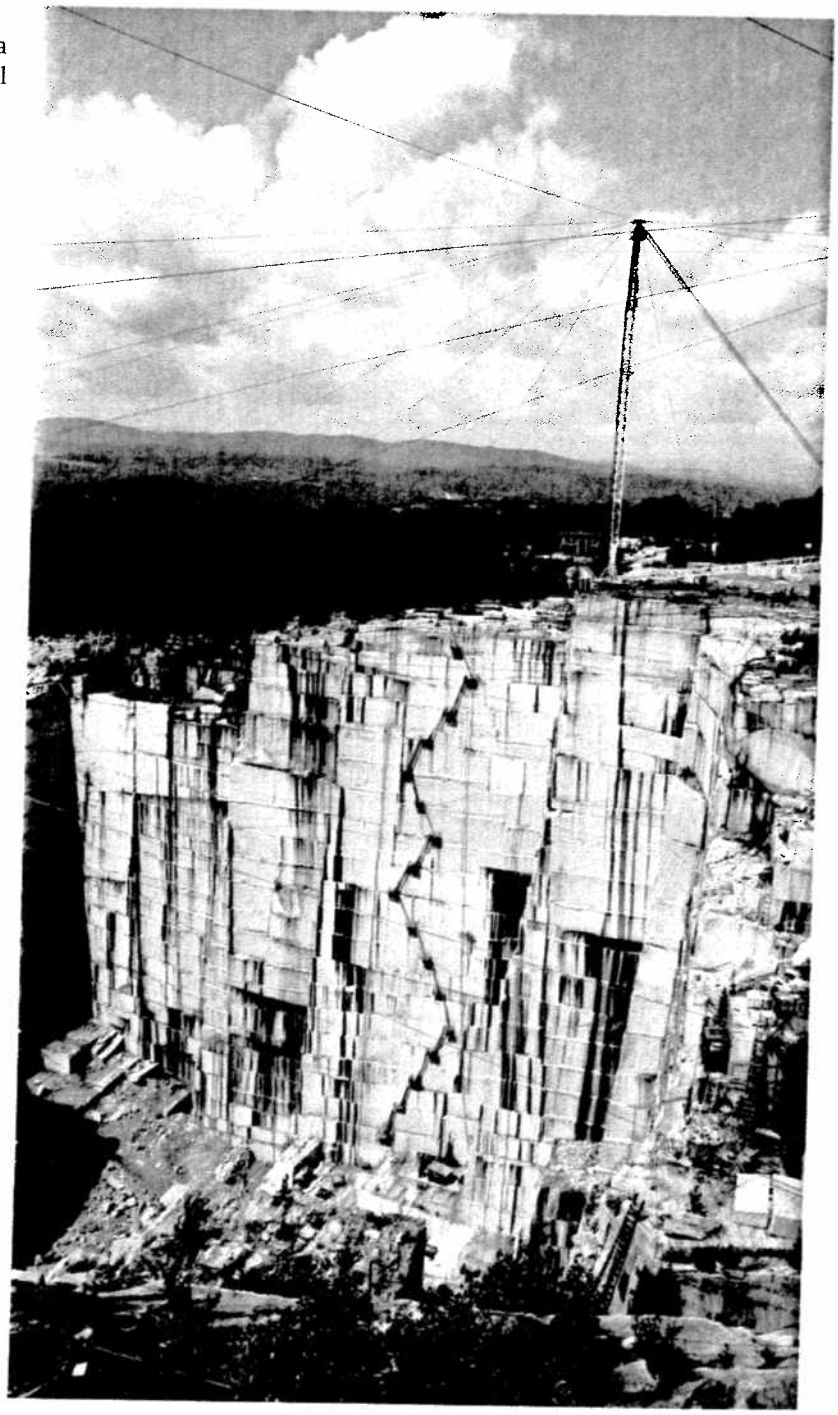
GREEN BUILDING

Costly Stone

Alternatives to Granite Countertops

BY LINDA KINCAID, DAVID BERNHARDT AND AL GERHART

Granite, a popular countertop material, is often considered "green" because it is natural. Stone provides a durable and attractive surface, and it coordinates well with other natural materials. However, granite presents a unique set of challenges to individuals seeking environmentally and socially responsible building materials.



