Modelling the fire behaviour of glass fibre reinforced epoxy (GRE) pipework

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ABSTRACT

Fibreglass pipework, especially GRE, is finding increasing use in the oil, gas and pipeline industries because of weight and corrosion resistance advantages over metals. As is often the case with composites, there is concern about the behaviour of the material in fire, especially when used on offshore platforms. The qualification, manufacture and use of GRE pipework is often carried out under the guidelines laid down in ISO 14692. Part 4 of this standard contains guidance, amongst other things on requirements for GRE pipes that are subject to fire. One of the most stringent requirements is encountered with fire-water deluge systems for offshore platforms. In this application dry pipe is expected to survive in a hydrocarbon fire for 5 minutes, prior to the deluge system being activated. The test procedure, shown in Figure 1, involves a simulation of this situation, using an external propane burner on the dry pipe exterior, followed, after 5 minutes, by water pressurisation. Because of the degradation of the resin in the fire, this test is difficult for GRE to pass without the addition of external passive fire protection to the composite pipe. Failure occurs, as is usual with this type of pipe, by weepage of fluid through the pipe wall due to cracking and degradation of the resin. The purpose of the research reported here was to model the behaviour of GRE pipework, with and without external, fire protection in this test.

Com-Fire is a computer model, modelled on the Henderson Equation and developed at Newcastle University to assist in modelling the decomposition behaviour of composites in fire. This package has been used to interpret and model the behaviour of GRE pipe in the wet/dry test. Figure 2 shows the modelled wall temperature profile, at the 6 o clock position, for a 200 mm diameter, 4.7 mm wall thickness GRE pipe in the burner test in the dry condition. Also shown are the experimentally measured bore temperature at the same position and the modelled weepage pressure of the pipe..

Figure 1. 200 mm diameter GRE pipe in the burner test.

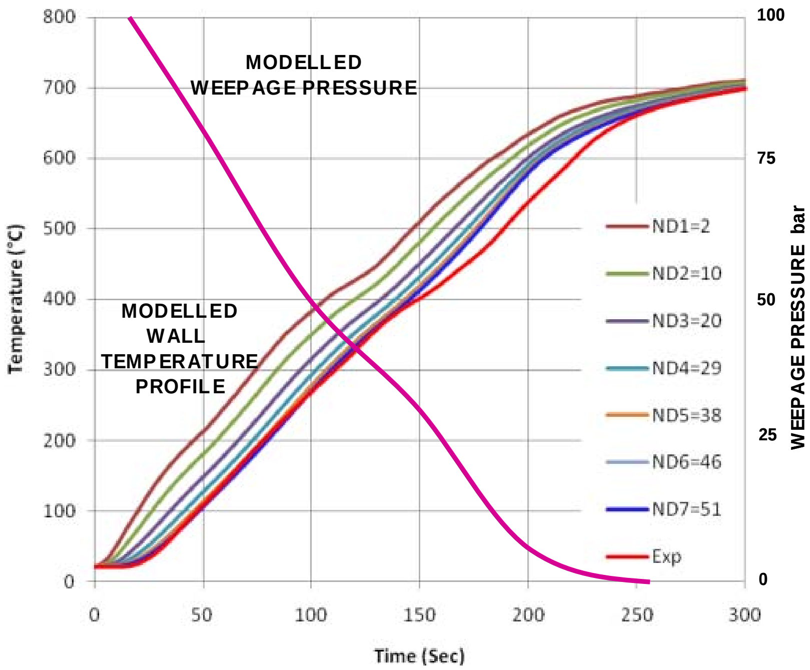

Figure 2. Modelled wall temperature profile, at the 6 o clock position, for a 200 mm diameter, 4.7 mm wall thickness GRE pipe in the burner test in the dry condition. Also shown are the experimentally measured bore temperature at the same position and the modelled weepage pressure.