AMERICAN GILSONITE: MINING SOLID HYDROCARBON

INTRODUCTION

Gilsonite, a soft asphaltite found in near-vertical veins over a large area around Bonanza, Utah (Fig. 1), is mined by American Gilsonite Co. (AGC) using air-powered chipping hammers instead of explosives and mechanical equipment. A vacuum air lift moves 100,000 st/yr of ore to the surface through bored shafts at several mines. The system virtually eliminates dust explosion and fire hazards inherent in mining this hydrocarbon, which, depending on grade and quality, sells to specialized markets that include the oil well drilling industry, automotive sealer manufacturers, ink and paint producers, foundries, and the nuclear industry.

AGC has recently completed a $6 million processing plant that doubled its capacity from 5,000 st/m to 10,000 st/m while improving product quality. "Processing stages that were performed at four widely separated locations are now done at one complex," notes Robert Haffner, president. "This includes cleaning, drying, screening, pulverizing, storing, and packaging. The new plant replaced a 30-year-old mill and complies with all state and federal environmental and safety regulations at substantially reduced operating costs."

The gilsonite occurs in parallel, near-vertical fractures in the Uinta Formation of the Uinta Basin of Utah and Colorado. The Green River Formation also contains rich oil shales that may have been the source of the hydrocarbons that formed the gilsonite. The gilsonite-bearing fractures (Fig. 2) often outcrop and may be as much as 2,000 feet deep. They vary in width from a few inches to 22 feet and may be as long as 25 miles. Average vein thickness is 6 feet, but veins as thin as 18 inches have been mined. It is believed that these fractures were once filled with a heavy, viscous crude oil that lost most of its volatile constituents and then solidified.

Gilsonite resembles obsidian and has a specific gravity of 1.04. Its softening temperature varies from 250° to 500 °F, depending on the vein and depth at which it is mined.

MINING METHOD

The veins mined by AGC are near Bonanza in the eastern part of the Uinta Basin, about 45 miles southwest of Vernal, Utah, and 25 miles west of Rangely, Colorado. AGC operates 12 mines. Some are in development stages, but most are producing. A gilsonite mine may produce up to 23 st/shift with one miner, a helper, and a hoist operator.

Mine development begins with the boring of 84-inch-diameter shafts on 1,000-foot centers along the vein through about 150 feet of overburden. Total shaft depth varies, depending upon the vein, down to 1,500 feet. Shafts are connected by drifts in the ore, primarily to provide a second escapeway.

AGC builds 30-foot-long steel inserts to equip its shafts. The main elements of the inserts are four 10-inch-diameter pipes that are spaced equally around the perimeter of the shaft. The pipes serve as the main support for the guides and ladderway, and they carry conduit, air hose, electrical cables, and pipelines to the working areas.

After a shaft is bored, the 30-foot-long inserts are lowered into it by the same rig that was used to raise and lower the drill bit during shaft sinking. As each 30-foot section is lowered into the shaft, the next section is lined up with it, and the two are welded together at the surface. The procedure is repeated until the inserts line the shaft from top

Figure 1.—Location map.

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Figure 2—Typical gilsonite mine showing airlift, filter and storage facilities, located directly atop the vein.

to bottom. When a mine is worked out, the liner assembly is pulled in 30-foot sections and reused.

Stoping (Fig. 3) starts near the top of the gilsonite vein on both sides of the shaft. Air hammers (Fig. 4) with moil-point bits are used to take up stope floors in 5-foot slices that slope upward from the shaft at 40-45°. Stoping proceeds up to 500 feet from the shaft, measured horizontally. Compressed air is supplied by a 150-hp compressor on the surface and is delivered underground through a 3-inch pipe.

Broken ore flows by gravity to the bottom of the sloping stope floor near the shaft. From there, it is air-lifted to the surface through a 14-inch-diameter pipe. Vacuum for the air lift is produced by a 100-hp motor-fan unit capable of producing a pressure of about 60 inches water gage.

Stope length increases to a 500-foot limit—the half-way point between shafts—as mining proceeds. As mining progresses downward, horizontal pillars are left at vertical intervals of 300 feet for the full strike length of the vein. Pillars vary from 15 to 20 feet thick, depending on the thickness of the vein—the thicker the vein, the thicker the pillar. Wood stulls support the wall and are installed in a horizontal line perpendicular to the shaft. The stulls are installed in hitches cut into the walls with air hammers and then, if necessary, secured with wedges.

Access to the working areas is provided by walkways that are extended as mining advances toward the 500-foot horizontal mining limit. These walkways are installed on another set of stulls, also perpendicular to the shaft. Wooden lagging and chain link fencing form the floor. The fencing prevents rock from falling into the working area without cutting off visual contact between areas. Hand labor keeps the ash content of run-of-mine ore to less than 0.25%.

