spout also caused this mixer to be taken out of service.

The average increase in service life for the two mixers with basic lining was four times that obtained with various types of fireclay brick used, and the average hot metal tonnage increased 3½ times. Both mixers have been relined with the same type magnesite-chrome brick and have been operating five and six months with apparently little wear to the basic area.

The mixers are fired with coke oven gas and the normal roof temperature is held between 2450° and 2500°F. It is felt that the most economic mixer lining life is not as important as furnace production rate. The increase in production rate resulting from high temperature hot metal probably more than compensates for slightly decreased mixer lining life. With the normal charge of 65 to 70 pct hot metal, temperature of the metal is of prime importance. Open top type blast furnace ladles are used for delivering iron to the mixers and appreciable temperature loss occurs during the transfer. Attention is given to getting the hot metal in the mixers as fast as possible.

Burners have been installed for heating the hot metal transfer ladles when they are not in use, to decrease temperature loss in transfer of metal from mixers to the furnaces. Although hot metal temperatures in the mixers cannot be increased by high firing as a regular thing, temperature loss through the mixer can be minimized.

Skimming practice at the blast furnaces is generally good. A typical analysis of blast furnace slag for the last year is: SiO_2, 35 to 37 pct; Al_2O_3, 12 to 14 pct; CaO, 30 to 36 pct; MgO, 15 to 17 pct; S, 1.15 to 1.25 pct; MnO, 0.20 to 0.30 pct; and FeO, 0.30 to 0.50 pct.

The original cost of the magnesite-chrome brick is higher than any of the various fireclay brick used in the past. However, the amount of this basic brick comprises only about 25 pct of the total brick in the main mixer body lining. From the standpoint of mixer repair and availability, the use of this brick has been especially advantageous.

Mixer Linings at Clairton Works

by F. R. Smith

THE intermittent demand for hot metal by open hearth furnaces makes a storage place for blast furnace iron necessary in today's open hearth shops. The importance of the hot metal mixer is most forcibly shown when the mixer is off for repairs, with resulting operating difficulties reflected in noticeably decreased production. Every effort is being made to minimize such outage time by increasing the life of the mixer lining.

During the four years from June 1946 to July 1950 the 1000-ton mixer at the Clairton works of the U. S. Steel Co. averaged 5.7 months between relines, handling an average of 215,000 tons of metal. Approximately 40 pct of the lining was replaced on each repair, and the outage time for these jobs averaged eight days. The lining during this period was of mica schist stone bonded with prepared ganister. This 18 in. thick wall was backed with 4½ in. of blast furnace quality fireclay brick as a safety lining. A 12 in. semi-silica roof stood throughout this period.

As is generally the case, the most severe erosion occurred in the joints between the rough mica schist stones. However, the joints were not the only weak points as the stones also eroded quite rapidly.

The mixer is cylindrical with the exception of the front wall, built vertically to meet the spring of the roof. It is approximately 15 ft diam and 34 ft long inside, with a top side pouring-in spout 7½ ft from one end and a side pouring-out spout 8 ft from the other end. The mixer is fired with coke oven gas.

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In an effort to prolong the life of the lining, and with an eye toward the success of the Ohio works with this material, it was decided in July 1950 to try a refractory lining of cone 23 super duty brick with silimanite mortar. This brick has a fusion point of cone 33 to 34, corresponding to a temperature of 3173° to 3200°F and is dense and strong.

The safety lining was built of regular fired blast furnace quality brick and was 13½ in. thick on the bottom and up the back wall, to a point approximately 2 ft below the normal metal line, where the thickness was decreased to 9 in. On the front wall the safety lining acted as a filler between the perpendicular super duty wall and the shell of the mixer, and varied in thickness from 9 in. to approximately 15 in.

The super duty lining was 13½ in. thick on the bottom and up the back wall to the point where the safety lining was decreased. Here the thickness increased from 13½ to 18 in. The vertical front wall was constructed 27 in. thick with super duty quality brick. The ends, which had suffered considerable erosion in previous linings, were built to a 27 in. thickness with the super duty brick. Directly under the pouring-in spout, a section 10x10 ft was made 18 in. thick with super duty to ease heavy erosion. The bottom and jambs of the pouring-out spout were constructed of 18 in. super duty block set on end. A 12 in. semi-silica roof was built at this time.

The mixer was in continuous operation from August 1950 to February 1952, with one patch job on the bottom and jambs of the pouring-out spout. No appreciable wear was noted at any point. It passed 820,000 tons of metal in the 18 months, an increase of almost 400 pct over the average tonnage during the preceding four years.