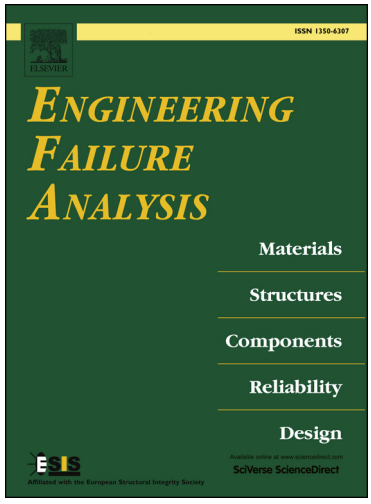

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ABSTRACT

In this paper a failure of steam pipe weld after 140000 hours of service in power generation plant has been analysed. Efforts were made to analyze the cause of failure in both experiment and finite element analysis (FEA) methods. Intergranular cavities and cracks were detected around the primary cracks. Study shows that the main failure mechanism is creep cracking. Cracks developped in this failed pipe as a result of cavity nucleation on grain boundaries, followed by cavity growth and linkage to form micro-and eventually macro-intergranular cracks. This paper brings out the details of investigation and suggests remedial measures to improve performance of this welded pipe under high temperature and pressure condition.

Keywords: Creep cracking; Cavity ; Failure analysis; Welded joint

1. Introduction

Components in power generating stations usually operate at high temperatures for long times. A large proportion of pressure components are manufactured from Cr-Mo-V steels which are selected for their high temperature creep resistance at optimum cost. When structural components are joined together by fusion welding, the thermal cycle introduces changes in the microstructure[1]. Welded pressure components are prone to creep deformation and fracture at high temperature, and the majority of the creep failures of pressurised components are associated with the welds[2].

During the maintenance halt of a power generation plant, a steam pipe connected with tee-junction structures was detected transverse cracks in welded joint (Fig. 1a). This failed pipe is manufactured from 1%Cr-0.3%Mo-0.2%V steel. Fig 1b displays the assemble diagram of the investigated steam pipe. The failed pipe is combined by shielded metal arc welding (SMAW) with matching electrodes (ASW E5515). The subsequent post-weld heat treatment(PWHT) (700℃×5h) is employed to alleviate the welding residual stresses. According to the record of operation for the steam pipe unit, the failed pipe has operated at around 140000 h. The pipe has an out-diameter of 450mm and a wall thickness of 50mm. The conveying medium is steam with average pressure of 17.4MPa and temperature of 510℃.

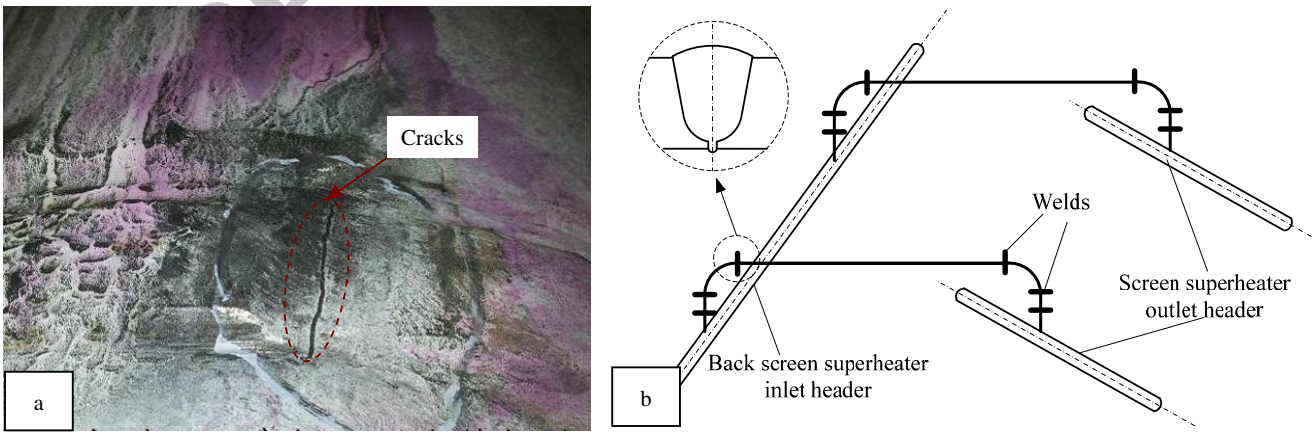

Fig. 1 General view of the cracks analyzed. (a) Cracks in welded joint; (b) Assemble diagram of the investigated steam pipe.

The aim of the present investigation is to identify the root cause of the failure and propose corrective measures. Finite