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A temperature-dependent global failure criterion for a composite/metal joint

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ABSTRACT: The use of composites to repair localized corrosion damage in metallic pipelines has significantly increased in the past years. Repair techniques using polymer-based composites are interesting, since they do not require draining the line and stop operation. However, pipelines conveying liquids may work at elevated temperatures, what can be a limitation for the use of polymeric materials. The adhesion between pipe and composite is the key to the effectiveness of the repair (sleeves or patches), mainly in the case of through-thickness defects. This paper is a preliminary attempt to propose and analyse a global failure criterion for a particular class of adhesively bonded composite-metal joints. Single-lap joints (SLJ) were fabricated with metal and composite adherends bonded with an epoxy resin reinforced with Aramid fibres. The surface treatment adopted in this study was the same used in the field for repairs. The performance of these joints in pure bending and in shear was studied at four test temperatures: 25 ºC, 50 ºC, 70 ºC and 90 ºC. The mechanical behaviour is rate and temperature dependent. A global energy criterion for the joint fracture is proposed. It is verified experimentally that, for a given temperature, the critical energy is the same in both kinds of tests and that this energy decreases almost linearly with temperature.

Keywords: (A) Composite/metal joints; (B) Adhesion; (B) High-temperature properties; (C) Analytical modelling; (E) Joints/joining