

## Early Kick Detection for Deepwater Drilling: New High Resolution Method with Ultrasound

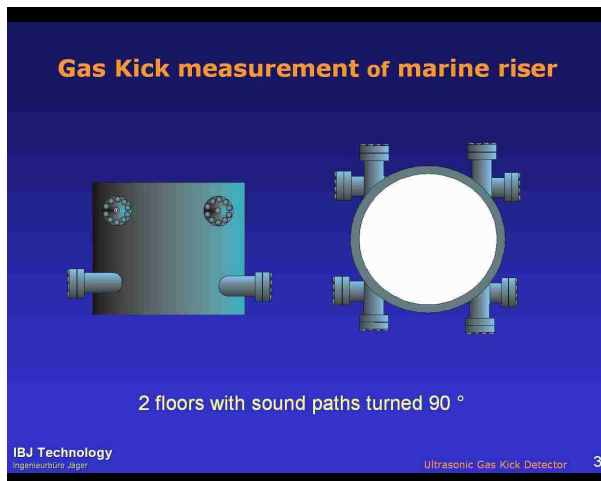


Fig. 1 Sensor for marine riser

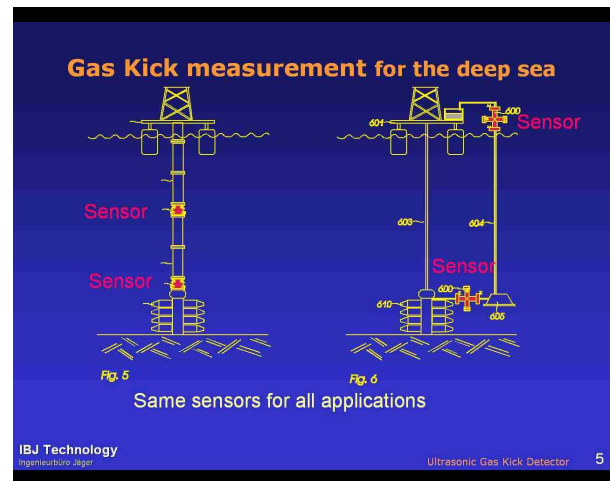


Fig. 2 Applications for riser and riserless

Early detection of gas kicks in water and oil -based mud is possible through a new improved ultrasound technology in a new quality.

Until now, concerns about the speed of sound measurement of oil -based drilling muds partially saturated under high hydrostatic pressure.

But it is possible with new circuits, to measure even the smallest time differences. In particle physics it has for a long time standard in studies on particle accelerators to analyze the trajectories and durations of the components of the atoms in the range of picoseconds.

With this technology you can dissolve the sound velocity is very high. For example, can be measured with a standard deviation of better than 1 nanosecond with a measurement base of 20 inches (0.5 meters) between transmitter and receiver, the transit time of the ultrasonic wave. This corresponds to a longitudinal spatial resolution better than 10 mm per second.

