SOIL AND VADOSE ZONE SAMPLING

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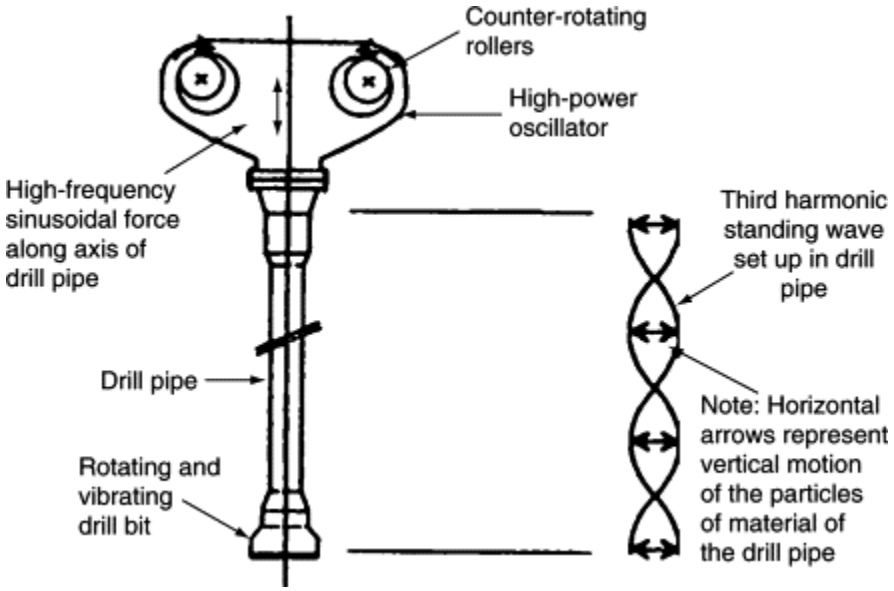
SONIC DRILLING

Sonic drilling is a relatively new technique for obtaining vadose zone soil samples for pore liquid analyses (www.sonic-drill.com). This technique is essentially a dual-cased drilling system that uses high-frequency mechanical vibrations to allow continuous core sampling and advancement into the profile. The drill head uses offset counterrotating weights to generate sinusoidal wave energy, which operates at frequencies close to the natural frequency of the steel drill column (up to 150 cycles per second) (Figure 7.9). The counterrotating balance weights are designed to direct 100% of the vibration at 0 degrees and 180 degrees. This action causes the column to vibrate elastically along its entire length. Resonance occurs when the vibrations coincide with the natural resonant frequency of the steel drill casing. This allows the rig to transfer timed vibrational energy to the top of the drill string. The high-energy vibrations are transmitted down to the face of the drill bit, producing the cutting action needed for penetration. Rotation and application of a downward force causes the drill string to advance through the profile. During drilling, the walls of the steel pipe expand and contract, causing the fluidization of soil particles along the drill string, which enhances drilling speed.



A dual-string assembly allows the use of an outer casing to hold the borehole open and an inner core barrel for collecting samples. Diameters of the outer casing range up to 12 in (30.5 cm). Diameters of the sampling core barrel range from 3 in (7.5 cm) to 10 in (25 cm). When the borehole is drilled, the core barrel is advanced ahead of the outer casing in 1 to 30 ft (95 m)

increments, depending on physical conditions. After the core barrel is removed from the borehole, a plastic sheath is slipped over the barrel. The sample is extruded into the sheath. Subsamples are taken and stored in appropriate containers. Lined split-spoon samplers or Shelby tubes can also be used for sampling. In addition to the drilling of vertical holes, sonic rigs can angle-drill holes up to 75 degrees from horizontal. This is advantageous when sampling beneath existing waste disposal facilities such as landfills and impoundments.

The principal advantages of sonic drilling are that water is not required, perched water can be identified, and there is a relatively safe operating environment. Other advantages include the ability to collect continuous cores; drilling rates (up to 10 times faster than hollow-stem rigs [no drilling fluids needed]; fewer drill cuttings to dispose of (up to 80% less than other rigs); the ability to drill through bedrock, cobbles, and boulders; and the ability to drill to greater depths than hollow-stem augers (sonic drills can provide 3-in cores to a depth of 500 ft [153m]). Disadvantages include a higher cost than that for hollow-stem augers, equipment breakdowns, and potential volatilization of VOCs due to the heat that is generated.