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TECHNICAL NOTE

Study on the Strength of Explosive Plugged Part under the Environment of Steam Generator†

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Abstract

Supposing the case in which a leakage occurs in tubing of steam generator of nuclear reactor, the explosive plugging method is developed by Japan Welding Engineering Society. The mechanical strength of explosive plugged part are examined by the investigators. However, the stability of strength of explosive plugged part during long service life in the environment of steam generator of nuclear reactor dose not yet have been investigated. Environmental strength of the part is studied in this experiment. Some informations on the stability of strength of explosive plugged part in different environments are obtained by these studies.

KEY WORDS: (Explosive Plugging) (Fast Breeder Reactor) (Steam Generator) (Thermal Shock Cycle) (Stress Corrosion Cracking) (Liquid Sodium Corrosion)

Supposing the case in which leakage takes place in tubing of steam generator, the explosive plugging method was developed by Japan Welding Engineering Society etc. (Fig. 1). It was indicated by the researchers that this method is effective to the purpose. It is not yet known whether the plugged parts keep the stable strength or not, during the long service period in the environment of steam generator.

Under the above consideration, following three tests on plugged part are conducted.

(1) Thermal Shock Test
(2) Stress Corrosion Cracking Test
(3) Liquid Sodium Corrosion Test

Testing results are gained as follows.

1. Peeling occures immediately after beginning of thermal shock test. Cracking occures after 150 ~ 200 thermal cycles in SH, 200 ~ 400 thermal cycles in EV and 1000 thermal cycles in SG. (Fig. 2)
2. Residual stress in tube plate near the plug is compressive. SCC does not occur in the tube plate there. It occures on the inner surface of plug.
3. The susceptibility to SCC of explosive bonded boundary is lower than that of base metal due to martensite in bonded boundary. (Fig. 3)

