

**Pre-Feasibility Study for Stone recycling plan**



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**Abstract:**

If the waste stones are from the igneous group, can one use them for cobblestone. However, if they are soft such as travertine, they can be converted to stone powder, or can one use them to produce antic stone to be applied in facades. Granite quarries constitute 25% of all quarries. In Iran, the most stone wastes belong to granite stones, and the coping coefficient of granite quarries is about 40%.

Travertine wastes are suitable for producing stone artifacts, due to their acceptable resistance, low hardness, grinding and cutting capabilities, formability, and their porosity which enables adherence to mortars. As well, one can name other advantages for travertine, including its beauty appearance, crystalline structure, the ease of access, color diversification, its low price compared to other stones, and the impossibility of its resources’ alteration.

The required land area is 10,000 square meters. The required electricity power is 432000 kWh annually, the water required is 3000 cubic meters annually and the fuel required is 90000 Liters of gas oil annually. The project is expected to employ 13 people.

**Product Introduction:**

The stones which their waste are used in the production of stone artifacts, can have many applications depending on the type of stone. If the waste stones are a type of igneous rock which are hard, then they can be used to produce cobblestones. But if the rocks are soft, like travertine, they can be converted into stone powder or use them to make antique stones used in the facades. Granite quarries make up 25 percent of the rock quarries in the world. In Iran, most of the stone waste is related to granite. The mining coefficient in granite mines is about 40%. This is caused by the granite mining method in the country which is very far from world standards.

In soft rock mines such as travertine, due to the use of mechanized methods, the amount of waste is lower and the mining coefficient is about 80%. In the past, travertine waste was deposited in the mines, but now, with the increase in the rock prices, the processing of these wastes has been economically justified. Travertine stone wastes have acceptable strength, low hardness and ability to be cut and shaped, formability, and porosity for full adhesion to the mortar which makes them suitable for the manufacture of stone artifacts. Some other advantages of Travertine stone include beauty of appearance, crystallinity, ease of access, variety of colors, cheapness over other stones and the impossibility for its reserves to be altered.

**The impact of stone color variation on stone artifacts**

• Carbonate rocks which are big and crystallized because of their luster and brightness have better quality if they also have transparent colors.

• Carbonate rocks with oolitic texture in their polished section (trimmed and polished facade stones), might have a specific beauty to them if they have transparent and nice colors.

• Carbonate rocks with a large shell like the strata may have an attractive appearance, because the interior of the fossils is displayed on a polished surface at different parts.

Considering that the wastes are recycled alongside the raw materials (mine and factory), it does not include most of the costs including transportation, drilling and operation costs. Antique stones are less expensive than natural stones, because it is easy to cut Travertine, and you can obtain a larger surface range by reducing its thickness compared to the common decorative stones. In addition, Travertine stone waste is used for preparing antique stones, thus, the cost of preparing raw materials for antique stone production is the minimum amount possible.

Different types of artifacts made of stone waste (antique stone). Antique stones are produced by placing rock fragments and crumbs side by side (Scrap and waste of travertine stone), and gluing them together by resin-based mortars. Development of the construction industry and different tastes of people, made it necessary to have stones with varied designs, reasonable price and acceptable physical and mechanical properties. Travertine stone has the ability to be colored due to its porosity and the waste of this stone can be colored. When the natural color of Travertine stone is lighter, then it is easier to paint the stone as well. The colored stones can be beautifully put together and glued to each other, to create a very exceptional look.

The advantages of the antique stones are mentioned below:

- Diversity and beauty

- The ability to be installed on any surface

- Ease of production in custom shapes and sizes

- The possibility to run in all interior and exterior spaces of buildings

- Having aesthetically pleasing effects with fancy designs

- Consistency with most building materials such as wood, brick and etc.

The problems with the production of antique stones:

- High water consumption in recycling process of the waste, slurry and crumbs, specifically in processing factories and the related recycling issues

- Lack of sufficient knowledge regarding the new technology of the required devices.

- Lack of scientific and business information center in this field

- Lack of efficient specialists in the field of antique stones

**Review of the production price of domestic products as well as the global price of the product:**

**Status of stone powder production in the country**

Currently, there are 237 active units producing industrial stone powder in the country. Most of these units are located in the provinces of Tehran, Isfahan, South Khorasan, Khorasan Razavi, Markazi, Yazd and Lorestan. The total nominal capacity of these units is about 18 million tons.

Also, there are currently 401 stone powder production projects in the country. As can be seen, there is a significant capacity in the country to produce stone powder. Therefore, the stone waste produced can be used as raw materials for consumption in these factories.

**Production status of granulated stone in the country**

There are currently 120 active units producing industrially granulated stone in the country. Most of these units are located in the provinces of Khorasan Razavi, Yazd and South Khorasan. The total nominal capacity of these units is about 17 million tons per year. Also, currently 323 projects are being implemented in the country. There are more than 100 projects underway in South Khorasan province with a capacity of over one million tons. In this sector, there is a significant capacity for the production of granulated stone. Therefore, coarse stone waste can be used to produce granulated stone.

