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Failure analysis of corroded pipelines reinforced with composite repair systems

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ABSTRACT

The present paper is concerned with the analysis of corroded thin-walled metallic pipes reinforced with polymer based composite repair systems. The goal is to propose a simple methodology to predict the failure pressure of a reinforced pipeline with arbitrary geometry of the corroded region and considering any composite repair system. Hydrostatic tests performed in different laboratories were used to validate the proposed methodology, showing that a simple expression allows estimating a lower bound for the failure pressure.

1. Introduction

Composite sleeve reinforcement systems are being increasingly used as repair systems for metallic pipelines with localized imperfections or damage that impair the serviceability [1–3]. One of the main applications is the lifetime extension of corroded pipelines with part-wall metal loss defects in petroleum, petrochemical and natural gas industries. The damages derived from the corrosion process cause very important economic losses and the classical repair procedures using welding (to cut and replace a corroded segment or to replace a localized damaged section and use a steel patch) require stopping the operation while the repair is being performed. Composite repair systems are particularly interesting in environments where any repair method using equipment that may produce heat and/or sparkling is forbidden (such as in offshore platforms which are hydrocarbon atmospheres). In these systems, a piping segment is repaired and reinforced by wrapping it with concentric coils of composite material after the application of a polymer filler (generally epoxy) in the corrosion defect (Fig. 1). Different commercial repair systems based in fibre reinforced composite materials can be found: (a) dry fibreglass fabric to be wrapped with impregnation of liquid resin, (b) ready pre-cured layers ready to wrap around the pipe, and (c) flexible resin pre-impregnated bandage to be wrapped with water.

The present paper is concerned with the analysis of thin-walled metallic pipelines with localized corrosion damage reinforced with polymer based composite repair systems. The study is not focused on the analysis of the different composite systems (see [4,5], for instance) or on their feasibility and suitability as repair systems for corroded pipelines. The goal is to propose a simple methodology to estimate the failure pressure of a reinforced specimen with arbitrary localized corrosion damage only taking into

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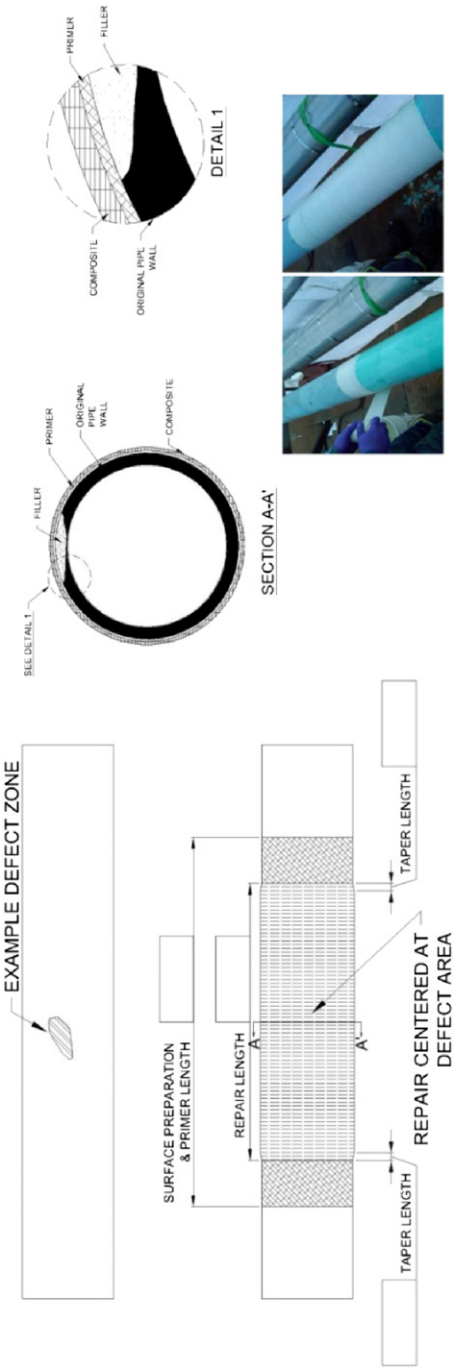

Fig. 1. Composite repair system in a corroded pipeline.