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THE REFRACTORIES INDUSTRY IN THE PHILIPPINES[1/]

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In the Philippines, refractory making like the other branches of ceramics such as procelain pottery, etc. is relatively a new development. Earthenware pottery, however, is an old small scale industry in the country. Likewise the manufacture of common red bricks. The refractory making industry started with the beginning of the country's industrialization. The need of refractories by other industries initiated the establishment of the first refractory factory producing fire-bricks.

THE MARKET

The main users of refractory in the Philippines include:

a) Iron and steel industry
b) Glass industry
c) Lime and cement industry
d) Ceramics industry
e) Non-ferrous metal industry
f) Other industries such as pulp and paper manufacturing, petroleum refining, coke production, power generalization, foundries, sugar production, fertilizer production, etc.

The cement industry at present is the biggest consumer of refractories with the steel industry closely following.

For the last 15 years, consumption of refractories in the Phillipines averages about 15,000 metric tons per annum and most of the annual consumption is derived from importation which accounts for about 60 per cent, particularly of the basic refractories. The balance of local requirements is manufactured by the private existing refractory plants producing mainly fire clay types of refractories.

During the last 4 years, there has been an abrupt increase in refractory requirements in the Philippines so that Government agencies have now estimated consumption to be about 65,000 tons per annum broken down into refractory types as follows:

1. Fire-clay - 30,000 metric tons per annum
2. Basic refractory - 15,000 " " " "
3. High alumina - 16,000 " " " "
4. Speciality - 4,000 tons.

PRODUCTION

Of the 6 manufacturers of refractories in the Philippines, the biggest produces about 12,000 metric tons per annum and uses the dry press process and wood mold process. All the other smaller producers use the same manufacturing process. Oil fired shuttle kilns or tunnel kilns are used as firing equipment.

As mentioned above, the types of refractories manufactured locally are classified under low temperature type of refractory. These are fire-clay, high alumina, insulating and common red bricks.

RAW MATERIALS

The Philippines have abundant basic raw materials for manufacture of refractories. The Philippines being composed of many islands (more than 7,000) has its raw materials spread out over the Archipelago. Kaolin and fire-clay deposits are extensive and are found all over the country. Table I lists the sources of refractory clays and their analysis and the amount of estimated reserves.

Materials for the manufacture of high quality silica bricks are also available. Table II gives a list of all the possible sources of silica in the Philippines.

Magnesite deposits have been reported in Davao and Sibuyan of the Romblon Group of islands. They occur as cryptocrystalline or compact magnesite. Table III shows the location and alaysis of these reserves of magnesite.

Dolomite in the Philippines occur as dolomite limestone and is found abundantly in Negros and Cebue Islands. Samples of dolomite having MgO content of at least 19-20% have been found. At present, except for the limited needs of some ceramics and glass plants, dolomite is not being utilized. A reserve of 150,000 MT of 16-20% MgO is available. The Calatrava, Toboso, Negros Occidental dolomite has a reserve of 1,000.000 MT of 16-19% MgO.

The Philippines is one of the leading world producers of refractory chromite and our exports of this product amounted to 349,000 metric tons in 1972. So far this has been mined only in Luzon Island. Abundant deposits occur in the Zambales province. Estimated reserves of one mining company alone amount to 6,000.000 metric tons with an average content of 32.13% Cr_2O_3. Because of the low volume requirements for domestic consumption of refractory materials the development of the mining operation has been very slow.

It is interesting to note that while the country abounds in natural deposits of these refractory materials our importation of refractory products still continue to increase. Apparently our efforts to utilize our own materials for the production of the much needed refractory products are not in pace with our expanding industrialization resulting in increasing demands for these products.

Cognizant of this situation, the Philippine Government through its appropriate agencies has taken the necessary steps to encourage the local production of these products.

Very recently, private industries and the Board of Investments of the Philippine Government prepared a project study on the feasibility of establishing a refractories plant. The idea was to be able to replace the imported refractories required by the various industries by locally produced ones. At the moment the Philippine Government is in the process of approving three proposals to manufacture basic bricks and high alumina bricks with an aggregate total capacity of 35,000 metric tons per annum. With these additional 3 factories when operational, the refractory industry will be able to supply the requirements of the Philippine industry during the next 5 years.

