GHQ/SCAP Records(RG 331)
Description of contents

(1) Box no. 2494

(2) Folder title/number: (2)
Cement Industry of Japan

(3) Date: Apr. 1948

(4) Subject:

Classification	Type of record
621	d

(5) Item description and comment:
NRS Report No. 105

(6) Reproduction: Yes No

(7) Film no. Sheet no.

105

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CEMENT INDUSTRY OF JAPAN

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
NATURAL RESOURCES SECTION
REPORT NO 105

TOKYO 1948

REPORT NUMBER 105

29 April 1948

CEMENT INDUSTRY OF JAPAN

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
Natural Resources Section

NATURAL RESOURCES SECTION
REPORT NUMBER 105
29 April 1948

CEMENT INDUSTRY OF JAPAN

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CEMENT INDUSTRY OF JAPAN

SUMMARY

1. Japan was among the five leading countries of the world in the production of cement from 1935-45. However, its cement production capacity has never been fully utilized. In 1946, production was about 20 percent of usable capacity, and 36.4 percent of 1946 shipments were to the Occupation Forces.

2. The demand for cement for home consumption is expected to increase. The cement industry can supply the national demand, and an exportable surplus can be developed if coal, shipping, and repair materials are made available. Exports of cement to countries outside Japanese influence averaged 8.3 percent of the total production from 1931-40, while total exports were 21.8 percent.

3. Most of the Japanese cement factories were designed, built, and for a time operated by foreign engineers. Between 1919 and 1937, 10 Japanese manufacturers produced 24 rotary kilns, 13 firms produced 43 raw grinding mills, and 10 firms made 37 finishing grinding mills. Thirty-nine of the 131 rotary kilns in Japan in 1939 have been transferred overseas.

4. Since 1938 the trend has been toward consolidation of ownership into fewer companies. Continuous operation of only the efficient plants located near consumption centers would be effective in saving coal, increasing kiln lining life, and reducing unit production costs.

INTRODUCTION

1. General

The demand for cement in Japan will continue for many years. Sufficient reserves of raw materials for cement production to support a peacetime economy are available within the Home Islands. Major equipment, although partially neglected during World War II, can be repaired. However, shortages of coal and transportation, particularly coastwise shipping, impede the attainment of an economic production level.

The cement plants are well distributed throughout the Home Islands; 22 are on Honshu, 12 on Kyushu, 2 on Hokkaido, and 1 on Shikoku. Since 1939 many have been relocated nearer consumption centers.

Japan was one of the five leading cement-producing countries from 1935-45, according to available records. Data on year-end factory stocks are conflicting but indicate that from 1930-44 the stocks were less than six percent of production. During the Japanese war period (1938-45), cement plants produced pig iron, steel, nickel, and alumina.

The effective capacity of the Japanese cement industry has never been fully utilized. In this report the term "capacity" means apparatus capacity, the ability of the plant to produce cement. Shortages of raw materials and difficulties in transportation are not considered in this connection. Capacities may be segregated into the following categories: (a) rotary kiln, (b) designed, (c) repairable, and (d) usable.

This report was prepared by Lawrence G. Houk, scientific consultant, Mining and Geology Division.

The number of companies engaged in producing cement increased from 1925-38. Since then the number of companies has steadily decreased through amalgamations and consolidations. Six companies now control 85.2 percent of the capacity.

The number of plants operated by the various companies followed the same pattern but to a lesser degree. Rotary kiln transfers since 1931 total 52, of which 39 were transferred overseas. These transfers aided in disposing of excess production capacity. In 1946 Japan had 84 rotary kilns, 132 raw grinding mills, and 120 finishing mills for cement making. No major equipment has been manufactured or purchased since 1939.

The Japanese cement industrialists have followed foreign improvements in manufacturing technique and machinery design. They have tried to increase efficiency by utilizing waste heat and diversifying their products. As most of the cement plants have been designed and built by foreign engineers, their technique follows European and American practices.

Portland cement accounted for 95 percent or more of the total production from 1925-35. The proportion in other types of cement has increased gradually since 1935, until in 1940 they accounted for 28 percent and in 1943 to 42 percent of the total production.

Coal consumption per ton of clinker produced averaged 279 kilograms, or 27.9 percent, from 1932-39. The average consumption of coal in the United States was 33.4 percent in 1944, while in Japan it was 38.9 percent in 1946 and 42.0 percent in 1947.

Twenty-seven plants utilize waste heat for the production of electrical energy. Three plants have the equipment but do not use it, and seven have no facilities for producing electricity.

Cost data are very misleading, owing to an inflationary cycle, but indicate the general and irregular rise in costs. The prices of cement have been increased in an attempt to balance cost and prices. The output per man employed has decreased steadily since 1940. In 1947, labor unrest, increase in working population, and decrease in efficiency and attendance have increased unit costs and decreased output per man. Lack of sufficient inland rail and coastwise shipping for raw materials and finished products has also increased costs and decreased production.

A cement federation formed in 1923 was not effective until 1937, when companies inside and outside the federation were brought under government regulation. Supervision of distribution is now under the Ministry of Commerce and Industry.

The cement industry of Japan was damaged slightly by the war. Explosive bomb damage to major equipment was limited to two plants. Five other plants were damaged by incendiaries. All war damage was repaired within six months after the cessation of hostilities.

All basic data in this report are from Japanese sources. Some inconsistencies have resulted from inaccurate translation and Japanese statistical methods.

Table 1, as shown on page 6, presents the salient statistics of the cement industry. These data represent the best available summary. Chaotic conditions following surrender, loss of records through bombing, and problems in obtaining complete coverage have made gathering facts on the cement industry difficult.

2. <u>Historical Summary</u>

The first Japanese portland cement plant was established in Fukagawa, Tokyo Prefecture, in 1871 by the Public Works Bureau of the Home Ministry. The first cement plant built with private capital was constructed in 1881, and in 1896 Japan began exporting cement. The first rotary kiln was introduced from the United States in 1903. During World War I Japan increased its productive capacity and monopolized the oriental markets. The recession following World War I and depression resulting from overproduction and overexpansion were temporarily relieved by the reconstruction of the Tokyo and Yokohama areas after the Kanto earthquake in 1923. In 1923 a cement federation was formed to maintain prices and to adjust supply and demand, and in 1933 an export group, Japan Export Assn, was formed. At no time did the associations represent the entire cement manufacturing industry.

TABLE 1 - THE JAPANESE CEMENT INDUSTRY, 1931-46						
Calendar Year	Capacity (metric tons)	Production All Types (metric tons)	Imports (metric tons)	Exports (metric tons)	Factory Stock a/ at End of Current Year (metric tons)	Apparent Consumption (metric tons)
1931	5,666,400	3,198,677	52,817	841,098	131,715	2,424,262
1932	5,995,320	3,386,516	17,572	779,148	91,543	2,665,112
1933	6,960,360	4,316,883	16,676	1,058,137	121,197	3,245,768
1934	8,709,480	4,428,780	4,450	1,176,400	134,524	3,243,503
1935	10,984,800	5,484,857	102,600	1,317,436	236,918	4,167,627
1936	11,645,280	5,578,985	182,500	1,389,028	242,743	4,366,632
1937	12,875,760	5,982,215	183,549	1,338,298	252,499	4,817,710
1938	13,911,840	5,476,516	97,789	972,189	296,278	4,558,337
1939	14,386,560	5,979,042	21,175	1,561,476	183,778	4,551,241
1940	9,763,200	6,048,499	0	529,415	323,253	5,379,609
1941	9,621,600	5,836,378	0	762,218	311,825	5,291,750
1942	7,797,600	4,356,628	17,070	165,950	234,771	4,284,802
1943	6,613,200	3,739,248	128,209	95,711	125,000	3,881,517
1944	5,956,800	2,959,686	32,130	15,076	128,230	2,973,510
1945	6,109,200 b/	1,176,859	0	2,700	131,184	1,131,205
1946	6,109,200	927,089	0	31,144	110,729	916,400

Calendar Year	Number of Companies	Number of Factories	Number of Kilns*	Value at Mill (yen/ metric ton)	Production Portland Cement (metric tons)	Production Other Types (metric tons)
1931	16	32	87	18.50	3,098,677	100,000
1932	16	33	88	19.50	3,268,516	100,000
1933	18	33	91	20.20	4,174,883	142,000
1934	18	33	100	17.40	4,242,780	186,000
1935	22	40	113	17.00	5,216,857	268,000
1936	25	42	117	17.00	5,175,415	403,570
1937	26	44	124	17.00	5,415,545	566,670
1938	28	47	129	18.20	4,750,002	696,514
1939	26	46	131	18.20	4,932,076	1,046,966
1940	21	39	117	18.40	4,379,394	1,669,105
1941	19	38	107	18.40	4,639,346	1,197,032
1942	14	36	100	25.75	3,037,456	1,319,172
1943	13	32	80	29.72	2,187,155	1,552,093
1944	10	30	72	41.00	2,100,242	859,444
1945	11	36	84	83.60	976,065	200,794
1946	13	37	84	240.00	742,821	184,268

a/ Does not include government and privately held stocks in warehouses or clinker stock
b/ Repairable capacity
SOURCE: Cement Industrial Assn

A second expansion in production capacity began in 1931. Each company, in order to obtain larger production quotas, enlarged its plants until rotary kiln capacity exceeded output by more than 150 percent (1938). During 1934 powerful interests outside the association almost broke its power. The Ministry of Commerce and Industry curbed this competition and expansion by applying the Major Industries Control Law to the cement industry. Those inside and outside the association were brought under government regulation. However, new companies were formed in Korea, Formosa, and Manchuria, and the competition continued until 1937, when complete control was created for the empire.

In 1940 the Cement Distribution Co, Ltd, a governmental agency, was formed to ration cement, and in the following year the Portland Cement Control Assn was formed to control both production and distribution. Following Japan's surrender after World War II, the Cement Control Assn was dissolved.

PRODUCTION

1. Japanese Production

Production of all types of cement in Japan increased gradually from 3,247,951 metric tons in 1930 to the peak in 1940, when 6,048,499 metric tons were produced. A slight decrease in production in 1941 was followed by a sharp drop which lasted to the end of the war in 1945, when only 1,176,859 metric tons were produced. In 1946, the first full peacetime year, production was only 927,089 metric tons. The decline subsequent to 1940 can be attributed to an economy geared for war, decrease in construction, and diversion of labor to more essential industries.

Production data in Table 2 include all manufactures within the Home Islands.

TABLE 2 - CEMENT PRODUCTION, IMPORTS, DOMESTIC SHIPMENTS, EXPORTS, AND YEAR-END STOCKS, 1930-46
(metric tons)

Calendar Year	Production	Imports a/	Shipment	Exports b/	Factory Stocks at End of Year c/
1930	3,247,951	56,033	2,686,484	574,161	145,581
1931	3,198,677	52,817	2,576,484	841,098	131,715
1932	3,386,516	17,572	2,711,525	779,148	91,543
1933	4,316,883	16,676	3,436,836	1,058,137	121,197
1934	4,428,780	4,450	3,378,233	1,176,400	134,524
1935	5,484,857	102,600	4,287,181	1,317,436	236,918
1936	5,578,985	182,500	4,554,088	1,389,028	242,743
1937	5,982,215	183,549	4,901,809	1,338,298	252,499
1938	5,446,516	97,789	4,817,983	972,189	296,278
1939	5,979,042	21,175	4,639,832	1,561,476	183,778
1940	6,048,499	0	4,829,290	529,415	323,253
1941	5,836,378	0	4,967,056	762,218	311,825
1942	4,356,628	17,070	3,965,713	165,950	234,771
1943	3,739,248	128,209	3,469,047	95,711	125,000
1944	2,959,686	32,130	2,865,245	15,076	128,230
1945	1,176,659	0	1,038,444	2,700	131,184
1946	927,089	0	916,450	31,144	110,729

a/ Shipments from Formosa and Korea, then parts of Japanese Empire. No cement was imported from foreign countries.
b/ Shipments to both the former Japanese territories and foreign countries.
c/ Stocks owned by factories, not including private or government cement stocks or clinker stocks, even though they may be at the factory.
SOURCE: Cement Industrial Assn

Of the eight administrative districts, Kyushu (Fukuoka) produced the most cement from 1930-46, 22,434,076 metric tons, or 31.1 percent of the total production during that period. Kanto (Tokyo) produced 11,212,115 metric tons, or 15.6 percent of the total. Kinki (Osaka) produced 15.2 percent of the total, Chugoku (Hiroshima) 14.9 percent, Tokai (Nagoya) 7.9 percent, Tohoku (Sendai) 7.7 percent, Hokkaido (Sapporo) 4.8 percent, and Shikoku 2.8 percent. Table 3, as shown on page 8, lists annual production by administrative districts.

TABLE 3 - CEMENT PRODUCTION IN JAPAN BY DISTRICTS, 1930-46
(metric tons)

Year	Hokkaido	Tohoku	Kanto	Tokai
1930	157,554	247,190	599,110	235,657
1931	139,355	230,282	573,433	216,099
1932	139,678	248,092	593,166	247,449
1933	172,889	319,288	725,997	378,886
1934	223,829	337,271	739,607	367,187
1935	259,486	377,356	695,552	447,909
1936	239,715	329,961	645,732	474,805
1937	244,976	407,502	824,571	578,188
1938	252,605	373,509	932,071	603,832
1939	268,610	484,101	957,499	597,239
1940	278,501	531,720	902,179	490,778
1941	268,100	539,737	866,726	436,126
1942	238,753	344,306	684,469	181,992
1943	218,059	299,847	593,728	144,638
1944	212,925	292,139	509,069	144,106
1945	86,949	113,479	179,570	71,535
1946	39,520	82,577	189,636	83,278
TOTAL	3,441,504	5,558,357	11,212,115	5,699,704

Year	Kinki	Chugoku	Shikoku	Kyushu	Total
1930	376,503	435,037	99,771	1,097,129	3,247,951
1931	407,516	445,073	113,644	1,073,275	3,198,677
1932	414,176	499,427	102,133	1,142,395	3,386,516
1933	563,827	642,484	129,621	1,383,891	4,316,883
1934	618,559	634,108	167,810	1,340,409	4,428,780
1935	841,365	851,774	182,552	1,828,863	5,484,857
1936	964,709	907,268	156,513	1,860,282	5,578,985
1937	1,030,414	795,336	172,889	1,928,339	5,982,215
1938	903,259	765,596	153,694	1,461,950	5,446,516
1939	992,257	837,161	151,155	1,691,020	5,979,042
1940	989,675	965,845	158,673	1,731,128	6,048,499
1941	1,022,766	936,397	144,725	1,621,801	5,836,378
1942	704,960	671,024	117,093	1,414,031	4,356,628
1943	537,019	690,368	81,630	1,173,759	3,739,048
1944	349,969	382,926	77,279	991,273	2,959,686
1945	92,017	152,670	30,200	449,494	1,175,914
1946	92,443	177,948	16,650	245,037	927,089
TOTAL	10,901,434	10,790,442	2,056,032	22,434,076	72,093,664

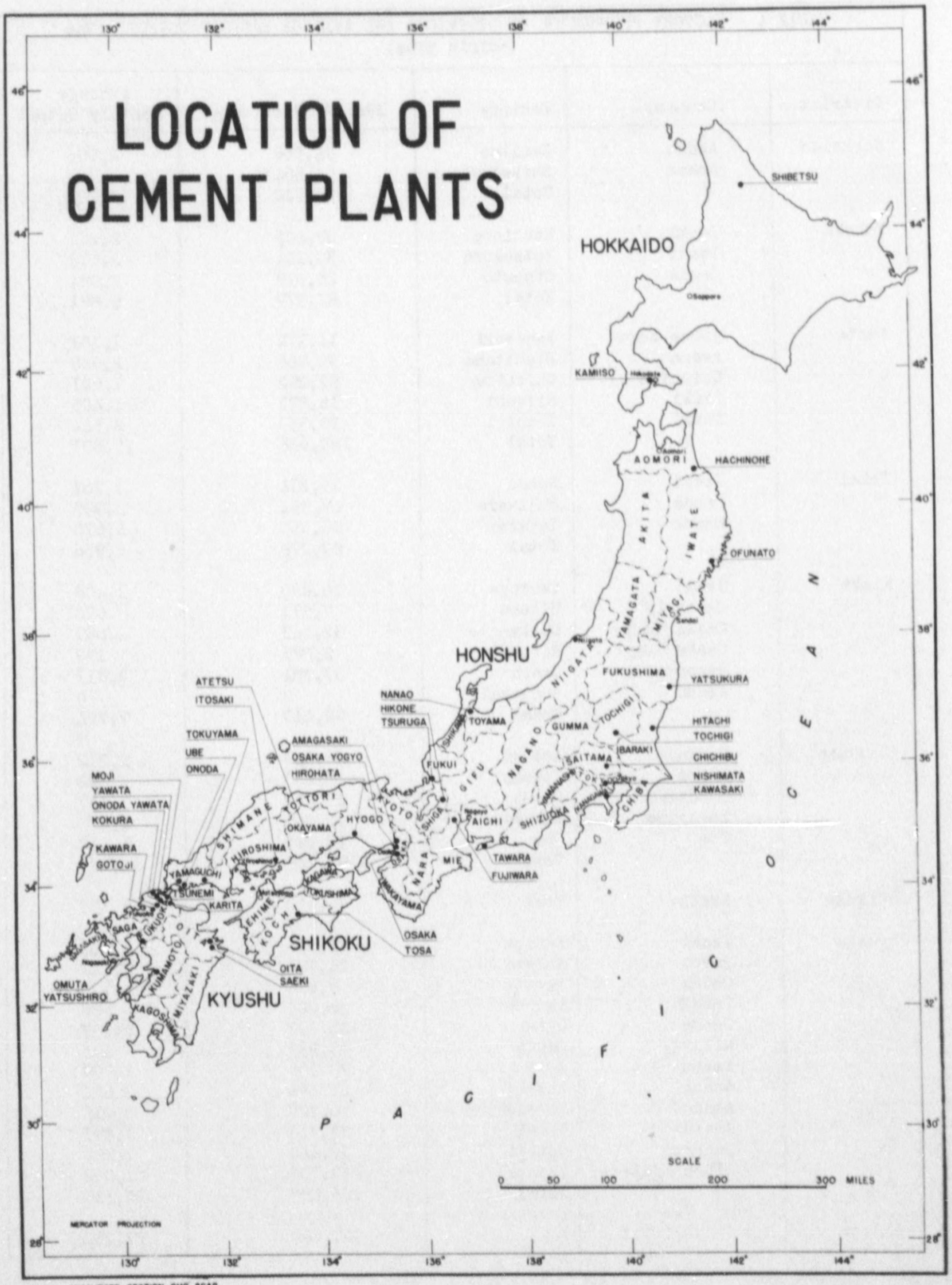
SOURCE: Cement Industrial Assn

Thirty-seven cement plants are dispensed throughout the Home Islands, with 22 on Honshu, 12 on Kyushu, 2 on Hokkaido, and 1 on Shikoku. Figure 1 shows the location of the cement plants. No data are available on consumption by locality, but in 1941 the Asano Cement Co pointed out that many cement plants were poorly situated with regard to demand centers.

