

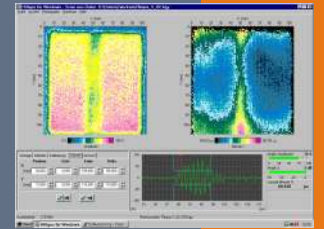
USPC 4000 AirTech



A New Air Coupled Ultrasonic Imaging System

The modular ultrasonic imaging system USPC 4000 AirTech provides non-contact ultrasonic testing with air in single shot technique. Because of the large impedance mismatch between solids and air special transducers and a special pulser/receiver system are necessary. The programmable burst transmitter of the USPC 4000 AirTech enables a powerful excitation. On the other hand the separate ultra-low noi-

se preamplifier and the signal processing on the receiver side indicate lowest pulses with a high signal to noise ratio. The system provides a maximum pulse repetition frequency of 5 kHz! Our software Hillgus for Windows enables an easy operation of the system. Not only A-, B-, C- and D-scans can be processed but also full-wave data recording with software-evaluated A-, B-, C- and D-scans.



Software Hillgus for Windows: clear, modular and easy to handle

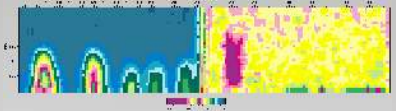
Applications:

Sandwich Components with Foam Core

Sandwich components are attractive materials for aerospace because of their high specific stiffness and stability. The core materials, especially foam, cause an extremely high sound attenuation. Therefore only test frequencies below 200 kHz are possible. The air coupling provides the advantage of a low velocity in air so that the wavelength for a given



frequency in air is smaller than that one in water, which means that the air coupling gives a higher resolution than the classic coupling with water or gel. The sandwich component (shown in the picture above) contains artificially inserted defects (bore holes), which are all indicated in the C-scan. Because of

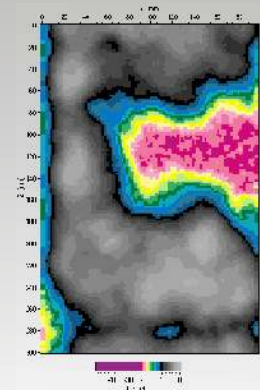
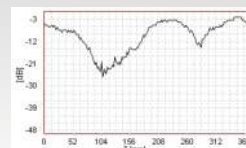


the different densities of the core materials the C-scans indicate different attenuations shown by blue and yellow colours. (DLR Braunschweig, Germany)

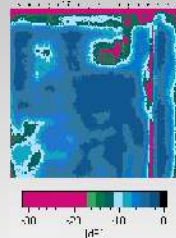
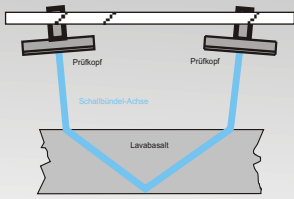
Concrete Inspection

The application of new broadband high power transducers (sensitivity -32 dB, bandwidth up to 40%) provides the inspection of concrete components up to a thickness of 1m in through transmission technique. This method delivers C-scans within a few minutes, which clearly display internal defects like cracks, cavities and gravel nests. Until today the recording of concrete C-scans has been difficult because of the

coupling problems (rough surface, coupling paste and others). The artificially inserted gravel nest with a diameter of 10 cm of a specimen (20 x 20 x 50 cm) is also clearly mapped in the C-scan because of an amplitude decrease of 18 dB. Even a bore hole of a diameter of 16 mm can be displayed with a change in amplitude of 9 dB.

