Research Report on Characterization and Monitoring of Cracking in Wet H_2S Service

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FOREWORD

In 1990 cracking of refinery process equipment in wet H_2S service was being widely reported. As a result, committees and task groups of industry organizations, including API, NACE and the Materials Properties Council, were actively seeking improved understanding of the phenomenon. Of particular concern were conditions leading to cracking and blistering, the incidence of cracking, the consequences of such damage, and the efficacy of NDE methods for detection and monitoring.

The Program reported herein was one of several significant industry-wide efforts on this subject. It was intended to supplement other activities by examining, in a large-scale test vessel, issues which could not be addressed satisfactorily either with conventional small-scale laboratory specimens or with in-situ exposures in refineries.

The construction of a welded steel pressure vessel with a replaceable "window" for test purposes was proposed by MPC to the API Subcommittee on Corrosion and Materials. Its Task Group on Materials and Corrosion Research developed the program to study the effect of variables on cracking and the capabilities of certain NDE monitoring methods. At that time, it was realized that the results would not be directly translatable to field application because the environment to be used would be extremely severe, and the thickness of the steel studied was limited to 0.5 inch. Nevertheless the guidance to be obtained would be valuable.

The results of the program have helped to provide validation of observations of conventional laboratory test specimens and clarify the roles of the variables considered. The work on acoustic emission monitoring was particularly enlightening. However, it must be realized that the information obtained is to be viewed in the context of specific service demands before application in the plant should be attempted. For example, pressure vessels usually have thicker shells than used in the test which will affect NDE capabilities, hydrogen permeation and material behavior.

A large measure of the credit for the success of this program goes to the members of the API Subcommittee and Task Group and the MPC Sponsor Committees who contributed their ideas and vast experience.

M. Prager