Energy and Environmental Costs

Although it is a natural material, granite leaves a substantial environmental footprint. Granite quarries are open pit mines, often located thousands of miles from the destination of the product. Much of the granite used in the United States is quarried in Brazil, but considerable amounts also come from India, Africa and China. Only a small percentage of the granite used in the U.S. is quarried domestically or in Canada. Many of the granite blocks that are blasted from quarries are damaged and not suitable for use, leaving considerable waste at the site of origin. Slabs that are suitable for use are typically transported thousands of miles for polishing, often to Europe or Asia, then shipped to the U.S. and trucked to distributors across the country.

Fabrication of granite slabs for installation has additional environmental costs. The waste from granite fabrication—about 30 percent for a typical job—is not usually reused or recycled. Cutting and shaping granite are energy-intensive processes, and fabrication shops consume many saw blades, grinding wheels and router bits.

Residential Health Hazards

Although most granite countertops do not pose health hazards to homeowners, a few granites contain enough uranium, thorium and radioactive progeny to be a cause for concern. One such case involved a homeowner in San Carlos, Calif., who installed deep red Jupurana Bordeaux granite countertops in June 2008. She soon encountered news articles about the radioactivity of some granite, and over the following months she contracted professionals to measure gamma radiation and radon gas in her home.

The professionals found that gamma radiation throughout her kitchen was several times greater than background. The highest gamma emission was from a granite table where the homeowner anticipated

spending several hours a day. Given her anticipated use of the space, the homeowner's dose of gamma radiation could have exceeded the EPA recommended limit of 0.1 rem/year.

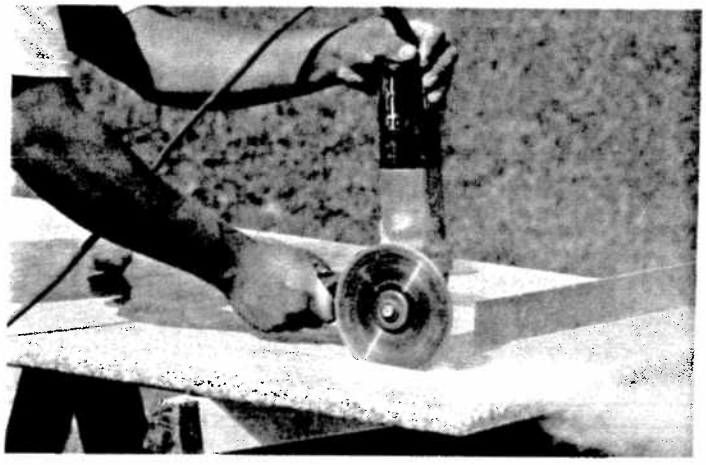
However, her greatest concern was increased radon gas, a uranium daughter, emitted from the granite. Radon concentration in her kitchen was 3.8 picoCuries per liter (pCi/L), more than triple the concentration in the rest of her home. The EPA action level for radon is 4.0 pCi/L; according to the agency, this concentration presents a risk of lung cancer similar to smoking 10 cigarettes per day. The World Health Organization recommends that radon in homes should be below 2.7 pCi/L.

