

**Pre-Feasibility Study for**

**Producing Refractory bricks**



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**Abstract:**

The Refractory bricks is kind of brick which is produced from kaoline and fireclay. It has a compressed molecular and fine structure and is produces in high temperatures, that is more than 1500 C. As can be perceived by its name, it is employed in furnaces, cauldrons, as well as industrial insulations due to its high thermal resistance.

Silica Refractory brickss are used in glasses and ceramics’ production, as well as in coke production furnaces, because this kind of bricks has a high thermal conductivity to inhibit the penetration of gases.

The required land area is 5,000 square meters. The required electricity power is 480000 kWh annually, the water required is 30000 cubic meters annually and the fuel required is 535000 Liters of gas oil annually. The project is expected to employ 34 people.

**Product Introduction**

Brick is a synthetic stone whose clay type is made of adobe (shaped earth and straw) and calcareous sand type is made of processing the calcareous sandy clay (made from squeezing a homogeneous mixture of silica sand and lime in a mold) with pressurized steam. Concrete bricks are made like cement blocks. Clay bricks are mainly made of aluminum silicates, and calcareous sand bricks are made of fine siliceous gravels that are linked together by a calcium silicate paste. The brick is usually gray but can be recolored by adding the appropriate materials. Brick is produced in cubic solid rectangular, perforated, hollow (blade and roof cavity) and thin pieces. Bricks are used in the construction of bearing walls, separating blades, beam and block floorings, archeries between beams and exterior and interior of buildings.

**Some Characteristics of Red Shale Bricks**

Low water Consumption: As previously mentioned, the most important advantage of these bricks is the very low consumption of water in the construction and production process compared to ordinary bricks.

Color: Color is one of the most important advantages of Shale Bricks. The most significant feature of the Shale Brick color is being natural. Therefore, the color of these bricks is permanent and does not change with time, increasing or decreasing temperature, as well as precipitation or radiation of the sun. The primary color of Shale rock is gray-to-black, which gradually turns to light orange after absorption of heat in the furnace and eventually turns to black as the temperature of furnace increases.

Lack of efflorescence: Shale bricks have low water absorption compared to the traditional bricks (clay bricks) due to differences in chemical composition., they do not maintain moisture and repels it quickly, so the possibility of efflorescence is much less in these bricks.

Physical and Chemical Resistance: Shale bricks are highly resistant to acids, bases, moisture, heat, very high cold temperatures and freezing, and have high color stability and high quality against gases and pollutants in the air.

Stability: These bricks are resistant to conventional physical pressures and wear and tear, so they will last for hundreds of years according to similar situations in different countries.

Heat Resistance: Shale brick has a lower heat transfer coefficient in comparison with other types of materials used in building facades, such as glass and aluminum, so it acts as a favorable thermal insulator.

Moisture Extraction: Shale brick does not retain moisture and quickly repels it.

Environmental compliance: The source used for traditional bricks is agricultural soils and since the soil is the most important basis of agriculture and the formation of any centimeter of soil takes a long time, so using another source rather than agricultural soil to produce bricks will protect the environment.

Advantages of using Shale stone for brick production:

• Very high compressive strength

• Anti-wear properties (carpet bricks)

• Very low water absorption rate

• Freeze-thaw resistance

• Non-absorption of environmental contamination to the brick surface

• decoration of building facades

• Reduce environmental damage during production

**Study of Shale Mine for Manufacturing Red Brick**

Brick is obtained by heating and cooking the adobe. The adobe is a formed homogeneous mixture of soil and water. The primary soil of brick production is provided by sedimentary deposits such as clay, shale, and marl. A large number of local workshops near the towns and villages, often produce specific bricks using their local soils. With the industrialization of brick, production centers have become more centralized and the process became more mechanized and even red brick production has been aided by other materials.

These young alluvial deposits containing fine clay and silt particles, form large fields and are highly fertile and suitable for agriculture due to their significant amounts of minerals. The prolonged and irregular extraction of these soils on the one hand, and the expansion of cities on the other hand, not only cause creating an unpleasant view of large dug pits, but also destruct and endanger the agricultural soils. In this regard, take Isfahan province and the big cities in it as an example. Manufactured bricks should have a pleasant look and appearance in addition to its stability and strength. Given the current importance of sustainable development and the goals, replacing new brick soil resources seems to be necessary, considering the appropriate soil composition for brick production and the red color of shale and marl deposits, which are abundant in this province, can be considered as the best choice.

