

SOLUTION MINING RESEARCH INSTITUTE

679 Plank Road
Clifton Park, NY 12065, USA

Telephone: +1 518-348-6995
www.solutionmining.org

**Research
Report
2021-1**



SMRI Research Report RR2021-1:

“Brine String Dynamics, Phase IV

Deformation/vibration of brine strings in solution-
mined caverns 2019-2021”

Michael P. Païdoussis

McGill University

Montreal, QC, Canada

Note: Phase IV of this research was funded jointly by SMRI and Pipeline Research Council International (PRCI), and PRCI has published this same report with some formatting differences.

March 2021

1. Executive Summary

Flow-induced vibration is known as the leading cause of brine string failures in solution-mined storage caverns. Such failures have a significant impact on public and employee safety, the environment, production and financial performance. Motivated by these challenges we started working on “Flow-induced vibration failures of brine strings in solution-mined hydrocarbon storage caverns” in the Department of Mechanical Engineering of McGill University since 2009 — initially funded by SMRI and later phases of this work jointly by SMRI and PRCI. The main goal of the project was to gain a better understanding of the physics of the project, develop appropriate laboratory testing and simulation techniques and develop analytical models which would help increase storage cavern productivity and reliability.

The aim of the present report is to provide descriptions of the main theoretical and experimental activities performed in Phase IV of the project in the 2019-2021 period. This report includes the following sections.

- Configuration 4 model development
- Improved Configuration 3 model and the Reitze field test results
- Buckling and flutter and the effect of confinement
- An executable file for calculating critical velocity
- Dynamics of cantilevered plates and cylinders in reverse axial flow

Three draft papers (submitted for publication) are provided in appendix form.