RESEARCH AND DEVELOPMENT

To assist in the development of refractory industry, the National Institute of Science and Technology (NIST), a Government agency, is charged to facilitate and extend technical assistance in research and development requirements of the private manufacturers of refractory. It provides a liaison between the Philippine Bureau of Mines and the private industry in the study and locating of sources of raw materials. NIST conducts studies on the properties of locally available refractory materials and, where necessary, conducts beneficiation studies on these materials so as to render them suitable for utilization in refractories production.

PROBLEMS

The lack of efficient means of transporting raw materials from sources to users is a problem of the industry. The islands of the Philippines being separated by bodies of water, to transport raw materials from minesite to the centre of production in the urban area is an intricate and expensive operation.

Trasportation as well as the low volume requirements of these raw materials are the main impediment of full scale development of the raw materials sources of the Philippines.

TABLE I

PROSPECTIVE REFRACTORY CLAY MATERIALS

Reserves	Chemical Analysis	PCE
Buruanga, Aklan White clay		29
Merong, Bataan Plastic Fireclay		31
Pulang Bato, Leclec White clay Bauan, Batangas	SiO_2 - - 48.36 Al_2O_3 - - 46.13 Fe_2O_3 - - 0.95 CaO - - 0.78 MgO - - 0.60 L.O.I. - 13.72	31+
Malimaga, Nabini, Batangas	SiO_2 - - 43.02 Al_2O_3 - - 40.33 Fe_2O_3 - 1.61 CaO - - 0.04 MgO - - 0.59 L.O.I. - 14.36	30
Abio, Guimaras White clay		30+
San Rafael, Guimaras White clay	SiO_2 - - 36.08 Al_2O_3 - - 36.81 Fe_2O_3 - - 1.01 CaO - - 0.87 MgO - - 0.21 L.O.I. - - 10.74	
Daet, Camarines Norte Creamy-White clay		29-30
Larap, Jose Panganiban, Camarines Norte White Clay		29
Labo, Camarines Norte	SiO_2 - - 46.17 Al_2O_3 - - 39.09 Fe_2O_3 - - 1.52 CaO - - 0.30 MgO - - 0.27 LO.I. - - 12.99	29-30
Sbi Gallego, Camarines Sur Brown Plastic Fireclay	SiO_2 - - 49.32 Al_2O_3 - - 30.30 Fe_2O_3 - - 2.12 CaO - - 1.52 MgO - - 0.32 NaSO - - 0.11 K_2O - - 0.49 L.O.I. - - 14.75	29+
Binahaipan, Sbi Gallego Camarines Sur Fireclay	SiO_2 - - 43.90 Al_2O_3 - - 34.60 Fe_2O_3 - - 3.90 CaO - - 0.99 MgO - - 0.36 L.O.I. - - 14.87	31
Iriga, Camarines Sur Light Gray Clay		30+

	Reserves	Chemical Analysis	PCE
Naragondon, Cavite Clay			30
Balut Island, Davao Clay			30
Iloilo Gray Ball Clay		SiO_2 - - 45.97 Al_2O_3 - - 32.57 Fe_2O_3 - - 2.76 CaO - - 0.98 MgO - - 0.49 L.O.I. - - 17.12	31+
Bulan, Sorsogon White Clay		SiO_2 - - 52.72 Al_2O_3 - - 35.86 Fe_2O_3 - - 1.04 CaO - - 0.59 MgO -x- 0.38 L.O.I. - - 6.82	31+

	Reserves	Chemical Analysis		PCE
		HEAD	WASHED	
Barotac, Viejo, Iloilo City		SiO_2 46.92	43.32	31
		Al_2O_3 31.15	33.55	
		Fe_2O_3 4.01	0.81	
		CaO 0.31	0.51	
		MgO 0.30	0.88	
		Na_2O 0.30	0.78	
		K_2O 0.19	0.12	
		H_2O 2.51	1.05	
		L.O.I. 13.18	13.87	
La Chica, Barotac Viejo, Iloilo White Clay		SiO_2 - - 62.00		31+
		Al_2O_3 - - 27.14		
		Fe_2O_3 - - 0.56		
		CaO - - 0.17		
		MgO - - 0.30		
		L.O.I. - - 10.98		
Gigante Island Kaolin Gigante Norte and Sur, Carles, Iloilo	70,000 MT	SiO_2 - - 42.50		29-30
		Al_2O_3 - - 38.51		
		Fe_2O_3 - - 0.99		
		CaO - - 0.51		
		MgO - - 0.91		
		H_2O - - 3.59		
		L.O.I. - - 14.13		
Siocon Island Clay Carles, Iloilo	51,000 MT	SiO_2 - - 61.88		30
		Al_2O_3 - - 22.96		
		Fe_2O_3 - - 0.68		
		CaO - - 0.54		
		MgO - - 0.73		
		L.O.I. - - 12.98		

