Evaluation of Crack Damage Found in the Outlet Nozzle of an Ammonia Converter

The paper reviews the fitness for service (FFS) evaluation of Agrium's D921 Ammonia Converter vessel. Cracking damage was sustained by the vessel during a 24-year run completed in 2007.

Details are outlined of the technical methodology leading to a return to service conclusion. The primary topics covered will be the applicable sections of the API 579-1 / ASME FFS-1 Fitness-For-Service standard, non linear finite element analysis, material temperature dependency, and transient load modeling along with experimentally derived data to provide a high confidence assessment upon which a decision to return to service may be made.

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Introduction

The Agrium Redwater Fertilizer Operations, located near the town of Redwater, Alberta, Canada undertook a project to replace the Haldor Topsoe S-200 ammonia converter catalyst basket with an S-300 basket during a scheduled turnaround in 2007. The basket had been in service for some 24 years and a decision was made to perform an internal inspection of the pressure containment envelope because of the increasing frequency of basket parts being retrieved in downstream equipment.

Two areas of cracking were found in the pressure vessel bottom area, in the outlet nozzle and, more extensively, in the outlet nozzle assembly.

Mechanical Design

The ammonia converter pressure vessel was constructed in 1981 as a layered pressure vessel per ASME Section VIII Division 2 1980 Edition S80 Addenda and placed in service in 1983. The shell inner layer material is SA 387 Grade 11 alloy steel with outer layers of SA 533 Grade B alloy steel.