When the air-lifted ore reaches the surface, it enters a baghouse. The larger pieces drop first, and the rest are collected in the filter bags. All solids are discharged into a 150-ton storage bin and then transferred by truck to the processing plant.

The air lift transport works well with the present mine system of 1,000-foot-deep shafts bored on 1,000-foot centers. When mining reaches the 1,000-foot level 500 feet away from the shaft, air lift capacity with one fan unit can move as much as 10 st/hr. Beyond these distances, capacity drops off rapidly and another fan must be added. A second unit will increase the water gage to about 90 inches, against 60 inches for one unit. Most AGC mines are equipped with two fans.

The air lift transport provides flexibility when it is necessary to open a raise or install a sump in a drift. At one operation, a remnant block of gilsonite is being mined that underlies an old, mined-out area. To reach this block, crews penetrated a partially collapsed, mined-out area and drove a drift into solid ground. A winze was then sunk 900 feet away from the main shaft to reach the ore, which was then air-lifted to the surface through the winze. "It would not have been possible to recover this block of gilsonite by any other method," Rick Dewey, vice-president mining, commented. "Costs would have been too great."
Figure 3.—Typical extraction schedule for gilsonite (vertical section along strike).

Figure 4.—Typical operation within a vein.
Figure 5.—The new gilsonite plant combines cleaning, drying, screening, pulverizing, packing, and storage operations.

The company has also applied the suction air lift system to its shaft boring operation and has achieved penetration rates of up to 5 feet per hour in drilling 84-inch-diameter shafts. The critical factor is keeping the hole dry (wet horizons are grouted before shaft boring). Cuttings are removed quickly through ports installed near the center of the 84-inch bit.

**GILSONITE PROCESSING**

The 120,000 st/yr processing plant (Figs. 5, 6) has five concrete silos with a combined storage capacity of 7,500 st; three truck receiving bins; a 30-st/hr vibrating-bed dryer; double-deck screen; pulverizing machine; pneumatic conveying systems; dust control equipment; enclosed vacuum air pickup system for screening, breaking, and derocking operations; seven 55- and one 25-st-capacity gravity feed bins, which direct products to pulverizer bagging machines or bulk trucks; and a complete packing facility.

Other facilities include an 80 x 90-foot building that houses bagging equipment, packing facilities, controls, laboratory, warehouse, change rooms, operations office, and a six-truck loading dock. There is also a small flotation plant for recovering gilsonite from tailings left over from earlier operations.

Bagged gilsonite from the main plant at Bonanza is transferred into containers for overseas shipment. Gilsonite for U.S. markets is shipped bagged (on pallets) and in bulk. Most products are trucked 120 miles to the railhead at Craig, Colorado, where the company has bulk transfer and bagging facilities.

Before the present methods were introduced, AGC had developed a unique hydraulic mining system, using high-pressure water to cut gilsonite at the working face and to transport a slurry of ore in flumes to a shaft pumping station, where the pulp was pumped to the surface. On the surface, the slurry was pumped 72 miles through a 6-inch-diameter pipeline over some of the ruggedest terrain in the west to a refinery at Fruita, Colorado. AGC designed and build the refinery in 1957 and operated it until 1973. During the 16 years that AGC operated the refinery, it produced gasoline, fuel oils, and coke from gilsonite. At one point, the company produced gasoline by combining gilsonite and crude oil or gilsonite and coal. It later produced gasoline from coal alone.

Industrial customers now specify a dry product, so the company developed its present mining system and built the new processing plant to meet this specification.
FINDING NEW MARKETS

After the refinery was sold in 1973, AGC's production was cut back from about 400,000 st/yr to about 60,000 st/yr. The company cut the number of employees by half and redirected its marketing activities, concentrating on new industrial uses for gilsonite. "Within a 10-year period, the industrial demand for the mineral tripled to approximately 100,000 st/yr," notes T. C. Moseley, secretary-treasurer, "and we see our markets expanding to 150,000 st/yr in the foreseeable future." Significant markets that have been developed include the use of gilsonite to produce an automobile body sealer, as a lightweight aggregate for cement used in the oil well drilling industry, and in asphaltic building board.

Gilsonite is also used in protective coverings, anticorrosive paints, roofing compounds, dark rotogravure printing inks, carbon electrodes for the nuclear industry, varnishes, and as a reducing agent in slurry explosives.

American Gilsonite now produces and ships world-wide four grades of gilsonite—general purpose, select, sealer, and nuclear—in pulverized and nonpulverized sizes. The company has been in business 77 years. AGC is owned by Standard Oil of California.
Lower Green River Formation sandstone and carbonate beds, Raven Ridge. (Photo — M. Dane Picard)