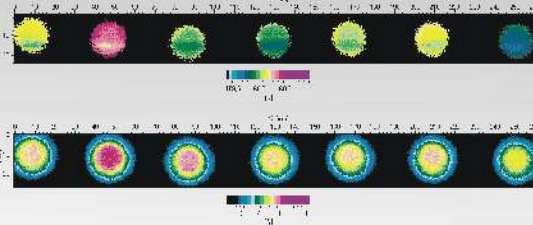


One-sided Testing of Natural Stones



For example the one-sided inspection of natural stones is shown by air-coupling, where cracks in the material can be found. Through tilted intromission of sound, a mode conversion from longitudinal waves into transversal ones is carried out in the material. On the backside of the component the transversal waves are reflected and received again by a second transducer after having been rechanged into longitudinal waves. The inspections can also be carried out in field with „transducer vehicles“. The C-scan shows cracks in a support plate out of natural stones, which are indicated by a 8 dB decrease of the echo amplitude.

Characterisation of Green Ceramics

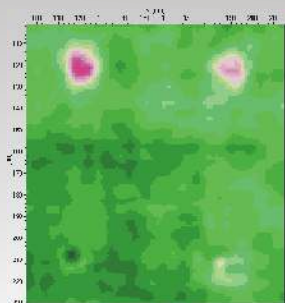


In order to achieve an economic production of ceramic components it is important to indicate material defects as soon as possible before the high-energy sintering.

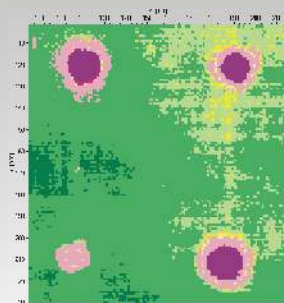
It is not allowed to inspect the green state with coupling agent; therefore an air-coupled ultrasonic testing is very useful. The different densities are clearly shown by different times of flight (the figure above).

The C-scan below presents the sound attenuation which shows amplitude differences caused by changing densities.

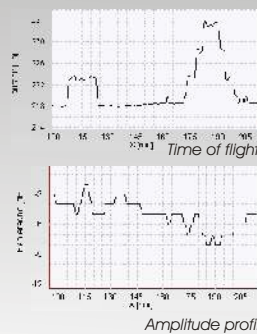
Defect Detection of Ceramic Composites



C-Bild (amplitude)



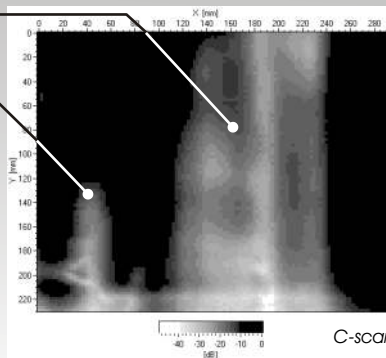
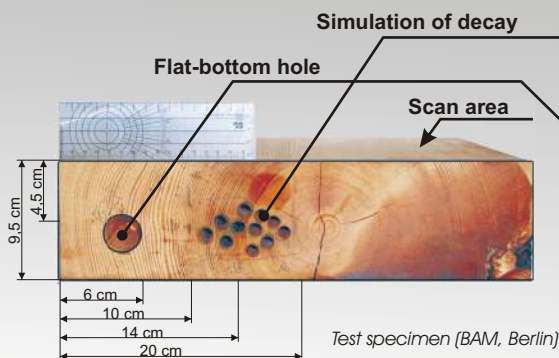
D-scan (time of flight)



Amplitude profile

Ceramics provide high compression strength and can be used up to very high temperatures. Special ceramics are stronger with carbon fibres in order to increase the tensile strength. By immersion testing these porous composites would upsoard water, which makes the detection of defects very difficult. The coupling with air avoids these disadvantages and simplifies the inspections. The C- and the D-scan complete each other by clearly showing the artificially inserted delaminations.

Testing of Wood



Frequently for the testing of wood any coupling agent cannot be used. The test specimen contains a single bore hole in fibre direction ($\varnothing = 30$ mm) and a group of holes ($\varnothing = 10$ mm), which simulates the decay. On the right hand side there are cracks caused by drought. All defects in the inner material are displayed in the C-scan by projection.

Source: A. Hasenstab et al., DGZIP-conference 2005, poster 54