Table 4, as shown on page 10, gives the 1946 production and monthly average by administrative district, company, and factory.

The number of cement-producing companies increased slowly from 1925-38, then steadily decreased through amalgamation and consolidation. The number of factories remained nearly constant from 1925-34, increased from 33 plants in 1934 to 47 in 1938, then decreased to 30 in 1944. In 1925, 19 companies were operating 30 plants; in 1938, 28 operated 47 plants; and in 1946, 12 operated 37 plants.

Table 5, as shown on page 11, lists the number of companies and plants in operation each year from 1925-46.



NATURAL RESOURCES SECTION GHQ SCAP

Figure 1

TABLE 4 - FACTORY PRODUCTION BY DISTRICTS AND AVERAGE MONTHLY OUTPUT, 1946
(metric tons)

District	Company	Factory	1946 Production a/	Average Monthly Output
Hokkaido	Asano	Kamiiso	34,856	2,905
	Asano	Shibetsu	4,664	389
		Total	39,520	3,294
Tohoku	Iwaki	Hachinoe	27,405	2,284
	Iwaki	Yotsukura	30,154	2,513
	Onoda	Ofunato	25,018	2,084
		Total	82,577	6,881
Kanto	Nihon Koro	Kawasaki	14,172	1,181
	Asano	Nishitama	35,768	2,980
	Chichibu	Chichibu	92,292	7,691
	Iwaki	Hitachi	16,871	1,405
	Iwaki	Tochigi	30,533	2,544
		Total	189,636	15,801
Tokai	Iwaki	Nanao	15,234	1,267
	Onoda	Fujiwara	47,994	3,999
	Onoda	Tawara	20,050	1,670
		Total	83,278	6,936
Kinki	Iwaki	Tsuruga	16,890	1,408
	Onoda b/	Hikone	7,571	630
	Osaka Yogyo	Osaka	32,143	2,689
	Osaka Yogyo	Hirohata	2,075	173
	Asano	Osaka	33,764	2,813
	Asano	Amagasaki	0	0
		Total	92,443	7,704
Chugoku	Onoda	Atetsu	26,549	2,212
	Asano	Itosaki	8,660	722
	Onoda	Onoda	45,079	3,757
	Tokuyama	Tokuyama	20,045	1,670
	Ube	Ube	77,615	6,468
		Total	177,948	14,829
Shikoku	Asano	Tosa	16,650	1,388
Kyushu	Iwaki	Karita	22,356	1,863
	Toyo	Kokura	24,171	2,014
	Onoda	Yawata	8,678	723
	Onoda	Tsunemi	6,004	500
	Onoda	Oita	26,822	2,237
	Mitsui	Omuta	5,939	495
	Asano	Moji	20,506	1,709
	Asano	Kawara	43,490	3,624
	Asano	Yatsushiro	36,220	3,018
	Asano	Saeki	22,710	1,893
	Sangyo	Gotoji	15,440	1,287
	Nihon Seitetsu	Yawata	12,701	1,058
		Total	245,037	20,419
	GRAND TOTAL		927,089	77,257

a/ Calendar year
b/ Returned to Nozawa Sekimen Kogyo KK, February 1947
SOURCE: Cement Industrial Assn

TABLE 5 - NUMBER OF CEMENT COMPANIES AND PLANTS, 1925-46					
Calendar Year	Number of Companies	Number of Plants	Calendar Year	Number of Companies	Number of Plants
1925	19	30	1936	25	42
1926	18	30	1937	26	44
1927	17	29	1938	28	47
1928	18	32	1939	26	46
1929	16	31	1940	21	39
1930	16	31	1941	19	38
1931	16	32	1942	14	36
1932	16	33	1943	13	32
1933	18	33	1944	10	30
1934	18	33	1945	11	36
1935	22	40	1946	12	37

SOURCE: Cement Industrial Assn

2. Comparison With World Production

World production of hydraulic cement from 1939-45 by countries is listed in Table 6, starting on page 12. Japan has been among the leading cement-producing countries since 1935. Comparison of the production of the Japanese cement industry with that of the United States shows that in 1939 the United States produced 3.5 times as much as Japan; in 1940, 3.7 times; in 1941, 4.9 times; in 1942, 7.3 times; in 1943, 6.2 times; in 1944, 5.3 times; and in 1945, 14.9 times the amount produced in Japan. The data available for Russia for 1939 and 1940 show that its cement industry was about as large as the Japanese industry.

3. Other Products Manufactured

Table 7, shown on page 15, gives data of by-products from seven plants during 1938-45.

4. Stocks

Table 8, shown on page 16, shows that no large stocks of cement have been accumulated at any period since 1925. It also shows the increase in production of types other than portland cement during the war years, and a sharp decrease in total production of cement since 1943.

CAPACITIES

1. General

Cement production in Japan under the present conditions of limited coal supplies and repair materials, as well as restricted transportation facilities, is only a fraction of capacity. However, the major equipment exists, ready for repair and an increase in production when normal conditions return.

Capacities are segregated into four categories in order that the potentialities under present and future conditions may be considered. The categories are: (a) rotary kiln, (b) designed, (c) repairable, and (d) now usable.

2. Rotary Kiln

The rotary kiln capacity as reported by the Cement Industrial Assn was 10,474,827 metric tons annually; as computed by the Economic and Scientific Section, General Headquarters, Supreme Commander for the Allied Powers, it was 9,580,200 metric tons. An average of these figures gives a rotary kiln capacity of about 10,000,000 metric tons.

TABLE 6 -- WORLD PRODUCTION OF HYDRAULIC CEMENT, 1939-45
(metric tons)

Country	1939	1940	1941	1942	1943	1944	1945
North America							
Canada	909,875	1,200,143	1,328,587	1,448,818	1,159,286	1,141,595	1,330,116
Cuba	a/	a/	154,618	165,189	169,609	173,750	180,166
Guatemala	a/	a/	a/	a/	a/	a/	a/
Mexico	409,784	484,992	537,464	588,476	578,253	a/	a/
Nicaragua	a/	a/	a/	620	10,627	a/	a/
United States	21,267,269	22,640,675	28,465,880	31,609,381	23,067,914	15,716,820	17,533,628
South America							
Argentina	1,127,608	1,082,279	1,168,281	1,076,858	957,076	a/	a/
Bolivia	a/	24,285	a/	22,579	22,675	a/	a/
Brazil	697,793	743,634	767,506	752,839	747,409	809,908	815,000 b/
Chile	340,758	385,091	359,720	364,584	374,747	362,877	a/
Colombia	167,000	187,619	210,912	207,793	258,578	281,626	300,981
Ecuador	14,249	16,481	17,014	19,802	27,860	34,607	38,170 b/
Peru	119,986	124,480	167,872	138,882	208,599	248,537	255,000 b/
Uruguay	173,500	167,880	179,066	a/	a/	165,990	185,290
Venezuela	38,399	87,068	115,415	121,833	111,721	119,670	a/
Europe							
Albania	a/	a/	a/	a/	a/	a/	a/
Belgium	2,551,756	212,550 c/	630,580 c/	510,670 c/	459,520 c/	141,750 c/	647,200
Bulgaria	180,000 b/	a/	a/	a/	a/	a/	a/
Czechoslovakia d/	276,000	214,000	300,000	320,000	350,000	a/	a/
Denmark	696,000	441,000	a/	a/	a/	a/	a/
Eire	261,000	272,000	294,000	202,000	251,980	222,515	a/
Estonia	77,000	a/	a/	a/	a/	a/	a/
Finland	563,000	301,000	307,000	179,000	a/	a/	a/
France	a/	a/	3,402,000	3,462,000	2,934,000	1,467,000	1,500,000
Germany e/	13,957,000	10,746,000	11,349,000	7,287,000	9,073,000	a/	a/
Austria	742,000	819,000	842,000	682,000	773,000	a/	a/

Continued

TABLE 6 -- WORLD PRODUCTION OF HYDRAULIC CEMENT 1939-45 (CONT'D)
(metric tons)

Country	1939	1940	1941	1942	1943	1944	1945
Greece	343,000	190,000	63,000	30,000	a/	a/	a/
Hungary	a/	a/	a/	a/	a/	a/	a/
Italy	5,111,610	4,802,124	2,793,548	a/	a/	a/	a/
Latvia	164,601	a/	a/	a/	a/	a/	a/
Netherlands	541,000	a/	a/	a/	a/	a/	a/
Norway	390,000	337,849	312,830	373,648	a/	a/	a/
Poland	a/	a/	a/	a/	a/	a/	a/
Portugal	297,000	273,000	272,000	186,967 f/	246,799	252,000 b/	198,530 f/
Roumania	531,000	400,000	368,000	357,000	493,000	a/	a/
Spain	1,194,481	1,557,878	1,639,923	1,646,280	1,701,520	1,843,037	1,544,448
Sweden	1,184,991	700,749	645,023	823,880	935,000	a/	a/
Switzerland	a/	650,000	711,000	439,000	367,000	430,000	415,000
USSR	5,700,000	5,800,000	a/	a/	a/	a/	a/
United Kingdom	a/	a/	a/	a/	a/	a/	a/
Yugoslavia	663,000	a/	a/	a/	750,000 b/	a/	a/
Asia							
China	540,000 g/	652,500	a/	a/	a/	a/	a/
Manchuria	a/	a/	a/	a/	a/	a/	a/
Hong Kong	110,000 b/	a/	a/	a/	a/	a/	a/
India, British	a/	a/	a/	a/	a/	a/	a/
Indo-China	305,800	278,500	a/	a/	a/	a/	a/
Iran	a/	69,000	55,000	55,000	35,000	38,000	a/
Japan	5,979,042	6,048,499	5,836,378	4,356,628	3,739,248	2,959,686	1,176,859
Korea (Chosen)	1,200,000 b/	a/	a/	a/	a/	a/	a/
Netherlands Indies	170,000 b/	a/	a/	a/	a/	a/	a/
Palestine	112,350	148,487	114,841	216,577	166,804	176,499	147,237
Philippine Islands	a/	a/	a/	a/	a/	a/	a/
Siam (Thailand)	92,000 b/	116,864 b/	a/	a/	a/	a/	a/
Syria and Lebanon	227,285	91,653	82,400	214,800	151,900	155,000	190,000
Turkey	283,624	267,054	272,919	210,855	151,472	285,350	300,000 b/

Continued

TABLE 6 -- WORLD PRODUCTION OF HYDRAULIC CEMENT 1939-45 (CONT'D)
(metric tons)

Country	1939	1940	1941	1942	1943	1944	1945
Africa							
Algeria	a/	a/	a/	a/	a/	95,000	a/
Belgian Congo	35,000	24,700	42,586	64,340	69,221	84,776	a/
Egypt	371,941	360,832	420,107	420,980	322,859	423,902	a/
Eritrea	30,000	15,000	9,000	25,000	27,500	38,000	a/
Morocco, French	a/	a/	a/	a/	140,000 b/	a/	a/
Mozambique	27,618	27,893	27,260	24,941	30,647	27,932	a/
Tunisia	66,500	61,800	57,200	56,300	17,812	58,428	a/
Union of South Africa	948,664	831,018	878,000	948,000 b/	915,000 b/	a/	a/
Oceania							
Australia i/							
New South Wales	409,896	381,697	390,171	337,947	351,887	313,976	a/
Tasmania	92,190	93,921	85,729	53,324	43,530	a/	42,782
Victoria	180,349	228,388	215,301	172,017	a/	127,971	133,407
New Zealand j/	235,000	218,000	a/	a/	217,000 b/	a/	a/
	93,000,000 b/	81,000,000 b/	77,000,000 b/	72,000,000 b/	81,000,000 b/	a/	a/

a/ Data not available; estimate included in total, except for 1944 and 1945.
b/ Estimate
c/ Excludes portland cement data, which are not yet available.
d/ Slovakia only
e/ Includes Sudetenland
f/ January to September inclusive
g/ Shipments
h/ Year ended 31 March of year stated
i/ Cement is also produced in Queensland and South Australia, but data are not released.
j/ Year ended 30 June of year stated.

SOURCE: Minerals Yearbook, US Bureau of Mines; figures for Japan from the Japanese Cement Industrial Assn

TABLE 7 -- PRODUCTION OF BY-PRODUCTS, BY ROTARY KILNS IN JAPANESE CEMENT FACTORIES, 1938-45
(metric tons)

	Iwaki's Nanao Plant	Asano's Moji Plant		Chichibu's Chichibu Plant	Onoda's Onoda Plant	Nihon Koro's Kawasaki Plant
Calendar Year	Luppe	Sponge Iron	Pig Iron	Pig Iron a/ (by Basset method)	Alumina b/ Clinker	Pig Iron (by Basset method)
1938	0	0	0	258	0	43
1939	219	0	0	649	0	0
1940	6,119	0	0	0	0	0
1941	11,795	11,712	0	56	0	0
1942	16,416	11,668	0	0	0	0
1943	24,939	2,711	193	0	0	0
1944	15,787	0	202	0	34,878	0
1945	2,089	0	0	0	24,669	0
TOTAL	77,364	26,091	395	963	59,547	43

a/ Itosaki of Nihon Cement Co produced 2,720 tons of pig iron in 1939.
b/ Osaka Yogyo produced 14,687 tons of alumina clinker in 1945.
SOURCE: Cement Industrial Assn

TABLE 8 -- PRODUCTION AND STOCKS OF PORTLAND CEMENT AND OTHER TYPES, 1925-46
(metric tons)

Calendar Year	Production				Stocks a/			
	Portland	Percent of Total	Others	Total	Portland	Others	Total b/	Clinker
1925	2,210,414	97	60,000	2,270,114	105,701	2,300	108,001	ND
1926	2,840,041	97	60,000	2,900,041	87,302	2,400	89,702	ND
1927	3,189,193	98	60,000	3,249,193	107,157	2,500	109,657	ND
1928	3,405,272	97	70,000	3,475,272	72,357	3,000	75,357	62,915
1929	3,683,697	97	80,000	3,763,697	165,132	2,500	167,632	73,375
1930	3,147,951	97	100,000	3,247,951	ND	ND	145,581	83,211
1931	3,098,677	97	100,000	3,198,677	128,115	3,600	131,715	66,905
1932	3,286,516	97	100,000	3,386,516	88,343	3,200	91,543	120,748
1933	4,174,883	97	142,000	4,316,883	116,318	4,879	121,197	ND
1934	4,242,780	96	186,000	4,428,780	128,271	6,253	134,524	107,656
1935	5,216,857	95	268,000	5,484,857	224,598	12,320	236,918	206,529
1936	5,175,415	93	403,570	5,578,985	229,635	13,108	242,743	228,611
1937	5,415,545	91	566,670	5,982,215	235,077	17,422	252,499	345,518
1938	4,750,002	87	696,514	5,446,516	274,057	22,221	296,278	163,774
1939	4,932,076	82	1,046,966	5,979,042	163,011	20,767	183,778	255,825
1940	4,379,394	72	1,669,105	6,048,499	246,274	76,979	323,253	285,890
1941	4,639,346	79	1,197,032	5,836,378	238,241	73,584	311,825	221,616
1942	3,037,456	70	1,319,172	4,356,628	150,253	84,518	234,771	293,615
1943	2,187,155	58	1,552,093	3,739,248	ND	ND	125,000	157,738
1944	2,100,242	71	859,444	2,959,686	88,478	39,752	128,230	ND
1945	976,065	83	200,794	1,176,859	93,583	37,601	131,184	137,696
1946	742,821	80	184,268	927,089	ND	ND	110,729	115,461

a/ Factory stocks for which the title has not passed from the producer. Does not include government stocks held at the factory or private stocks in warehouse.
b/ Stocks of finished cement only, excluding clinker stock.
ND: No data available
SOURCE: Portland Cement Control Assn

3. Designed

The designed capacity of the major items of equipment, as computed by Economic and Scientific Section and shown in Table 9, on page 18, is 8,046,000 metric tons annually. However, the present maximum capacity attainable is not accurately known. The designed capacity does not represent the maximum attainable, since this can be increased by substituting lime for limestone. On the other hand, where major items of equipment are permanently damaged and cannot operate at rated loads or speed even after thorough repair, the maximum attainable capacity will be less than the designed capacity.

4. Repairable

The repairable capacity as of October 1946, submitted by the Cement Industrial Assn, is 6,109,200 metric tons annually. This is the capacity that may be expected if materials for repair of all plant equipment are made available. Raw material and transportation shortages are not considered.

5. Now Usable

The present usable productive capacity, reported by the Cement Industrial Assn as 4,646,400 metric tons annually, is given in Table 10, shown on page 20. This capacity estimate takes into consideration all limiting factors within the plant, and state of repair of equipment. It is the capacity that is attainable if coal and all raw materials are made available.

The productive capacity of the cement industry has always been in excess of Japan's home consumption and export demands. In 1931, 56.4 percent of the rotary kiln capacities was utilized in producing cement. The percentage rose to 62.0 by 1933, gradually declined to only 39.4 percent in 1938, rose again to 51.2 percent in 1941, and fell to 8.9 percent in 1946. Table 11, shown on page 21, containing the only available historical data on capacities, shows the rotary kiln capacities and utilization from 1925-46.

The monthly designed capacities of Japanese cement plants are listed in Table 9. Two factories in Hokkaido have 3.6 percent of the total designed capacity of Japan; three in Tohoku district, 9.8 percent of capacity; five in Kanto, 16.0 percent; three in Tokai, 6.3 percent; six in Kinki, 20.7 percent; five in Chugoku, 15.5 percent; one in Shikoku, 2.1 percent; 12 in Kyushu, 26.0 percent. The average plant designed capacity is 18,122 tons monthly.

The total mix grinding capacity, as shown in Table 9, is 11,670,000 metric tons, the rotary kiln capacity 9,580,200 metric tons, and the clinker grinding 9,630,000 metric tons. By taking the smallest capacity in each of the three departments of a mill as a measure, the balanced designed capacity is 8,046,000 metric tons.

The balance among the mix grinding, rotary kiln, and clinker grinding capacities was upset when some parts of plants were shipped overseas during the war. Auxiliary equipment is not always available to produce at the designed rate. Most of the present plants show a well-balanced design, but the clinker grinding capacity at the Nihon Koro, Kawasaki plant, and at the Iwaki Nanao plant is insufficient. The Onoda Co, Onoda factory, is deficient in raw grinding capacity, while the Nihon Tosa has excessive raw grinding capacity. The Ube Co, Ube factory, is deficient in rotary kiln capacity, as is Nihon Seitetsu.

CAPITAL EQUIPMENT

1. Amalgamations and Consolidations of Cement Factories Since 1939

The Saeki and Yatsushiro factories of Nihon Cement Co, Ltd, were absorbed in 1939 by Asano Cement Co, Ltd. The Itosaki factory of Nitto Cement Co was amalgamated with Asano Cement. In August 1942 Asano Cement absorbed the Amagasaki factory of Toa Cement Co, Ltd. Capacity for producing 4,380 tons of cement was transferred in March 1943 from the Yura factory of the Onoda Cement Co to the Shibetsu factory of the Asano Cement Co, Ltd. Asano Cement Co, Ltd, changed its name to Nihon Cement Co, Ltd, on 1 May 1947.

