

CLAMP-ON ULTRASONIC GAS FLOW MEASUREMENT IN CAVERN STORAGE OPERATIONS

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1 ABSTRACT

Accurate flow measurement of gas injection and withdrawal in cavern operations is one of the important indicators for monitoring a cavern's capacity and integrity. It is also a tool to operate clusters of caverns efficiently. Clamp-on ultrasonic technology allows this measurement to be performed non-intrusively with the additional benefit of being able to install the instruments without shutting down the process.

This paper addresses the specific measurement challenges involved in cavern gas storage operations such as the amount and changes in gas wetness, wide variations in gas pressure, pipe wall thickness, short straight pipe runs and acoustic disturbances caused by valve noise or low flow velocities.

The effects of gas wetness on accuracy and reliability were investigated in a recent measurement series conducted at the Colorado Experiment Engineering Station Inc. (CEESI) wet gas test facility in Colorado. The paper will report on the objectives of this test as well as on the procedures and results. The findings of other gas laboratory tests will be presented to show the effects of insufficient straight pipe runs or low flow velocities on accuracy. The effects of changing gas pressures will be explained based on ultra-sound theory and actual measurement results will be presented. Examples of clamp-on flow measurement applications in cavern storage operations will be shown.

Key words: Cavern Hydraulics, Cavern Operation, Caverns for Gas Storage, Compressed Air Energy Storage (CAES), Gas storage, Germany, Instrumentation and Monitoring, Pipelines and Pigging, Safety, Storage Cavern

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