

**Sonar surveys under extreme conditions  
(e.g. gas at very low pressure or crude oil)**

Frank Hasselkus, Dr. Andreas Reitze  
SOCON Sonar Control Kavernenvermessung GmbH, Giesen

**Abstract**

Sonar surveys have for decades been the established technique for the regular monitoring of gas and oil storage caverns. So as to have the best possible basic physical conditions gas caverns should be under the highest possible pressure at the time they are surveyed. This is all the more important the greater the distances to be measured. With regard to caverns located deeper than 1000 m (~3000 ft) pressures > 150 bar (2160 psi) provide a good basis for achieving qualitatively reliable and focussed measurements.

Surveying shallow caverns with a low maximum pressure < 100 bar (1450 psi) or caverns that for operational reasons have to be under low pressure is considerably more challenging than a “standard survey” under high pressure. The lower the pressure, the higher the attenuation of the acoustic waves.

Consequently to be able to interpret these reflections the measuring system must be in a position to amplify the significantly attenuated signal reflections by a suitable amplifier technology and by applying mathematical correlation techniques. Furthermore special transducer technology is necessary when working at such low pressures.

Surveys in caverns at pressures between 80 and 90 bar (1160 to 1305 psi) had been carried out successfully for years. Then the task of surveying gas caverns with a pressure of just 45 bars (653 psi) presented a new challenge. Indeed, to obtain qualitatively usable results under these demanding basic conditions it was essential to have sophisticated transducer technology as well as high performance transmitter and receiver equipment. By carrying out special developments and modifications in this area equipment has been designed which enables distances of more than 85 m (280 ft) to be measured even if the pressure is as low as 45 bar. This provides the customer with a means of monitoring all parts of those caverns which previously were internally regarded as “unsurveyable” without having to flood the cavern with brine.

The technical changes that have been made not only bring about advantages in terms of measuring greater distances at low pressure, but also provide extra performance. In caverns with an extremely long extension (e.g. elongated fingers due to leached potash zones, steeply inclined bedding and so on) it is now possible to measure considerably longer distances. In some cases it is even possible to measure distances of well over 100 m (330 ft) in gas or crude oil.

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