

fast neutrons. Hydrogen is the principal neutron moderator in coal; so neutron thermalization is nearly directly related to hydrogen content and can be correlated with moisture. Density is determined by back-scattered gamma radiation. The combination unit is lowered into a steel tube driven into the coal pile, and a series of readings is made at various depths in a sampling grid over the pile. Variations in both moisture and density with position are rapidly and accurately observed in situ, and the results lead to a more precise and rapid measurement of coal inventory than was previously possible.

Density-moisture gauges also have proved themselves in the national highway construction program. A critical factor in building roads is the compaction of the road bed, which can be determined from a wet and dry density measurement of the soil. These measurements involved taking a sample, measuring its volume by backfilling with sand, and then weighing the sample before and after baking it in an oven to obtain the wet and dry density data. These data, used in an appropriate equation, give the percent of soil compaction. Not only was this time consuming, but also the act of taking the sample disturbed the soil and hence the validity of the data. Portable isotope density-moisture gauges are now routinely employed in many state highway programs to obtain on-the-spot, quick, accurate measurements of soil compaction.

The following list should indicate the many diverse isotope gauging applications now routinely employed in industry.

- Determination of saline water in oil fields.
- Detection of empty and underfilled packages.
- Determination of moisture in wood chips.
- Control of roofing paper thickness.
- Retention of resin by paper and migration of resins during drying.
- Control of the amount of tobacco in cigarettes, and, an application now being developed, control of the thickness of cigarette paper.
- Measurement of bulk density of heterogeneous mixtures.
- Measurement or control of thickness in metallic capsule manufacturing.
- Testing of auto-wax thickness and durability.
- Measurement of the level of liquid chlorine.
- Measurement of concrete density.
- Level measurement in glass furnaces.
- Neutron moisture gauge for concrete.
- Accurate weighing of sand and gravel during loading at pit site.
- Weighing of iron ore on a large belt conveyor at ore-processing plant.