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CEMENT MATERIALS IN DOOR COUNTY, WISCONSIN

by

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Purpose of Investigation. A half-day trip to Door County was made on May 11, 1956 to obtain some information on materials available for a proposed cement plant at Sturgeon Bay. The trip was made at the request of Mr. G. I. Mullendore, County Agent. In so brief a time no borings or test pitting could be attempted.

Cement Materials. In starting a discussion of cement materials in Door County it is well to realize that the abundant "limestone" of the county is really dolomite with far too much magnesium to make Portland cement. The same remark applies to the Richmond or Maquoketa shale which underlies the Niagara dolomite. Exposures seen of this formation disclosed abundant thin layers of dolomite. Materials for cement manufacture comprise marl and clay. Tolerance of magnesium oxide in cement is about 5% maximum. It is also possible to import pure limestone from Michigan as is done at Manitowoc.

Marl. Marl is a chemical and organic precipitate of reasonably pure calcium carbonate which was deposited in quiet warm waters much of which are now swamp land. Bulletin 66 of the Wisconsin Geological Survey, published in 1924, gives the presently available information on marl deposits. Test drilling was confined to (1) a deposit in section 9 of Clay Banks, (2) Clarks Lake, (3) near Jacksonport, and (4) Kangaroo Lake. These deposits were estimated to contain slightly over 1½ million cubic yards and range from 77.4% to 88.6 of calcium carbonate and 3.0 to to 4.6% magnesium carbonate after drying. This material appears chemically suitable for cement although on excavating it would contain more than half water. Most of the marshes are forested and would require considerable expense to clear and remove roots. Test borings for the bridge at Sturgeon Bay showed 7 to 29 feet of marl but none has been analyzed. There are extensive marshes along the Lake Michigan shore which have not been tested and showings of marl were observed in some of them.

Clay. Clay must be mixed with limestone in the proportion of at least one quarter. Up to date no good deposit of clean clay has been found in Door County. The brickyard southeast of Sturgeon Bay in SW $\frac{1}{4}$ SE $\frac{1}{4}$ of sec. 17, T.27N., R.26E. was once operated by one Simon whose son we interviewed. The source of clay was a stony deposit known to geologists as till. Trouble with pebbles in the brick led to confining operations to the surface weathered zone where stones have been largely dissolved. The red color of the brick shows that it was made from weathered material.

Work was discontinued here in 1907. Although the bank below the cherry orchard is high in clay, washing would be needed to eliminate stone and sand. The Door County soils report, Bulletin 52D, Wisconsin Geological Survey, published in 1919, shows for the subsoil of the Kewaunee (Superior) loam as follows: gravel 10.7%, sand 31.7%, remainder very fine sand, silt and clay. For the Kewaunee (Superior) clay loam the subsoil contains: gravel 1.0%, sand 28.1%, remainder very fine sand, silt and clay. The difference is not very great. Most of the cuts visited belong to these soils. The deposit southwest of Brussels is entirely too far distant from Sturgeon Bay to be considered. It may have been in part deposited under a lake.

History of Glacial Lakes. It is necessary to review the history of the glacial lakes in Door County to understand where to explore for lake clays which would be reasonably free of stones. When the margin of the glacier reached to the southern part of the county the water stood much higher in the Green Bay basin than on the other side of the peninsula. The overflow to the Lake Michigan basin was at Dyckesville at elevation just below 140 feet above present lake level. When the ice cleared the low place north of Ahnapee River this level fell abruptly to about 60 feet above modern Lake Michigan. However, these high level lakes did not last long enough to make any deposits or shore lines so far as could be observed. The water level stood some time at about 40 feet above Lake Michigan at what is known as the Algonquin level. At this time much clay

was deposited farther south. Glacial ice could not have been far distant. It is in the area within 40 feet elevation from lake level that search should be directed to find nearly stone-free clay. The only favorite place thus far observed is just west of the State Park in section 34, T.28N., R.25E. where there seems to be a level terrace which may have some lake clay on it although cuts along the south line showed only red till with pebbles and boulders. Following the draining of Lake Algonquin the water level fell several hundred feet below that of the present and Lake Chippewa was the shrunken predecessor of Lake Michigan 350 feet lower than now. Earlier deposits were much eroded. Rising of the land in Canada raised the water level to one about 20 feet higher than now. This level is called Lake Nipissing, and as marked by prominent lake shores such as that at Robert LaSalle Park. This lake is postglacial and shells are found in the beaches deposits near Green Bay. It is unlikely that any clay was deposited near shore and hence in a position in which it could be excavated. Erosions of St. Claire River lowered the level to that of the present.

Other Clays. At the Forest Bed on the north line of Manitowoc County, there is 10 to 12 feet of lake clay between the red till and the older gray till which underlies it but no evidence of such a deposit is known in Door County. This is the clay which was used first at Manitowoc but exhaustion of this has led to excavation of the underlying gray till. At Two Creeks this gray till contains: gravel 6%, sand 16%, very fine sand, silt and clay 78%. In the cut for filling southwest of Sturgeon Bay this older till shows: gravel 0.5%, sand 56%, with the remainder of very fine sand, silt and clay. At Ellisville we found in gray till: gravel 20.2%, sand 46.8%, with the remaining third of the deposit finer materials. An analysis of the red till near the brickyard showed gravel 5%, sand 17%, and 78% very fine sand, silt, and clay not separated. The red till is known by the name Valders from its exposure near that village in Manitowoc County. The gray till is called Cary. The only available chemical analysis of Valders till is from

Oshkosh where it shows: SiO_2 43.2%, Al_2O_3 11.4%, Fe_2O_3 4.4%, MgO 6.1%, CaO 11.5%, CO_2 14.8% and H_2O 4.6%. Gray Cary till at Oshkosh shows: SiO_2 56.6%, Al_2O_3 14.2%, Fe_2O_3 2.9, MgO 7.0, CaO 14.4, CO_2 15.5, H_2O 15.1.

To transform MgO to MgCO_3 (magnesium carbonate) multiply by 2.1.

To transform CaO to CaCO_3 (magnesium carbonate) multiply by 1.75.

Conclusions. (1) There is no limestone suitable for cement in Door County.

(2) The shale of Door County is apparently unsuited for cement. (3) No lake clay free of sand and stone has yet been found in Door County although exploration is needed. (4) Marl is present although the amount thus far explored is below the estimated 1150 acres of 10 feet average thickness needed for a 50 year life of a plant. Excavation of many marl deposits is hampered by a dense forest growth. (5) Pure limestone as well as coal can be imported by water. (6) Although no cement plants using marl deposits are now operating in Michigan it may be their abandonment was due primarily to exhaustion of the small deposits rather than to high cost. (7) Washing of glacial till to furnish clay is possible. Sand must be removed to allow grinding of the cement. Methods used at Manitowoc should be investigated fully. The obvious source for washing is the red Valdars till which contains much less sand and gravel than does the gray till.

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