TABLE 9 -- DESIGNED MONTHLY CAPACITIES OF JAPANESE CEMENT PLANTS, 1946 a/
(metric tons)

District	Company	Factory	Raw Grinding Capacity	Rotary Kiln	Clinker Grinding	Designed Capacity	Percent of Total
Hokkaido	Asano	Kamiiso	22,400	29,500	22,200	22,200	3.3
	Asano	Shibetsu	3,600	2,160	3,200	3,160	0.3
Total			26,000	31,660	25,400	25,360	3.6
Tohoku	Iwaki	Hachinoe	35,300	38,000	27,200	27,200	4.1
	Iwaki	Yotsukura	21,600	16,700	15,800	15,800	2.4
	Onada	Ofunato	31,000	23,800	22,400	22,400	3.3
Total			87,900	78,500	65,400	65,400	9.8
Kanto	Nihon Koro	Kawasaki	27,900	28,800	8,300	8,300	1.2
	Asano	Nishi-tama	34,700	20,200	23,600	20,200	3.0
	Chichibu	Chichibu	36,200	53,300	57,600	36,200	5.4
	Iwaki	Hitachi	23,200	15,100	21,600	15,100	2.2
	Iwaki	Tochigi	40,800	27,400	31,900	27,400	3.1
Total			162,800	144,800	143,000	107,200	16.0
Tokai	Iwaki	Nanao	26,000	32,400	7,900	7,900	1.2
	Onoda	Fujiwara	37,000	28,800	33,600	28,800	4.3
	Onoda	Tawara	6,800	5,040	6,400	5,040	0.8
Total			69,800	66,240	47,900	[illegible],740	6.3
Kinki	Iwaki	Tsuruga	11,100	10,400	10,100	10,100	1.5
	Onoda b/	Hikone	8,600	11,900	7,900	7,900	1.2
	Osaka Yogyo	Osaka	133,000	87,800	103,000	87,800	13.1
	Osaka Yogyo	Hirohata	ND	ND	ND	ND	ND
	Asano	Osaka	33,400	20,800	22,000	20,800	3.1
	Asano	Amagasaki	16,700	12,600	13,900	12,600	1.9
Total			202,800	143,500	156,900	139,200	20.7
Chugoku	Onoda	Atetsu	11,100	12,200	7,900	7,700	1.2
	Asano	Itosaki	27,500	23,800	13,000	18,000	2.7
	Onoda	Onoda	14,600	23,800	19,200	14,600	2.2
	Tokuyama	Tokuyama	24,800	28,800	26,800	24,800	3.7
	Ube	Ube	75,500	38,500	68,600	38,500	3.7
Total			153,500	127,100	140,500	103,800	15.5

Continued

TABLE 9 -- DESIGNED MONTHLY CAPACITIES OF JAPANESE CEMENT PLANTS, 1946 a/ (CONT'D)
(metric tons)

District	Company	Factory	Raw Grinding Capacity	Rotary Kiln	Clinker Grinding	Designed Capacity	Percent of Total
Shikoku	Asano	Tosa	33,500	15,100	14,400	14,400	2.1
Kyushu	Iwaki	Karita	24,500	19,400	25,400	19,400	2.9
	Toyo	Kokura	12,400	14,400	12,500	12,400	1.8
	Onoda	Yawata	6,800	4,700	6,500	4,700	0.7
	Onoda	Tsunemi	5,900	5,750	4,800	4,800	0.7
	Onoda	Oita No 2	25,500	27,400	18,000	18,000	2.7
		No 1	11,800	14,400	14,400	11,800	1.8
	Mitsui	Omuta	0	2,500	2,500	2,500	0.4
	Asano	Moji	17,700	18,000	19,200	17,700	2.6
	Asano	Kawara	49,500	30,200	33,600	30,200	4.5
	Asano	Yatsushiro	17,700	14,400	14,400	14,400	2.1
	Asano	Saeki	12,400	13,000	11,200	11,200	1.7
	Sangyo	Gotoji	17,400	11,500	15,000	11,500	1.7
	Nihon Seitetsu	Yawata	34,600	15,800	31,500	15,800	2.4
Total			269,400	189,150	223,400	187,800	26.0
MONTHLY TOTAL			972,500	798,350	802,500	670,500	
YEARLY TOTAL			11,670,000	9,580,200	9,630,000	8,046,000	

a/ State of repair not considered
b/ Returned to Nozawa Sekimen Kogyo KK, February 1947
ND: No data available
SOURCE: Economic and Scientific Section

TABLE 10 -- USABLE CAPACITIES OF CEMENT FACTORIES IN JAPAN, OCTOBER 1946				
Company	Factory	Monthly Productive Capacity (metric tons)	Percentage of Total	Number of Kilns
Asano Cement Co, Ltd	Kamiiso	14,800	3.8	2
	Shibetsu	1,000	0.2	1
	Nishitama	15,800	4.1	2
	Osaka	13,800	3.6	2
	Amagasaki	0	0.0	1
	Itosaki	7,000	1.8	2
	Tosa	8,700	2.2	1
	Moji	10,600	2.7	2
	Kawara	19,900	5.2	2
	Yatsushiro	9,200	2.4	1
	Saeki	8,600	2.2	1
Total		109,400	28.2	17
Onoda Cement Mfg Co, Ltd	Ofunato	10,400	2.7	2
	Fujiwara	12,000	3.2	2
	Tawara	3,100	0.8	1
	Hikone a/	2,600	0.7	1
	Atetsu	7,800	2.0	1
	Onoda	15,600	4.0	3
	Yawata	3,900	1.0	2
	Tsunemi	2,000	0.5	1
	Oita (1 and 2)	22,500	5.8	4
Total		79,900	20.7	17
Iwaki Cement Co, Ltd	Hachinoe	13,400	3.5	4
	Yotsukura	7,000	1.8	4
	Hitachi	5,600	1.4	2
	Tochigi	11,500	3.0	2
	Nanao	7,100	1.8	3
	Tsuruga	6,900	1.8	2
	Karita	12,400	3.2	4
Total		63,900	16.5	21
Osaka Yogyo Cement Co, Ltd	Osaka	37,400	9.6	6
	Hirohata	ND	ND	ND
Chichibu Cement Co, Ltd	Chichibu	30,000	7.7	5
Ube Kosan Co, Ltd	Ube	25,600	6.6	4
Toyo Cement Co, Ltd	Kokura	10,800	2.8	1
Nihon Koro Cement Co, Ltd	Kawasaki	8,300	2.1	4
Tokuyama Soda Co	Tokuyama	9,700	2.5	2
Mitsui Mining Co, Ltd	Omuta	1,400	0.4	1
Sangyo Cement Railway Co, Ltd	Gotoji	5,200	1.3	2
Nihon Steel Mfg Co, Ltd	Yawata	5,600	1.4	4
MONTHLY TOTAL		387,200		84
ANNUAL TOTAL		4,646,400		

a/ Returned to Nozawa Sekimen Kogyo KK, February 1947
SOURCE: Cement Industrial Assn

TABLE 11 - CAPACITY OF ROTARY KILNS AND UTILIZATION, 1925-46 a/			
Year	Number of Kilns	Annual Capacity (metric tons)	Percent Utilized
1925	ND	2,611,200	ND
1926	ND	3,008,400	ND
1927	ND	3,482,400	ND
1928	ND	3,687,600	ND
1929	ND	4,291,200	ND
1930	84	5,178,000	ND
1931	87	5,666,400	56.4
1932	88	5,995,320	56.5
1933	91	6,960,360	62.0
1934	100	8,709,480	50.9
1935	113	10,984,800	49.9
1936	117	11,645,280	47.9
1937	124	12,875,760	46.5
1938	129	13,911,840	39.4
1939	131	14,386,560	41.6
1940	117	13,132,404	49.9
1941	107	11,399,808	51.2
1942	100	11,317,008	38.5
1943	80	10,641,868	35.1
1944	72	10,382,668	28.5
1945	84	10,474,827	11.3
1946	84	10,474,827	8.9

a/ The historical data on rotary kiln capacities do not indicate the present ability to produce cement. They are included here so that comparisons on the same bases may be made for an extended period.

ND: No data available

SOURCE: Cement Industrial Assn

Onoda Cement Mfg Co, Ltd, absorbed the Ofunato factory of Tohoku Cement Co, Ltd, in August 1943, the Tahara factory of Toyo Sangyo Co, Ltd, in August 1943, and the Hikone factory of Nozawa Sekimen Kogyo Co, Ltd, in July 1944. The latter factory was returned to the Nozawa Sekimen Kogyo Co, Ltd, in February 1947, after Nozawa brought suit against Onoda, claiming the sale was forced during World War II.

Iwaki Cement Co, Ltd, absorbed Hitachi Cement Co, Ltd, and the Tochigi factory of Fukoku Cement Co, Ltd, in December 1940, the Nanao factory of Nanao Cement Co, Ltd, in December 1941, the Tsuruga factory of Tsuruga Cement Co, Ltd, and the Karita factory of Hokoku Cement Co, Ltd, in December 1941.

In March 1941, Nihon Cement Co, Ltd, invested in Nihon Koro Cement Co, Ltd. This firm has since been under the co-management of the two companies.

During the war the Kokura factory of Toyo Cement Kogyo Co, Ltd, was absorbed by Ube Kosan Co, Ltd. This factory has been returned to its former owner, Toyo Cement.

2. Rotary Kiln Transfer

Since 1939, 11 kilns have been transferred within Japan, 39 have been transferred overseas, and two have been scrapped. From 1939-45 capacity for producing 4,229,492 metric tons of cement annually was moved, of which 3,468,932 metric tons were transferred overseas, 710,160 metric tons were transferred with Japan, and 50,400 metric tons were scrapped. Table 12, as shown on page 22, gives the details of kiln movement. Table 13, starting on page 22, shows rotary kiln movement by year and destination.

TABLE 12 - ROTARY KILN MOVEMENT BY COUNTRY SINCE 1939

Transferred To	Number of Kilns	Capacity (metric tons)	Percent Transferred
Manchuria	18	1,690,752	48.7
North China	6	600,000	17.3
Formosa	5	519,600	15.0
Korea	2	201,600	5.8
Celebes	2	117,368	3.4
Malaya	2	115,200	3.3
South China	1	104,412	3.0
South Sakhalin	1	57,600	1.7
Sumatra	1	32,400	0.9
Inner Mongolia	1	30,000	0.9
TOTAL	39	3,468,932	100.0
Within Home Islands			
Japan transfers	11	710,160	
Scrapped	2	50,400	
TOTAL	13	760,560	
GRAND TOTAL	52	4,229,492	

TABLE 13 - ROTARY KILN MOVEMENT BY YEAR SINCE 1939

Year	Transferred From	Transferred To	Number of Kilns	Annual Capacity (metric tons)
1939	Tomiaki factory (Gifu)	Anto (Antung) Cement (Manchuria)	2	225,600
TOTAL				225,600
1940	Tokyo factory (Nihon)	Kahoku Cement Co (North China)	4	283,200
	Futami factory (Toyama)	Honkeiko Cement (Manchuria)	2	302,400
	Hikone factory (Nozawa)	Kichirin Synthetic Oil (Manchuria)	1	57,600
	Tosa factory (Nihon)	Formosan Cement	1	158,400
	Moji factory (Nihon)	Daito Cement (Manchuria)	2	111,600
	Saheki factory (Nihon)	Korean Asano Cement (Korean)	2	201,600
	Amakusa factory (Asahi)	Eastern Manchurian Industrial Co, Ltd (Manchuria)	2	34,356 105,000
TOTAL			14	1,254,156

Continued

TABLE 13 - ROTARY KILN MOVEMENT BY YEAR SINCE 1939 (CONT'D)				
Year	Transferred From	Transferred To	Number of Kilns	Annual Capacity (metric tons)
1941	Kamiiso factory (Nihon)	Wanishi Iron Mfg (Hokkaido)	2	100,800
	Tochigi factory (Iwaki)	Bujun Cement (Manchuria)	1	151,200
	Tochigi factory (Iwaki)	South Manchurian Mining Co (Manchuria)	1	151,200
	Tsuruga factory (Iwaki)	Formosan Chemical Product Industry Co (Formosa)	1	115,200
	Nagoya factory (Iwaki)	Formosan Chemical Product Industry Co (Formosa)	2	44,400 104,400
	Tahara factory (Onoda)	Tohoku Zinc Mining Industry (Fukushima)	1	39,600
	Takahama factory (Toyo Sangyo)	Formosa Nanpo Cement (Formosa)(not completed)	1	97,200
	Aichi factory (Onoda)	Tsunemi Cement (Fukuoka)	1	64,800
	Osaka factory (Nihon)	Manchurian Special Mining Industry (Manchuria)	1	43,200
	Amagasaki factory (Nihon)	Manchurian Special Mining Industry (Manchuria)	1	90,000
	Ube factory (Ube)	Manchurian Special Mining Industry (Manchuria)	1	122,400
	Ube factory (Ube)	Manchurian Special Mining Industry (Manchuria)	1	132,480
	Yatsushiro factory (Nihon)	Manchurian Special Mining Industry (Manchuria)	2	77,316
	Ube factory (Ube)	Kahoku Light Metal Industry (North China)	1	151,200
	Osaka factory (Nihon)	Japan Light Metal Industry Shimizu (Shizuoka)	1	43,200
	Tokuura factory (Onoda)	Manchurian Onoda Cement (Manchuria)	1	86,400

Continued

TABLE 13 - ROTARY KILN MOVEMENT BY YEAR SINCE 1939 (CONT'D)				
Year	Transferred From	Transferred To	Number of Kilns	Annual Capacity (metric tons)
	Yatsushiro factory (Nihon)	Nihon Koro Cement (Kawasaki, Kanagawa Prefecture)	2	117,600
TOTAL			21	1,732,596
1942	Hachinoe factory (Iwaki)	Tsuruga Cement (Fukui)	1	82,800
1943	Yotsukura factory (Iwaki)	Mokyo (Inner Mongolia)	1	30,000
	Chichibu factory (Chichibu)	Japan Light Metal Plant (Shizuoka)	1	115,200
	Yura factory (Onoda)	Macassar Onoda Cement (Celebes)	1	59,768
	Tsukumi factory (Onoda)	Macassar Onoda Cement (Celebes)	1	57,600
	Kagami factory	Palanbang Cement (Sumatra)	1	32,400
	Karita factory (Iwaki)	Kualalampur Iwaki Cement	2	115,200
	Yura factory (Onoda)	Shibetsu Cement (Hokkaido)	1	52,560
	Hinode (Kyushusoda)	Asano Cement Kainan Island (South China)	1	104,412
	Saga factory (Iwaki)	Scrapped	2	28,800 21,600
	Tokuura factory (Onoda)	Karafuto Cement Industrial Co (South Sakhalin)	1	57,600
TOTAL			12	675,140
1944	Tosa factory (Nihon)	Sumitomo Light Metal Industry's Shikoku Factory (Ehime)	1	93,600
	Kokura factory (Toyo)	Kahoku Light Metal Industry (North China)	1	165,600
TOTAL			2	259,200
GRAND TOTAL			52	4,229,492

Table 14 shows the dimensions of the 39 rotary kilns which have been transferred overseas since 1939.

TABLE 14 - DIMENSIONS OF ROTARY KILNS SHIPPED OVERSEAS SINCE 1939

Shipped To	Number of Kilns	Diameter (centimeters)	Length (centimeters)	Annual Capacity (metric tons)
Manchuria				
Manchuria Special Mining Co	2	2,438	38,100	77,316
	1	3,450 2,750 3,450	93,275	132,480
	1	3,600 3,950	72,047	122,400
	1	3,048	49,987	90,000
	1	2,286 2,743	46,000	43,200
Honkeiko Cement Factory	2	3,700 3,700	70,000	302,400
Anto Cement Factory (Antung)	2	3,300 2,800	60,000	225,600
Daito Cement Factory	2	2,134	24,384	111,600
Eastern Manchurian Industrial Co, Ltd	2	2,743 2,134 3,500 3,200	62,400	34,356 105,000
Bujun Cement Factory	1	3,700 3,700	70,000	151,200
South Manchurian Mining Co	1	3,700 3,700	70,000	151,200
Manchurian Onoda Cement Co	1	2,743 3,200	54,864	86,400
Kichirin Synthetic Oil Factory	1	3,050 2,600	50,000	57,600
North China				
Kahoku Cement Co	4	2,438	36,743	283,200
Kahoku Light Metal Co	1	3,800 3,400	74,000	165,600
	1	3,450 2,700 8,450	93,275	151,200

Continued

TABLE 14 - DIMENSIONS OF ROTARY KILNS SHIPPED OVERSEAS SINCE 1939 (CONT'D)				
Shipped To	Number of Kilns	Diameter (centimeters)	Length (centimeters)	Annual Capacity (metric tons)
South China				
Asano Cement Kainan Island	1	3,500	60,000	104,412
Formosa				
		2,438	45,720	44,400
Formosan Chemical Product Industry Co	2	2,743 3,300	60,227	104,400
	1	3,650 3,150	60,000	115,200
Formosan Cement Factory	1	3,800 3,300 3,200	69,450	158,400
Formosa Nanpo Cement Factory (not completed)	1	3,200	32,000	97,200
Celebes				
Macassar Onoda	1	2,743	37,100	59,768
	1	2,743	38,099	57,600
Korea				
Korean Asano	2	3,048	49,987	201,600
Malaya				
Kualalampur Iwaki Cement Factory	2	2,743	28,100	115,200
Inner Mongolia				
Mokyo Factory	1	2,438 2,134	32,918	30,000
Sakhalin				
Karafuto Cement	1	2,400 2,845	54,864	57,600
Sumatra				
Palangbang Cement Factory	1	2,286	45,720	32,400
TOTAL	39			3,468,932

The Cement Industrial Assn reported 131 rotary kilns in Japan in 1939. Since then 39 kilns have been moved overseas, and others have been converted to uses not connected with the production of cement, or have been scrapped.

The rotary kiln capacity reported by the Cement Industrial Assn in 1939 was 14,386,560 metric tons. From this capacity, 392,400 metric tons of kiln capacity were converted to use in other industries, 50,400 metric tons were scrapped, and 3,468,933 metric tons were shipped overseas from 1939-45, leaving 10,474,827 metric tons of rotary kiln capacity.

3. Capital Equipment and Kiln Dimensions

In 1946 Japan had 84 rotary kilns, 132 raw grinding mills, and 120 finishing grinding mills for cement making. No capital equiment has been manufactured in Japan since 1937. Table 15 gives the names and addresses of firms manufacturing raw and finishing grinding mills and rotary kilns.

