SOLUTION MINING
RESEARCH INSTITUTE

1745 Chris Court
Deerfield, Illinois 60015-2079
847-374-0490

Meeting
Paper

Pipelines and Sinkholes: When is There a Problem?

Joe L. Ratigan

RE/SPEC INC.
P.O. Box 725
Rapid City, South Dakota 57709

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INTRODUCTION

Solution mining, underground storage, and waste disposal cavern facilities typically have buried pipelines directly over or near the underground caverns. The buried pipelines can be low-pressure water or brine lines or high-pressure natural gas or liquid hydrocarbon lines. The development of a sinkhole below a buried pipeline can lead to failure of the pipeline.

In some parts of the United States, such as the Southeast, sinkholes naturally occur. These natural sinkholes are typically associated with karstic limestone formations that experience seasonal changes in groundwater levels. Other parts of the United States experience sinkholes from underground dry mining. Coal mining-related sinkholes have occurred in Pennsylvania and Wyoming, for example.

The solution-mining and underground storage cavern industries have experienced sinkholes at both bedded and domal salt facilities. Sometimes the sinkholes are a direct result of actions during contemporary underground cavern operations. In other instances, the sinkholes would have eventually appeared because of historical underground operations or natural geologic phenomena.

Sinkholes associated with caverns can be tens or hundreds of feet in width. If a sinkhole occurs beneath a pipeline, significant stresses can develop in the pipeline. Under certain circumstances, the increased pipeline stress can result in total pipeline stresses that exceed the strength of the pipeline.

The objective of this paper is to present an analysis of sinkhole-induced stresses in pipelines. The analysis includes presentation of an analytical solution for the pipeline deflection and stresses, formulation of a nondimensional representation of the bending stresses, evaluation of stress development for two typical high-volume natural gas pipelines, and suggestions for pipeline construction and installation modifications that may minimize the impact of sinkhole development.