	Reserves	Chemical Analysis		PCE
Lemery, Iloilo Gray Plastic Fireclay	27,200 MT	SiO_2 - -	51.71	29
		Al_2O_3 - -	28.30	
		Fe_2O_3 - -	4.61	
		TiO_2 -	0.13	
		CaO - -	0.68	
		MgO - -	1.60	
		Na_2O Na-	2.82	
		K_2O - K	0.33	
		L.O.I. - -	10.98	
San Dionisio, Iloilo White Clay		SiO_2 - -	50.00	31+
		Al_2O_3 - -	36.69	
		Fe_2O_3 - -	1.75	
		CaO - -	0.84	
		MgO - -	0.47	
		L.O.I. - -	9.66	
Bondalan, San Dionisio, Iloilo Gray Plastic Fireclay	660,000 MT	SiO_2 - -	56.49	30
		Al_2O_3 - -	28.99	
		Fe_2O_3 - -	2.96	
		CaO - -	0.47	
		MgO - -	0.99	
		L.O.I. - -	11.13	
Sipit, Bitin, Bay, Laguna Clay	35,000 MT			29+
Calamba, Laguna White Clay		SiO_2 - -	46.84	32
		Al_2O_3 - -	34.43	
		Fe_2O_3 Fe	1.74	
		CaO - -	0.86	
		MgO - -	0.86	
		Na_2O - -	1.11	
		K_2O - -	0.64	
		L.O.I. -	13.74	
Puncol, Calamba, Laguna White Clay				29-30
Mt. Makiling White Clay	37,000 MT	SiO_2 - -	40.96	31+
Puting Lupa, Los Baños, Laguna		Al_2O_3 - -	38.71	
		Fe_2O_3 - -	1.81	
		CaO - -	0.84	
		MgO - -	0.51	
		L.O.I. -	15.70	
Calaba, Biliran Island Clay Leyte del Norte				29-30
Capoocan, Leyte del Norte White Clay				31

	Reserves	Chemical Analysis	PCE
Dolores and Sta. Cruz, Marinduque White Clay		SiO_2 - - 50.06 Al_2O_3 - - 32.12 Fe_2O_3 - - 1.18 CaO - - 0.70 MgO - - 0.39 L.O.I. - 15.08	30
Torrijos, Marinduque White Clay		SiO_2 - - 57.77 Al_2O_3 - - 29.99 Fe_2O_3 - - 1.59 CaO - - 0.45 MgO - - 0.57 L.O.I. - 9.72	31
Milagros, Masbate Clay		SiO_2 - - 55.54 Al_2O_3 - - 31.38 Fe_2O_3 - - 1.61 CaO - - 0.40 MgO - - 0.57 L.O.I. - 10.44	30
Daclan, Bokod, Benguet Mt. Province White Clay	30,000 MT	SiO_2 - - 47.94 Al_2O_3 - - 32.10 Fe_2O_3 - - 0.44 CaO - - 0.39 MgO - - 0.43 L.O.I. - 16.63	30
Talakag, Bukidnon, White Clay			31+
Mambucal, Negros Occidental	5,900 MT	SiO_2 - - 44.22 Al_2O_3 - - 30.69 Fe_2O_3 - - 0.70 CaO - - 0.28 MgO - - 0.15 LC.I. - - 12.00	31
Nueva Ecija Plastic Clay		SiO_2 - - 53.82 Al_2O_3 - - 37.10 Fe_2O_3 - - 2.47 CaO - - 0.48 MgO - - 0.63 L.O.I.- - 14.33	29
Burgos, Nueva Ecija White Clay			29-30
Carranglan, Nueva Ecija Gray and Brown Plastic Clay		SiO_2 - - 55.51 Al_2O_3 - - 29.03 Fe_2O_3 - -0 3.25 CaO - - 0.51 MgO - - 0.59 L.O.I. - 10.41	29
Aritao Nueva Biscaya Plastic Clay			31