TABLE 15 - FIRMS MANUFACTURING RAW GRINDING MILLS, ROTARY KILNS, AND FINISHING MILLS
Tsukishima Kikai Seisakusho (Tsukishima Machinery Works) 9, 5-chome, Tsukishima-dori, Chuo-ku, Tokyo
Kobe Seikosho (Kobe Steel Works) Head office: No 1 of 36, 1-chome, Wakihama-cho, Fukiai-ku Kobe-shi, Hyogo Prefecture Branch 1, c/o Matsusakaya, Ueno Hirokoji, Shitaya, Daito-ku, Tokyo
Osaka Tekkosho (Osaka Iron Works)---formerly known as "Hitachi Zosen Kabushiki Kaisha (Hitachi Ship-Building Co, Ltd)" No 45 of 3, Nihonbashi-suji, Naniwa-ku, Osaka
Hitachi Seisakusho (Hitachi Machinery Works) 2, 2-chome, Marunouchi, Chiyoda-ku, Tokyo
Kawasaki Zosensho (Kawasaki Ship-Building Works) 23, 8-chome, Onoe-dori, Fukiai-ku, Kobe, Hyogo Prefecture
Toyo Kogyosho (Toyo Industrial Works) 6047 Aza-shinchi, Fuchu-machi, Aki-gun, Hiroshima Prefecture
Ishikawajima Zosensho (Ishikawajima Ship-Building Works) 54, Tsukuda-shima, Chuo-ku, Tokyo
Kawasaki Jukogyo (Kawasaki Heavy Industries) 4, 1-chome, Marunouchi, Chiyoda-ku, Tokyo
Ube Tekkosho (Ube Iron Works) No 1 of 1976, Oaza Kogushi, Ube-shi, Yamaguchi Prefecture
Sumitomo Goshi Kaisha (Sumitomo Limited Partnership Co) 60, Minami-moto-cho, Onga-shima, Konohana-ku, Osaka
Kurimoto Tekkosho (Kurimoto Iron Works) c/o Fukko Sangyo Bldg, 14, 1-chome, Shinmachi-dori, Nishi-ku, Osaka
Mitsubishi Seiko KK (Mitsubishi Steel Mfg Co, Ltd) 2, 2-chome, Marunouchi, Chiyoda-ku, Tokyo
Osaka Kikai Seisakusho (Osaka Machinery Works) 8, 2-chome, Tsukuda-cho, Nishiyodokawa-ku, Osaka

Of the 84 kilns in Japan in 1946, 24 were of domestic manufacture, 19 Danish, 13 United States, 9 German, 2 of unknown origin, and 17 of foreign manufacture, having lost their identity through repair and redesign. Table 16 lists the 10 firms which manufactured 24 rotary kilns from 1923-37.

TABLE 16 - ROTARY KILNS MANUFACTURED, 1923-37 a/

Company	1923	1924	1929	1933	1934	1936	1937	Total
Kobe Seikosho	0	0	1	4	1	0	0	6
Kawasaki Zosensho	0	0	0	4	1	1	1	7
Masuno Seisakusho	0	1	0	0	0	0	0	1
Ishikawa-jima Zosensho	0	0	0	0	1	0	0	1
Kawasaki Jukogyo	0	0	0	0	0	2	0	2
Toyo Kogyosho	0	0	0	1	0	0	0	1
Ube Tekkosho	0	0	0	0	0	0	1	1
Osaka Tekkosho	0	0	0	0	0	0	1	1
Hirao Tekkosho	1	1	0	0	0	0	0	2
Kobukuro Seisakusho	0	0	0	0	2	0	0	2
TOTAL	1	2	1	9	5	3	3	24

a/ Years omitted (between 1923-37) had no production.
SOURCE: Cement Industrial Assn

Of the 132 raw grinding mills in Japan in 1946, 52 were of domestic manufacture, 26 Danish, 17 United States, 7 German, and 30 of unknown origin. Table 17 shows that 43 raw grinding mills were manufactured from 1919-37 by 13 firms.

TABLE 17 - RAW GRINDING MILLS MANUFACTURED, 1919-37 a/

Company	1919	1923	1924	1925	1929	1930	1932	1933	1934	1936	1937	Total
Tsukishima Kikai Seisakusho	3	6	0	0	0	0	0	0	0	0	0	9
Kobe Seikosho	0	0	0	2	4	1	0	3	4	1	1	16
Adachi Tekkosho	0	0	1	0	0	0	0	0	0	0	0	1
Masuno Seisakusho	0	1	1	0	0	0	0	0	0	0	0	2
Osaka Tekkosho	0	0	1	0	0	0	0	0	1	4	0	6
Okura Shoji Kaisha	0	0	0	0	0	0	1	0	0	0	0	1
Osaka Kikai Seisakusho	0	0	0	0	0	0	0	0	0	1	0	1
Hitachi Seisakusho	0	0	0	0	0	0	0	0	0	1	0	1
Nishiyama Tekkosho	0	0	0	0	0	0	0	0	0	0	1	1
Kawasaki Zosensho	0	0	0	0	0	0	0	2	0	1	0	3
Toyo Kogyosho	0	0	0	0	0	0	0	1	0	0	0	1
Ashida Tekkosho	0	0	0	0	0	0	0	0	1	0	0	1
TOTAL	3	7	3	2	4	1	1	6	6	8	2	43

a/ Calendar years. Years omitted had no production.
SOURCE: Cement Industrial Assn

In 1946 there were 120 finishing grinding mills in Japan, 52 produced locally, 22 imported from Denmark, 14 from the United States, 5 from Germany, and 27 of unknown origin. Table 18 gives the number of finishing grinding mills manufactured from 1923-37, showing 37 mills produced in this period by 10 manufacturers.

TABLE 18 - FINISHING GRINDING MILLS MANUFACTURED, 1923-37 a/

Company	1923	1924	1925	1927	1929	1930	1933	1934	1936	1937	Total
Mitsubishi Seiko KK	1	0	0	0	0	0	0	0	0	0	1
Kobe Seikosho	0	3	1	3	5	0	2	2	1	3	20
Osaka Tekkosho	0	0	0	0	0	0	5	2	2	0	9
Ishikawajima Zosensho	0	0	0	0	0	0	1	0	0	0	1
Sumitomo Goshi Kaisha	0	0	0	0	0	0	1	0	0	0	1
Osaka Kikai Seisakusho	0	0	0	0	0	0	0	0	0	1	1
Nishiyama Tekkosho	0	0	0	0	0	0	0	0	0	1	1
Kurimoto Tekkosho	0	0	0	0	0	0	0	0	1	0	1
Kawasaki Zosensho	0	0	0	0	0	0	0	0	1	0	1
Hitachi Seisakusho	0	0	0	0	0	1	0	0	0	0	1
TOTAL	1	3	1	3	5	1	9	4	5	5	37

a/ Calendar years. Years omitted had no production.
SOURCE: Cement Industrial Assn

Table 19, as shown on page 30, lists the 84 rotary kilns in Japan in 1946 by dimension, ownership, and factory.

PREPARATION OF CEMENT

1. General

Cement preparation plants in Japan include 25 dry plants, 7 wet plants, and 4 plants using both wet and dry processes. Of the 1946 production, 62.6 percent was manufactured by the dry plants, 21.8 percent by the wet plants, and 15.6 percent by combined wet and dry plants. Table 20, as shown on page 31, shows the 1946 production segregated by factory, company, and method of manufacture.

The wet process of manufacturing cement was introduced into Japan in 1930. By 1941 three factories of Asano Cement Co and one of Onoda were in operation.

Figures 2 and 3 show the generalized process diagram for the preparation of portland cement by the dry and wet methods.

2. Specifications

Temporary Japanese Standard Specifications No 149 issued in September 1941 were still being used in 1947. The Cement Industrial Assn plans to issue a new and permanent set of specifications for cement in 1948.

A translation of Temporary Japanese Standard Specifications No 149 is included at the end of this report as Appendix A. Appendix B is Temporary Japanese Standard Specifications for Ordinary and Ornamental Cement No 271, and Appendix C is Specifications for Cement Produced for the Occupation Forces.

3. Types of Cement

Four types of cement are now being manufactured in Japan: (a) portland, (b) silica, (c) blast furnace slag or koro, and (d) nonconstructive.

TABLE 19 - DIMENSIONS OF CEMENT ROTARY KILNS IN JAPAN					
				Internal Diameter	
Company	Factory	Number of Kilns (listed by different sizes)	Length of Each Kiln (centimeters)	Upper End (centimeters)	Lower End (centimeters)
Asano	Kamiiso	1	74,500	3,470	3,170
	Kamiiso	1	60,960	2,463	2,463
	Shibetsu	1	34,347	2,310	2,310
	Nishitama	2	62,700	3,170	2,870
	Osaka	2	62,200	3,170	2,870
	Amagasaki	1	63,000	3,020	2,720
	Itosaki	1	60,000	3,370	2,770
	Itosaki	1	60,606	3,175	2,872
	Tosa	1	74,000	3,520	3,020
	Moji a/	1	60,956	2,770	2,463
	Moji	1	60,956	2,920	2,463
	Kawara	2	74,500	3,470	3,470
	Yatsushiro	1	64,100	3,470	2,870
	Saeki	1	59,900	3,170	2,870
Onoda	Ofunato	2	76,000	3,470	3,170
	Fujiwara	2	70,030	3,470	3,020
	Tahara	1	26,000	2,320	2,320
	Hikone b/	1	62,900	3,170	2,870
	Atetsu	1	63,400	2,720	2,720
	Onoda	3	60,000	2,720	2,220
	Yahata	2	45,711	2,158	2,158
	Tsunemi	1	45,320	2,463	2,463
	Oita	2	48,770	2,463	3,320
	Oita	1	65,700	2,770	3,380
	Oita	1	68,000	2,870	3,470
Iwaki	Hachinoe	1	57,515	2,463	2,311
	Hachinoe	1	59,740	2,463	2,463
	Hachinoe	1	56,259	2,720	2,270
	Hachinoe	1	52,460	2,720	2,463
	Yotsukura	1	38,100	2,311	2,006
	Yotsukura	3	38,100	2,311	2,006
	Hitachi	1	52,456	2,770	2,770
	Hitachi	1	68,000	2,866	3,172
	Tochigi	2	70,000	3,420	3,020
	Nanao	2	73,505	3,170	2,720
	Nanao	1	88,870	3,170	3,170
	Tsuruga	1	60,000	3,370	2,870
	Tsuruga	1	44,844	2,463	2,311
	Karita	2	60,000	2,770	3,370
	Karita	2	38,100	2,463	2,463
Ube	Ube	1	69,940	3,320	2,770
	Ube	1	78,700	3,160	3,170
	Ube	1	60,000	2,920	2,420
	Ube	1	70,000	3,720	3,020
Toyo	Kokura	1	74,000	3,120	3,520
Osaka Yogyo	Osaka	1	73,762	3,070	3,073
	Osaka	1	73,762	3,070	3,073
	Osaka	1	73,762	2,577	3,225
	Osaka	3	73,762	3,073	3,530
Nihon Koro	Kawasaki	2	55,000	2,480	2,770
	Kawasaki	2	60,060	2,463	2,463
Chichibu	Chichibu	2	70,000	3,320	2,768
	Chichibu	1	60,000	2,920	2,920
	Chichibu	1	63,100	3,170	2,570
	Chichibu	1	80,000	3,620	2,920
Tokuyama	Tokuyama	2	85,600	3,320	3,320
Mitsui	Omuta	1	45,720	2,006	2,006
Sangyo	Gotoji	2	60,000	2,720	3,220
Nihon Seitetsu	Yawata	2	28,000	2,520	2,520
	Yawata	2	37,800	2,020	2,020

a/ Five additional kilns used for sponge iron not in use now
b/ Transferred to Nozawa, February 1947
SOURCE: Cement Industrial Assn

TABLE 20 - PRODUCTION BY FACTORY AND METHOD, 1946 (metric tons)				
Company	Factory	Production		
		Dry	Wet	Wet and Dry
Iwaki	Hachinoe	27,405	0	0
	Yotsukura	30,154	0	0
	Hitachi	16,871	0	0
	Tochigi	30,533	0	0
	Nanao	0	15,234	0
	Tsuruga	16,890	0	0
	Karita	22,356	0	0
Nihon Seitetsu	Yawata	0	0	12,701
Nihon Koro	Kawasaki	14,172	0	0
Tokuyama	Tokuyama	0	20,045	0
Chichibu	Chichibu	92,292	0	0
Osaka Yogyo	Osaka	32,143	0	0
	Hirohata	2,075	0	0
Onoda	Ofunato	25,018	0	0
	Fujiwara	0	47,994	0
	Tahara	0	0	20,050
	Hikone a/	7,571	0	0
	Atetsu	26,549	0	0
	Onoda	45,079	0	0
	Yahata	8,678	0	0
	Tsunemi	6,004	0	0
	Oita	26,822	0	0
Ube	Ube	0	0	77,615
Toyo	Kokura	24,171	0	0
Asano	Shibetsu	4,664	0	0
	Kamiiso	0	0	34,856
	Nishitama	0	35,768	0
	Osaka	0	33,764	0
	Amagasaki	0	0	0
	Tosa	16,650	0	0
	Itosaki	8,660	0	0
	Moji	20,506	0	0
	Kawara	0	43,490	0
	Saeki	22,710	0	0
	Yatsushiro	36,220	0	0
Sangyo	Gotoji	15,440	0	0
Mitsui	Omuta	0	5,939	0
TOTAL		579,633	282,234	145,222
PERCENTAGE OF TOTAL		62.6	21.8	15.6

a/ Transferred to Nozawa, 1947
SOURCE: Cement Industrial Assn

In 1925 portland cement accounted for 97 percent of the total production. In 1943 the production of other types of cement rose to 42 percent of the total, accounting for 1,552,093 metric tons. Of this amount, 41.6 percent was silica cement, 54.9 percent blast furnace cement, and 3.5 percent nonconstructive cement. In 1946 portland cement accounted for 80 percent of the total manufactured. The remaining 20 percent, or 184,268 metric tons, of other types of cement consisted of 83.9 percent silica cement, 11.9 percent blast furnace cement, and 4.2 percent nonconstructive cement.

Table 8 gives percentage and total production figures for portland cement from 1925-46. Table 21, as shown on page 34, gives production figures for other types of cement for the same period.

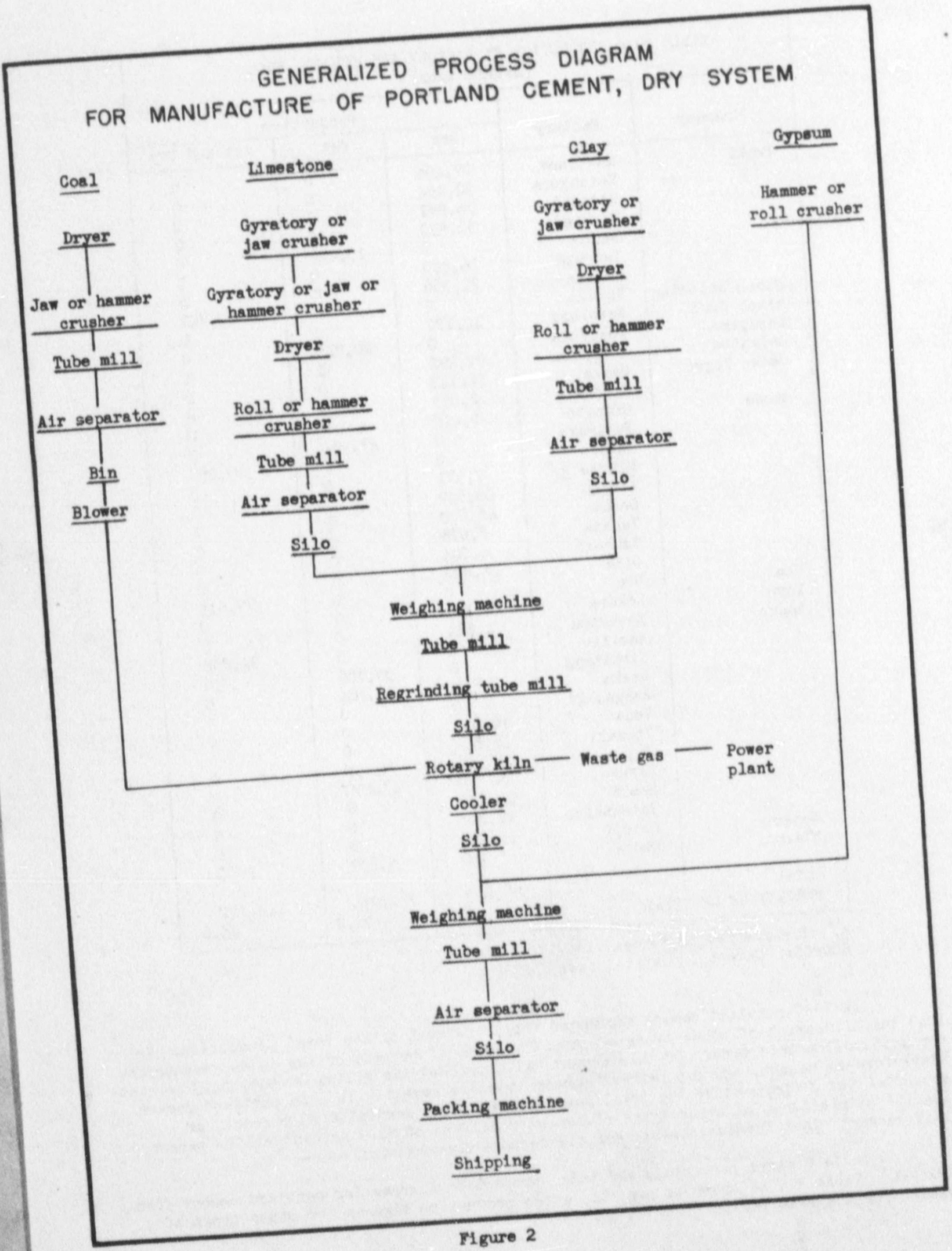

GENERALIZED PROCESS DIAGRAM
FOR MANUFACTURE OF PORTLAND CEMENT, DRY SYSTEM
Coal
Dryer
Jaw or hammer crusher
Tube mill
Air separator
Bin
Blower
Limestone
Gyratory or jaw crusher
Gyratory or jaw or hammer crusher
Dryer
Roll or hammer crusher
Tube mill
Air separator
Silo
Clay
Gyratory or jaw crusher
Dryer
Roll or hammer crusher
Tube mill
Air separator
Silo
Gypsum
Hammer or roll crusher
Weighing machine
Tube mill
Regrinding tube mill
Silo
Rotary kiln
Waste gas
Power plant
Cooler
Silo
Weighing machine
Tube mill
Air separator
Silo
Packing machine
Shipping

