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THE ECONOMIC POSSIBILITIES OF MANUFACTURING PORTLAND CEMENT IN WISCONSIN

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THE ECONOMIC POSSIBILITIES OF MANUFACTURING PORTLAND CEMENT IN WISCONSIN

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The principal factors governing successful cement manufacture in Wisconsin are (1) raw materials, (2) market, (3) transportation, and (4) labor.

RAW MATERIALS

This is the most important factor. The plant must be located in a place where abundant supplies of raw materials may be cheaply obtained. These raw materials are limestone or marl, and clay or shale. In previous chapters the following facts in regard to raw materials in Wisconsin have been presented.

1. Limestone. Some of the "glass rock" beds in Grant County are chemically suitable for cement manufacture, but the beds are thin and the overburden usually heavy, making the cost of quarrying high. Though the cost of quarrying does not necessarily condemn a deposit properly located with reference to transportation and center of demand, the location of the Grant County limestone is very unfavorable. All other limestones in the state have such a high magnesia content that they cannot be used for cement manufacture.
2. Marl. Investigation has shown that there is marl

chemically suited to cement manufacture in many localities in Wisconsin.

3. Clays. Investigation during the summer of 1922 has shown that there are chemically satisfactory clays in southeastern Wisconsin.
4. Shale. The analysis indicates that Devonian shale from the intake tunnel north of Milwaukee is chemically suitable for cement. There is considerable doubt whether this shale is near enough to the surface to permit economical exploitation. All samples of Richmond shale which were analyzed are high in magnesia. The fact that certain beds of this formation are being successfully used for the manufacture of tile at Fond du Lac would indicate that there are some beds relatively free from lime. It is possible that future exploration will lead to the discovery of beds chemically suitable for cement manufacture.
5. Michigan stone at lake ports. There is a possibility of shipping in chemically suitable limestone by water from Michigan.

Before the erection of a cement mill can be seriously considered, investigation must be made to determine whether at a suitable site we have marl and shale or clay of proper quality and in sufficient quantity to justify the erection of a mill. This investigation will involve considerable field work to determine what areas are most encouraging.

The geological work should be followed by very careful exploration, sampling, and chemical analyses. Samples from the more favorable sites should be made into cement and the product tested before final decision is made.

Coal is an important factor. We know this must be shipped in. Freight from various mines to certain prospective sites must be considered.

Plant possibilities.--There are two distinct possibilities of plant location as determined by raw materials. First, a plant on the Lake Michigan shore, on Green Bay, or Lake Winnebago utilizing Michigan limestone. Such a plant would have the advantage of water hauled limestone and coal. This plant could use a local clay or shale, or these could be shipped in. Such a plant would be obliged to stock-pile limestone and coal during the transportation season in sufficient quantities to carry the mill through the four months when navigation is closed. Such a plant would not have absolute control of its raw materials unless it bought and operated a quarry outside the state.

The second possibility is a marl plant. The information at hand indicates that such a plant would be located away from the lake and would be dependent upon rail-hauled coal. A million barrel plant would need for a 50 year life 1150 acres of marl averaging ten feet in depth. This means that no small deposit can be considered. The disadvantages of a marl plant are: (1) As excavated the marl contains 50 to 60 per cent of water. This would require a wet process mill involving some-

what higher fuel consumption than would the limestone plant described above. The use of longer kilns makes it possible to use the wet process more efficiently than with short kilns, but there seems to be an advantage of about 5 cents per barrel in favor of the dry process. (2) Marl deposits are likely to be erratic in quantity and quality. Very thorough exploration of the deposits will be necessary to insure the plant against much of this uncertainty. (3) It is impossible to excavate marl during the winter months. The plant would be obliged (a) to shut down during the winter, (b) to stock pile marl during the summer, or (c) to operate during the summer at increased capacity and operate only the clinker grinding department in the winter.

MARKET

Wisconsin offers a good market for Portland cement. In 1920 its rank as a cement consumer was eighth in the Union. The states which used more cement than Wisconsin in that year include New York, Pennsylvania, Illinois, Ohio, California, Michigan, and New Jersey.

According to the U. S. Geological Survey, Wisconsin used 3,484,709 barrels of cement in 1920. Its per capita consumption of cement was 1.31, that of the United States as a whole was only 0.87 per capita . Of the total cement production of the United States 3.4 per cent was consumed in Wisconsin.

In 1921 the total shipment of cement into Wisconsin was 3,849,000 barrels. Of this total 1,173,590 barrels or 30.5 per cent was used in highway construction. This does not include cement for city pavements. In 1922 the total ship-

ments were 3,756,000 barrels. Of this 1,193,800 barrels or about 32 per cent was used in highway construction.

