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BUCKLING AND LATERAL PRESSURES IN SPIRAL WOUND GASKETS

Hocine Attoui
École de Technologie Supérieure
Mechanical Eng. Dept.,
Montreal (Quebec), CANADA.
attoui_houcine@yahoo.fr

Abdel-Hakim Bouzid
École de Technologie Supérieure
Mechanical Eng. Dept.,
Montreal (Quebec), CANADA.
hakim.bouzid@etsmtl.ca

Jerry A. Waterland
VSP Technologies Inc.
Prince George, Virginia, USA
Jerry.waterland@vsptechnologies.com

ABSTRACT

The buckling of spiral wound gaskets (SWGs) causes turbulence of the fluid flow inside flanges and may result in leakage failure over time due to the unwinding of the spirals. A few limited studies on the lateral forces generated by axial compression of the gasket sealing element which cause this phenomenon are available in the literature. The lateral forces are generated during initial tightening and are not distributed uniformly in the circumferential direction. Hence there is an introduction of concentrated forces in small areas.

The non-uniform gasket contact stress caused by the tightening sequence makes the problem more complex. It is suggested to study experimentally the buckling of spiral wound gaskets by developing a special test bench designed for this purpose. This test bench is able to measure the lateral loads and winding inward displacement during the tightening process. The experimental results are to be compared to those obtained by numerical FE simulation for the purpose of extrapolating for other size gaskets.

INTRODUCTION

In general, industrial installations that use pressurized equipment are routinely subjected to leakage failure and the unintended escape of fluids. When these leaks exceed acceptable limits, they can cause accidents, shut downs of units, environmental damage, and loss of revenue. Gaskets are used in the mechanical components of these industrial installations to contain these fluids and prevent fluid loss. The reliability of this equipment is evaluated by their capacity of confining pressure, i.e. to prevent the fluid from escaping towards the outside of the equipment. A spiral wound gasket (SWG), is composed of metal windings and a filler made of a softer material, an outer ring to limit the compression and an inner ring to reduce buckling. The most critical part is the sealing element. There is limited research on spiral wound gasket behavior and only few papers treat their buckling [1,2].

The SW gasket is compressed by clamping the bolts using a tightening procedure which exerts a non-uniformly distributed load on the sealing element or the windings. Referring to Fig. 1, the axial compression of the windings transfers the load to the inner and outer rings, through the contact areas, and introduces radial contact pressures that can cause buckling. The quality of the sealing performance of the gasket depends on the values of these radial contact stresses.

The axial compression increases with the clamping bolts and causes deformation of the windings towards the inside of the pipe. The knowledge of the relationship between axial load compression, generated contact pressure and the nature of winding deformation is the key solution to solve the buckling problem and improve the sealing performance [3].

This paper evaluates the buckling issue of the outer ring and inward buckling of the windings by indirect measurements of the radial contact pressure or lateral pressure generated during compression. Therefore, the characteristics of a SW gasket are obtained by a numerical-experimental procedure. Then the results are evaluated and compared to the ones obtained by numerical simulation.

NOMENCLATURE

a	outer radius of packing or ring
A	cross section area of ring
C_1, C_2, C_3	coefficients
c	autofrettage radius
D_n	lateral displacement of windings
E	Young's modulus
G	shear modulus