Figure 2

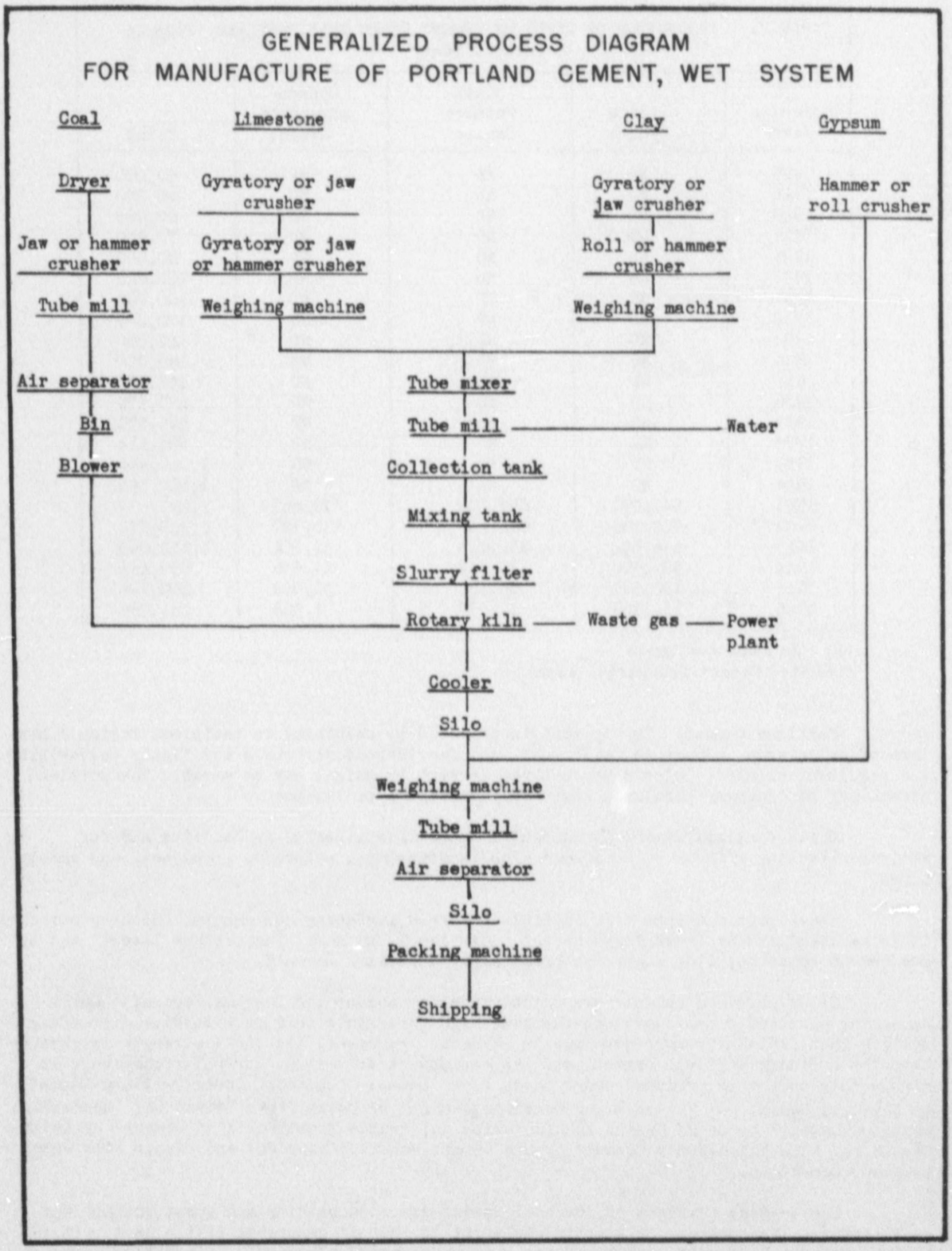

GENERALIZED PROCESS DIAGRAM
FOR MANUFACTURE OF PORTLAND CEMENT, WET SYSTEM
Coal
Limestone
Clay
Gypsum
Dryer
Gyratory or jaw crusher
Gyratory or jaw crusher
Hammer or roll crusher
Jaw or hammer crusher
Gyratory or jaw or hammer crusher
Roll or hammer crusher
Tube mill
Weighing machine
Weighing machine
Air separator
Tube mixer
Bin
Tube mill
Water
Blower
Collection tank
Mixing tank
Slurry filter
Rotary kiln
Waste gas
Power plant
Cooler
Silo
Weighing machine
Tube mill
Air separator
Silo
Packing machine
Shipping

Figure 3

TABLE 21 - PRODUCTION OF TYPES OF CEMENT OTHER THAN PORTLAND, 1925-46
(metric tons)

Calendar Year	Silica Cement	Blast Furnace Cement	Nonconstructive Cement	Total
1925	ND	ND	ND	60,000
1926	ND	ND	ND	60,000
1927	ND	ND	ND	60,000
1928	ND	ND	ND	70,000
1929	ND	ND	ND	80,000
1930	ND	ND	ND	100,000
1931	ND	ND	ND	100,000
1932	ND	ND	ND	100,000
1933	ND	ND	ND	142,000
1934	ND	ND	ND	186,000
1935	ND	ND	ND	268,000
1936	ND	ND	ND	403,570
1937	ND	ND	ND	566,670
1938	ND	ND	ND	696,514
1939	ND	ND	ND	1,046,966
1940	ND	ND	ND	1,669,105
1941	543,892	639,472	13,668	1,197,032
1942	525,535	683,450	110,187	1,319,172
1943	646,804	852,725	52,564	1,552,093
1944	387,570	430,338	41,536	859,444
1945	130,391	38,434	31,969	200,794
1946	154,763	21,539	7,966	184,268

ND: No data available
SOURCE: Cement Industrial Assn

Portland Cement: This cement is produced by calcining to incipient fusion a mixture of calcareous, aluminous, siliceous, and ferriferous materials and finely pulverizing the resultant clinker. Gypsum up to three percent by weight may be added. The portland cement may be ordinary portland, high early strength, or low-heat.

White portland cement is used as a decorative material in building and for artistic lighting effects. It is used also in crossings, pathways, stoplines, and safety zones.

Black portland cement is suitable for road surfacing and general building purposes. It is manufactured by Osaka Yogyo Cement under the brand name "Yogyo Black Cement" and by Ube Cement Seizo Co, Ltd, under the brand name "Ube Black Cement".

Other portland cements are quick-hardening cement and low-heat cement. Quick-hardening portland cement develops the same high strength within four to five days after setting that ordinary cement develops in 28 days. Moreover, its final strength is greater than the ordinary portland cement, and its resistance to various corrosive chemicals is high. This cement is produced under these brand names: "Chichibu Super Portland Cement" by Chichibu Cement Co; "Yogyo Super Portland Cement" by Osaka Yogyo Cement Co; "Onoda Fine Portland Cement" by Onoda Cement Manufacturing Co; "Nanao Super Portland Cement" by Iwaki Cement Co; "Ube Extra-Super Cement" by Ube Cement Manufacturing Co; and "Asano Velo Cement" by Asano Cement Co.

The special features of low-heat cement are slow setting and great gravity and consistency. Its concrete is plastic and workable, but it generates little heat. It has a high strength-heat ratio and a greater rate of strength increase. In addition, because it contracts only slightly in the air and is highly resistible to corrosive agents, it is suitable for manufacturing thick mass concrete.

Silica Cement: This cement is obtained by mixing 70 percent portland cement clinker and 30 percent siliceous material by weight and finely pulverizing the mixture. Less than three percent gypsum and three percent lime by weight may be added.

Silica cement is waterproof and has a high resistance to salt and heat. With aging it develops high strength, particularly tensile, bending, and bond strength. Its resistance to wear and shock is also high. This cement is manufactured under the brand names: "Iwaki Silica Cement" by Iwaki Cement Co; "Nippon Silica Cement" by Nippon Cement Co; "Chichibu Silica Cement" by Chichibu Co; and "Ube Silica Cement" by Ube Co. It is a substitute cement, and its use has increased especially since 1939.

Blast Furnace Slag Cement: This cement is obtained by mixing and pulverizing blast furnace slag and portland cement clinker. No other material may be added to this cement, except gypsum, not exceeding five percent, and lime, not exceeding three percent by weight. At present the average mixture contains 60 percent clinker and 40 percent blast furnace slag. Figure 4 presents a generalized diagram of processing slag cement.

Because blast furnace cement resists salt and acids, it is suitable for construction in the sea or for drainage work.

Blast furnace cement is produced at Nihon Seitetsu Yawata plant, Nihon's Kamiiso, Tosa, and Kawara, and the Onoda's Yawata and Ube plants. Ube and the Nihon's Moji formerly produced blast furnace slag cement, but because of a shortage of slag they are not producing now.

Nonconstructive Cement: This type is divided into two classes: Grade A, suitable for floors, and Grade B, usable only as plaster. At the end of 28 days, Grade A has a crushing strength of more than 50 kilograms per square centimeter, and Grade B has less.

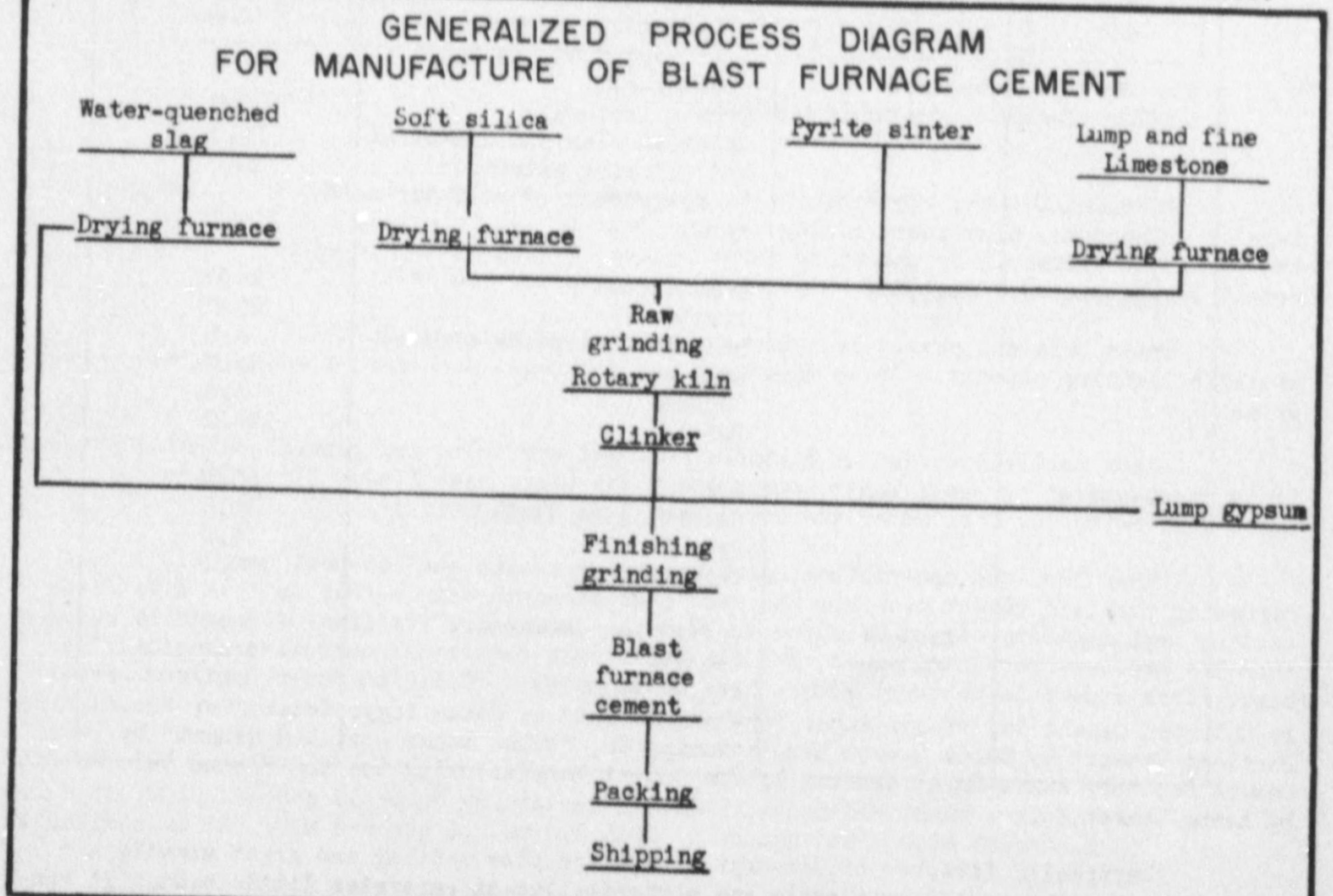


Figure 4

Table 22 shows the composition of various nonconstructive cements.

TABLE 22 - COMPOSITION OF NONCONSTRUCTIVE CEMENTS

Company	Trademark		Percentage of Raw Material Mixture
Asano	Ressment	Kagawa white siliceous sand	23.3
		Cement dust	30.0
		Pyrite cinder	20.0
		Gravia a/	23.3
		Gypsum	3.4
		Total	100.0
Onoda	Plaster	Pyrite	40.0
		Cement dust	35.0
		Lime	10.0
		Plaster	15.0
		Total	100.0
Iwaki	Sokkosei Neo-Plaster (high early strength plaster)	Gravia	70.0
		Oya stone b/	25.0
		Kanuma stone b/	5.0
		Total	100.0
Ube	Ube Red Plaster	Plaster material with hydraulic property (cement dust, hardened clinker)	50.0
		Gypsum (natural)	15.0
		Calcined clay and limestone	25.0
		Red coloring materials (by-product of sulfuric acid)	10.0
		Total	100.0
Tokuyama	Raiku	Cement dust	25.0
		Pyrite	25.0
		Reclaimed concrete crushed	5.0
		Coal ash	25.0
		Gypsum	5.0
		Total	100.0
Kawasaki	Rassmol	Slag	65.0
		Cottrel dust (kiln)	30.0
		Gypsum	5.0
		Total	100.0
Sangyo	Sangyo Plaster	Quicklime powder	60.0
		Gravia	20.0
		Cement dust	10.0
		Pyrite	10.0
		Total	100.0

a/ Gravia is a burnt siliceous limestone containing up to 10 percent SiO_2, from 4.0 to 5 percent Al_2O_3, and generally from 1.0 to 2.0 percent MgO. It is similar to hydraulic lime.

b/ Oya stone and Kanuma stone are altered siliceous material found in Tochigi Prefecture.

SOURCE: Cement Industrial Assn

At present no high-alumina cement is being manufactured in Japan. This cement, a fluxed product produced in an electric kiln, has high early strength and ability to resist salt, acid, fire, heat, and cold, and hardens within six hours after pouring. It can withstand temperatures as high as 1,400°C and may be used in severely cold weather. Osaka Yogyo was the only maker in Japan.

4. Raw Material Requirements

Almost all Japanese cement is made from a mixture of limestone and clay or limestone and shale. Average raw material consumption from 36 factories for January 1945, as reported by Economic and Scientific Section was:

TABLE 23 - AVERAGE RAW MATERIALS CONSUMPTION, JANUARY 1945

Materials	Consumption (kg/metric ton)	Percent of Total
Limestone	1,250	70.3
Clay	265	14.9
Silica	181	10.1
Pyrite cinder	41	2.2
Gypsum	40	2.3
TOTAL	1,777	99.8

Coal consumption per ton of cement produced varied from 200-500 kilograms. The numerical average for the 36 factories was 389 kilograms of coal varying in calorific content from 4,700-6,500. The approximate average calorific value of coal in August 1947 was 5,300 calories. In 1945 the average consumption of coal in the United States cement plants was 307.4 kilograms.

Japanese specifications for production of portland cement clinker require coal containing 5,500-7,000 calories per kilogram (9,940-12,600 BTU per pound) and not more than 20 percent ash. In 1944 the factories were receiving coal of 5,000 calories and 30 percent ash. As a result, proper fusion was not obtained, and structural failures of concrete installations were common. The high ash content interferes with the proper mixture, especially in a wet plant where the lumps are coated with a siliceous ash, and a nonuniform clinker results.

Table 24, as shown on page 38, presents the raw material consumption per ton of clinker produced during 1932-39 and 1946.

For regular yearly repair the cement industry requires from 12-13 tons of steel for each 10,000 tons of cement produced, according to the Cement Industrial Assn. The steel ball consumption as reported by the association is 1.1 pounds per ton of cement produced. The white pig iron ball consumption is 1.32 pounds per ton of cement produced, and the liner wear is 0.6 pounds per ton of cement produced. During the war period much of the regular replacement was not made, and this neglect accounts in part for the reduction in usable capacity.

The Cement Industrial Assn states that 7.07 pounds of iron and steel materials per ton of cement are required to maintain a monthly production capacity of 387,200 metric tons. This includes steel, cast iron, steel balls, cast iron balls, liners, and other miscellaneous iron materials.

Paper bags for shipping cement are in short supply. In 1928 conversion from wooden barrels to paper bags began, and by 1930 almost all cement was shipped in paper bags. Use of straw bags is not practical, because their low strength results in high losses in transit.

TABLE 24 -- RAW MATERIAL CONSUMPTION, 1932-39, 1946

(1) Per Ton of Clinker Produced
(kilograms)

Fiscal Year	1932 a/	1933 a/	1934 a/	1935 b/	1936 b/	1937 b/	1938 b/	1939 b/	1946 a/
Coal	282	283	280	274	277	274	274	288	389
Limestone	1,350	1,260	1,220	1,240	1,230	1,230	1,210	1,220	1,330
Clay	289	272	278	280	274	274	228	258	221
Silica	71	73	71	68	68	56	66	45	73
Iron oxide	19	20	22	22	29	37	47	45	46
Gypsum	29	30	30	31	30	29	30	32	58

(2) Total Consumption of Raw Materials
(metric tons)

	1932 a/	1933 a/	1934 a/	1935 b/	1936 b/	1937 b/	1938 b/	1939 b/	1946 a/
Coal	936,361	1,198,152	1,243,431	1,174,993	1,222,564	1,288,931	1,220,573	1,226,645	189,041
Limestone	4,480,245	5,317,731	5,423,456	5,318,282	5,442,022	5,774,617	5,420,398	5,207,534	649,960
Clay	959,640	1,152,304	1,333,388	1,199,199	1,208,271	1,288,442	1,017,749	1,099,595	107,837
Silica	233,944	307,665	315,371	291,506	301,714	262,131	293,791	193,483	29,645
Iron oxide	62,508	83,812	98,626	93,258	127,250	171,600	211,922	191,559	21,909
Gypsum	94,005	127,374	132,849	133,301	128,920	140,366	123,223	146,240	23,352

a/ Includes Onoda Co
b/ Excludes Onoda Co
SOURCE: Cement Industrial Assn

Twenty-seven cement factories utilize their waste heat to generate electrical energy, seven factories are without generating equipment, and three factories have boilers and generators but do not use them. All factories not generating electricity use waste heat gases to dry raw materials.

The cement factories which generate electricity and the amount of power (kwh) they produced in 1944 are given in Table 25.

