SECTIONING

Purposes

Sectioning helps to: (a) obtain a smaller, manageable sized specimen from the parent material, which helps to keep the rest of the sample for other analysis; (b) expose the internal surface of interest for grinding; and (c) reduce the thickness of the sample to minimize time for subsequent grinding as in thin sectioning. Sectioning can be the most damage-producing step (especially for a brittle or poorly consolidated material) in the entire process of sample preparation. Proper selections of saw and blade are, therefore, crucial to minimize the surface damage. More damage will increase the grinding time, which, in turn, can increase the relief. Minimizing surface damage during sectioning is, therefore, beneficial for subsequent grinding.

Large Saws

Various abrasive-wheel or diamond-bonded sectioning machines containing blades from 8-10 in. to 18-24 in. in diameter and using water or oil as coolant are used for sectioning large samples. Wet cutting produces a smooth, sectioned surface and prevents excessive surface damage from overheating. An oil-cooled saw usually produces smoother sections than do the surfaces produced with a water-cooled saw. Various abrasive wheels (i.e., abrasive cut-off blades, ~ 9-in. to 14-in. diameter) consisting of alumina, silicon carbide, or cubic boron nitride abrasive filler in a resin, rubber, or resin/rubbed mixed binder are common for sectioning ferrous and non-ferrous metals and minerals in abrasive cutters. Resin-bonded or metal-bonded diamond blades are most common for sectioning rocks and concrete. In order to reduce any potential damage to the sectioned surface during sectioning (especially for the brittle materials that are susceptible to grain plucking), thin abrasive or diamond blades are used for sectioning large samples. A 10-in. diameter ($^{5}/_{8}$ in. diameter arbor), good quality thin (blade thickness 0.032 to 0.045-in.), continuous rim diamond blade in a table top tile saw is suitable to cut many materials. The type and thickness of the blade used, grain-size of diamond or other abrasives in the blade, the pressure applied during sectioning, blade speed and feed rate, and the coolant supply rate are the important factors, which control the ultimate smoothness of the sectioned surface. As a general rule, the quality of the surface finish is proportional to the blade thickness and abrasive size on the blade.

Precision Saws

Precision saws, as the name implies for very precise cuts, are used to section materials that are small, delicate, friable, extremely hard, or where a cut must be made as close as possible to a feature of interest, or where the cut width and material lost must be kept minimal. Precision saws house 3 to 8-in. diameter diamond wafering (ultra-thin) blades and are recommended for sectioning small samples and for thin sectioning. Wafering blades in precision saws are much thinner (from 0.006-in. thick for the 3-in. size to 0.035-in. thick for the 8-in. size blade) and load applied during cutting are much lesser than the abrasive cut-off blades in abrasive cutters. Consequently, less heat generates during sectioning and the sectioned surfaces have minimal deformations. Although cubic boron nitrade (CBN), aluminum oxide, and SiC are used for abrasives in precision blades for metallurgical applications, diamond blades are most common for both metallurgical and petrographic sample preparations. Selection of a thin, proper diamond blade is crucial to reduce the surface deformation. Various types of wafering blades are: bonded blades composed of inner metal core and an outer rim of metal or resin bonded abrasive; plated blades consisting of a solid metal core with diamonds nickel-coated to the rim; and diamond segmented rim or continuous rim blades.

Coolant

Water is the most common coolant, which should be mixed with a corrosion resistant chemical to prevent rusting of the blade. Water-sensitive materials should be sectioned with a cutting fluid, propylene glycol, isopropyl alcohol, or more economically with a low viscosity cutting oil, or a hydraulic food-line mineral oil (e.g., baby oil or Mobil DTE FM 32). Cutting fluids should not be flammable and should not impose any health hazards in the form of vapor or aerosol, in which case proper safety precautions and ventilations should be taken in handling and disposing the fluid. Use of gloves is recommended.

The sectioned sample should be thoroughly cleaned with water, acetone, or isopropyl alcohol to remove the debris formed by sectioning, and any cutting fluid, and then air- or oven-dried prior to subsequent grinding and other preparation steps. Small samples should be cleaned in a sonic cleaner with the appropriate cleaning solution.