Use of Nuclear Methods to Measure Mineral Filler Content and Asphaltic Content of Bituminous Concrete

PAUL K. HOWARD and DONALD O. COVAULT
Respectively, Traffic Engineer, Mel Connor and Associates, Tallahassee, Florida, and Professor of Civil Engineering, Georgia Institute of Technology

ABRIDGMENT

•UNIFORMITY of mixing is a good criterion by which to judge the quality of a bituminous concrete mix and mixing adequacy. In this research, sponsored by the Isotope Development Division of the Atomic Energy Commission, mineral filler content, fineness modulus of aggregate, and stability were used to indicate the uniformity of mixed bituminous concrete produced at various mixing times. Methods were studied to evaluate mineral filler content of bituminous concrete using neutron activation and the asphaltic content of bituminous concrete using neutron backscatter. Fineness modulus of the aggregate and stability of the mix were determined using conventional methods.

An attempt was made to determine mineral filler content of bituminous concrete mortar samples approximately ½ in. in diameter and ¾ in. high by neutron activation analysis of Ca^{49} produced by the neutron bombardment of calcium contained in the mineral filler. The Georgia Tech Van de Graaff was used to produce a neutron flux of approximately 1×10^5 $n/cm^2/sec$ for activation analysis of the mineral filler.

The count rate vs mineral filler content chart shown in Figure 1 was developed from samples containing a known quantity of mineral filler after the mineral filler in each sample was irradiated in the neutron flux for a period of 10 min. The count rate was determined by normalizing the activity of the 3.07-mev peak of the Ca^{49} energy spectrum.

As can be noted in Figure 1, the low correlation coefficient and the comparatively large increment of the upper and lower confidence limits from the regression line indicate rather poor predictive qualities of this method of mineral filler determination. The predictive qualities of this chart perhaps can be significantly improved by using a higher neutron flux to irradiate the mortar samples. These higher neutron fluxes presently can only be obtained by the use of reactors and/or some neutron generator producing a higher flux than the Van de Graaff used in this research.

Neutron backscatter techniques did not prove feasible for the measurement of the asphaltic content of in-place bituminous concrete pavement. The basic problem associated with this measurement is that the backscatter count rate is seriously influenced by the backing material (base) on which the relatively thin bituminous concrete layer rests. Asphaltic content can be determined, however, at the plant if the neutron backscatter measurement can be made in a controlled environment. Such a technique requires that a unique testing device be constructed. One possible device (Fig. 2) consists of neutron source, detector, borated paraffin moderator, and cadmium shield.

In summary, this study indicates that nuclear methods to measure calcium mineral filler content and asphaltic content of bituminous concrete are feasible, and additional research is required to develop these methods for routine testing programs.

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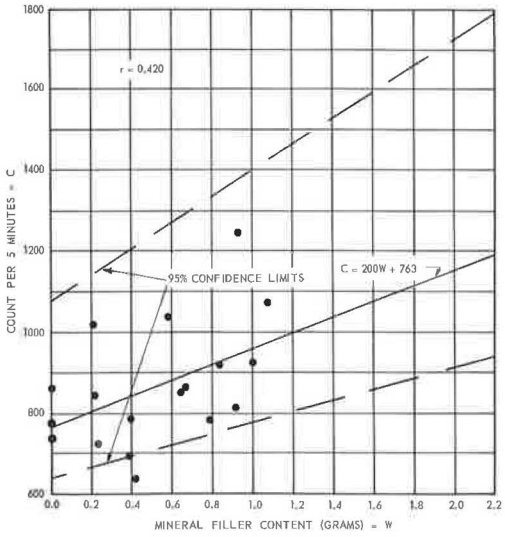
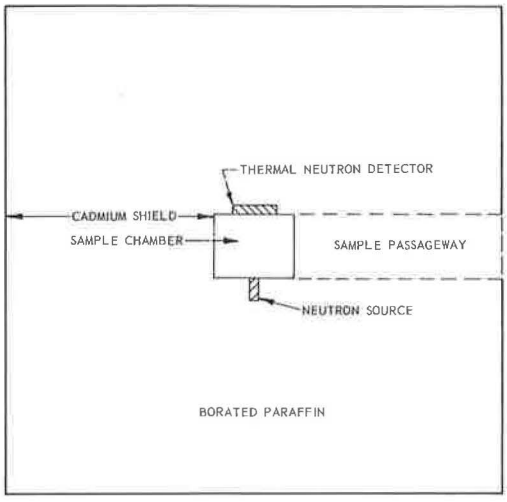


Figure 1. Mineral filler content vs count chart.



POSSIBLE NEUTRON SOURCES
1. AMERICAN – BERYLLIUM
2. PLUTONIUM – BERYLLIUM

Figure 2. Possible development of gage to measure asphaltic cement content of bituminous concrete.