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DEPARTMENT OF MINES

THE PORTLAND CEMENT INDUSTRY IN ONTARIO

By
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The Portland Cement Industry in Ontario

By

D. F. Hewitt[1]

There has been a large expansion of the portland cement plant capacity in Ontario between 1950 and 1967. In 1950 there were 3 cement plants in operation in Ontario, with 5 kilns having a total rated capacity of about 1,090,000 tons per year. In 1967 there were 6 cement plants with 16 kilns having a total rated capacity of about 3,918,750 tons per year. These plants are listed in (1).

(1) Portland Cement Producers in Ontario, 1967.

Company	Location	No. Kilns	Approx. Annual Capacity in tons
Canada Cement Company	Belleville	3	770,000
Canada Cement Company	Port Colborne	1	210,000
Canada Cement Company	Woodstock	2	595,000
Lake Ontario Cement Company	Picton	3	900,000
St. Lawrence Cement Company	Clarkson	2	700,000
St. Marys Cement Company	St. Marys	5	743,750
	Total	16	3,918,750

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[1]Senior Geologist, Ontario Department of Mines, Toronto.
Manuscript received by the Director, Geological Branch, 7 Dec. 1967.

A new kiln is being installed at the Clarkson plant of St. Lawrence Cement Company which should be in operation in 1968. This will increase the plant capacity to approximately 1,750,000 tons per year and make it the largest cement plant in Canada. Canada Cement Company has announced plans for a new kiln at their Woodstock plant.

In 1950 the three portland cement plants in operation were St. Marys Cement Company at St. Marys, and the Port Colborne and Belleville plants of Canada Cement Company. Since World War II the St. Marys Cement Company plant has been expanded to 5 kilns, while the Belleville plant of Canada Cement Company has been expanded to 3 kilns. In 1956 and 1957 new plants were opened by St. Lawrence Cement Company at Clarkson, and Canada Cement Company at Woodstock. In 1958 production began at the new plant of Lake Ontario Cement Company at Picton. In 1965 this plant was expanded to 3 kilns and is at present the largest cement plant in Ontario.

All the cement plants in Ontario with the exception of Lake Ontario Cement Company at Picton are wet-process plants. The kilns are fired with powdered coal or gas. The plants are described by Hewitt (1960, 1964).

Production of Portland Cement

The production of portland cement in Ontario from 1950 to 1966 is given in (2).

(2) Production of Portland Cement in Ontario, 1950 to 1966.

Year	Tonnage	Value in $
1950	930,000	10,953,896
1951	950,000	12,494,677
1952	975,000	14,142,060
1953	1,228,000	18,497,744
1954	1,260,000	18,958,173
1955	1,359,000	20,309,648
1956	1,447,000	21,455,019
1957	2,184,000	33,516,000
1958	2,400,158	35,195,552
1959	2,386,334	31,731,767
1960	2,007,044	30,699,800
1961	2,226,923	35,671,569
1962	2,510,783	38,704,090
1963	2,552,665	39,551,719
1964	3,043,771	46,804,126
1965	3,145,873	50,055,554
1966	3,242,591	52,680,630

In 1966 the portland cement industry in Ontario was operating at 83 percent of rated capacity.

Uses of Portland Cement

One of the major users of portland cement in Ontario in the 1950's was the Hydro Electric Power Commission of Ontario in its extensive hydro-electric power developments. In twelve power development projects completed by Ontario Hydro between 1950 and 1958, including the Robert H. Saunders power station and dam on the St. Lawrence seaway, the Sir Adam Beck No. 2 generating station at Niagara Falls, and the Des Joachim power plant and dam on the Ottawa River, over 16,000,000 barrels of portland cement were used, amounting to about 23 percent of the total Ontario production during the period. The completion of most of this hydro-electric expansion program releases more cement for other markets. The uses of portland cement have been recently given by V.C. Hamilton of Canada Cement Company in the May 1967 issue of Canadian Pit and Quarry as follows:

Uses of Portland Cement

Residential construction	20%
Non residential building	30%
Highways and streets	10-12%
Power facilities	8-10%
Subways, bridges and overpasses	15%
Miscellaneous uses	15-20%

Among the miscellaneous uses for portland cement is cement stabilization of hydraulic mine tailings backfill which was pioneered in Ontario by Inco and Falconbridge Nickel in co-operation with Canada Cement Company in 1960. There is an increasing trend towards the use of cement for soil stabilization for road bases.

V.C. Hamilton points out that a trend toward vertical integration of cement companies and their markets began in the late fifties. He states that the cement industry in Canada is far more vertically integrated than a few years ago and in fact most of the large ready mix companies in Canada are either directly controlled or indirectly connected with cement companies. The primary purpose of forward vertical integration by cement manufacturers has been to secure captive customers and thus protect market outlets for their products.

Cement Raw Materials

Consumption of raw materials used in the manufacture of portland cement in Ontario in 1966 is given in (3).

(3) Consumption of Raw Materials used in Portland Cement in Ontario in 1966.