We have no statistics on the distribution of cement other than that used for highway purposes. Assuming that the non-highway cement is distributed equally according to population, the center of non-highway cement consumption coincides with the center of population, which in 1920 was 2.5 miles south of Neshkoro in Marquette County. Since 1880 the center of population has been in eastern Marquette County. If it is fair to assume that the center of consumption of non-highway cement will continue to be relatively near the center of population, it seems likely that this center of consumption will not move very far during the life of a cement mill.

The center of highway construction cement consumption in 1923 was about five miles southwest of Fond du Lac. This center will change somewhat from year to year as the amount of concrete construction in bond issue counties fluctuates. With an increase in concrete construction in the southwestern part of the state, it is to be expected that the general movement of the center of highway consumption will be westward.

There is a strong demand for cement in Wisconsin. A cement plant located near the center of this demand would find a ready market for cement of proper quality. If other factors permit, the plant should be located near the center of least competition with outside plants.

TRANSPORTATION

The mill should be located on or near two competing main railway lines although the question of rates and transfer charges would probably be satisfactorily settled by the Wis-

consin Railroad Commission. The freight rates on cement from Mason City, La Salle, Buffington, Duluth, and Petoskey to Wisconsin points should be determined. With this data it will be possible to construct a freight rate contour map, thus determining the center of least competition.

LABOR

In determining the location of a plant the labor supply and the housing of employees must be considered. If the plant is near a town and transportation can be arranged, labor supply and housing will not present many difficulties. If the plant is at some distance from a town, it will be necessary to establish a village which would contain 500 to 600 people. This would require houses for married men, a boarding house, a church, schools, and a store, as well as sewage, water, and lighting systems. Such an additional expenditure would add materially to the cost of the completed plant. For this reason it would appear advisable to locate a plant near a town.

SIZE AND COST OF MILL

In order to be a real factor in competition and to operate at as low a cost as possible, the mill should have a capacity of 1,000,000 barrels per year.

Hilté estimates (December 9, 1920) that a first class 1,000,000 barrel mill will cost about $4,500,000. The South Dakota Cement Commission reports (January 23, 1923) that the most recent estimate of the cost of a 600,000 barrel state owned plant is $1,500,000. It has been stated recently by a well informed engineer that a 1,000,000 barrel mill would cost about $2,000,000. The average invested capital plus

funded indebtedness of seven Lehigh Valley companies[1] having

[1] United States of America, Plaintiff, v. Cement Manufacturers Protective Association et als, Defendants: In the District Court of the United States, Southern District of New York, Answer of defendant p. 18.

an annual production of about a million barrels is $2,387,000.

COST OF MANUFACTURING CEMENT

In the present state of our knowledge it is futile for the writer to attempt to estimate the cost of manufacturing cement in Wisconsin. A properly located plant with an ample supply of raw materials with proper management would be able to compete successfully with outside mills, since the local plant would have a great advantage in cost of freight on finished cement. This would probably outweigh the increased cost of coal since the freight on the coal necessary to manufacture a barrel of cement is less than the freight on a barrel of cement. For example the freight on 200 pounds of northern Illinois coal at Fond du Lac is 26 cents. The freight on a barrel of cement shipped from La Salle, Illinois to Fond du Lac is 57 cents. If shipped from Buffington, Indiana, the freight is 51 cents per barrel.

The estimated freight advantage in favor of the Fond du Lac plant is 25 cents per barrel. Assuming the fuel consumption at Fond du Lac to be 200 pounds per barrel using the wet process and at La Salle or Buffington 130 pounds per barrel using the dry process, there is a differential of 70 pounds of coal in favor of the outside plant. At $5.00 per ton this is 17.5 cents per barrel, leaving a balance of 7.5 cents in favor of the Fond du Lac plant.

PROFITS OF CEMENT MILLS

There is an impression that the cement mills are making exorbitant profits. The following quotation has reference to nineteen Lehigh District cement manufacturers[1].

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[1] United States of America, Plaintiff, v. Cement Manufacturers Protective Association et als, Defendants: In the District Court of the United States, Southern District of New York, Answer of defendant p. 13.

"Beginning with the common 'pre-war standard' year, the following table gives the average cost per barrel and the average price received per barrel by the defendant manufacturers operating each year from 1913 to 1920, inclusive, together with the percentage which the margin between cost and price bears to the selling price - or what would be the percentage of profit on the selling price but for the fact that other items reducing profit are not included in cost:-"

Year	Cost per barrel	Price received per barrel	Per cent margin to price
1913	$ .7151	$ .8403	14.9
1914	.7398	.8616	14.1
1915	.6796	.7257	6.3
1916	.8158	.9699	15.9
1917	1.1069	1.2410	10.8
1918	1.3923	1.5426	9.7
1919	1.4496	1.6529	12.3
1920	1.7798	1.9290	7.7

The average profit of these companies figured from net income minus taxes on invested capital was in 1919 7.4 per

cent, in 1920 5.0 per cent[1].