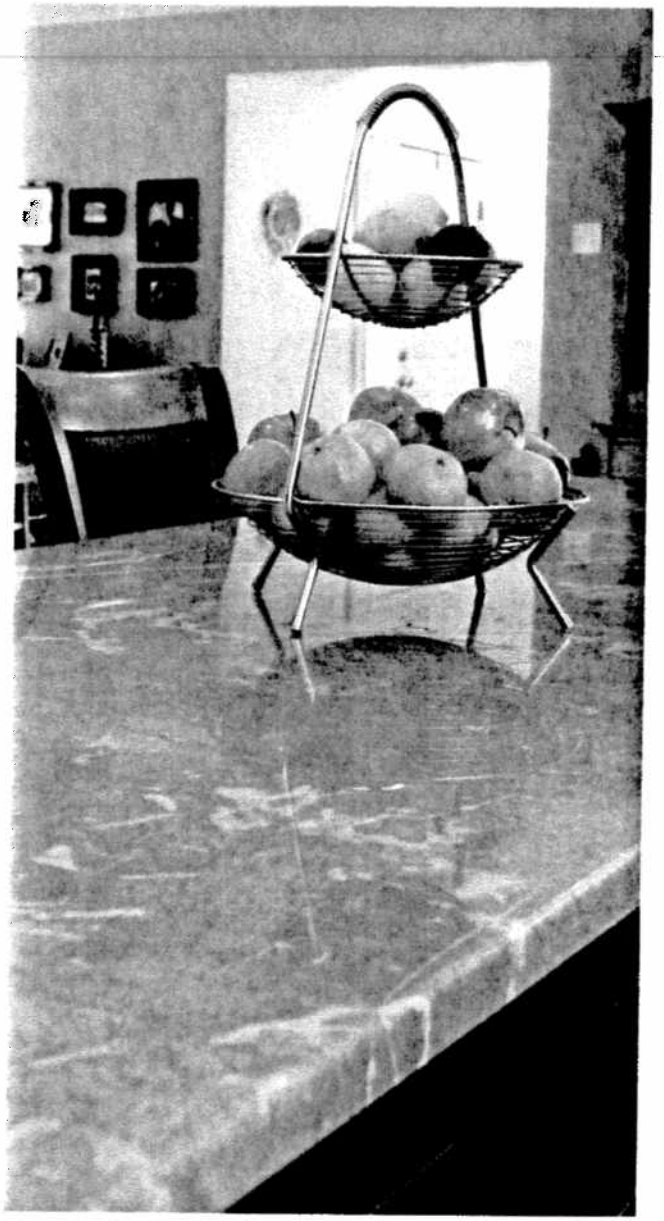
The homeowner, who had a family history of cancer, felt she had no choice but to remove her granite countertops. The vendor that sold her the granite and her fabricator refused to accept any responsibility for replacing the product. The homeowner's cost for replacement granite and fabrication was approximately $8,000 (Kincaid 2009).

Occupational Health Hazards

Granite quarry workers suffer respiratory illnesses, as do residents of nearby communities. However, the health risks are not limited to areas surrounding quarries. Granite fabricators in the U.S. experience occupational exposures to dust, silica, uranium and radiation. At AIHce 2005, Robert Senchy of California OSHA presented data on occupational exposures to dust and crystalline silica in Sacramento fabrication shops, where engineering controls are rare and respiratory protection is not customary. Workers are unaware of the hazards. More recent concerns about radioactive granite have raised questions of uranium exposure and radiation dose to granite fabricators.

The authors of this article used the Jupurana Bordeaux granite removed from the San Carlos kitchen to measure occupational exposures. Professional granite fabricator Al Gerhart used tools and methods typically found in small to medium-size granite fabrication shops. During fabrication, Linda Kincaid, a Silicon Valley CIH, collected air samples following NIOSH method 7300. The samples were taken during edge-grinding, the most time-consuming task in granite fabrication, as well as the dustiest and most likely to present inhalation hazards. To simulate a worst-case exposure, Gerhart performed the grinding dry; most small to medium-size granite shops do grinding without water. Final shaping and sink cutouts at the installation site are always done without water.