Commodity	Tons
Limestone	4,283,727
Gypsum	150,081
Clay	822,369
Shale	47,136
Iron oxide	14,564
Sand	97,935

Limestone contains the lime necessary for portland cement. Shale, clay or sand furnish the alumina and silica required. Silica and lime together form the cementitious constituents, tricalcium silicate (C_3S)[1] and dicalcium silicate (C_2S). Alumina forms tricalcium aluminate (C_3A) which causes the high heat of hydration and contributes to early strength of concrete. Alumina acts as a flux, lowering the kiln cement clinker formation temperature. Iron oxide in the form of hematite or mill scale or iron sulphide (pyrite) is added to produce tetracalcium aluminoferrite (C_4AF). Iron oxide further lowers the reaction temperature and lowers the heat of hydration in concrete.

Gypsum is added during grinding of the cement clinker in the finish grinding process to act as a set regulator in the cement in the proportion of about 1 to 6 percent. Three to five percent MgO can be held in solid solution in the glassy phase of the clinker and in chemical composition. If the MgO crystallizes out in the clinker as periclase, due to improper cooling, this is slow to hydrate and causes expansion of the concrete.

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[1]Symbol used by Portland Cement Industry.

Excessive alkaline oxides, Na_2O and K_2O, are deleterious as they contribute to the reaction of concrete with such aggregates as opal and chert, decreasing the resistance of concrete to freezing and thawing, and the water soluble portion contributes to concrete staining and masonry efflorescence.

The chemical requirements for the various types of portland cement vary, but in general the limestone chosen should contain less than 2.5 percent magnesia and preferably less than 2 percent magnesia. Silica should not exceed about 13 percent, and alumina should not exceed about 3.7 percent.

The types of portland cement include normal portland cement for use in general construction; cement for general concrete construction exposed to moderate sulphate reaction and where moderate heat of hydration is required; high early strength cement; low heat cement; concrete products cement; sulphate-resisting cement; oil well cement; and masonry cement.

Special properties are obtained by increasing or decreasing one or another of the cement compounds in the clinker. For high early strength the C_3S/C_2S ratio is increased due to the capacity of C_3S to hydrate and set rapidly. For lower heats of hydration in massive concrete structures the percentage of C_3S is decreased and more important the C_3A is lowered. Resistance to sulphate waters increases with a decrease in C_3A content. Fineness of cement has great effect on early strength and heat evolution during setting due to the increased hydration rate.

Typical analyses of raw mix for type cements is given by Taggart (1947, 3A-17):

Percentages

	ASTM No.1	High Early	Moderate Heat	Low Heat	Sulphate Resistant
SiO_2	14.1	13.3	14.6	16.5	16.5
Al_2O_3	4.2	4.0	3.2	2.5	2.3
Fe_2O_3	1.8	1.8	2.3	2.5	2.2
CaO	41.5	42.8	41.4	41.0	41.2
MgO	2.4	1.8	2.5	2.0	2.3
Ignition loss	36.0	36.3	36.0	35.5	35.5

Calculation of the mix is based on use of empirical formulae.

History of Cement Production in Ontario[1]

The first cement manufactured in Ontario was natural hydraulic cement made from "cement rock" composed of lime, magnesia and shale. Production probably began in the 1840's at Thorold at the quarry of John Battle opened in 1841 and later called the Thorold Hydraulic Cement Works. This works closed in 1891, and operated under the name "Estate of John Battle" until 1907. There were five natural hydraulic cement

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[1]After A.M. Blair (1965, p. 48-54, 213-217)

producers in Ontario. In 1880 Rathbun and Company began operations at Strathcona (then Napanee Mills) and operated until 1897. Between 1881 and 1891 the Toronto Lime Company began production of natural hydraulic cement at Limehouse and continued production until 1907. Between 1881 and 1891 the Queenston Cement Works of Isaac Usher & Sons began production of natural hydraulic cement at Queenston and continued until 1907. In 1894 F. Schwendiman began production of natural hydraulic cement in Barton township near Hamilton and continued until 1907. In all there were five producers of natural hydraulic cement in Ontario in the period from 1841 to 1907.

The list of natural hydraulic cement producers in Ontario from 1841 to 1907 is given in (4).

(4) Natural Hydraulic Cement Producers In Ontario, 1841-1907 (after Blair 1965, p. 213).

County	Place	Company	Year Operation Started	Year Operation Ended
Lennox and Addington	Strathcona (Napanee Mills)	Rathbun & Co.	1880	1897
Halton	Limehouse	Toronto Lime Co.	a	1907
Wentworth	Barton Township	F. Schwendiman	1894	1907
Welland	Thorold	Thorold Hydraulic Cement Works	1841	1891
		Estate of John Battle	1891	1907
Lincoln	Queenston	Queenston Cement Works (Isaac Usher & Sons)	a	1907
		Empire Cement & Lime Co.	1907	1907

(a) Operations probably started after 1881 and before 1891.

In 1824 Joseph Aspdin of Leeds, a stonemason, patented the invention of portland cement. The manufacture of portland cement was begun in Ontario using marl as the essential raw material in 1886 by Rathbun and Company at Strathcona. During the period when marl-using portland cement plants flourished in Ontario, between 1886 and 1919, there were 14 plants active.

