CREEP DAMAGE OF POWER PLANT COMPONENTS AND REMANENT LIFE ASSESSMENT

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Features of creep cavitation damage and failure of pipe bends have been studied. It was found that the logarythm of volume fraction of cavities was linearly dependent on the distance from outer convex surface of pipe bends. Consideration was given to the assessment of remanent life of critical components: bends and welds where failure occurs.

CREEP DAMAGE AND FAILURE OF PIPE BENDS

The structure of pipe bends made of CrMoV ferritic steel has been studied. The appearance of cavity damage is shown in Fig.1. Volume fraction of cavities along the section of stretched area of pipe bends is presented in Fig.2. In structure of straight area of the failed bend only few descrete cavities were observed and in the straight area of other bends in fact there were no cavities.

REMANENT LIFE ASSESSMENT

Mechanistic model developed by Cane et al (1) gives opportunity to evaluate residual life by measurement of strain or by metallographic measurement of creep damage. The latter can be used in the

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case of critical parts. It involves assessment of ω proposed by Kachanov (2). It can be assumed that ω reaches unity at V_f corresponding to the stage from which development of microcracks begins:

$$\omega = V_f^t / V_f^{crit} \quad \text{.........................(1)}$$

The assessment of V_f can be made by metallographic examination of the surface of the component where V_f is maximal,Fig.2. For multiaxual stress state:

$$\bar{\sigma}_{eff} = \frac{\bar{\sigma}}{1 - V_f^t / V_f^{crit}} \quad \text{.................(2)}$$

Using (1) and (2) within the framework of the mechanistic model gives the opportunity to assess remanent life of critical parts.

SYMBOLS USED

ω = Generalized damage parameter

V_f^t = Volume fraction of cavities at time t

V_f^{crit} = Critical value of volume fraction of cavities

$\bar{\sigma}_{eff}$ = Equivalent effective stress (Pa)

$\bar{\sigma}$ = Equivalent stress (Pa)

REFERENCES

(1) Cane,B. et al, Int.J.Pressure Vessel and Piping,Vol.107,1985, pp 295-300.

(2) Kachanov,L.,Izw.Akad.Nauk USSR. Otd.Techn.Nauk, Vol.8, 1958, pp 26-31.

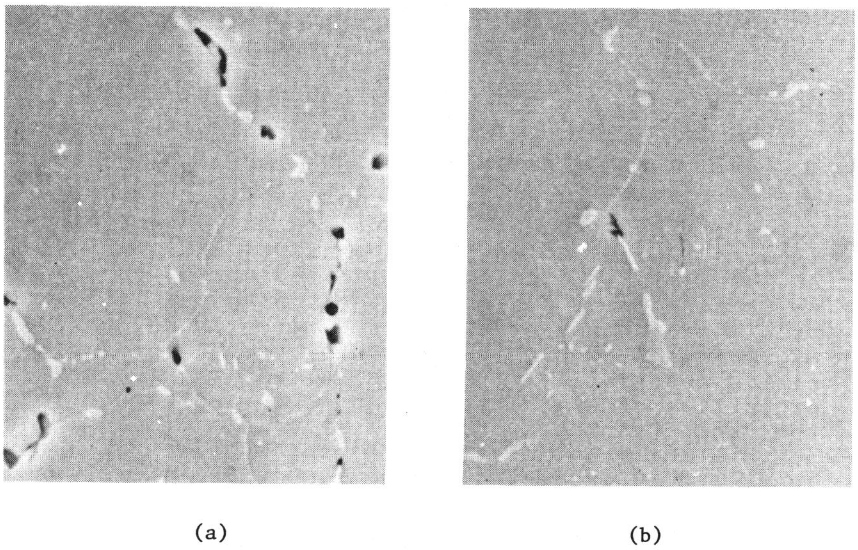
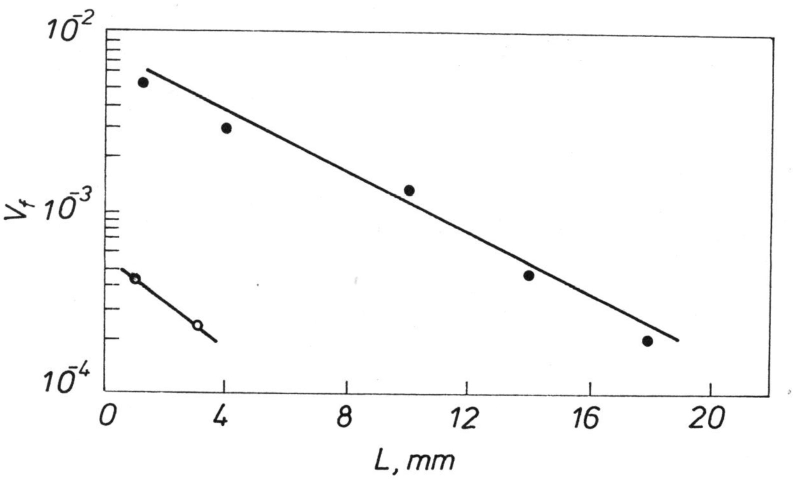


Fig.1 Cavities at a distance of 1mm (a) and 10mm (b) from outer convex surface of the failed bend. SEM, x4000.



• - failed after 104000 h., o - removed after 121000 h.

Fig.2 Variation of volume fraction of cavities V_f with the distance L from outer convex surface of bends.