At AIHce 2009, Kincaid presented data showing that inhalable airborne particulate exceeded the Threshold Limit Value® for uranium of 0.2 milligrams per cubic meter (mg/m^3) (Kincaid 2009). David Bernhardt, CHP, utilized the measured uranium concentrations and estimated thorium concentrations to calculate the radiation dose for fabricators (Bernhardt 2009). The dose estimates were calculated using a 1-micrometer estimated aerodynamic diameter (EAD) as specified by 10 CFR 20 when particle size is unknown. Some of the radiation doses due to uranium, thorium and their decay products exceeded 300 rem/year. The standard for occupational radiation workers, specified by the Nuclear Regulatory Commission, is 5 rem/year[1]; the appropriate standard for non-radiation workers such as granite fabricators is much lower (0.1 rem/year).

Kincaid's field measurements of approximately 1,000 slabs of granite indicated that 5 to 10 percent of countertop granite on the market is at least as radioactive as the Jupurana Bordeaux used for this assessment. The test granite emitted gamma radia-

tion at about 120 microRoentgen per hour (μR/hr)2, as measured by a PM1703 rate meter. Many types of granite in showrooms read over 100 μR/hr on a PM1703, and readings exceeding 500 μR/hr are not uncommon. One sample of granite removed from a home read over 1,000 μR/hr on a PM1703.

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Greener Countertop Choices

Preferable countertop materials would have less impact on their sites of origin and consume less energy to produce and transport. Ideally, "green" countertop options would be recyclable and utilize recycled materials. Alternative countertop materials include the following:

Cement-based products pose a risk of silica exposure during fabrication, but they are not radioactive.

Bottlestone™, a fine-textured countertop alternative, is a mix of 80 percent ceramic and recycled glass crushed to an eighth of an inch or smaller. Because well-fired ceramics do not absorb moisture, Bottlestone countertops do not require sealing or special treatment. Firing ceramics requires far less energy than the manufacture of cement products, so Bottlestone production has a smaller energy footprint than similar concrete products. Waste Bottlestone is as recyclable as glass. Bottlestone is manufactured in the San Francisco Bay area, using waste glass from local recyclers.

Fuez is a mix of up to 80 percent recycled glass and low-carbon cement, which emits 30 percent less carbon than Portland cement. The glass fragments in Fuez are slightly larger than in Bottlestone, creating a more varied visual texture. Fuez production recycles 50 percent of its process water. All of the electricity used in production is generated by wind power. Fuez is manufactured in Portland, Ore.

Squak Mountain Stone™ is manufactured from recycled paper, recycled glass, coal fly ash and cement. It most closely resembles soapstone or limestone. Slabs are handmade in Woodinville, Wash.

Concrete, poured in place, is a countertop option that produces minimal waste. These countertops avoid the challenges inherent in fabricating preformed slabs. Concrete countertops are finished with a variety of textures and colors. The manager of California's Indoor Radon Program, George Faggella, has concrete countertops in his very green home.

Solid Surfaces

Professional fabricator Al Gerhart encourages homeowners to consider the lifespan of a countertop material. His experience indicates that some granite and cement countertops crack, chip, and stain, and become unacceptable after a few years of use. Gerhart recommends solid surface countertops due to their ease of repair and potential for recycling. Installation of solid surface products produces considerably less waste than installations of other products. Although solid surface materials are petroleum based, post-industrial waste is recycled into new countertops. With an appropriate business model, post-consumer waste could be recycled as well.

Notes

1. A rem or Roentgen Equivalent Man is a unit that relates the dose of any radiation to the biological effect of that dose. One roentgen of gamma radiation exposure results in about one rad (radiation absorbed dose).
2. The roentgen measures the energy produced by gamma radiation in a cubic centimeter of air.

References

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Nuclear Regulatory Commission: Title 10 Codes of Federal Regulations Part 20 (10 CFR 20).

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David Bernhardt, CHP, has four decades of professional experience measuring radiation exposures. He is on the board of the Greater Salt Lake Chapter of the Health Physics Society.

Al Gerhardt is proprietor of The Carpenter Shop, which specializes in unique custom cabinets and countertops. He is actively involved in efforts to reduce radiation exposure during granite fabrication.