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[1]United States of America, Plaintiff, v. Cement Manufacturers Protective Association et als, Defendants: In the District Court of the United States, Southern District of New York, Answer of defendant p. 18.

In the following table the first column represents the average costs of a large group of American mills representing about 25 per cent of the total output of Portland cement.

"It should be noted that the large group tabulated above represent about the lowest-cost large fraction of the American industry; for the American industry taken as a whole the average cost of cement shipped would be from 10 per cent to 20 per cent higher than the costs in Table 214, according to the year and to local conditions as regard coal, labor, etc."[2]

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[2]Eckel, E. C., Cements, limes, and plasters, p. 500, New York, John Wiley & Sons, 1922.

The second and third columns represent the range in average cost at all mills as indicated by Eckel's estimate. The fourth column is the average factory price for the United States as given by the U. S. Geological Survey.

Year	Total cost per barrel shipped from 25 per cent of lowest cost production[1]	Eckel's estimate of total cost at all mills from	to	Average factory price in U. S. per barrel[2]
1913	$ .734	$ .8070	$ .8808	$1.005
1914	.7314	.8045	.8776	.927
1915	.696	.7656	.8352	.86
1916	.798	.8778	.9576	1.103
1917	1.129	1.2419	1.3548	1.354
1918	1.454	1.5994	1.7448	1.598
1919	1.467	1.6137	1.7604	1.71
1920	1.812	1.9932	2.1744	2.02
1921	1.625	1.7875	1.9500	1.89

[1]Eckel, E. C., Cements, limes and plasters, p. 501, New York, John Wiley & Sons, 1922.

[2]Mineral Resources: U. S. Geol. Survey 1921, p. 223.

The difference between the above figures for any year does not accurately measure the average profits since we are not comparing similar data. It does suggest, however, that the profits are not so excessive as has sometimes been stated.

When it is realized that labor and fuel commonly make up about three fourths of the mill cost, it is readily apparent that the rise in the price of cement from 1916 to 1920 was due in large measure to rapidly increasing wages and fuel costs. We can hope for a reduction in the price of cement only as a reflection of reduced cost of labor and coal.

A study of the relative or true prices of cement is interesting. From this table it will be seen that the

PRICES, NOMINAL AND REAL, OF PORTLAND CEMENT 1914 - 1920[1]

Year	Nominal price per barrel in currency	Index number, average prices	Relative or true price
1914	$ 0.927	100	$ 0.927
1915	0.860	101	0.851
1916	1.103	124	0.889
1917	1.354	176	0.770
1918	1.596	196	0.814
1919	1.71	212	0.807
1920	2.01	244	0.829

[1] Eckel, E. C., Cements, limes and plasters, p. 503, New York, John Wiley & Sons, 1922.

relative price of cement from 1915 to 1920 was actually less than the 1914 price and that the nominal price of cement has lagged considerably behind the average of commodity prices. This lag in prices was in part the result of sharp competition between cement mills with productive capacity about 50 per cent in excess of output.

SUMMARY

Granted that investigation develops the fact that there are several places where raw materials of proper quality exist in sufficient quantity, the final decision regarding the location of a plant will depend upon a proper balancing of the remaining factors (1) location with reference to center of demand, (2) location with reference to center of least outside competition, (3) transportation, (4) labor, and (5) cost of fuel. In order to save time and expense the investigation should be confined to the area defined by the four factors mentioned above.

THE NEED FOR A CEMENT MILL IN WISCONSIN

We believe that a cement plant in Wisconsin is absolutely essential to uninterrupted progress in concrete highway construction and that the point has been reached where the existing mills cannot supply the demand.

	Percentage of capacity utilized			
	1918	1919	1920	1921
United States as a whole	51.7	60.2	68.3	69.6
Mills directly affecting the supply of Wisconsin	51.9	63.9	73.9	75.5

It will be noted from the above figures that during this period the mills have greatly increased the percentage of capacity utilized and that the mills affecting the supply of Wisconsin have been increasing this percentage at a more rapid rate than has the country as a whole. This is probably a reflection of the large concrete paving programs of this area.

