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Mechanical Behaviour of Adhesively Repaired Pipes Subject to Internal Pressure

Ş. Çitil[1*], Y.Ayaz[2], Ş. Temiz[3], M.D.Aydın[4]

[1]*Adıyaman University, Department of Mechanical Eng., Adıyaman, 02040, Turkey*
[2]*İnönü University, Department of Civil Eng., Malatya, 44280, Turkey*
[3]*İnönü University, Department of Mechanical Eng., Malatya, 44280, Turkey*
[4]*Erzurum Technical University, Department of Mechanical Eng., Erzurum, 25000, Turkey*

[*]Corresponding Author. Tel.: +90 416 223 3800. scitil@adiyaman.edu.tr

Abstract

Pipes can crack over time, particularly in areas with pipefittings and joints subject to high pressure and unsteady temperatures. Repair of these cracks requires labour, time, and expense and the cracked pipes are currently repaired with two methods. The first method is cutting out the damaged section of the pipe and adding an additional joint, which requires much time and labour. The second method is replacing the damaged pipe, which requires expensive materials. The aim of this study is to propose an alternative method that reduces or eliminates the use of labour, time, and materials, in order to quickly re-activate pipelines. For this purpose, the cracked steel pipes were repaired by using an adhesive, and the mechanical behaviours of the repaired pipes were investigated experimentally and numerically. In the first step of the study, artificial cracks were created on the pipes and the cracked pipes were repaired using adhesive and galvanized steel patches with different overlap lengths, overlap angles and thicknesses. Then, the repaired pipes were subjected to internal pressure in order to evaluate the effects of patch thickness, overlap angle and overlap length on the joint strength. Finally, the numerical analyses and experimental results show that the variation of the patch thickness, overlap length and overlap angle will change the stress distributions and strength of the adhesively repaired pipes.

Keywords: Pipe; crack; internal pressure; finite elements; adhesive

1-Introduction

In pipelines, a concentric, solid residue can build up in a restricted region due to drops in temperature. Lower temperatures encourage residue growth and create internal pressure on internal pipe walls, which can cause pipes to burst [1]. Damage also occurs to pipes over time because of corrosion, which can stop the system. Repairs can be lengthy and expensive.

Several studies have been conducted to solve this problem. Lees [2] reported that the cost of the damage caused by corrosion in both gas distribution networks and main pipelines was approximately 40 billion dollars in 2005. To address this, Lees proposed using GFRP composite pipe and adhesive joints, which is a more durable solution than steel pipes. Metal