been published in *ASTM STP 407, Temper Embrittlement of Steel*.

After the 1967 symposium the ASTM Special Task Force on Large Turbine and Generator Rotors of Subcommittee VI on Forgings of Committee A-1 on Steel undertook a study of the effects of residual elements in temper embrittlement. Other research was undertaken by several investigators on the microstructural and segregation aspects of temper embrittlement.

The papers which appear in this volume present new information about the effects of the residual elements, arsenic, antimony, tin, and phosphorus, in the Ni-Cr-Mo-V steel used for rotor forgings. Several papers describing the statistical plan, analysis, and problems encountered in chemical analyses should be useful to those concerned with design and execution of metallurgical experiments. The application of Auger electron spectroscopy to the analysis of fracture surfaces and scanning electron microscopy for characterizing the mode of fracture shed important new light on the mechanisms of embrittlement, on the magnitude of segregation of both alloying elements and impurity elements at grain boundaries, and on the kinetics of embrittlement produced by various elements.

It seems evident that the control of temper embrittlement in alloy steels used in heavy sections or operating in the embrittlement range will require further investigation of the effects of composition and heat treatment; will require further cooperative work in developing procedures for chemical analysis for residual elements; and will be facilitated by further exploitation of new techniques such as Auger emission spectroscopy.

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