

"DRILLING AND BLASTING IN THICK SEAM COAL MINES IN THE POWDER RIVER BASIN"

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Today I would like to share with you some blasting practices used in the thick coal seam mines of Northeastern Wyoming. I will begin by giving you a general overview of a thick seam coal operation at The Carter Mining Company's Rawhide Mine. I will then discuss the blasting procedures used at this operation. The Rawhide Mine is one of 13 mines operating in the Eastern Powder River Basin of Northeastern Wyoming. Approximately 23 billion tons of recoverable coal lies in the Powder River Basin. The Rawhide Mine is currently producing approximately 8 million tons per year. Rawhide is the 9th largest coal mine in the United States according to 1982 production. We also received the 1982 Sentinels of Safety Award for being the safest surface coal mine in the United States. Rawhide's permitted capacity is 24 million tons.

The coal seams at the Rawhide Mine are generally flat. An average life of mine strip ratio of 1.3:1 covers the two coal seams. The top or Roland seam averages 18-20 feet in thickness, while the bottom or Smith seam averages 85-90 feet in thickness. Total recoverable reserves at the Rawhide Mine are estimated at 685 million tons.

The mining process begins with scrapers stripping the topsoil. The topsoil is either direct hauled to reclaimed areas or transported to stockpiles for future use. Once the topsoil is removed, electric shovels mine 45 foot benches to uncover the coal. We use 22 yard and 27 cubic yard shovels to load overburden into 170 ton end dump trucks. The overburden is hauled around the perimeter of the pit and dumped in 50 foot dump lifts. With the overburden removed, coal is loaded into 180 ton bottom dump trucks. Electric shovels load both the Roland coal and upper 70 feet of the Smith coal. The bottom 20 to 40 feet of the Smith coal is mined using a dragline. This dragline allows coal to be loaded into trucks on top of the hard surface of the coal instead of the soft pit floor. Coal is then hauled from the pit to the crushing facility.

Once the coal is removed and the backfill is recontoured, topsoil is placed in preparation for reclamation. As mentioned before, topsoil is hauled from either a topsoil stockpile or directly from topsoil stripping in a new mining area. After the topsoil is replaced, the area is reclaimed. Reclamation consists of discing and harrowing to loosen and aerate the soil, fertilizing, seeding, mulching, and crimping. The seed mixture is a variety of premining grasses and shrubs.

Drilling and blasting at Rawhide Mine is done by a crew of four technicians with one supervisor. The technicians' duties alternate between drilling and loading on a weekly basis. The equipment used consists of two hydraulic top head drive crawler mounted drills, a 5-ton bulk ANFO truck and a truck to haul bagged products.

Rawhide overburden consists of layers of sand, clay, shale, sandstone, and siltstone. One of the problems encountered is the inconsistent deposits of the sandstone and siltstone. The shales and clays are very elastic in nature and contain perched water in the lower overburden benches.

Normal overburden benches are 150 feet wide. Double advances 300 feet wide are sometimes taken. The hole depths range from 48 to 50 feet while pattern size ranges from 20x20 feet to 30x35 feet. Hole diameters are 7 1/2 and 7 7/8 inches. The advance crest line is rayed out by a survey crew with the drill pattern marked by the blasting technicians. The holes are marked with paint. In the winter, if it has snowed or may snow, 18 inch pin flags are used.

Blast holes are drilled on a square pattern but delayed on an echlon pattern. Each drill is capable of drilling 2,000 feet per eight hour shift. However, this production could be reduced to 1,500 feet per shift if rock and/or water are encountered. The first row of holes is usually 20 feet from the crest with the back row 25 feet from the advance line.

The blast holes are loaded with bulk ANFO and primed with a two pound slurry high explosive primer. The primers are made up beforehand with a two foot length of 25 grain cord secured to the primer by a nylon ty-wrap. A 17 grain cord is used down the hole. Wet holes are either loaded with a bulk emulsion by a vendor or, if there is only a little water, 6 inch x 40 pound bagged emulsion is used and bulk ANFO is used to top off the hole. The bags are primed with one pound cast primers using one or two primers for the bags and one for the bulk ANFO with 25 grain cord used as the downline.

