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# POSSIBILITIES FOR A REFRACTORIES MANUFACTURE IN IRAQ 1/

by

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## A. RAW MATERIALS

There are four main classes of materials from which refractories are made:

1. Fire clay
2. Rocks consisting of almost pure silica
3. Rocks composed chiefly of silica but containing about 10% clay (known as Dainster)
4. Neutral and basic materials such as chromite, alumina and magnesia

Treatment of the materials depends on their nature.

In order to know the general direction in which demand tends to run, the chief characteristics needed in the refractories must be studied. It is impossible to obtain all these in single brick as they are to some extent mutually incompatible, but the user should know which to select from the whole.

The chief characteristics required are:

1. Resistance to high temperature.
2. Resistance to high pressure at high temperature.
3. Non-absorptive power at any temperature.
4. Uniformity in size, shape and composition.
5. Non-expansion or contraction in use.
6. Resistance to abrasion by dust, flames, metal slag and other materials.
7. Resistance to reduction and oxidisation.
8. Resistance to wear and tear and accidental blows.
9. Resistance to sudden change in temperature.

## B. MARKETS

The main uses of refractories are for a variety of furnaces, boiler work, etc. where their heat resisting power is of preliminary importance and different types of refractories may be used in one furnace. In order to know exact consumption of refractories in different industries, a market survey was made and the result showed the following figure for the annual consumption of various refractories in Iraq:

1. Basic Refractories

| | |
|---|---|
| - Chrome magnesite brick sc40 for existing factories | 2,250 tons |
| - Chrome magnesite brick sc40 for factories under construction | 2,250 tons |
| - Magnesite brick for existing factories | 820 tons |
| - Magnesite brick for factories under construction | 4,300 tons |

2. Neutral Fire Brick Refractories

- Very high alumina sc38, $Al_2O_3$ more than 75%
  for existing factories — 3,140 tons
  for factories under construction — 2,700 tons
- High alumina type sc35-36, $Al_2O_3$ 40 - 45%
  for existing factories — 1,150 tons
  for factories under construction — 5,000 tons
- Chamotte sc37-38, sillimanite
  for existing factories — 250 tons
  for factories under construction — 600 tons

3. Acidic Brick Refractories

- Fire clay brick sc26-34, $Al_2O_3$ 30-35%
  for existing factories — 6,715 tons
  for factories under construction — 12,500 tons
- Silica brick sc32-33
  for existing factories — 860 tons
  for factories under construction — 860 tons

4. - Zirconium brick
  for existing factories and those under construction — 73 tons

5. Insulation Bricks — small quantities

From the above, one can see that the maximum consumption is for two types of refractories:

1. Magnesite brick which, after the factories under construction have been finished, equal about 5,000 tons per year.
2. Neutral fire brick:
   a) Very high alumina refractory which reach about 6,000 tons per year
   b) High alumina refractory which reach about 6,000 tons per year
   c) Fire clay brick of sc26-34 which reach about 2,000 tons per year.

## C. LABOUR AND INVESTMENT POSSIBILITIES

In general, the Iraqi Government has the two possibilities in labour and investment, but there is no specialist labour in refractories and therefore the beginning operation of any factory producing refractories must be done under supervision of experts. A theoretical estimate of labour that can work in a factory producing less than 10,000 tons of refractories per annum is 64 persons and the total investment required for a 10,000 tons per year refractory project is estimated to be US$ 6,562,500. This investment is composed of the following:

| Capital Investment: | US$ |
|---|---|
| Testing material | 18,400 |
| Designing | 150,000 |
| Machinery and equipment | 3,370,000 |
| Erection | 337,000 |
| Civil engineering work | 1,348,000 |
| Utilities | 356,600 |
| Total capital cost | 5,570,000 |

| Working Capital Investment: | |
|---|---|
| Wages and salaries | 918,000 |
| Electricity and fuel oil | 50,700 |
| Raw materials | 816,000 |
| Transportation | 34,000 |
| Total working capital investment | 992,500 |

Total Investment:

US$ 5,570,000 + 330,800 = 5,900,800

## D. ASSESSMENT OF RAW MATERIALS

In general, the Iraqi raw material has the following characteristics:

1. Gaora clay - chemical analysis:

| | | |
|---|---|---|
| $SiO_2$ | - | 51.55% |
| $Al_2O_3$ | - | 31.65% |
| $Fe_2O_3$ | - | 1.95% |
| $TiO_2$ | - | 1.85% |
| CaO | - | 1.12% |
| MgO | - | 0.58% |
| $SO_4$ | - | 0.92% |

A sample with the above analysis has been used in a trial manufacture of refractory bricks and was found feasible for the manufacture of refractory bricks. The refractories that can be produced are sc34, sc36 and sc38, but after addition of various percentages of foreign clay and sillimanite of two different sizes.

The conclusions of the trial were as follows:

- It is possible to manufacture refractory bricks with the desired refractoriness up to sc33 by adding sillimanite and clay.
- The product of the test was found to be in fine condition; porosity was also found to be comparatively low and the compressive strength satisfactory.
- The Iraqi clay alone will only suffice to make refractory bricks below sc33 in refractoriness.

2. Dolomites

As a preliminary investigation regarding a raw materials basin, it was found that there are many deposits of dolomites but unfortunately no trial manufacture of dolomite refractories has been made.

A sample of Iraqi dolomite has the following characteristics:

| | |
|---|---|
| $MgO$ | 18.32% |
| $CaO$ | 29.21% |
| $Fe_2O_3$ | 1.02% |
| $SiO_2$ | 1.48% |
| $Al_2O_3$ | 1.79% |
| $P_2O_5$ | 0.03% |
| $SO_3$ | 0.75% |

The above analysis is from one Iraqi deposit alone; there are many other deposits. The best deposit should be selected after a trial manufacture test.