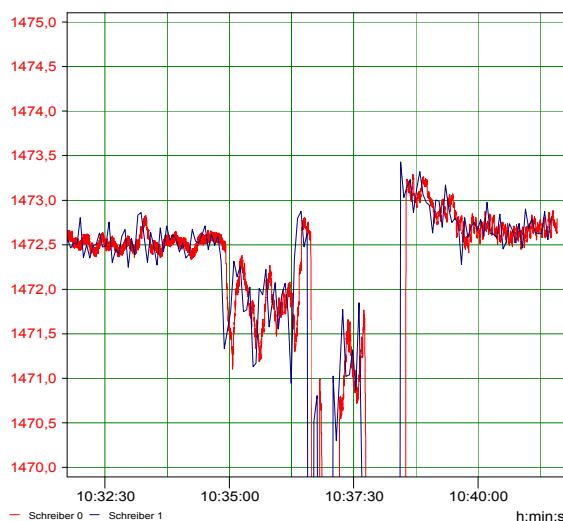


Fig. 3 Speed resolution with a small inflow of hydrocarbons

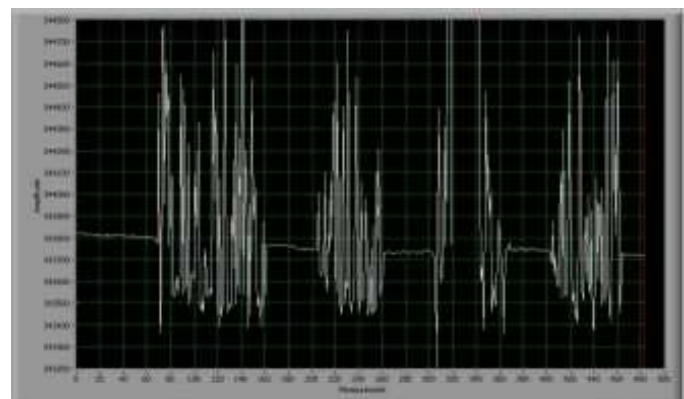


Fig. 4 Transit time resolution with interval inflow of hydrocarbons

The signal noise of the ultrasonic wave can be lowered below a nanosecond through appropriate measures.

The new solution for the early detection of gas kicks, therefore the measurement of the speed of sound of the P wave in the mud inside the marine riser is proposed.

In measuring systems, the velocity resolution was confirmed.

So as to obtain a sensitive measuring tool, which is able to detect the speed of sound in different discontinuity saturation of the dissolved gas, even at very high pressures.

A plurality of detectors are arranged at different depths, can be seen the different signal changes in correlation with the hydrostatic pressure.

At the same time to speed the attenuation of the ultrasonic signal is measured. The higher the percentage of gas bubbles and with an increase of the gas volume of the gas bubbles, the attenuation of the ultrasonic signal is increased. With decreasing hydrostatic pressure, the proportion of free gas will rise very quickly and be recognized as a loss.

The system is universal for all marine riser applicable. Also riserlose installations with mud return lines can be equipped with specific systems. The method and devices are patent pending.

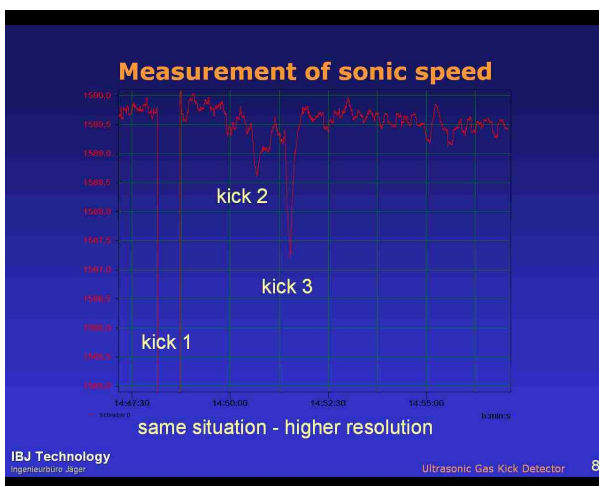


Fig. 5 Measurement of sonic speed solvent

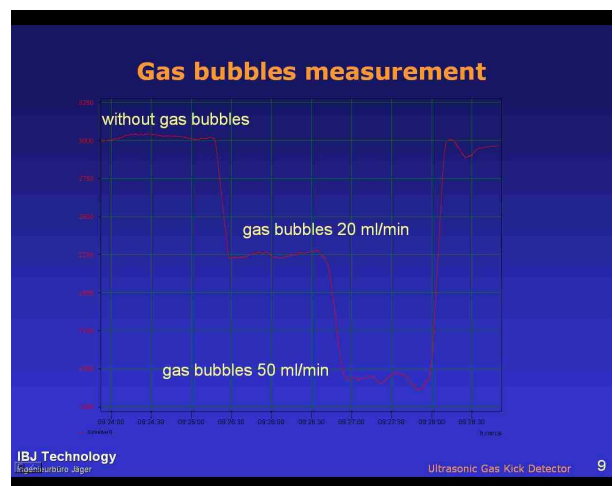


Fig. 6 Measurement of attenuation with free gas bubbles



Fig. 7 Test equipment