**Production plan for all types of refractory bricks**

**Review of alternative goods, competitors and analysis and its effect on product consumption:**

The raw materials and production process of refractory bricks vary according to place of consumption, furnace temperature, chemical environment, pressure, trituration and temperature changes, and are prepared with the least amount of flux materials. In fact, it is made from a variety of fireclay. These bricks are produced in different sizes depending on the number of uses they have. The way of making this brick is that refractory materials, mixture of clay, sand, magnesite and dolomite are mixed together then are cooked with clay and slaked lime and magnesium oxide together. This type of brick is commonly used in the steel industry, construction work, as well as in heaters, boilers and even fireplaces.

The most common use of these bricks is in the inner coating of open steel kilns, rotary cementing kilns, and smelting furnaces. Stone and refractory bricks which have their own beauty, are used for facade. The bricks with their beautiful colors create stylish and luxurious buildings. Ordinary bricks are among the substitute goods of studied product, which have their places in the open market and a significant share for them due to the tendency of construction industry to the higher quality of refractory bricks.

Due to the high price of fireclay, the price of refractory bricks are higher than other bricks. We can realize the importance of it because of existence of rich mines in South Khorasan province, including fireclay, export and domestic markets, and the import of this product.

## **Investing the production process, exporting and importing product over the past five years**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Demand** | **Export** | **Import** | **Domestic production** | **Year** |
| 295,238 | 7,391 | 35,773 | 266,857 | 2014 |
| 299,360 | 11,361 | 24,335 | 286,387 | 2015 |
| 304,293 | 11,955 | 23,807 | 292,442 | 2016 |
| 333,648 | 7,983 | 19,930 | 321,702 | 2017 |
| 497,410 | 7,863 | 175,662 | 329,612 | 2018 |

Due to the existing export markets around the province and the borders of South Khorasan province, it is possible to imagine good markets for products in Afghanistan, Pakistan and other neighboring countries.

### Predicting product sales in the next five years

According to studies, it is considered that the existing units will continue to produce in coming years with 70% of other nominal capacity. We will also consider that units with 75-99% progress in 1398, units with 50-74% progress until 1399, units with 25-49% progress until 1400 and units with 1-24% physical progress until 1401, will be exploited.

Therefore, the forecast of supply unit 1401 is estimated in the following tables.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Forecasting the supply of refractory bricks (ton measurement unit)** | | | | | |
| 2022 | 2021 | 2020 | 2019 | 2018 | Description |
| 329,612 | 329,612 | 329,612 | 329,612 | 329,612 | Capacity of active units |
| 17,920 | 15,680 | 13,440 | 11,200 | 0 | Units capacity 75-99% progress |
| 43,855 | 37,590 | 31,325 | 0 | 0 | Units capacity 50-74% progress |
| 30,492 | 25,410 | 0 | 0 | 0 | Units capacity 25-49% progress |
| 12,600 | 0 | 0 | 0 | 0 | Units capacity 1-24% progress |
| 434,479 | 408,292 | 374,377 | 340,812 | 329,612 | Total |

**2-6-2 Predicting product demand over the next five years**

According to the consumption trend in the fast five years, the amount of domestic demand has been estimated in order to predict the total demand in the coming years, and also due to the lack of special trends in the import and export of products, it is considered that the import of product will decrease by 10 % annually, and its export will increase by 10 % annually. To check the need for the product, we must pay attention to the gap between the forecast of supply and demand, which is discussed in the table below for this type of product.

Product requirement= (domestic demand +export) + (domestic supply+ import)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predicting the need for the product (ton)** | | | | | |
| 2022 | 2021 | 2020 | 2019 | 2018 | Description |
| 452,266 | 434,479 | 408,292 | 374,377 | 340,812 | Domestic supply |
| 16 | 158 | 1,581 | 15,810 | 158,096 | importation |
| 653,038 | 609,175 | 565,311 | 521,448 | 477,585 | Domestic demand |
| 12,664 | 11,513 | 10,466 | 9,515 | 8,650 | export |
| 213,420 | 186,050 | 165,905 | 140,777 | -12,673 | Need a product |

Due to the exciting exports markets around the province and borders of South Khorasan province, it is possible to imagine good markets for products in Afghanistan, Pakistan and other neighboring countries.

