Grind taken out of refining

By BEV OHLINE

About seven percent of the energy consumption in the United States goes into crushing and grinding ores, the early stages in preparing metals and minerals for commercial production.

"About 15 billion of the 200 billion kilowatt hours of total U.S. energy consumption go into these crushing or communition processes," says Marc A. Meyers, associate professor of metallurgy at New Mexico Tech.

Communition, Meyers continues, is accomplished both during initial blasting which fractures and fragments ores into various particle sizes and during mechanical crushing which reduces these fragments to a more uniform size for further processing.

Dr. Meyers and Dr. Catherine T. Aimone, an assistant professor of mining engineering also at the New Mexico Institute of Mining and Technology, are part of a team of researchers which believes a more complete understanding of blasting fundamentals could lead to improve efficiency for numerous industrial problems.

"The chemical energy used in explosives is much less expensive than mechanical energy," explains blasting expert Dr. Aimone, "yet explosives used in mining today are only about 20 percent effective.

"If we could improve their efficiency, we would lower production costs. And U.S. products of metal and nonmetal ores could become more competitive on the world market, assuming a sufficient demand," she adds.

MEYERS AND AIMONE recently received a $50,000 grant from the University of Utah Generic Mineral Technology Center to study the fundamental effects of rock fragmentation using explosives. They will be using various copper ores from the Southwest.

The New Mexico Tech scientists will study the effects of shock waves set off by the compressive energy of various explosives as they pass through the different copper ores. In industrial blasting, shock waves are very strong near the borehole. They cause considerable crushing and fragmentation in this area. But, they quickly lose energy and begin only to crack the ore in a radial pattern as they move further from the initial blast area.

"The ideal distribution of explosives in contact with the ore would cause a uniform fracture pattern throughout the area affected by the blast," Aimone explains. "And, if the fracture pattern followed mineral boundaries, it would allow the economic component to be easily freed from the host rock."

Meyers and Aimone will study the pattern and size distribution of fragmented ore, the fracture patterns of the various ores under high compressive pressures, and the rate at which the shock waves lose strength as a function of the initial explosives used and the type of rock being tested.

"Our tests will be done on bench scale," Dr. Meyers points out, "using explosives which simulate two industrial types." Meyers has designed an apparatus which uses explosives in combination with a flyer-plate to create a uniform, simultaneous impact across the surface of the sample.

To test the shock wave attenuation or loss of strength, gauges are placed at three distances from the explosive in the ore sample. They measure the impact energy and the energy remaining at various distances as the waves pass through the sample.

THE APPARATUS for fracture and fragmentation studies is similar in design to the first, but no gauges are used in the samples. Since only compressive shock wave effects are being studied, momentum traps will be placed on the sides and bottom of the sample to eliminate reflected waves. Once a sample is blasted, particle size and distribution are studied. At lower pressure levels, thin sections of the ore are studied microscopically to determine the fracture patterns.

"This type of explosives research is not only important in the study of rocks and mining engineering and related processes," stresses Aimone. "It is important in the development of other materials too."

'New Mexico Tech is one of the few places where this work is being done'

"Explosives research is much needed," Meyers concurs. "New Mexico Tech is one of the few places in the world where this type of work is being done. We would like to develop into a center for all types of explosives research for industrial purposes."

In fact, that is just what New Mexico Tech is planning. The 1983 State Legislature appropriated $1.3 million to the Institute for further development of a center of excellence in explosives technologies.

Funding for Aimone's and Meyer's research is coming from the Generic Mineral Technology Center at the University of Utah, which was established last year as an outgrowth of the Surface Mining Act of 1977. This center funds studies on problems of communition.

THIS YEAR five affiliate universities have received grants from the center: New Mexico Tech, Colorado School of Mines, the University of Minnesota, Michigan Tech, and the University of California at Berkeley. Research conducted at the affiliate universities is done on the same types of copper porphyries. This makes the research results easy to correlate and provides direct application to regional economic problems.

"The generic center concept will certainly be effective in solving industrial problems," Dr. Meyers says. "When you earmark a certain number of dollars for a particular problem and identify a good team of people to do the work, the research tends to produce useful results."

Although the research being conducted at New Mexico Tech is fundamental in nature, Meyers and Aimone believe researchers will be able to build on their base of information.

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