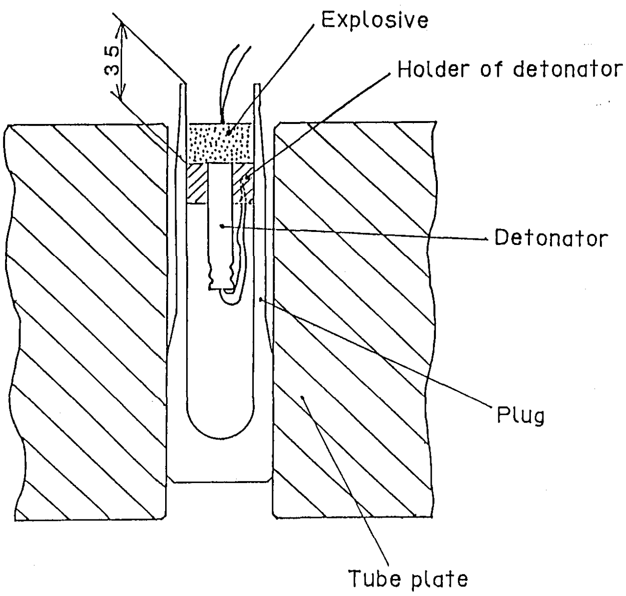

Fig. 1 Setup of explosive plugging

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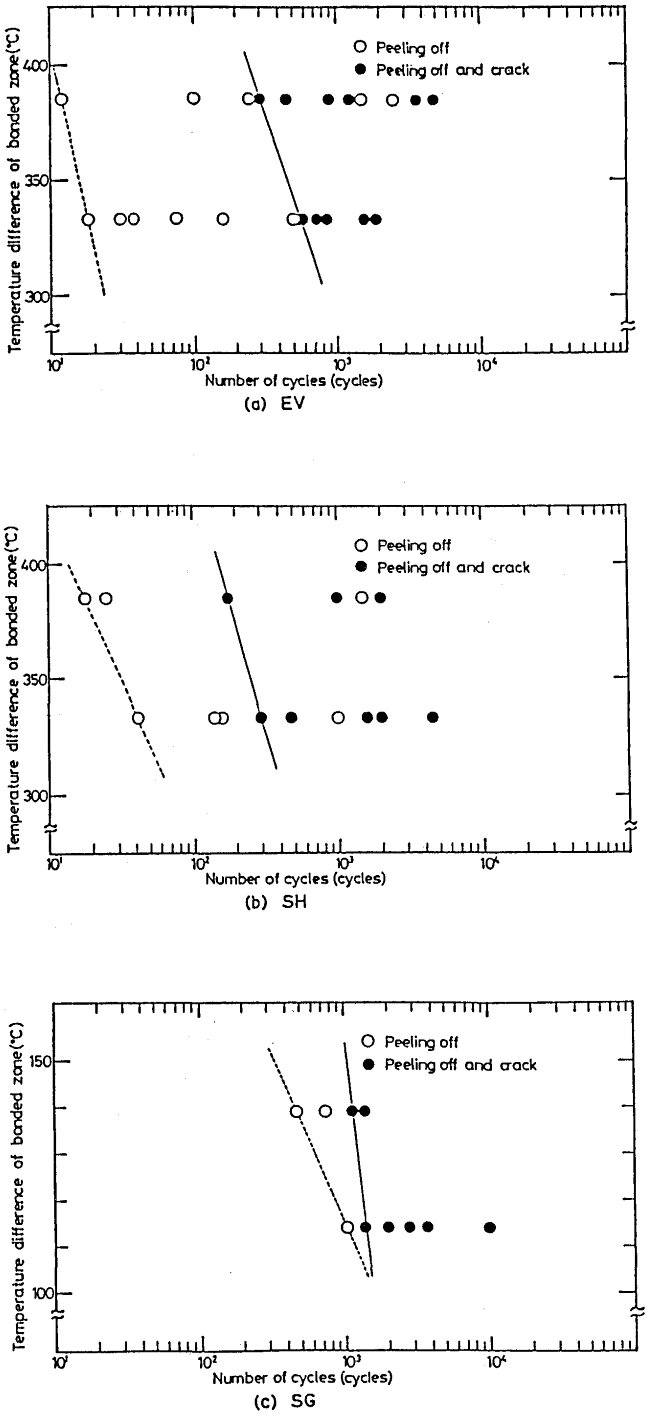

Fig. 2 Results of thermal shock test

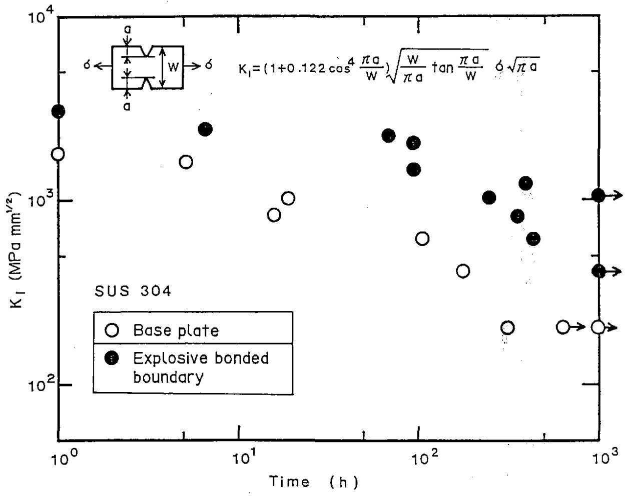

Fig. 3 Result of $MgCl_2$ SCC test

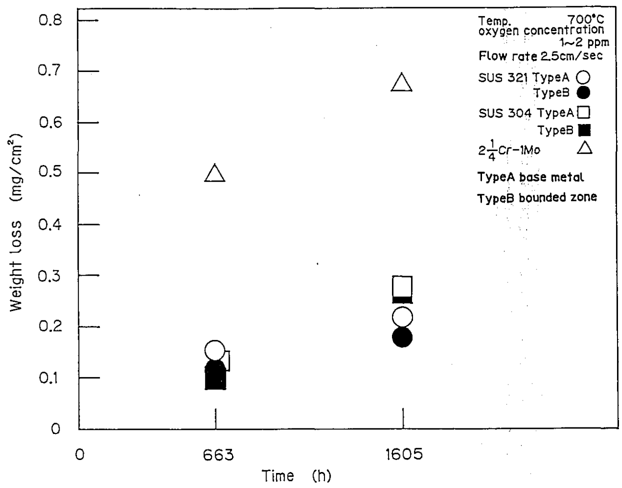

Fig. 4 Weight loss vs. in Na corrosion test

4. Explosive bonded boundary is somewhat weaker than base metalline the resistance to the sodium attack under the testing condition employed in liquid sodium corrosion test. (Fig. 4)