Reserves	Chemical Analysis	PCE
Infanta, Pangasinan Clay		30
Mangatarem, Pangasinan White Clay		31
San Nicolas, Pangasinan Light Brown Clay		30
Canigaran, Aurora, Quezon White Clay		29-30
Tagkawayan, Quezon Yellowish Brown Plastic Clay	SiO_2 - - 52.52 Al_2O_3 - - 33.05 Fe_2O_3 - - 1.61 CaO - - 0.22 MgO - - 0.49 L.O.I. - - 12.30	30
Irosin, Sorsogon Clay	SiO_2 - - 44.69 Al_2O_3 - - 38.13 Fe_2O_3 - - 2.03 CaO - - 0.12 MgO - - 0.47 L.O.I. - - 14.25	31+
Juban, Sorsogon Ball White Clay		31
Sta. Cruz, Zambales White Clay		29-30
Labason, Zamboanga Del Norte White Clay	SiO_2 - - 43.66 Al_2O_3 - - 32.94 Fe_2O_3 - - 1.76 CaO - - 1.63 MgO - - 0.84 L.O.I. - - 18.84	300
Ipil, Zamboanga del Sur White Clay		30

TABLE II

PROSPECTIVE SOURCES OF SILICA

LOCALITY	SOURCE	RESERVE (Metric Tons)	ANALYSIS
Dacian, Boko Benguet, Mt. Province	Siliceous sinter	Limited reserve	SiO_2 - 97.0 Al_2O_3 - 2.0 Fe_2O_3 - 0.4 Alkalies - Trace
Kabangkalan, Negros Occ.	Chert boulders	5,000	SiO_2 - 96.00 Al_2O_3 - 1.37 FeO_3 - 0.56

LOCALITY	SOURCE	Reserves (Metric Tons)	ANALYSIS
Sagay, Negros Occidental	Silicified rock, friable and granular	Sand - 224,000 Rock - 747,500	SiO_2 - 90.00-99.00 Al_2O_3 - 0.26-0.73 FeO_3 - 0.64- 2.21
Siaton, Negros Occidental	Silicified rock, friable and granular	1,000,000	Similar to Sagay deposit
Abra de Ilog, Occidental Mindoro	Veins in schist and gneiss sand to boulders	3,600	SiO_2 - 97.80 Al_2O_3 - 1.21 LOI - 0.30
Lubang Island, Occidental Mindoro	Veins in schist and gneiss gravel to boulders	No estimate	SiO_2 - 97.49 Al_2O_3 - 1.58 LOI - 0.34 Size range from pea to 75 mm. in diameter
Rexas, Palawan	Quartz sand from quartzite	2,700,000	SiO_2 - 95.00-98.00 Al_2O_3 - 1.47- 3.00 Alkalies 0.45- 0.48 LOI - 0.43 45% - 60,+100 mesh
Tagkawayan, Quezon	Bull quartz in diorite	45,000	SiO_2 - 96.00-97.00 Al_2O_3 - 1.58 Alkalies 0.58 LOI - 0.19
Baguio City	Silicified zones in volcanic rocks	1,000,000	SiO_2 - 80.00-90.00 Al_2O_3 - 2.24 FeO_3 - 0.22 CaO - 0.05

TABLE III

RESERVES AND ANALYSIS OF DAVAO MAGNESIT

	Reserves	Analysis
Lapon, Davao	15,000 tons (later study by private geologists place it at 400,000 tons)	MgO - 49.24 SiO_2 - 0.15 Fe_2O_3 - 0.29 CaO - Trace
Magum, Davao	15,000 tons	MgO - 46.89 SiO_2 - 3.08 Fe_2O_3 - 0.70 CaO - 0.26

TABLE IV

*CHEMICAL ANALYSIS OF LOCAL RAW MATERIALS

	Raw Materials	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Cr_2O_3	Alkali	LOI
1.	Kaolin:								
	a) -	55.98 %	0.282 %	32.756%	-	-	-	-	10.72 %
	b) -	52.73 %	-	33.396 %	-	-	-	-	13.05 %
2.	Ball clay -	47.31 %	0.686 %	34.344 %	-	2.31 %	-	-	15.35 %
3.	Fire-clay -	44.20 %	3.420 %	36.78 %	-	2.20 %	-	-	13.73 %
4.	Chromite ore -	5.90 %	14.200 %	29.80 %	1.20 %	18.50 %	30.40 %	-	-
5.	Silica:								
	a) -	98.56 %	0.14 %	0.73 %	-	-	-	-	0.52 %
	b) -	89.80 %	1.00 %	8.30 %	-	-	-	-	1.70 %
6.	Dolomite -	0.59 %	0.199 %	0.022 %	32.42 %	21.91 %	-	-	44.85 %
7.	Limestone -	0.77 %	0.230 %	1.495 %	54.46 %	-	-	-	43.18 %
8.	Talc:								
	a) -	58.20 %	1.006 %	6.880 %	-	26.76 %	-	-	7.16 %
	b) -	59.34 %	0.791 %	6.931 %	-	25.42 %	-	-	7.02 %
9.	Feldspar:								
	a) -	71.43 %	0.465 %	13.995 %	-	-	-	8.46 %	2.65 %
	b) -	70.02 %	0.395 %	18.229 %	-	2.65 %	-	7.176%	1.53 %
10.	Feldspathic clay-	72.83 %	0.528 %	17.970 %	-	traces	-	3.888%	4.79 %

