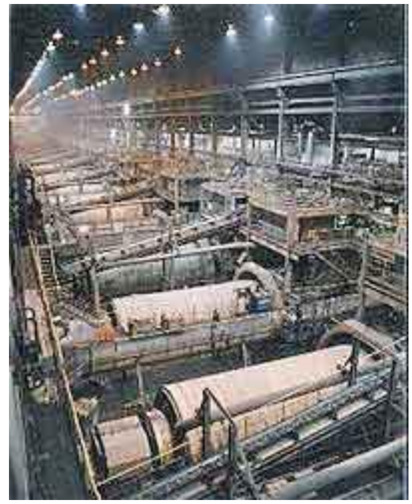
The Taconite Breakthrough

The taconite industry that sprang full-blown from the rust red hills of the Mesabi Range between 1955 and 1975 had its roots in scientific experiments conducted more than three-quarters of a century before. After selling his stake in the Edison General Electric Company in 1892, Thomas Edison retired to the Musconetcong Mountains of New Jersey where he spent nearly a decade experimenting with the electro-magnetic separation of iron ore.[1] Edison's plans to separate low-grade iron ore were dashed by the competitive edge that rich, natural ore had in the marketplace, but the Wizard of Menlo Park proved that magnetic separation of low-grade iron ore was certainly feasible.



"Pebble mills" are used in taconite processing operations to perform the final grinding of fine particles prior to magnetic separation of high-grade iron ore from waste rock. (Cleveland-Cliffs, Inc., Photo)

After low-grade iron ore (taconite) is blasted from the ground and broken apart, a gyratory crusher reduces the ore to pieces of about nine inches in diameter and shovels it into 240-ton capacity trucks. (Cleveland-Cliffs, Inc., Photo)

Taconite is named for the Taconic Mountains of upstate New York, and it is essentially a chert-like rock that has 30-32 percent iron content. Taconite reserves of the Mesabi Range are estimated in the billions of tons, and the existence of those reserves has been known since early in the 20th century. At the time of the First World War, Dwight E. Woodbridge, a prominent Duluth mining engineer, convinced Hayden, Stone & Company of New York and Daniel C. Jackling to underwrite a project on the East Mesabi Range to test the magnetic separation of iron ore. Jackling, who had developed the massive Bingham Canyon copper mines in Utah, spent much of 1917 and 1918 shuttling back and forth between New York and Babbitt, Minnesota, overseeing the progress of the project. Jackling's crews were able to improve the iron content of taconite from 32 percent to 62.2 percent but they were never able to make the costs competitive with natural ore.[2]

In a modern taconite processing facility, nine-inch diameter crude ore is ground to a powdery consistency in grinding mills of up to 36 feet in diameter. (Cleveland-Cliffs, Inc., Photo)

The state of Minnesota was not unaware of the potential for development of the Mesabi Range's taconite resources. As early as World War II, the Minnesota Commissioner of Conservation began selling taconite leases on state lands. In 1943, the state sold 21 leases in northern Minnesota, but it would be more than a decade until the first taconite operations began commercial production.[3] Reserve Mining Company and Erie Mining Company applied the research undertaken by E.W. Davis of the University of Minnesota Mines Experiment Station to commercial production.[4]

When it did come, commercial production was on a scale that awed observers. At the pit, jet piercing rigs burn holes in the flint-like rock with a flame heated to 4,300 degrees. Once the holes cool, crews fill them with explosives and blast the rock loose. Electric shovels then scoop the broken rock into 240-ton trucks or railroad dump cars for the short trip to the processing plant. Visitors often comment on the size of the tires of the trucks, taller than an average-sized man.

At the mill, giant crushers reduce the size of the rock pieces, some as big as a piano, to the size of baseballs. Fine crushers then compress the smaller pieces of rock to gravel size, no more than 1/2-inch in diameter. The resulting rock is next conveyed to ball mills, large steel drums which further reduce the size of the rock to the consistency of sand. The sand is then run through a magnetic separator, which pulls out the magnetic ore particles. The particles are then again subjected to a trip through a ball mill containing hundreds of hard steel balls, which grind the magnetic sand finer still, to the consistency of talcum powder.[5]

Water is applied to the powder, and the slurry is again run through a separator to recover the iron particles. In some mills, the slurry is allowed to sink in a large basin. The iron particles remain on the bottom, while waste material rises to the top and is skimmed off. Water is removed from the iron-rich mixture, and the residue is fed into balling drums where a bentonite clay is added to the mix. The bentonite, mined in Wyoming, binds the semi-loose slurry into pellets in the balling mill. The "green pellets," as they are known to mining engineers, are then placed in a kiln and fired at 3,000 degrees.[6] Since most of the taconite facilities do not have storage capacity at the mill, the hot pellets are loaded into rail cars for the ore docks in Duluth, Superior, Silver Bay or Two Harbors.

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[1] Neil Baldwin, Edison: Inventing the Century (New York: Hyperion, 1995), pp.213-220. In the 1890s, Edison essentially laid out all of the processes that would materialize as taconite processing in Minnesota a half-century later.

[2] "Separation of Iron Ores By A Magnetic Process Demonstrated To Be Very Successful," *Skillings' Mining Review,* November 30, 1918, p.1. In 1918, Jackling's East Mesaba Syndicate produced 6,000 tons of baseball-sized enriched iron pellets.

[3] "Keen Demand for Taconite Permits," *Skillings' Mining Review,* December 25, 1943, p.1

[4] "Minnesota's Lean Iron Ore Future," *Skillings' Mining Review,* August 7, 1943, p.6

[5] Beck, Northern Lights, p.401

[6] Ibid., p.401. On a cold winter's day, the unit trains of pellets from the Mesabi Range send plumes of steam into the air as their cargo cools in the frosty air.