Overburden powder factors may vary from .25 pounds/BCY to .85 pounds/BCY. These are higher than we would like, but are necessary because our stemming material is fine and does not confine the explosion very well. We are presently experimenting with a three foot plug of two to four inch crushed scoria to help control rifling of the holes and perhaps enable us to reduce the powder factor. Surface delays with intervals of 65 to 100 MS between echlons and 17 MS between holes are connected using 17 grain cord.

Our coal is mined in three benches. T would like to discuss each bench separately since we drill and shoot each one differently. All of our powder factors are figured on a volume basis and not hole by hole. The Roland, our uppermost seam, is approximately 18 feet thick and is drilled on a 30 x 30 foot pattern with a 7 1/2 inch drag bit in a 150 foot wide advance. Each hole is loaded with 100 pounds of bulk emulsion and the pattern shot row by row with 17 MS between rows and 25 MS on the safety line. This results in a powder factor of between .16 pounds/ton to .23 pounds/ton. One problem in the Roland is that the holes usually have water in them and when the hole is stemmed with coal cuttings, it takes a long time to settle. Therefore, if the water is within three feet of the top, no cuttings are

added. Blast results seem just as satisfactory using water only as when we try to stem through the water.

The Upper Smith, the upper portion of Smith seam is drilled on 30 x 30 foot square pattern in a 150 foot wide advance. The holes are drilled 75 feet deep with a 7 1/2 inch drag bit and plugged to prevent cuttings from falling in. The first row is placed 20 foot from the crest and the last row 5 feet from the advance line. The dry holes are loaded with 850 pounds of bulk ANFO using a two pound slurry primer. The wet holes are loaded out of the water with 6 inch x 40 pound bagged emulsion and capped with bulk ANFO. The resulting powder factor is .30 pounds/ton to .35 pounds/ton. Stemming heights are 15 feet on the first four rows and 18 feet on the last row. The holes are tied in with 17 grain cord using 100 MS delays between rows and 35 MS delays between holes. This gives us a very flat echlon that works very well. With a bench height of 65 to 70 feet, we want to drop and pull the shot coal away from the highwall as much as possible. With our present loading and delay pattern, we are able to drop the coal about eight feet and move it horizontally 15 to 20 feet. This gives us a competent highwall which requires only minimal scaling with a backhoe from above. After the shot, the cuttings on the far edge of the last row of holes are often left intact.

The Lower Smith is mined by a dragline and is shot to provide adequate fragmentation without displacing the coal. The normal advance is only 75 feet wide to allow room for truck traffic. The holes are drilled 35 to 45 feet deep using a rectangular 35 x 40 foot pattern with a 7 7/8 inch drag bit. The holes are loaded with approximately 350 to 475 pounds of bulk emulsion with 22 to 28 feet of stemming. The first row of holes is 15 to 20 feet from the crest with the last row 10 feet from the advance line. The holes are tied in with 17 grain cord with 35 MS delays between rows and 17 MS between holes. This gives a 17 MS echlon which does a great job of shattering the coal without throw and is slow enough to help control backbreak. On the key cut where the dragline will start the advance, we reduce the burden and spacing and load up to 18 feet to help break the top. The dragline does not sit on this portion of the shot. Our powder factor varies from .18 pounds/ton to .25 pounds/ton.

In general, our experience has been that we achieve better coal fragmentation when we use products that generate a large gas volume at a relatively low velocity, shot at short delay intervals. The fact that coal cuttings make poor stemming, especially in wet holes, continues to be a problem. We have attempted to generate a coarse cutting by using step drag bits in coal.

We are pleased with the results achieved using a two pound slurry primer which is considerably cheaper than cast primers. We also find that primer quality can vary and therefore test the primers using 3/4 inch stell plates.

In all phases of our drilling and blasting operations safety comes first. We closely adhere to all state and federal safety regulations. We are also governed by many state and federal environmental regulations. Our blasting procedure, consisting of a series of radio and siren warnings in advance of each shot, is posted at main entrances and is published in local

newspapers. Our drill patterns are marked with cones and signs and all persons are required to obtain permission before entering an area being loaded. A safety check off list is used for every shot and access road blockers are used. A final pit sweep is made prior to each shot to ensure the area is clear. In compliance with our state mine permit, all shots conform to the standard scale distance formula and a seismograph is used on most shots.

I would like to thank you for allowing me this time today and would be very happy to have you visit our mine, the safest surface coal mine in the nation, if you are in the Gillette area.