**Analysis and determination of the minimum economic capacity**

## **1- project's fixed costs**

|  |  |  |
| --- | --- | --- |
| # | Description | Amount in Million Rials |
| 1 | Land | 1,750 |
| 2 | Landscaping and Buildings | 4,525 |
| 3 | Facilities | 2,376 |
| 4 | Vehicles | 1,050 |
| 5 | Equipment and machinery | 320112 |
| 6 | Office and workshop equipment | 340 |
| 7 | Pre-operation costs | 6603 |
| 8 | Miscellaneous costs | 1,193 |
|  | Total | 337949 |

## 1-1- Equipment and Machinery

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # | Machinery | Quantity | Unit | Unit cost in Thousand Euros | Acceleration rate | Total Costs (Million Rials) |
| 1 | The complete brick production line is attached to the Proposal | 1 | Device | 2470 | 120000 | 296400 |
| Machinery transportation, customs and installation costs (equivalent to 8%) | | | | |  | 23712 |
| **Total** | | | | |  | 320112 |

## **2- Estimation of project's working expenses**

|  |  |  |
| --- | --- | --- |
| # | Description | Costs in Million Rial |
| 1 | Raw materials | 864 |
| 2 | Salary | 10,657 |
| 3 | Fuel and energy | 1,674 |
| 4 | Repair and maintenance | 1,247 |
| 5 | Wear and tear | 3,460 |
| 6 | Unexpected expenses (5% of the sum of rows 1 to 4) | 722 |
|  | Total | 18,625 |

## 1-2- Raw materials

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # | Main Raw Materials |  | Annual Consumption | Unit | Unit Cost  (Rials) | Total Costs in Million Rials |
| 1 | Soil for brick production |  | 3457 | ton | 250000 | 864 |
|  | **Total** | | | | | 864 |

2-2- Salary Estimate

Salaries are estimated for two categories; production and non-production personnel. Benefits, bonuses and employer premiums for non-production and production personnel are 70% and 90% of the annual salary, respectively. The following tables depict the estimated salaries.

## Non-production personnel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Description | Number | Monthly Salary (Rial) | Annual Salary (Million Rial) |
| 1 | Project Manager | 1 | 25,000,000 | 300 |
| 2 | Administrative and financial | 4 | 20,000,000 | 960 |
| 3 | Guardian and attendant | 2 | 12,000,000 | 288 |
|  | Total | 7 |  | 1,548 |
|  | Benefits, bonuses and premiums | | | 1,084 |
|  | Total | | | 2,632 |

## Production personnel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Description | Number | Monthly Salary (Rial) | Annual Salary (Million Rial) |
| 1 | Technical Assistant | 1 | 18,000,000 | 216 |
| 2 | Skilled worker | 5 | 14,000,000 | 840 |
| 3 | Simple worker | 20 | 12,000,000 | 2,880 |
| 4 | Driver | 2 | 12,000,000 | 288 |
|  | Total | 27 |  | 4,224 |
|  | Benefits, bonuses and premiums | | | 3,802 |
|  | Total | | | 8,026 |

2-3- Estimating the amount of required energy and water

In a production unit, in addition to the raw materials needed to produce a product, facilities are needed to operate the equipment and machinery. These requirements, also known as utilities, include: electricity, process water, cooling water, and diesel. In this section, the amount of consumption of each of these components is determined in two categories; the process components (required for manufacturing equipment) and the non-process components (utility and general use).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Description | Unit | Annual Consumption | Unit Cost (Rial) | Total cost (Million Rials) |
|  | Gasoline | Liter | 555,000 | 2,000 | 1,110 |
|  | Water | Cubic meter | 30,000 | 3,500 | 105 |
|  | Petrol | Liter | 9,000 | 7,000 | 63 |
|  | Electricity | KWh | 480,000 | 700 | 336 |
|  | Viscosine and oil | Liter | 1,000 | 30,000 | 30 |
|  | Communications | --- |  |  | 30 |
|  | Total | | |  | 1,674 |

**3- Estimating project's circulating capital**

|  |  |  |  |
| --- | --- | --- | --- |
| # | Description | Time (days) | Total Costs (Million Rials) |
| 1 | Raw material storing costs | 1 | 73 |
| 2 | Petty cash | 1 | 1480 |
| Total | | | 1553 |

**4- Investment Table**

|  |  |  |
| --- | --- | --- |
| # | Description | Total Costs (Million Rial) |
| 1 | Fixed investment | 337949 |
| 2 | Circulating capital | 1553 |
| Total | | 339502 |

**5- Annual Production Costs**

The total annual production costs are estimated from the sum of fixed and variable costs.