TABLE 25 - FACTORIES WITH EQUIPMENT FOR GENERATING WASTE HEAT POWER, 1944

Firm Name	Factory	District	Power Produced per Year (kwh)
Asano Cement Co, Ltd	Kamiiso	Hokkaido	26,197,400
Onoda Cement Mfg Co, Ltd	Ofunato	Tohoku	10,782,900
Iwaki Cement Co, Ltd	Yotsukura	Tohoku	7,618,264
Iwaki Cement Co, Ltd	Hachinoe	Tohoku	10,932,240
Nihon Koro Cement Co, Ltd	Kawasaki	Kanto	6,115,350
Chichibu Cement Co	Chichibu	Kanto	16,814,935
Iwaki Cement Co, Ltd	Tochigi	Kanto	7,379
Asano Cement Co, Ltd	Nishitama	Kanto	11,433,550
Nozawa Sekimen Kogyo Co, Ltd	Hikone	Kinki	660,820
Onoda Cement Mfg Co, Ltd	Fujiwara	Tokai	9,970,600
Iwaki Cement Co, Ltd	Tsuruga	Kinki	9,800,000
Asano Cement Co, Ltd	Osaka	Kinki	6,515,710
Osaka Yogyo Cement Co, Ltd	Osaka	Kinki	15,734,320
Asano Cement Co, Ltd	Itosaki	Chugoku	758,650
Ube Kozan Co, Ltd	Ube	Chugoku	37,693,000
Onoda Cement Mfg Co, Ltd	Onoda	Chugoku	4,430,900
Onoda Cement Mfg Co, Ltd	Atetsu	Chugoku	9,180,480
Asano Cement Co, Ltd	Tosa	Shikoku	7,066,000
Asano Cement Co, Ltd	Yatsushiro	Kyushu	13,563,640
Asano Cement Co, Ltd	Moji	Kyushu	9,054,700
Asano Cement Co, Ltd	Kawara	Kyushu	19,165,960
Asano Cement Co, Ltd	Saeki	Kyushu	10,265,005
Iwaki Cement Co, Ltd	Karita	Kyushu	12,165,790
Toyo Cement Co, Ltd	Kokura	Kyushu	4,861,392
Sangyo Cement Railway Co, Ltd	Gotoji	Kyushu	4,970,550
Onoda Cement Mfg Co, Ltd	Oita No 1	Kyushu	8,488,800
	Oita No 2	Kyushu	12,059,300
TOTAL			269,307,635

Generating equipment not used in 1944:

Asano Amagasaki has generator BBG 2800 kw-Boiler 1150m^2.
Tokuyama Tokuyama has generator Turbogenerator-Boiler 1330m^2, 3 pieces.
Onoda Tsunemi has generator Zoelly 3500 kva-Boiler Babwi.

Cement factories without waste heat power stations:

Asano Shibetsu
Iwaki Hitachi
Iwaki Nanao
Onoda Yawata
Onoda Tawara
Mitsui Omuta
Nihon Seitetsu Yawata
No data on Osaka Yogyo Hirohata

SOURCE: Cement Industrial Assn

Table 26 gives data on the total electrical power (kwh) produced by the cement industry and the amount purchased from 1932-39 and in 1946. Data for the intervening years were lost in bombing.

TABLE 26 - PRODUCTION AND PURCHASE OF ELECTRIC POWER, 1932-39, 1946 a/

	1932	1933	1934	1935 b/	1936 b/
Generated by factories	ND	ND	ND	483,895,856	509,091,582
Purchased	ND	ND	ND	102,207,491	87,096,116
TOTAL	410,060,067	545,055,929	583,772,517	586,103,347	596,187,698
Per ton of cement	124	128	133	136	138

	1937 b/	1938 b/	1939 b/	1946
Generated by factories	573,798,244	533,108,163	499,029,717	45,958,836
Purchased	78,698,924	79,212,342	94,506,712	58,449,552
TOTAL	652,497,168	612,320,505	593,536,429	104,408,388
Per ton of cement	137	138	131	207

a/ Fiscal year: 1 Dec to 31 Nov, except for 1946, which is average figure from January to December. Data in kilowatt-hours.
b/ Excludes Onoda Co. Complete figures from 1935-39 are not available, since Onoda Co was not a member of the manufacturers' association.
ND: No data available
SOURCE: Cement Industrial Assn

In 1945 the cement industry in the United States generated 44.5 percent of the electrical energy used and purchased 55.5 percent. The average electrical energy used per ton of cement produced was 129.9 kwh.

COSTS AND PRICES

1. General

Present cost data are misleading, but they are presented to indicate the general but irregular rises. Price increases have been made in an attempt to keep a balance between prices and costs.

2. Costs

Table 27, as shown on page 41, compares the prewar average costs at 37 mills with cost of cement production in November 1945, as reported by the Cement Industrial Assn.

The cost of producing cement has increased since the end of hostilities, as may be seen by comparing Table 27, on page 41, with Table 28, on page 42.

TABLE 27 - COSTS OF PRODUCTION, PREWAR AND 1945 (yen per ton of cement)		
Item	Prewar Cost	Cost in November 1945
Limestone	3.86	9.89
Clay	0.46	1.36
Silica	ND	0.39
Iron material	0.40	0.65
Coal	8.11	9.40
Gypsum	1.01	2.17
Others	1.08	0.80
Total raw material	14.92	24.66
Wages	3.16	7.36
Electric power	2.06	4.41
General repair	3.92	6.84
Mill repair	2.16	6.85
Miscellaneous factory expenditures	1.74	5.42
Depreciation	2.21	5.37
Business expenditures	1.22	4.44
Taxes	0.44	4.06
Packing and loading	0.67	1.54
Total operating expense	17.58	46.29
Freight and selling	10.80	17.80
TOTAL COST	43.30	88.75
Wholesale price	51.80	101.40
Margin of profit	8.50	12.65

a/ The reliability of these figures may be gauged by the data on the cost of coal. Coal cost increased from ¥14.70 per ton to ¥20.13 per ton, and the consumption per ton of cement from an average of 275 kilograms of coal per ton of cement to 389 kilograms per ton of cement. These figures are apparently inaccurate.

ND: No data available

SOURCE: Cement Industrial Assn

Petitioning for an increase in the price of cement, the Cement Industrial Assn submitted to the Price Control and Rationing Board cost data which were supposed to represent the average costs at the 37 cement plants in August 1946. Total costs were said to be ¥491.44. The Price Control and Rationing Board allowed only ¥415.09 to represent average costs at 37 plants. Table 28, as shown on page 42, gives the cost data as approved by the Price Control and Rationing Board in 1947.

Table 29, as shown on page 42, gives cost data at three plants in Japan: Osaka Yogyo, the largest; Asano Kawara, an average-sized plant; and Asano Kamiiso, a smaller plant. Production is at 12 percent of capacity at Osaka Yogyo, 25 percent at Asano Kawara, and 15 percent at Asano Kamiiso. The material costs at Osaka Yogyo are particularly high, mostly because of high transportation expenses. Salary and wage costs are especially high at Asano Kamiiso.

Table 30, as shown on page 43, shows a progressive increase in the cost of manufacture of cement at the Iwaki Yotsukura for three periods: (a) before World War II, (b) during World War II, and (c) one year after cessation of hostilities.

TABLE 28 -- COSTS OF PRODUCTION, 1946
(yen per ton of cement)

Item	Cost
Raw materials	
Limestone	39.97
Clay	4.11
Silica	2.49
Iron oxide	2.19
Coal	98.05
Gypsum	6.15
Other	0.21
Total	153.17

Item	Cost
Operating expenses	
Labor cost	149.83
Repair materials	42.84
Repair expense	6.23
Electrical power	26.47
Examination fees	1.22
Taxes	0.56
Office expenses	13.34
Depreciation	0.00
Amortization of special repair	0.00
Total	240.49

Item	Cost
General expenses	
Labor cost	7.69
Directors salaries	0.66
Taxes	3.76
Interest	6.70
Business expenses	2.62
Total	21.43
TOTAL	415.09

SOURCE: Cement Industrial Assn

TABLE 29 -- COST DATA, AT THREE PLANTS, AUGUST 1946
(per ton of clinker)

Item	Asano Kawara	Osaka Yogyo	Asano Kamiiso
Monthly capacity (metric tons)	19.900	37.400	14.800
Monthly production (mtric tons)	7.990	4.551	2.222
Raw materials			
Limestone	¥30.226	¥134.647	¥58.525
Clay	4.114	35.863	1.462
Silica	2.316	ND	ND
Iron oxide	3.566	0.749	0.637
Coal	53.204	121.694	57.573
Gypsum	12.165	3.915	10.343
Other	ND	ND	1.934
Total raw materials	105.591	294.873	130.474
Salaries and wages	51.582	27.288	190.070
Welfare and allowances	20.888	54.161	83.832
Overhead expenses			
Repair materials	41.296	111.658	52.462
Repairs	3.254	9.644	2.700
Power	10.598	7.200	14.027
Examination	0.384	2.403	1.159
Taxes and dues	0.193	0.545	0.450
Office	2.789	1.055	23.618
Miscellaneous	9.377	5.979	34.786
Packing and loading	12.012	9.304	6.442
Others	ND	ND	ND
Total overhead expenses	79.903	147.788	125.644
Total direct expenses	152.373	229.236	399.546
General expenses			
Depreciation	4.523	5.079	15.056
Amortization of special repairs	5.006	ND	48.004
Head office expense	28.486	29.367	52.009
Total general expenses	38.015	34.446	115.069
TOTAL	¥295.979	¥558.556	¥645.089

ND: No data available
SOURCE: Cement Industrial Assn

TABLE 30 - COST OF MANUFACTURE BY PERIODS			
Cost Item	1 Dec 34-30 Nov 35	1 Apr 44-31 Mar 45	31 Aug 46
Raw materials			
Limestone	¥2.126	¥6.210	¥65.324
Clay	0.178	0.484	5.394
Silica	ND	ND	ND
Iron slag	0.092	0.613	3.892
Coal	2.622	7.505	66.259
Gypsum	0.275	1.194	3.904
Other	0.000	1.078	0.000
Total materials	5.293	17.084	144.773
Salaries and wages	0.843	7.664	105.839
Welfare and allowances	0.118	1.241	37.385
Overhead			
Repair materials	0.846	4.874	36.630
Repair disbursement (to other firms)	0.003	0.000	7.758
Electric power	0.448	2.081	18.938
Testing	0.037	0.021	0.067
Taxes	0.022	0.134	0.722
Office expenses	0.037	0.512	9.396
Miscellaneous	0.078	1.373	3.868
Packing and loading	1.574	2.917	0.914
Other	5.392	0.456	4.062
Total overhead	8.437	12.368	82.355
General expenses			
Depreciation	1.000	3.597	14.306
Amortization for special repair	0.000	0.000	17.059
Head office expenses	2.628	6.814	42.790
Total general	3.628	10.411	74.155
GRAND TOTAL	¥18.319	¥48.768	¥444.507
Percent of production capacity	48	36	35
Number of workers	199	322	245
Wages per employee per month	¥43.79	¥78.63	¥542.06

SOURCE: Cement Industrial Assn

Table 31 gives the distribution of profits for the Iwaki Yotsukura cement plant.

TABLE 31 - DISTRIBUTION OF PROFITS, IWAKI CEMENT CO			
Distribution	1 Dec 34 - 30 Nov 35	1 Apr 44 - 31 Mar 45	1 Apr 45 - 31 Mar 46
Dividend	¥812,320.00	¥2,926,400.00	0.00
Annual rate of dividend (percent)	8	8	0
Reserve fund	¥164,000.00	¥820,000.00	¥210,000.00
Other funds	ND	ND	ND
Balance carried over from previous year	9,805.49	19,227.97	510,391.94
TOTAL PROFIT	¥986,125.49	¥3,765,627.97	¥720,391.94

ND: No data available
SOURCE: Cement Industrial Assn

According to the Japanese Annual Review for 1938-39, the Chichibu Cement Co earned 38.8 percent profit and paid 13 percent dividend for the second half of 1938. Of the 15 companies named, none earned less than 11 percent or paid less than four percent.

Three Japanese cement companies have invested ¥140,136,000 in countries outside Japan Proper (Formosa, Korea, southern Sakhalin, and the former Japanese Mandated Islands). According to the Cement Industrial Assn, the Nihon Cement Co has ¥48,505,000 of foreign investments, Onoda Cement Co ¥70,664,000, and Iwaki Cement Co ¥20,967,000.

3. Prices

Table 32, as shown on page 45, lists the cement prices from 1925-46. The prices shown for 1945-46 are the official ceiling prices, regulated by the Ministry of Commerce and Industry. A semigovernment agency buys all cement produced from each factory at various prices depending upon their costs. The cement is then sold to wholesale and retail trade at a fixed price. Table 33, as shown on page 46, shows the selling price of non-constructive cement.

4. Employment

Employment in the cement industry increased steadily from 6,682 persons in 1931 to 8,973 in 1941. During the war and until the surrender, employment declined to 6,917 in 1945 and then rose sharply in 1946 to 10,755, the largest employment in the history of the cement industry.

Labor unrest has affected the cement industry. The increase in working population in 1946 reflects decrease in attendance and decrease in efficiency, as well as re-employment of returning war veterans. A survey of labor in the cement industry is being conducted by Economic and Scientific Section.

Table 34, as shown on page 46, presents the number and output of laborers engaged in the cement industry from 1930-46. It shows a steady decrease in output per man since 1940, when each worker produced 2.23 tons per man per day, to 0.29 tons per man per day in 1946.

TABLE 32 - CEMENT PRICES, 1925-46
(yen per metric ton in 50 kg bags)

Calendar Year	Wholesale Prices: Value at Mill	Wholesale Prices: Portland	Wholesale Prices: Silica	Wholesale Prices: Koro	Wholesale Prices: High Early	Wholesale Prices: Nonconstructive	Retail Prices: Portland	Retail Prices: Silica	Retail Prices: Koro	Retail Prices: High Early	Retail Prices: Nonconstructive
1925	ND	31.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1926	ND	28.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1927	ND	25.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1928	ND	26.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1929	ND	26.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1930	ND	18.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1931	ND	20.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
1932	ND	21.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
1933	ND	22.20	ND	ND	ND	ND	ND	ND	ND	ND	ND
1934	ND	19.40	ND	ND	ND	ND	ND	ND	ND	ND	ND
1935	17.00	19.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1936	17.00	19.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1937	17.00	20.00	ND	ND	ND	ND	21.00	ND	ND	ND	ND
1938	18.20	21.20	ND	ND	ND	ND	22.20	ND	ND	ND	ND
1939	18.20	21.20	ND	ND	ND	ND	22.20	ND	ND	ND	ND
1940	18.40	24.20	24.20	24.20	28.40	ND	29.20	29.20	29.20	33.40	ND
							33.00	33.00	33.00	37.20	ND
1941	18.40	24.20	24.20	24.20	28.40	ND	25.20	25.20	25.20	29.40	ND
1942	25.75	30.00	30.00	29.00	34.40	ND	31.00	30.00	30.00	35.40	ND
1943	29.72	35.25	34.25	34.25	39.65	ND	42.60	41.80	41.80	47.00	ND
1944	41.00	51.80	50.80	50.80	58.20	ND	63.50	63.50	62.50	69.90	ND
1945	83.60	101.40	100.40	100.40	107.80	ND	113.10	112.10	112.10	119.50	ND
1946	240.00	300.00	294.00	294.00	335.00	291.00	335.00	329.00	329.00	370.00	326.00

ND: No data available
SOURCE: Cement Industrial Assn

TABLE 33 - SELLING PRICES OF NONCONSTRUCTIVE CEMENT, OCTOBER 1946					
Company	Trademark	Seller	Unit of Sale	Selling Price (yen)	
Asano	Rassment	Manufacturers Wholesalers Retailers	Per net 30 kg; charge for bags not included	15.00 18.00 22.00	
Onoda	Plaster			488.66	
Iwaki	Sokkosei Neo-Plaster (High early strength plaster)	FOB Tochigi Plant	Per net ton; charges for bags, packing and loading not included	250.00	
Ube	Ube Plaster		Per net ton	800.00	
				With Bags	Without Bags
Tokuyama	Raiku	Manufacturers Wholesalers Retailers	Per ton loaded at plant	900.00 990.00 1,139.00	800.00 880.00 1,012.00
Kawasaki Sangyo	Rassmol Sangyo Plaster	Manufacturers	Per ton; FOB railfreight car at plant; in bulk	800.00	

TABLE 34 - EMPLOYMENT AND OUTPUT PER MAN, 1930-46			
Calendar Year	Number of Laborers a/	Man Days	Tons per Man per Day b/
1930	6,776	2,032,800	1.62
1931	6,682	2,004,600	1.60
1932	6,695	2,008,500	1.64
1933	6,986	2,095,800	2.04
1934	7,241	2,172,300	2.03
1935	7,532	2,259,600	2.39
1936	7,968	2,390,400	2.33
1937	8,157	2,447,100	2.38
1938	8,187	2,456,100	2.32
1939	8,981	2,694,300	2.21
1940	8,957	2,687,100	2.23
1941	8,973	2,691,900	2.17
1942	8,231	2,469,300	1.76
1943	7,859	2,357,700	1.59
1944	7,488	2,246,400	1.33
1945	6,917	2,075,100	0.58
1946	10,755	3,226,500	0.29

a/ Does not include clerks
b/ All types of cement
SOURCE: Cement Industrial Assn

In 1944 the Cement industry in the United States employed an average of 20,376 men for 289 days, producing 2.77 tons per man per day.

5. Transportation

Raw materials for cement production in Japan are moved principally by inland transportation. Twenty-seven plants use inland transportation for limestone, and nine plants depend on sea transportation. For the movement of shale, 31 plants use rail, while 5 use sea transportation. For coal, 13 factories use sea, and 24 use rail transportation. To move cement, 19 factories use sea, and 18 use inland transportation.

A survey conducted in 1939 to study factors hampering the cement industry showed that mining and transportation of limestone were the chief deterrents to increasing production.

6. Economic Control

Table 35 indicates the division of control of the designed cement producing capacity among companies. Asano Cement Co, which controls 25 percent of the total production capacity, and Iwaki Cement Co, which controls 19.4 percent, are the leaders. Onoda Cement Co, the largest independent producer and main force outside the cartel, controls 16.3 percent. In the past the other independent producers have been the Osaka Yogyo Cement Co, Chichibu Cement Co, and Ube Cement Co.

TABLE 35 - COMPANY CONTROL OF CAPACITY, 1946

Company	Number of Factories	Designed Capacity (tons/month)	Percent of Total
Asano	11	183,000	25.0
Iwaki	7	142,000	19.4
Onoda	8	119,500	16.3
Osaka Yogyo a/	1	90,000	12.3
Chichibu	1	50,000	6.8
Ube	1	40,000	5.4
Others	8	107,500	14.8
TOTAL	37	732,000	100.0

a/ Total capacity never utilized for cement making

CONSUMPTION AND USES

Table 36, shown on page 48, shows consumption by uses, separated into the prewar period 1931-39 and the war period 1940-45, because of the change in use pattern. Table 36 is not in agreement with Table 1, because of the indeterminate amount of privately held stocks unreported each year.