The question of vital importance to Wisconsin is whether or not the mills now supplying her needs can increase their output fast enough to supply the rapidly increasing demand. One hundred per cent capacity has not been reached and we believe it will not be reached. On the contrary we believe that the existing mills are approaching the practical limit of their capacity if they have not already reached it. This reduction in the theoretical capacity is due to the following conditions:

1. Production. Mills operate at full capacity for but a few months in the summer. This is due to (a) the demand for cement is heaviest during the construction season, (b) because of lack of storage capacity or lack of capital to finance storage the mills are unable to store adequate supplies of cement during the season of decreased demand. It has been impossible to induce consumers to anticipate their needs and store adequate stocks of cement in advance of their needs. If the mills provide this storage, it means an increase in price. Shortage of coal and transportation difficulties are additional factors which frequently limit production.
2. Distribution. Shortage of coal or cars, and strikes have seriously hampered the movement of cement away from the mills and have thus prevented capacity production even during the summer.

It is certain that the demand for cement is increasing. We belisve that the existing mills have about reached their practical production capacity. With inoreasing demand and at best but slightly increasing supply, Wisconsin faces the obvious result - rising prices of cement with increasing difficulties due to shortage of supply.

Two solutions are possible, the construction of a cement mill in Wisconsin, or the construction of new mills in the territory which now supplies our needs. The only solution possible by state action is the erection of a state owned plant.

The State of Wisconsin is engaged in a great business

undertaking, the construction of highways. This business can easily absorb the entire output of a 1,000,000 barrel cement mill. The economic possibilities of such a mill have been discussed. Whether for the purpose of erecting a plant by the state, or for the purpose of stimulating the erection of a plant by private capital, we believe that the raw materials for cement manufacture should be investigated, and have estimated the cost of such investigation. In the following pages we have also summarized some of the more apparent advantages and disadvantages of a state owned plant.

ESTIMATED COST OF INVESTIGATION OF RAW MATERIALS FOR CEMENT MANUFACTURE

If the investigation of raw materials were limited to the rectangular area extending from Fond du Lac to Racine and west from the lake to Madison, the estimated budget of minimum expenditure would be as follows:

Geological work	$4,500
Testing of most promising deposits	
Marl	5,000
Clay	3,000
Chemical analyses of samples	4,500
Practical cement testing of samples	1,000
Total	$18,000

SUGGESTIONS FOR FURTHER INVESTIGATION

In case investigation shows that raw materials of satisfactory quality and in sufficient quantity are available, the following investigation is necessary before a state plant can be established.

1. Consumption. A careful study should be made of the present consumption of highway cement and an estimate made of the probable future demand. With this data it will be possible to forecaet the m ovement of the center of consumption during the life of a plant.
2. Transportation. This should include (a) freight per ton on coal to the possible mill sites, (b) freight on cement from each prospective site to each county. From this data the total cement freight bill for

each site can be computed. (c) Freight per barrel to each county and total freight on cement from each of the outside mills which are now supplying the greater part of highway cement. (d) A study should probably be made of the present and future concrete highways in the vicinity of each prospective site.

3. Labor. The use of prison labor should be considered. The relative costs of prison labor and ordinary labor should be compared. This should include total cost of housing and labor in each case.

4. Plans for mill and estimate of cost of construction of mill and cost of cement manufacture. A careful study of consumption, transportation, and cost of manufacture should lead to the selection of the site best suited to the needs of the state. If it is evident that cement can be manufactured at this site at such a cost that cement can be delivered within the state at costs well within the delivered cost of cement from outside mills, the state should probably build a mill.

5. Plans for financing a mill. This involves many interesting considerations which cannot be discussed here. One consideration, however, is essential in estimating cost of finished cement. If funds are raised by general taxation, the estimated cost of manufacture and the selling price should include maintenance, interest on investment, and an annual return of capital sufficient to wipe out the investment in twenty years. This is necessary since the counties will not share in the advantages of the cement mill in direct proportion to their share in taxes.

ADVANTAGES AND DISADVANTAGES OF A STATE OWNED PLANT COMPARED WITH PRIVATELY OWNED PLANT

A. ADVANTAGES

1. The state owned plant would pay no taxes. This would effect a saving of from 3 to 6 cents per barrel.
2. There would be no selling cost. Estimates on this vary considerably. We assume an average figure of 10 cents per barrel.
3. No financial or general overhead expense. This is estimated to be 2 cents per barrel.
4. Elimination of profit of private company. Not estimated.

The total estimated direct advantage of a state owned mill is 15 cents per barrel.

5. Indirect advantage in general stabilization of price.
6. Greater assurance of supply needed for highway construction.
7. No promotion cost.
8. Possible saving effected by using prison labor.

B. DISADVANTAGES

1. The usual criticism - that the state operation of a business is not efficient.
2. Such a plant could not serve all parts of the state.