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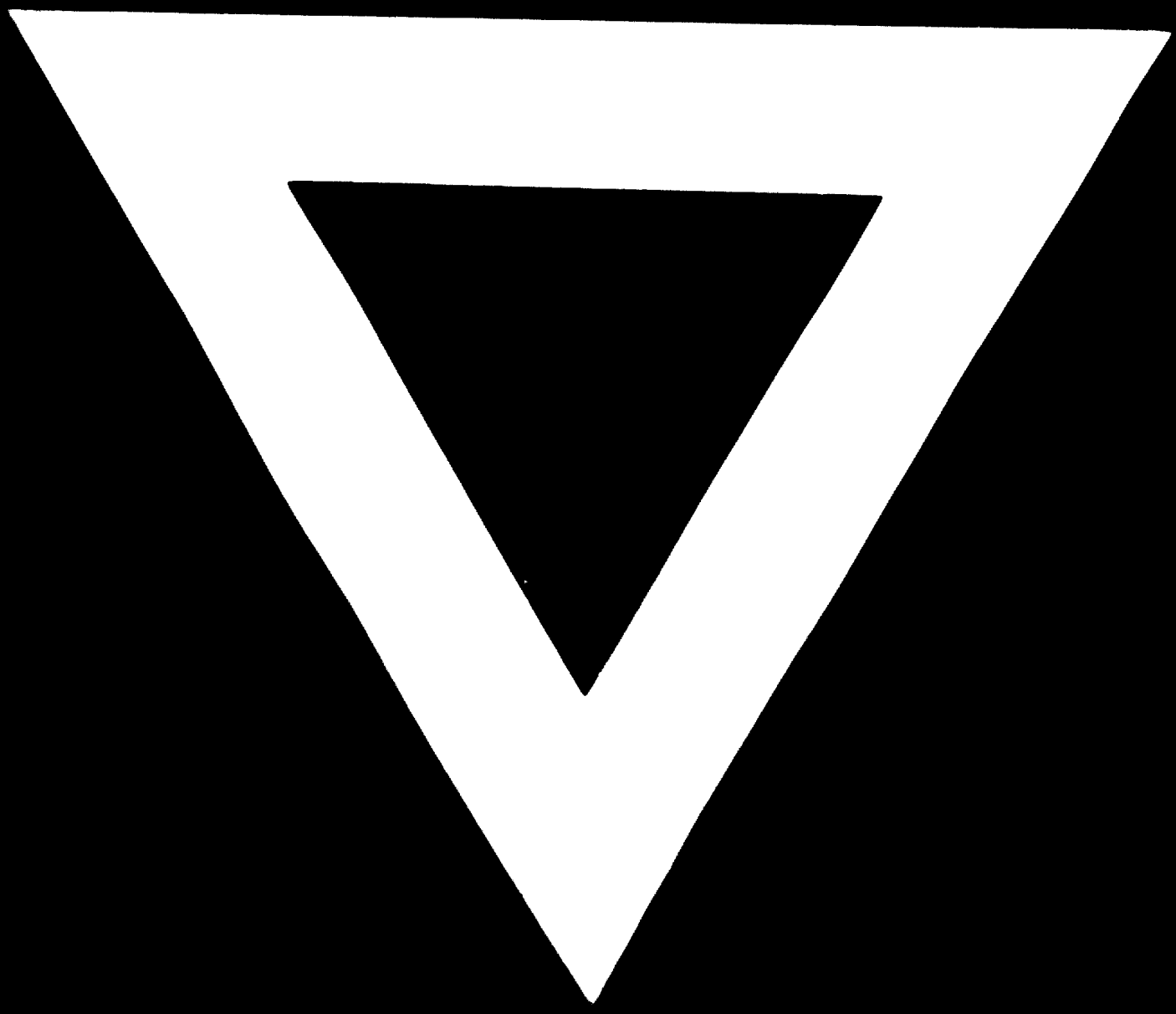

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