Retail sales of 11,116,493 metric tons accounted for the largest percentage, 31.49 of the total consumption in the 1931-39 period. The construction industry was the second largest consumer, taking 25.7 percent of the total. Power projects show the greatest increase in use in the nine-year period, followed by the mining industry and cement products.

Table 37, shown on page 49, gives the percentage of consumption by industry from 1931-39.

Immediately preceding and during World War II, the use pattern changed. During 1940-45 the military used 33.4 percent of the total consumption of 21,134,795 metric tons, and war industries used 21.5 percent. Retail sales show the greatest decrease from 1931-39, dropping from 31.5 percent of total consumption to 0.12 percent of the total consumption in 1940-45. This figure for retail sales is believed low, as building construction continued during the war. Table 38, shown on page 49, gives the percentage of consumption by industry from 1940-45.

TABLE 36 - CEMENT CONSUMPTION BY INDUSTRY, 1931-39, 1940-45
(metric tons)

(1) 1931-39

Calendar Year	Railroad	Power Projects	Ports and Harbors	Roads and Bridges	Civil Engineering	General Construction	Mining	Retail Sales	Cement Products	Miscel-laneous	Total
1931	271,304	84,508	77,037	260,998	269,758	542,865	36,071	959,998	56,425	17,520	2,576,484
1932	272,237	92,191	88,667	346,804	291,489	562,642	23,862	953,914	63,179	16,540	2,711,525
1933	313,096	135,068	176,997	432,010	388,019	793,222	39,867	1,054,421	86,264	17,872	3,436,836
1934	427,346	169,587	109,455	275,340	311,135	809,425	47,633	1,113,803	101,009	12,500	3,378,233
1935	324,968	352,406	107,608	305,247	412,856	1,178,546	78,456	1,361,180	148,765	17,149	4,287,181
1936	350,665	307,401	108,387	299,659	491,842	1,281,976	69,222	1,463,684	157,116	24,136	4,554,088
1937	394,106	482,338	110,291	274,501	428,418	1,363,193	99,017	1,501,914	211,758	36,273	4,901,809
1938	405,674	625,856	101,178	220,664	413,865	1,289,775	129,122	1,349,036	209,582	73,233	4,817,983
1939	297,413	607,818	84,909	177,242	-429,648	1,251,827	161,002	1,358,543	219,928	51,502	4,639,832
TOTAL	3,056,809	2,857,173	964,529	2,593,465	3,437,030	9,073,471	684,252	11,116,493	1,254,026	266,725	35,303,973

(2) 1940-45

Cal-endar Year	Military Use	Governmental Use	War Industry	Essential a/ Industry	Public Works	Agriculture, Forestry, Domestic Stock, and Fishing	Public School Repair	Retail Sales	Emergency Reserve	Public Use	Occupation Forces	Total
1940	346,260	1,786,354	1,286,040	272,372	565,510	35,254	0	0	0	537,500	0	4,829,290
1941	1,370,411	562,767	1,222,889	229,975	582,139	440,578	0	0	0	558,297	0	4,967,056
1942	1,466,917	333,120	830,024	308,929	432,660	304,169	0	0	0	289,894	0	3,965,713
1943	1,920,464	257,056	615,062	173,799	199,123	135,640	694	26,712	4,510	135,987	0	3,469,047
1944	1,556,974	32,664	465,316	426,635	0	0	0	0	0	383,656	0	2,865,245
1945	398,555	10,073	131,779	81,206	0	0	0	0	15,888	377,786	23,157	1,038,444
TOTAL	7,059,581	2,982,034	4,551,110	1,492,916	1,779,432	915,641	694	26,712	20,398	2,283,120.	23,157	21,134,795

a/ Essential industry includes manufacturing fertilizer, food, clothing for war workers, etc, believed to be indirectly contributing to the war efforts.

SOURCE: Cement Industrial Assn

TABLE 37 - PERCENTAGE OF CEMENT CONSUMPTION BY INDUSTRY, 1931-39		
Industry	Consumption (metric tons)	Percent of Total
Retail sales	11,116,493	31.5
Construction industry	9,073,471	25.7
Civil engineering	3,437,030	9.7
Railroads	3,056,809	8.7
Power projects	2,857,173	8.1
Roads and bridges	2,593,465	7.4
Cement products	1,254,026	3.5
Ports and harbors	964,529	2.7
Mining industry	684,252	1.9
Miscellaneous	266,725	0.8
TOTAL	35,303,973	100.0

TABLE 38 - PERCENTAGE OF CEMENT CONSUMPTION BY INDUSTRY, 1940-45		
Industry	Consumption (metric tons)	Percent of Total
Military use	7,059,581	33.40
Governmental use	2,982,034	14.11
War industry	4,551,110	21.50
Indispensable industry	1,492,916	7.06
Public works	1,779,432	8.42
Agriculture, forestry, domestic stock, and fishing	915,641	4.33
Public school repairing	694	0.00
Retail sales	26,712	0.12
Emergency reserve	20,398	0.10
Public use	2,283,120	10.82
Occupation Forces	23,157	0.11
TOTAL	21,134,795	99.97

In 1946 the Allied Forces received 334,553 metric tons, or 36.4 percent of the total shipments. Cement used for Occupation Force supplies, barter for coal, local barter, central reserve, and factory use constituted 72.6 percent of the total cement shipped in 1946. Table 39, as shown on page 50, shows shipments to the principal users in 1946.

Cement used in barter for coal and local barter represented more than 19 percent of the total. Since February 1947 this barter has been forbidden, but it probably continues on a reduced scale. The value of coal for barter varies with the supply and demand of coal. Generally, one ton of cement is traded for one ton of coal. However, trades of two tons of cement to one ton of coal have been reported.

Existence of substantial unofficial trading in cement is shown by the recent steps taken by the Economic Stabilization Board on 1 November 1947, set forth in the order: "On Methods Relating to the Firm Establishment on an Order in the Production and Circulation of Cement". The purpose of this order is to eliminate illegal transactions in cement and establish a smooth and foolproof rationing system. Part of the problem in connection with illegal operation is the diversion of clinker for the manufacture of substitute cements. The Economic Stabilization Board hopes to eliminate the illegal trading by marking bags, by changing the price of substitute cements according to their comparison with portland, by placing the responsibility on cement producers for production and shipment, and by licensing cement brokers.

TABLE 39 - SHIPMENTS OF CEMENT IN 1946	
Users	Amount (metric tons)
Allied Forces	334,553
Railway	30,197
Transportation	1,655
Harbors	4,352
Shipbuilding	7,412
Communication	6,444
Food production	23,466
Public works and buildings	42,983
Fiber	4,997
Fertilizer	22,159
Chemical manufacturing	14,327
Liquid fuel	2,301
Iron and steel	3,688
Mining industry	4,269
Gravel and sand	254
Machinery	1,291
Gas	1,109
Electricity	12,997
Forestry	1,763
Silk	1,364
Salt (industry)	3,615
Salt (table)	7,200
Necessaries	19,897
Solid fuel	28,849
Medicine	587
Ministry of Education and others	3,400
Factory use	63,507
Central reserve	92,018
Local barter	30,183
Barter for coal	145,613
TOTAL	916,450

SOURCE: Cement Industrial Assn

FOREIGN TRADE

Japan first exported cement in 1896. During World War I the cement industry increased its capacity and captured the oriental market, which it dominated until 1938.

Table 40, as shown on page 51, compares production with exports. The export data include all shipments to former Japanese territory and occupied areas. Exports rose to a peak of 1,561,476 metric tons in 1939 and have decreased rapidly since then.

Data on external exports (that is, to countries outside the Japanese empire) are available from 1931-40. During this period the average external exports were 8.3 percent of production, and average total exports were 21.8 percent of production. Most Japanese exports were shipped to Manchuria, Korea, and Formosa after 1932.

Table 41, as shown on page 52, indicates that from 1931-39 external exports varied from 336,552 metric tons in 1934 to a peak of 567,453 metric tons in 1937, dropping to one-tenth that amount in 1940. The Dutch Indies received the greatest amount, 706,043 metric tons, from 1931-40. Hong Kong was second in the amount of cement imported from Japan. Asiatic Russia was the greatest importer in a single year with 216,471 metric tons in 1937. In 1938 India, Burma, and Malaya established high protective tariffs against Japanese cement, and in 1940 the Dutch followed suit.

TABLE 40 - COMPARISON OF PRODUCTION AND EXPORTS (metric tons per calendar year)			
Year	Production	Exports	Percent of Production
1925	2,270,114	217,220	9.6
1926	2,900,041	332,716	11.5
1927	3,249,193	334,144	10.3
1928	3,475,272	337,604	9.7
1929	3,763,697	432,968	11.5
1930	3,247,951	574,161	17.7
1931	3,198,677	841,098	26.3
1932	3,386,516	779,148	23.0
1933	4,316,883	1,058,137	24.5
1934	4,428,780	1,176,400	26.6
1935	5,484,857	1,317,436	24.0
1936	5,578,985	1,389,028	24.9
1937	5,982,215	1,338,298	22.4
1938	5,446,516	972,189	17.8
1939	5,979,042	1,561,476	26.1
1940	6,048,499	529,415	8.8
1941	5,836,378	762,218	13.1
1942	4,356,628	165,950	3.8
1943	3,739,248	95,711	2.6
1944	2,959,686	15,076	0.5
1945	1,176,859	2,700	0.2
1946	927,089	31,144	3.4

SOURCE: Cement Industrial Assn

Japan has not imported cement from foreign countries since 1925. Effective control of imports has been obtained by strict control of foreign exchange. The data in Table 1 represent receipts from former colonies. Because the breakdown of imports from the colonies is not accurate, it is omitted from this report.

GOVERNMENT CONTROL

The Federation Association of Cement Manufacturers was organized in 1923 to control production. The Asano and Onoda companies, the two leaders in the cement industry, organized a cement cartel with 18 producing companies and restricted the supply on the market. However, after a year the supply control was abandoned. Simple production control did not have the desired effect, and during the 1930 world-wide depression, supply control was renewed.

Supply control was based on productive capacity. A race to increase capacity at a time when production was limited to 40-50 percent of capacity led to overexpansion. Powerful interests outside the association almost broke its power after 1934. Production quotas were violated, and unapproved selling existed.

The control of supply and production was brought under supervision of the Ministry of Commerce and Industry. Companies both inside and outside association were brought under the control of the Cement Association. However, capacity was further increased by formation of new companies both in Japan and in Korea, which was outside the area of control. In March 1937 Korea and other colonies were included in the zone of control, and the association had complete control of production and prices, and authority to prevent unnecessary competition.

During World War II the cement manufacturers were regulated by the Cement Control Assn. Consumers were compelled to obtain permits from the army and navy to buy from the Cement Control Assn. On 20 August 1946 the Cement Engineering Assn, the Cement Industrial Assn, and

TABLE 41 -- EXTERNAL EXPORTS, 1931-40
(metric tons)

Name of Country	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Total
British India	29,182	54,729	56,384	56,919	49,143	49,437	59,152	55,323	42,383	4,484	457,136
Burma	20,181	12,539	12,318	10,072	6,941	4,986	4,767	1,361	51	0	73,216
North China	7,617	19,254	9,366	17,362	15,802	19,800	28,170	44,166	53,465	4,296	219,298
South China	94,155	20,779	31,866	18,590	15,154	3,224	901	28,646	22,939	807	237,061
Dutch East Indies	107,379	123,779	103,092	51,604	5,844	46,531	80,765	93,582	83,416	10,051	706,043
Hong Kong	164,905	101,558	101,130	78,459	83,314	64,870	30,637	0	910	0	625,783
French Indo-China	4,811	5,710	20	68	0	0	204	129	0	0	10,942
Philippines	20,239	13,565	4,567	2,352	990	2,023	6,472	55,776	13,598	26	119,608
Malaya	87,256	39,885	38,651	64,601	87,807	90,812	37,144	30,565	39,021	9,054	524,796
Siam	7,323	1,979	7,540	3,507	5,551	6,481	2,582	0	0	0	34,963
Asiatic Russia	613	1,926	944	1,439	181,241	103,614	216,471	564	528	0	507,340
North America	6,895	5,904	3,334	3,502	3,728	49,078	21,470	12,155	9,700	1,105	116,871
South America	270	349	8,216	10,976	8,313	9,244	12,424	20,389	22,804	6,177	99,162
Africa	7,219	11,424	22,950	8,786	10,219	16,021	20,502	20,223	12,017	1,921	131,282
Others	0	0	7,259	8,315	39,937	42,683	45,792	67,882	65,163	20,653	297,684
TOTAL	558,045	413,380	407,637	336,552	513,984	508,804	567,453	430,761	365,995	58,574	4,161,185

SOURCE: Cement Industrial Assn

the Cement Sales Co were formed to take over functions of the Cement Control Assn not prohibited by law. The Cement Sales Co was ordered liquidated in February 1947. The distribution of cement is now under the supervision of the Ministry of Commerce and Industry.

The Japan Cement Engineering Assn was established 20 August 1946 by 11 cement manufacturers to bring progress to the cement industry by scientific and technical studies and to promote extensive use of cement and concrete.

The Cement Industrial Assn, an autonomous controlling organization of cement manufacturers, is governed by the Extraordinary Material Supply and Demand Adjustment Act. It calls general and directors' meetings and has committees as advisory bodies. The Association conducts the industry's control functions, such as the allocation of raw materials and establishment of productive plans for cement factories.

In the fourth quarter of the 1946 fiscal year the Economic Stabilization Board in accordance with the adjustment act, began allocating raw materials to all industries including cement. At present, the general rule for drafting a cement production plan is based on coal allocation. Economic Stabilization Board draws the supply and demand plan on a yearly basis by quarters. The Cement Industrial Assn, following the decision of the Board, allocates coal to the factories and directs plants in details of production.

Until February 1947, as the sole purchasing and selling agency of cement, Cement Sales Co issued the distribution certificates and conducted the pooling of various cement prices and freight charges. Actual shipments to distribute cement are carried out by the manufacturers. The Sales Co, which was liquidated in February 1947, was composed chiefly of the manufacturers and the wholesalers who were forced to give up their business during the war. Its capitalization was ¥7,250,000.

At each quarter of the fiscal year, the Economic Stabilization Board drafts the plan for cement allocation to various industries and informs them of it through the Ministry of Commerce and Industry. Each industrial group draws up a plan for cement distribution to its own consumers, based on the Board's instructions, and sends it to the Ministry of Commerce and Industry. The Ministry of Commerce and Industry then issues distribution certificates in accordance with the plan and notifies the consumers, who in turn conclude the purchase contract with the manufacturers.

APPENDICES

APPENDIX A

THE TEMPORARY JAPANESE STANDARD SPECIFICATIONS NO 149 1/

Chapter I - General Provisions

Article 1

The specifications shall be applied to cement of various grades.

Chapter II - Grades

Article 2

The grades of cement to which the specifications shall be applied are as follows:

1. Portland cement
2. Blast furnace slag cement
3. Silicious mixed cement

1/ Direct translation from the Japanese

Portland cement is subdivided into two kinds as follows:

1. Ordinary portland cement (this may be called "portland cement")
2. High early strength portland cement

Article 3

Ordinary portland cement and high early strength cement are the products obtained by mixing finely pulverized clinker with silica, alumina, iron oxide, and lime.

Other materials shall not be added to portland cement, except gypsum which amounts to no more than three percent of cement by weight.

Article 4

Blast furnace slag cement is the product obtained by mixing and finely pulverizing 100 tons blast furnace slag, which has been previously chilled suddenly by dropping into water, and 45 tons cement clinker by weight.

Other materials shall not be added to blast furnace slag cement, except no more than 5 percent gypsum and 3 percent lime by weight.

Article 5

Silicious mixed cement (it is henceforth called mixed cement) is the product obtained by mixing and finely pulverizing 70 percent portland cement clinker and no more than 30 percent siliceous mixing materials by weight.

Other materials shall not be added to mixed cement, except no more than three percent gypsum and three percent lime by weight.

Chapter IV - Method of Testing

Article 6

The specific gravity of cement shall come up to the standard of Table 1. Should the test of Portland cement and blast furnace slag cement fall below this requirement, a second test may be made on an ignited sample.

TABLE I

Grades of Cement	Specific Gravity
Portland cement	not less than 3.05
Blast furnace slag cement	not less than 2.85
Silicious mixed cement	not less than 2.75

Article 7 Fineness

The residue on a standard sieve 0.088 mm (150 mm x 60 mm) of the Japanese Standard Specifications No 408 standard testing sieve shall not exceed 12 percent by weight.

The test shall be made with 50 grams of cement. The cement shall be held on the sieve, and the sieve shall be moved in horizontal and perpendicular motion. The coagulated powder of cement shall be gently rubbed to the side of the sieve and crushed with fingers. The operation shall continue until not more than 0.1 gram passes through in one minute of continuous sieving, and then the fineness shall be determined from the weight of the residue on the sieve.

Article 8 Setting

The cement for ordinary uses shall not develop initial set in less than one hour after pouring of water at the temperature 15° - $25^{\circ}C$. Final set shall be attained within 10 hours. (Description of normal consistency and determination of time of setting is abridged).

Article 9 Soundness

The cement shall show no sign of cracking (including distortion) in the following tests:

The test for soundness shall be the cold water test, but when time is limited, boiling test may be adopted. Cold water test: two cement pastes shall be soaked in cold water about 24 hours after molding and kept in it for 27 days, during which cracking shall be detected. The temperature of water during this term shall be not less than $15^{\circ}C$. Boiling test: two cement pastes shall be placed in a vessel of cold water for 24 hours after molding. The water shall be gradually brought to boiling, which shall continue for 1½-hours. After the water is cooled gradually, the pastes shall be examined for cracking. (Method of molding pastes and other notes are abridged).

Article 10 Strength

Strength of cement shall be determined by the testing of bending and compression provided in Article 14, using test pieces composed in conformity to Article 11, 12, and 13.

In this testing, wet mortar shall be used as test pieces, and therefore this is called "wet mortar testing".

The testing of bending and compressive strength shall be applied to test pieces three days (24 hours in air, 48 hours in water), seven days (24 hours in air, six days in water), and 28 days (24 hours in air, 27 days in water) after molding. The strength shall be equal or higher than the provisions of Table II. The strength at the 28th day shall be higher than the strength at the seventh day.

TABLE II

Grades of Cement \ Strength / Test days	Bending (kg/cm^2) 3 days	Bending 7 days	Bending 28 days	Compression (kg/cm^2) 3 days	Compression 7 days	Compression 28 days
Ordinary portland cement	10	20	30	35	70	150
High early strength portland cement	20	35	55	80	160	250
Blast furnace slag cement	10	20	30	35	70	150
Siliceous mixed cement	10	20	30	35	70	150

Three test pieces for bending strength and six test pieces for compressive strength shall be examined, and the result shall be shown in average figures.

Article 11

Test pieces for bending strength shall be $4\ cm^2 \times 16\ cm$ in a column shape. The two broken pieces of the test pieces for bending strength shall be used for testing compressions.