|  |  |
| --- | --- |
| Description | Total cost |
| Raw material | 864 |
| Energy and fuel | 1,674 |
| Personnel expenses | 10,657 |
| Annual wear and tear, repair and maintenance costs | 4,708 |
| **Total** | 17,903 |

**6- Sales Forecast**

It is calculated based on the finished product price, taking into account the market price and deduction of overhead expenses. So the selling price of the product is estimated as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Description | unit | Production Amount (Kg) | Unit Value  (Rial) | Total costs (Million Rial) |
| 1 | Refractory bricks | Format | 10,395,000 | 7,500 | 77,963 |

**7- Plan’s Financial Indicators**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Special profit and loss | The rate of return on investment | The period of return on investment | Per capita fixed investment | Per capita total investment |
| 36542 | 0.32 | 3.14 | 3,326 | 3,371 |

**8- Profit and Loss Calculation Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Profit and Loss Forecast Table | | | | | |
| Description | 1st year | 2nd year | 3rd year | 4th year | 5th year |
| Production Amount | 8,316,000 | 9,355,500 | 10,395,000 | 10,395,000 | 10,395,000 |
| net sales | 62370 | 70166.25 | 77962.5 | 77962.5 | 77962.5 |
| Production Costs | | | | | |
| Raw material | 691 | 778 | 864 | 864 | 864 |
| Production staff salaries | 6,420 | 7,223 | 8,026 | 8,026 | 8,026 |
| Energy Consumption | 1,339 | 1,507 | 1,674 | 1,674 | 1,674 |
| Maintenance | 873 | 1,123 | 1,247 | 1,247 | 1,247 |
| Unexpected | 578 | 650 | 722 | 722 | 722 |
| Wear and Tear | 2,768 | 3,114 | 3,460 | 3,460 | 3,460 |
| Total production costs | 12,670 | 14,394 | 15,994 | 15,994 | 15,994 |
| The finished price of the sold product | 12,670 | 14,394 | 15,994 | 15,994 | 15,994 |
| Gross profit | 49,700 | 55,772 | 61,969 | 61,969 | 61,969 |
| Operation Costs | | | | | |
| Office staff salaries | 2,632 | 2,632 | 2,632 | 2,632 | 2,632 |
| Administrative and sales costs | 624 | 702 | 780 | 780 | 780 |
| Total operating costs | 3,255 | 3,333 | 3,411 | 3,411 | 3,411 |
| Operating Profit | 46,445 | 52,439 | 58,558 | 58,558 | 58,558 |
| Non-operation Costs | | | | | |
| Pre-operation depreciation | 239 | 239 | 239 | 239 | 239 |
| Fixed asset insurance | 226 | 226 | 226 | 226 | 226 |
| Total non-operating costs | 12,880 | 12,880 | 12,880 | 12,880 | 12,880 |
| Pre-tax net profit and net loss | 33,565 | 39,559 | 45,678 | 45,678 | 45,678 |
| Taxes | 6,713 | 7,912 | 9,136 | 9,136 | 9,136 |
| Net profit | 26,852 | 31,647 | 36,542 | 36,542 | 36,542 |
| Annual profit | 0 | 26,852 | 58,499 | 95,041 | 131,583 |
| Gross profit on sale | 0.64 | 0.79 | 0.79 | 0.79 | 0.79 |
| Net profit on sale | 0.34 | 0.45 | 0.47 | 0.47 | 0.47 |

**Pre-Feasibility Summary**

|  |
| --- |
| **General Specification** |
| Project Name: Production of refractory bricks |
| Project Capacity: 10,000,000 molds |
| Number of Personnel: 34 people |
| Working Days: 300 |
| Product Usage: Hot water and steam boilers - Construction applications |
| Technical Study |
| Land Area: 5,000 square meters |
| Building Area: 850 square meters |
| Main Raw Materials: Soil for brick production |
| Supplying Method of Raw Materials: Domestic mines |
| Power Requirement: 480,000 kwh annually |
| Water Requirement: 30,000 cubic meters annually |
| Fuel Requirement: 555,000 liters of diesel per year |
| Economical & Financial Study |
| Fixed Investment Cost (Rial & other Currencies): 337,949 million rials |
| Working Capital: 1,552 million rials |
| Total Investment: 339,502 million rials |
| Annual Sale: 77,963 million rials |
| Net Present Value(NPV): 27,052 million rials |
| Break Even Point(BEP): 35% |
| Internal Rate of Return(IRR): 32% |
| Investment Return Period: 3.14 years |