## E. SELECTION OF SUITABLE AND PROFITABLE ITEMS

The market survey shows that the most consumed refractories are different types of alumina fine brick which reach up to 30,000 tons per year for total types and since Gaora clay, as shown in the trial manufacture, is suitable for production of low quality refractories and also high quality with the addition of imported materials, these items of refractories are suggested for the start of the manufacture in Iraq.

If it is estimated that a fine brick factory of 30,000 tons per year can be constructed, the total cost of the project would be as follows:

Capital investment is estimated to equal:

| | US$ |
|---|---|
| Machines and equipment | 6,000,000 |
| Erection work | 400,000 |
| Civil engineering work | 2,200,000 |
| Other items | 600,000 |
| Total | 9,200,000 |

Working capital investment

Triple the working capital that was mentioned in investment possibilities and equal to US$ 1 million x 3 = US$ 3 million.

Total investment capital

US$ 9,200,000 + 1,000,000 = US$ 10,200,000

| Manufacturing Cost | US$ |
|---|---|
| Depreciation of machinery and equipment | 600,000 |
| Depreciation of civil works | 88,000 |
| Spare parts | 600,000 |
| Maintenance | 120,000 |
| Working capital | 3,000,000 |
| Total | 5,408,000 |

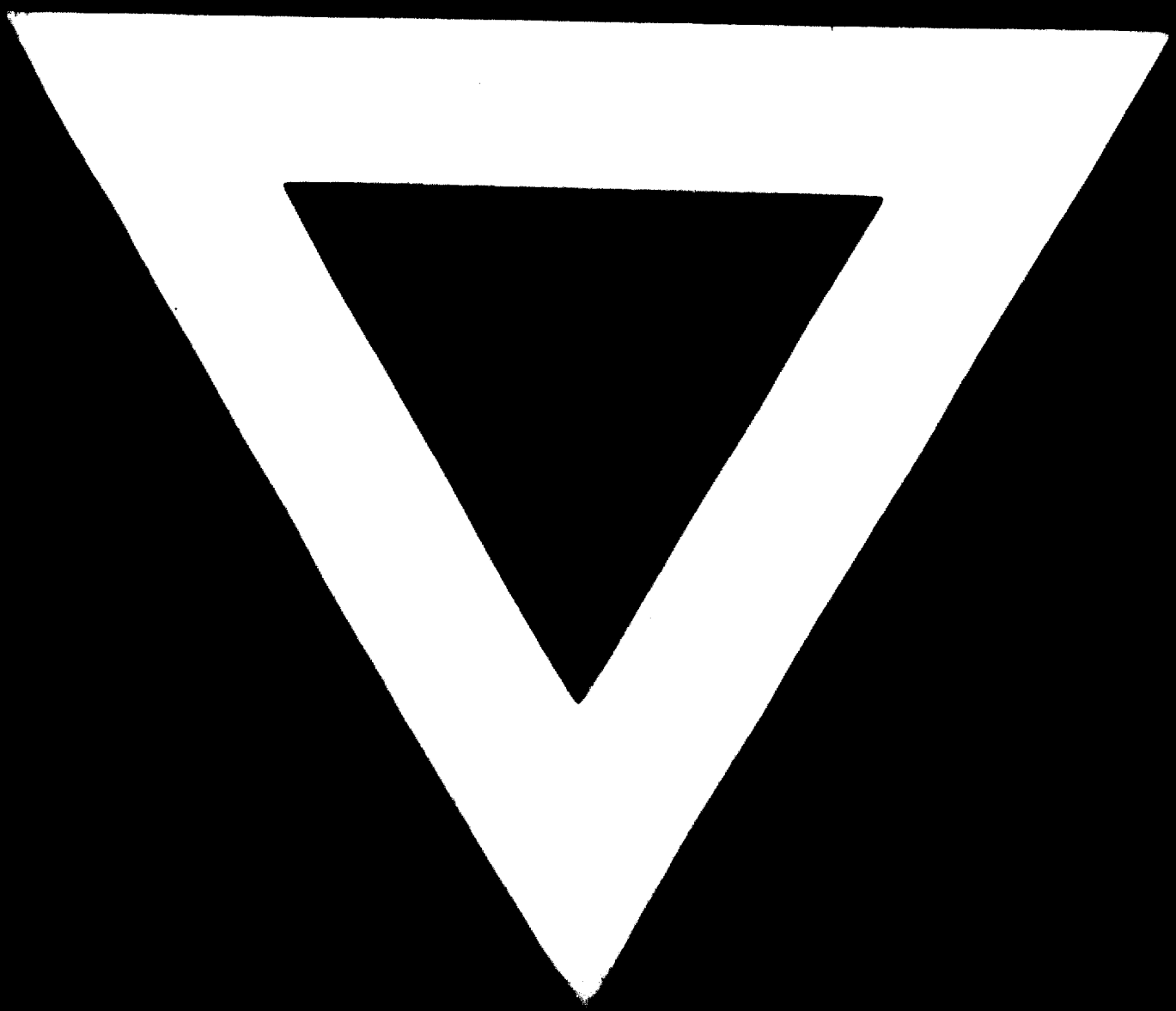
The average imported cost of one ton of fire clay brick is 65 Iraqi Dinars, which is equal to about US$ 220 and, as there is no production of this type in Iraq it is estimated that the above-mentioned figure be the selling price.

Total selling price = 220 x 30,000 = US$ 6,600,000

Total profit = US$ 1,192,000

Return of investment - 8 years

As there is no factory producing any type of refractory in Iraq it is impossible to make improvements in manufacturing technology or training new staff, but there is a possibility of performing certain research and development work in the Building Research Centre.



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