Article 12

Test pieces used for testing bending strength shall be molded three at the same time according to the following method:

Five hundred and twenty grams of cement and 1,040 grams of standard sand shall be accurately weighed, placed in a bowl, and mixed for two minutes, and then 338 grams of water shall be added. They shall be kneaded and mixed for three minutes. The mortar shall be filled in two seams in three molds according to the following method.

Article 13

Mortar shall be filled up to half of the height of every mold for the first seam and up to the upper end of every mold for the second seam. The whole top faces of two seams shall be pushed with a rod to such extent that the end of the pole penetrates about four mm into the mortar, and then mortar shall be heaped up two or three mm. The number of pushings must be equal to those shown on Table III which was determined as the result of softness test in accordance with Article 17.

TABLE III				
Limits of flow value	Less than 169	170-199	200-209	Over 210
No of pushings	20	15	10	5

The mold shall be lubricated with grease, tightened, and used only after no leakage has been confirmed.

More than five hours after the filling of the mortar, the surface of the mortar shall be stroked carefully and lightly to make smooth, avoiding spoiling the test piece and cutting off or pushing the excess over the mold.

More than 20 hours after the filling, the test piece shall be removed carefully from the mold.

Article 14 (abridged)

Mixing, kneading, heaping, smoothing and unfastening always shall be done indoors with protection from direct sunshine and drying. After mortars are heaped and filled, they shall be placed in a moist closet and covered to guard against change of temperature and air ventilation. After 24 hours, they shall be placed in a vessel of water and thoroughly soaked.

The standard temperature of the room and of the water during the period from molding to soaking shall be 15° - 30°C.

Article 15 (method of calculation of strength)

Calculation of breaking strength shall be performed immediately after the test piece is taken out of the water vessel. Distance of supporting points is to be 10 cm, and loading velocity is to be 5 kg per second on the average. Loading shall be done on the center of the lateral planes at the time of filling of test piece. Maximum load shall be estimated, and breaking strength shall be calculated by the following formula:

$$0.234 \times \text{maximum load (kg)} = \text{Breaking strength kg/cm}^2$$

Test of compressive strength shall be made immediately after the test of breaking strength. Pressure shall be delivered on the centers of two lateral planes at the time of filling with compression plate in the mean pressing velocity of 80 kg/sec. Maximum load shall be estimated and compressive strength calculated by the following formula (the factor of 16 refers to the area of the compression plate):

$$\frac{\text{Maximum load (kg)}}{16} = \text{Compressive strength kg/cm}^2$$

Article 16 (standard sand)

Standard shall be natural sand from Kumiho, Taikyu-men, Choen-gun, Kokaido, Korea, which is separated from impurities and screened to pass the standard sieve 0.30 mm (150 mm x 60 mm) of the Japanese Standard Specifications No 408 standard testing sieve. Then the following treatment shall be applied:

One hundred grams of sand shall be sampled and screened at least three times to pass the standard sieve, 0.30 mm (150 x 60) and 0.11 mm (150 x 60).

The sieving shall continue until not more than one gram passes through in one minute, and the sand shall be considered as standard when the residue in the standard sieve 0.30 is not more than 1 percent on the average, and the residue in the standard sieve 0.11 is more than 95 percent.

Impurities (the total of ignition loss and residue by hydrogen fluoride treatment) shall be not more than 3 percent in weight.

Article 17

When time is too limited for testing provided by Article 10, strength may be determined waiving the 28 days testing.

Article 18

Softness of mortar shall be determined by flow test. Flow table is used for flow test, and mean values are to be adopted after two tests.

Kneaded amount of mortar for every flow test is to be equal to the composition and the quantity of water for strength test, and it shall be divided into two parts. Mortar once used for flow test must not be used for strength test.

Flow test shall be performed by the following method:

Cement and standard sands shall be mixed with spoon in pot for two minutes, and after water is added, mixed for three minutes. Then these shall be filled in flow cone. Flow cone must be put in the center of a flow table which has been wiped clean with a dry cloth. Filling shall be done, dividing to two seams. Every seam shall be poked 15 times with a rod over the whole face to such a degree that the end of the rod is submerged to half the depth of the seam. After the deficiency is made good the surface shall be made smooth. Flow cone shall be taken away upward after filling, and it shall be tested by falling motion 15 times in 15 seconds. The radii of extent of mortar shall be measured both in the direction in which the radius is maximum, and in the direction perpendicular to it. Their mean value shall be expressed in millimeters and adopted as the results of the flow test.

If this strength test cannot be made, No 28 and No 29 of Japanese Standard Specifications and No 92 of Japanese Temporary Standard Specification may be adopted.

Article 19

Magnesia, sulphuric anhydride, and loss on ignition contained in cement shall come up to the standard of Table IV.

TABLE IV

Grade of Cement	MgO (percent)	SO_3 (percent)	Ig loss (percent)
Portland cement	3	2	4
Blast furnace slag cement	5	3	4
Siliceous mixed cement	4	2	

Method of analytical testing shall conform to the Japanese Standard Specifications No 341, Method of Chemical Analysis of Cement.

Article 20

Water for testing cement shall be fresh, but when cement is to be used in sea water, water in testing vessel shall be sea water.

Chapter V - Sample and Delivery

Article 21 Sample

Test sample of cement shall be taken from five sacks in each 50 tons or its fractional sum and well mixed, in order that sample may show average quality.

Article 22 Packing and Weight

Unit of weight of cement to be delivered shall be metric tons.

Article 23

Net weight of cement in a sack shall be 50 kg and net weight of cement in a barrel shall be 170 kg. Net weight in a sack may be 40 kg.

Article 24

Grades of cement, in other words, ordinary portland cement, high, early strength portland cement, blast furnace slag cement, or siliceous mixed cement, net weight, and manufacturer's name shall be distinctly shown on the outside of sacks or barrels.

Chapter VI - Machines and Tools for Strength Test

Article 25

Shapes and dimensions of machines and tools for strength test of this Standard Specification are shown on appended diagram No 1 to No 7.

Article 26

Common differences of the dimensions of machines and differences of machines and tools are as follows:

1. Mold of test piece

a. Material of mold shall be soft steel, and material of basal plate shall be cast steel or cast iron.

b. Faces of mold and upper surface of basal plate are to be polished, and their contacting parts are to be filed so that they touch closely.

c. Clasps and supports of metal fittings for tightening of basal plate of mold are to be cast metal equal to the basal plate.

d. Ends of metal fittings for tightening shall be set up with socket joints to avoid rotating.

e. Ribs shall be made on the under sides of basal plate and bent to the inside, centering the center of gravity of the mold when filled so that under plane of ribs will not shake.

f. Upper plane of basal plate and upper plane of mold shall be set up horizontally.

g. Metal fittings in length and breadth are to be perpendicular to each other, and also to the upper plane of basal plate.

h. Cones of metal fittings are to be perpendicular to the mold.

i. Breadth of grooves of molds on two ends is to be in close contact with the fixed part of dividing molds.

j. Every edge of mold needs to be rectangular and 0.025 mm wide.

k. Common differences of the breadth of molds, thickness of dividing molds, and distance between molds on two ends are to be ± 0.2 mm, and common difference of distance between dividing molds is to be ± 0.1 mm.

2. Rod for molding of test piece

a. Weight of rod is to be one kg.

b. Material used shall be soft steel, and its pushing part shall be polished. Its grasping part shall be zig-zag pattern (like "Nanako", a kind of swilled silk cloth).

c. Every edge of pushing part is to be rectangular.

3. Strength testing machine

a. Weights measured by the strength testing machine are divided into seven sorts as follows:

20 MT, 10 MT, 5 MT, 2 MT, 1 MT, 0.5 MT, and 0.2 MT

b. Common differences of scales are to be 1/100 of the weight for 20 MT, 10 MT, or 5 MT and 1/200 for less than 2 MT, and the smallest scale of every weight is to be 1/200 of weight.

c. This strength testing machine shall consist of both a breaking test apparatus and a compression plate for compressive strength test.

d. Breaking test apparatus and rolls for supports shall be hard-tempered steel, the hardness of which is more than 70 degrees of Shore.

e. Distance between the centers of rolls for supports is to be 100 mm, and its common difference is to be ± 0.2 mm.

f. Loads and rolls for supports need to have perfectly round section and to be parallel to each other, and rolls for loads must be at an equal distance from rolls for support on two sides.

g. Rolls shall be set up to be barely separate but to rotate easily.

h. Compression plate used for compressive strength test shall be tempered hard steel which is polished and which is hard to more than 70 degrees of Shore.

i. Compression plates are to be regular hexahedron, and their dimensions of length and breadth are to be 40 mm and their common differences are to be ± 0.1 mm.

j. A spherical base shall be attached to the compression plate to make the two planes, viz, upper and lower, parallel to each other.

k. Michaelis' breaking test apparatus which is made according to Article 4 to 7 may be used for breaking test in place of the machine mentioned above. The breaking test machine used for this purpose must satisfy the following clauses:

(1) Breaking test machine shall be so arranged that loading can be stopped when test piece is cut off.

(2) The machine shall be provided with a point regulating apparatus.

(3) Weight measured by this machine is to be 500 kg, and common difference of supporting center of gravity of rods is to be 1/500 of weight.

(4) When this machine is set up, support is to be vertical so that the force acts perpendicularly to rods. Center lines of rods are to be horizontal.

Other kinds of compressive strength testing machines which resemble the machine above in both weight and accuracy may be used. But in this case, a compression plate for compressive strength test shown on Article 8 and 9 shall be installed, and it must satisfy the condition of Article 10.

4. Flow table, flow cone, and rods for flow test

a. Cast iron shall be used for table, supports, and cone, and soft steel for spindle and rod. Materials for rolls of spindle and cams used shall be tempered hard steel, which is more than 70 degrees of Shore.

b. Four cut lines, 10 mm long, shall be notched in the position which corresponds to the margin of cone, on table in order to indicate the position of cone set up.

c. Upper plane of table and lower plane of cone shall be filed smooth in order to make them touch closely. Spindle shall be polished. Grasping part of rod shall be zigzag patterned (Nanako-wise), and other part of rod shall be polished.

d. Table shall be set up to make its upper plane horizontal.

e. Lower plane of table and upper plane of support are to be in close contact with each other.

f. Fixing of spindle shall be done tightly in order not to separate easily, and spindle is to be perpendicular to the upper surface of table.

g. Head of table is 10 mm.

h. In cam, effective contact angle is to be 270°, and radii shall be increased one mm every 27° starting at 36°.

i. Rolls of spindle are to be 22 mm in outer diameter, and diameter of spindle is to be 10 mm.

j. Handle shall be made in accordance with No 201 of Japanese Standard Specification and its wheel is to be 250 mm in outer diameter.

Grasp shall be made in accordance with No 203 of Japanese Standard Specification, and it is to be 25 mm in outer diameter.

k. Basal plane of rod is to be perpendicular to its lateral planes.

l. Common difference of heights, inner diameters of the upper parts, and inner diameters of the lower parts are to be - 0.5 mm.

5. Bowl and spoon for kneading

a. Materials shall be made of iron and shall be solid and stable.

b. Inner surface of bowl and spoon shall be finished to avoid the adherence of mortar.

c. Outer surface of bowl and spoon shall be rust proofed.

d. An enameled bowl and a large tablespoon shall be used in place of the bowl and the spoon mentioned above, if the latter are available.

Supplement

Shapes and dimensions of vicometer and standard needles above stated are to be in accordance with the Notification No 4 of the Ministry of Commerce and Industry on 19 February 1929.

APPENDIX B

TEMPORARY JAPANESE STANDARD SPECIFICATION FOR ORDINARY CEMENT AND ORNAMENTAL CEMENT 2/

This is a temporary specification announced during the war.

Chapter I - General

Article 1

This specification is applied to cement for general and ornamental use.

Article 2

The former is to be used for general use, as well as for wall cementing, and the latter, for wall cementing.

Article 3

Both cements should be manufactured by grinding and mixing of not less than two kinds of the following materials.

1. Clinker of portland cement
2. Quickly cooled blast furnace slag
3. Dust in kiln
4. Mixed substance of siliceous matter
5. Gypsum
6. Lime
7. Materials similar to the above

Chapter II - Method of Testing and Packing Solidification

Article 4

Both cements should complete solidification in 24 hours at 15° -25°C. In respect to solidification test, the method specified in Art 8, No 149, the Temporary Japanese Standard Specification, is applicable.

2/ Direct translation from the Japanese

Cracks Caused by Expansion

Article 5

Neither cement is allowed to develop any crack due to expansion in the following test. In case of the cracking test due to expansion, two pieces of cement mass are prepared and the above-mentioned test is to be carried out in accordance with the rules of Art 8, No 149, the Temporary Japanese Standard Specification. After allowing the former to set for two days and the latter for three days, they are submerged in water and the former must be kept in it for 26 days and the latter for 25 days. Then they are examined for cracks.

During this test the temperature of water should not be lower than 15°C. If the test piece is dried too much, it may crack, due to contraction. This crack must not be mistaken for that caused by expansion.

Strength

In case of strength test of both cements, some test pieces are to be prepared in accordance with Art 11-Art 13, No 149, Temporary Japanese Standard Specification, and physically tested with the testing machines for tensile and compressive strength which is specified by Art 14.

Testing should be executed after seven days (in wet air) and 28 days (7 days in wet air, 21 days in water), and the results must be better than the following table:

CEMENT STRENGTH REQUIREMENTS (kg/cm^2)

	General Use Cement		Ornamental Cement	
	After 7 days	After 28 days	After 7 days	After 28 days
Tensile Strength	10 +	18 +	6 +	14 +
Compressive Strength	30 +	80 +	20 +	50 +

For tensile strength three test pieces should be used; for compression, six test pieces. The mean value of these pieces is recognized as the strength of cement. The test piece must be taken out of the mold after two days for the former and three days for the latter.

Article 7

The standard sand for test piece is specified by Art 17, No 149, Temporary Japanese Standard Specification. The softness of mortar is also specified, Art 17, Temporary Standard Specification.

Article 8

The testing machine and tools are specified by chapter, No 149. Temporary Japanese Standard Specification.

Article 9

Test water and test material. Art 19 and Art 20 in No 149, Temporary Japanese Standard Specification, are applied for this purpose.

Packing and Weight

Article 10

For delivery of both cements, the metric ton is adopted as the unit.

Article 11

On the packing of both cements must be clearly marked "cement for general use" or "ornamental use". Whether or not portland cement clinker is contained must be indicated. Moreover, names of other important materials, net weight (kg), and name of maker, must be written.

APPENDIX C

SPECIFICATIONS FOR CEMENT PRODUCED FOR THE OCCUPATION FORCES 3/

1. General

All cement produced for the Occupation Forces will be marked by lots of 500 kilotons or smaller units, that is, the containers of each manufacturer for the first 500 kilotons of cement produced will be designated "Lot Number 1", the second 500 kilotons, "Lot Number 2", etc.

a. Lot numbers will be plainly marked on all containers.

b. All physical and chemical tests will show the lot number as reference.

c. Two copies of all tests conducted in accordance with these specifications will be submitted to the engineer office, General Headquarters, Far East Command, not later than 10 days after a representative sample of each lot of 500 kilotons or smaller unit has successfully passed the seven-day compressive test and other applicable procedures.

d. Cement may be ordered shipped after successful completion of the seven-day compressive test and other applicable procedures.

e. If the cement is ordered shipped after the seven-day test and before completion of the 28-day compressive test, two copies of the 28-day compressive test will be submitted to the engineer office, General Headquarters, Far East Command, as supplementary test data not later than 10 days after the completion of the tests.

f. Should a sample successfully pass the seven-day compressive strength test and fail the 28-day test, this failure will be sufficient cause for rejection.

2. Chemical Composition

a. Chemical analysis of normal portland cement (from analysis of 32 American cements):

SiO_2 - 21.92	SO_3 - 1.72
Al_2O_3 - 6.91	R_2O_3 - 0.82
Fe_2O_3 - 2.91	Loss on ignition - 1.50
CaO - 62.92	Insoluble residue - 0.20
MgO - 2.54	

b. Tolerances in chemical composition (percent):

SiO_2 - 19.0 to 25.0	MgO - Max 5.0
Al_2O_3 - 5.0 to 9.0	SO_3 - Max 2.0
Fe_2O_3 - 2.0 to 4.0	Loss on ignition - Max 3.0
CaO - 60.0 to 64.0	Insoluble residue - Max 0.75

3/ Direct translation from the Japanese

3. Testing Requirements

a. Chemical analysis will be a complete analysis of the finished product and will be made once for each lot of 500 kilotons or smaller unit of finished product.

b. Fineness test will show:

(1) Residue on a standard United States number 200 sieve not exceeding 22 percent by weight, or a 12 percent residue on a sieve of 4,900 holes/cm^2.

(2) Tests will be made once each hour.

c. Time of setting

(1) Cement will not develop initial set in less than 45 minutes when Vicat needle is used, or 60 minutes when Gilmore needle is used.

(2) Final set will be obtained within 10 hours.

(3) Tests will be made once every hour.

d. Soundness test

(1) A pat of neat cement in the form of a cone about 3" in diameter and ½" thick will be used.

(2) The Japanese practice of making pats as a section of a sphere will not be acceptable.

(3) Pats will remain firm and hard after 24 hours storage in moist air.

(4) Pats will show no sign of distortion, cracking, chipping, or disintegration when exposed for five hours to steam above boiling water in a loosely closed vessel.

(5) The practice of boiling pats in water will not be acceptable.

(6) Tests will be made once each hour.

e. Compressive strength of standard mortar

(1) Minimum strength requirements are:

Age of Test in Days	Storage of Test Pieces	Compressive Strength lbs/sq in Normal	High Early Strength	Moderate Heat	Sulf Resist
1	1 day moist air	-	1,300	-	-
3	1 day moist air, 2 days water	1,000	3,000	750	-
7	1 day moist air, 6 days water	2,000	-	1,500	2,000
28	1 day moist air, 27 days water	3,000	-	2,500	2,200

NOTE: For the compressive test a minimum of three cubes 2" x 2" x 2" (or 2 3/4" x 2 3/4" x 2 3/4") is to be utilized. These cubes are to be composed of one part cement and 2.75 parts standard-graded mortar sand by weight with a water cement ratio of 0.8 (volume ratio). The use of compressive samples 4 cm x 4 cm x 16 cm will not be acceptable.

(2) Test pieces may be made by the wet process system, although the machine casting system is preferred.

(3) Representative compressive tests will be made daily for mill production and one will be made for each lot of 500 kilotons or less.

Specific Gravity

(1) The specific gravity of the cement will have a minimum value of 3.10 and a maximum value of 3.25

(2) Tests will be made daily for mill production and once for each lot of 500 kilotons.

g. The hydraulic modulus of the cement will be calculated and included in the quantitative analysis report.

h. Testing procedures as described in Japanese Engineering Specifications No 149 may be utilized if they do not conflict with the procedures herein described.

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