A list of the marl-using portland cement plants in Ontario, after Blair (1965, p. 214-215), is given in (5).

(5) Marl-Using Portland Cement Producers In Ontario, 1886-1919

County	Place	Company	Year Operation Started	Year Operation Ended	Capacity Circa 1907-08 (bbl. per day)
Grey	Shallow Lake	North American Chemical Co.	1889	1892	
		Owen Sound Portland Cement Co.	1892	1909	800
		Canada Cement Co.	1909	1914	
Hastings	Marlbank	English Portland Cement Co.	1890	1898[a]	
		Beaver Cement Co.	1898	1900	
		Canadian Portland Cement Co.	1900	1909	1,300
		Canada Cement Co.	1909	1914	
Lennox and Addington	Strathcona	Rathbun and Co.	1886	1900	
		Canadian Portland Cement Co.	1900	1909	n.a.
		Canada Cement Co.	1909	?	
Grey	Hanover	Hanover Portland Cement Co.	1898	1919[b]	500
Grey	Owen Sound	Georgian Bay Portland Cement Co.	1900	1901	
		Imperial Portland Cement Co.	1901	1913	600
Grey	Owen Sound	The Sun Portland Cement Co.	1902	1911[c]	500
Grey	Brookholm	Grey & Bruce Portland Cement Co.	1902	1909	400[d]
Peterborough	Lakefield	Lakefield Portland Cement Co.	1902	1909	1,200
		Canada Cement Co.	1909	1914[e]	
Grey	Durham	National Portland Cement Co.	1903	1919	1,000
Victoria	Kirkfield	Raven Lake Portland Cement Co.	1904	1908	400
		Kirkfield Portland Cement Co.	1908	1914	

(5) Continued

County	Place	Company	Year Operation Started	Year Operation Ended	Capacity Circa 1907-08 (bbl. per day)
Brant (Paris)	Blue Lake	Ontario Portland Cement Co.	1904	1917	500
Perth	Atwood	Western Ontario Portland Cement Co.	1906	1909	350
		Maple Leaf Portland Cement Co.	1909	1913	
Dufferin	Orangeville	Superior Portland Cement Co.	1907	1914	500
Grey-Bruce	Wiarton	Colonial Portland Cement Co.	1908	1909	1,000
		Crown Portland Cement Co.	1909	1911	

[a]Plant not operated 1895-1898.

[b]Company used limestone 1920-1925.

[c]Reorganized as Doric Cement Co. in 1916 and consolidated with Grey & Bruce Portland Cement Co. to form Union Portland Cement Co. Limestone was to be used, but operation failed.

[d]Estimated on the basis of nine months' production of approximately 100,000 barrels and a twenty-eight day month.

[e]Plant later rebuilt to use limestone.

Sources:

Capacity data from Canada, Department of Mines, Report on the Mining and Metallurgical Industries of Canada, 1907-1908, p. 802-822.

Other information from Annual Reports of the Ontario Bureau of Mines, 1891 to 1926 inclusive.

Notes:

Plants are listed in order by year production began.

In 1905 the first limestone-using portland cement plant was built in Ontario by the Belleville Portland Cement Company at Point Anne near Belleville. Table (6) lists the limestone-using portland cement producers in Ontario, after Blair (1965, p. 216).

(6) Limestone-Using Portland Cement Producers In Ontario, 1905-1967

County	Place	Company	Year Operation Started	Year Operation Ended
Hastings	Point Anne	Belleville Portland Cement Co.	1905	1909
		Canada Cement Co.	1909	1914
Hastings	Point Anne	Lehigh Portland Cement Co.	1908	1909
		Canada Cement Co.	1909	
Welland	Port Colborne	Canadian Portland Cement Co.	1908	1909
		Canada Cement Co.	1909	
Perth	St. Marys	St. Marys Cement Co.	1912	
Grey	Hanover	Hanover Portland Cement Co.	1920	1925
		Canada Cement Co.	1925	1925
Peterborough	Lakefield	Canada Cement Co.	1927	1933
Oxford	Zorra Station	Canada Cement Co.	1957	
Peel	Clarkson	St. Lawrence Cement Co.	1956	
Prince Edward	Picton	Lake Ontario Portland Cement Co.	1958	

The competition in the cement industry in Canada in 1909 caused a merger of a number of the cement companies to form the Canada Cement Company. The companies in Ontario merging in 1909 to form the Canada Cement Company were four marl-using plants: The Owen Sound Portland Cement Company at Shallow Lake, the Canadian Portland Cement Company at Marlbank, the Canadian Portland Cement Company at Strathcona and the Lakefield Portland Cement Company at Lakefield; and three limestone using cement plants: The Belleville Portland Cement Company at Point Anne, the Lehigh Portland Cement Company at Point Anne, and the Canadian Portland Cement Company at Port Colborne. In addition the merger included two Quebec plants at Hull and Montreal. The four Ontario marl-using plants were closed by 1914. The Lakefield plant was converted to a limestone base in 1927 and operated until 1933.

A good description of the cement industry of Ontario in 1905 is given by Gillespie (1905).

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