

# Application Report

**BRANCH** : Universities, Laboratories, Research based organizations

**TEST TASK** : Material characterization and analysis

**SOLUTION** : Ultrasonic testing technique

The ultrasonic technique can be used to quantify some basic mechanical, structural and compositional properties of materials. The changes associated with measurable parameters when ultrasound energy passes through a medium such as transit time, attenuation scattering etc, are in turn co-related to changes in physical properties such as hardness, elastic modulus, density etc. in engineering materials.

In the past, the elastic constants of materials were traditionally determined by strain measurements in tensile or bending tests by preparing specific sized and shaped samples. The application possibilities of such a measuring method are largely limited due to the following reasons:

- It is mainly applied only to metallic materials and the method leaves no possibility to make measurements on synthetics, plastics etc
- It is difficult to make measurements on smaller sized samples.
- The conventional method also proves difficult on materials such as ceramics, concrete, stones etc.

The ultrasonic method proves to be a good solution for all the above conditions. The measurements can be largely carried out independent of sample size, geometry and other characteristics.

The sound velocity is a parameter which is directly dependant upon the Young's modulus of elasticity E or the shear modulus G.

$$G = \rho \cdot c_{\text{trans}}^2, \quad E = \rho \cdot c_{\text{long}}^2 \cdot \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

Also, the poisson's ratio  $\mu$  can be directly determined from the ratio of sound velocity values.

$$\mu = \frac{0.5 (C_{\text{long}} / C_{\text{trans}})^2 - 1}{(C_{\text{long}} / C_{\text{trans}})^2 - 1}$$

The calculation is based on the fact the density of material is known. For calculation of sound velocities, normal beam longitudinal wave probes and normal incidence shear wave probes are used. As far as possible, even the size of the transducer, connectors etc are tried to kept as similar as possible. The coupling of normal incidence shear wave probes has to be done with a special gel type couplant, which is viscous and granular. The probe operating frequency selection depends upon the sample thickness and attenuation properties in the material. To obtain higher accuracy levels, highly damped probes should be

used. Proper selection of instrumentation to analyze the waveform characteristics and make measurements is also necessary.

Depending upon client's varied needs, we have supplied now many configurations of instrumentation solutions for this application.



Scanning Systems

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#### Suitable Equipment :

- Our entire range of Pulser Receiver systems
  - Immersion Scanning Systems
  - Ultrasonic probes and testing accessories
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