

The Evolution of Rock Support in One Old Mine in Mexico

By Raul Bracamontes

An old mine located in Queretaro State, about a 2-hour drive from Mexico City, now uses wet-mix shotcrete as an integral part of its ground control system. This mine has poor ground conditions. The original support method of masonry arches constructed by the Spaniards has evolved to the modern day with the use of robotically applied wet-mix shotcrete containing fibers and alkali-free accelerator.

This is one of the many older mines in Mexico that are still operating today. This mine was founded over 200 years ago, during the Spanish colonization (1780). The rock support has been one of the main issues since then. The Spaniards developed structural arches made with pieces of rock glued with limestone in small tunnels with cross sections 5 ft (1.5 m) high and 4 ft (1.2 m) wide and used pillars made with stone and steel rings to keep the pieces in place. The mine was abandoned during the War of Independence in 1810.

The records show that the mine was bought for an English company in the time of Porfirio Diaz

(before the Mexican Revolution). They used steel arches and wood for underground support but they had problems with this system of support. They couldn't prevent the weathering of the rock and the resulting rock falls. Again, the mine was abandoned, this time during the Mexican Revolution of 1910.

The mine was operated for some time on a very small scale by the locals. Much of the folklore tells stories of corrals for goats, chickens, and donkeys inside the mine. The mine was purchased by a Mexican company, Luismin, in 1992. In this new era, the miners used the same methods of initial support as the English—steel arches and wood. In 1996, the mine started using dry-mix shotcrete and welded wire mesh for rock support. They have learned that with the use of shotcrete with silica fume, they can seal the surface of the rock—preventing weathering—and keep the rock mass in place.

As in most mines, there were the typical problems in using dry-mix shotcrete: very high rebound, dust, and needing to shoot thin layers. In 2001, they changed to the wet-mix method, incorporating steel fibers and shooting with a mechanical boom, making it the first mine in Mexico to switch to wet-mix shotcrete and the only one with robotic application. Today, the rock support is even more important because they are working very close to the old mining developments and creating larger tunnel sections of 10 x 40 ft (3 x 12 m) in some areas. Right now, the mine is developing a rock support program that incorporates a 41 MPa (6000 psi) wet-mix shotcrete using high-range water-reducing admixtures, a low water-cement ratio (w/c) (0.40), alkali-free accelerators, and steel fibers over high-strength steel to form lightweight arches.



Image courtesy of www.map-of-mexico.org

Raul Bracamontes works for Adra Tecnologia en Servicios Sa de CV in Mexico. He is an Underground Construction Specialist and an ASA-Approved Shotcrete Educator.