ASPHALT PAVEMENT RADAR ANALYSIS

Innovator: Robert L. Lytton, PhD, PE

What the Innovation Is:

Dr. Lytton has developed a method for determining pavement layer composition through the analysis of radar signals. The new method is called Pavement Composition Analysis (PCA) and works as described below.

A four-antenna array of air-launched, ground penetrating radar (GPR) equipment is used to obtain digitized images of reflected radar signals from a multi-layered subsurface system. Standard mathematical techniques are applied to each trace to determine the number of layers, the thickness of each layer, and the dielectric constant, or specific electric property, for each layer within the multi-layered system. PCA takes advantage of the fact that each layer is composed of three distinct types of material: solids, fluids, and gases (air). Thus, the dielectric constant obtained for a layer is, in fact, a composite value, namely a combination of the layer's solid, fluid, and gas dielectric constants.

PCA employs a wave propagation model of the subsurface system to generate a synthetic reflected radar signal. Through an iterative process, initial concentration estimates of each material (solid, liquid, gas) in each layer are adjusted to minimize the mean-squared-error between the measured reflected and calculated synthetic radar signals. This process converges rapidly and yields accurate values for solid, fluid, and gas composition for each layer. The PCA software then plots lane-width maps showing contours of the composition elements such as unit weight, voids in the mineral aggregate (VMA), asphalt content, and air content. The PCA method can also be applied to concrete, aggregate, and soil layers.

Origination/History/Future of the Innovation:

Dr. Lytton began work on PCA in 1995 in Bryan, Texas. In the early part of this decade, Lyric Technologies used the PCA method for various pavement projects in Texas, New Mexico, and Florida. EPIC, Inc. (www.epicpavements.com), headquartered in Tomball TX, licensed exclusive rights to PCA in 2004 with the express purpose of expanding PCA's use in the paving industry. EPIC, Inc. currently has 5 regional offices servicing 16 states.

Why It Is Innovative:

PCA provides complete versus discrete testing. PCA is equivalent to analyzing 18,000 cores in a given lane-mile of a project while reducing time, cost, and the risk of injury/death to workers and motorists inherent to coring operations.

What It Changed or Replaced:

Other than the 2 cores required for calibration/verification every 4 lane-miles, PCA eliminates the need for coring.

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Asphalt Pavement Radar Analysis Example
(Asphalt Content Variation across the Full Lane-Width)