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

This product is considered as a replacement as natural stones. Of course, products such as artificial stones and tiles can be used as an alternative to antique stones in some cases.

**Strategic importance of goods in Iran and foreign markets**

The results of various studies and statistics of stone production in the country and comparison of extraction and processing methods show that a large volume of rock waste is generated in the country annually.

In addition to causing many environmental problems, these wastes cause a waste of valuable natural resources. Due to the existence of various applications for these wastes and also the need to pay more attention to the environmental consequences of mines and stone processing plants, careful planning for the optimal use of these wastes is necessary. The construction of factories for the production of artificial stone and stone products, as well as the use of waste for the feed of stone powder factories is a suitable, economical and technically practical solution to solve these problems.

**Major countries producing and consuming the product**

Most of the global manufacturers of these products are based in China, India and Italy.

**Review of import and export trends**

According to information obtained from the Mining Industry and Trade Organization, there is no registered active unit in the field of stone recycling. Due to the lack of production and also the existence of special customs tariffs for the product, export and import have not been reported.

**Review of product demand**

According to information obtained from the stone cutting industry, more than 50% of the raw materials of stone cutting factories are disposed of as waste. The table below forecast the production of granite and marble quarries (according to mines and quarries in South Khorasan province).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Production of waste of granite and marble stone cutting units (tons) | | | | | |
| Description | Year | | | | |
| 2019 | 2020 | 2021 | 2022 | 2023 |
| Domestic Demand | 1826411 | 1976367 | 2082430 | 2234385 | 2308940 |
| Waste of stone cutting units (50% of raw materials) | 1826411 | 1976367 | 2082430 | 2234385 | 2308940 |

As can be seen, the production waste in stone cutting units (only marble and granite stone cutting) is very high and as a result, the construction of stone recycling units has a high justification and will prevent the waste of national capital.

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

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

|  |  |  |
| --- | --- | --- |
| # | Description | Amount in Million Rials |
| 1 | Land | 7000 |
| 2 | Landscaping and Buildings | 38340 |
| 3 | Facilities | 3634 |
| 4 | Vehicles | 400 |
| 5 | Equipment and machinery | 18106 |
| 6 | Office and workshop equipment | 970 |
| 7 | Pre-operation costs | 1368 |
| 8 | Miscellaneous costs | 1058 |
|  | Total | 70876 |

## Equipment and Machinery

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Machinery | Quantity | Unit Cost (Million Rials) | Total Costs (Million Rials) |
| 1 | Cutter machine | 1 | 12500 | 12500 |
| 2 | Gate crane | 1 | 1850 | 1850 |
| 3 | Guillotine Machine | 1 | 1200 | 1200 |
| 4 | Compressor 160 | 1 | 700 | 700 |
| 5 | Long over | 1 | 350 | 350 |
| 6 | Manual perforation | 1 | 300 | 300 |
| 7 | 18kg hammer | 1 | 30 | 30 |
| 8 | mixer | 1 | 176 | 176 |
| 9 | Others | 1 | 1000 | 1000 |
|  | Total | | | 18106 |

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

|  |  |  |
| --- | --- | --- |
| # | Description | Costs in Million Rial |
| 1 | Raw materials | 5626 |
| 2 | Salary | 9240 |
| 3 | Fuel and energy | 1550 |
| 4 | Repair and maintenance | 1820 |
| 5 | depreciation | 2272 |
| 6 | Unforeseen (2% of rows 1 to 4) | 364 |
|  | Total | 20872 |

## 1-2- Raw materials

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Main Raw Materials | Annual Consumption | Unit | Unit Cost  (Rials) | Total Costs in Million Rials |
| 1 | Stone waste | 3750 | ton | 1500000 | 5626 |
|  | Total | | | | 5626 |

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 | Quantity | Monthly Salary (Rial) | Annual Salary (Million Rial) |
| 1 | Project Manager | 1 | 70,000,000 | 840 |
| 2 | Administrative and financial employee | 2 | 30,000,000 | 720 |
| 3 | Guardian and attendan | 1 | 24,000,000 | 288 |
| 4 | Driver | 1 | 24,000,000 | 288 |
|  | Total | 5 |  | 2136 |
|  | Benefits, bonuses and premiums | | | 1496 |
|  | Total | | | 3632 |

## Production personnel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Description | Quantity | Monthly Salary (Rial) | Annual Salary (Million Rial) |
| 1 | Engineer | 1 | 46,000,000 | 552 |
| 2 | Skilled worker | 2 | 40,000,000 | 960 |
| 3 | Simple worker | 5 | 24,000,000 | 1440 |
|  | Total | 8 |  | 2952 |
|  | Benefits, bonuses and premiums | | | 2656 |
|  | Total | | | 5608 |

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) |
| 1 | Gasoline | Liter | 3,500 | 630 | 180000 |
| 2 | Gasoline | Liter | 10,000 | 90 | 9000 |
| 3 | Electricity | KWh | 750 | 648 | 864000 |
| 4 | Water | Cubic meter | 3,500 | 22 | 6000 |
| 5 | Viscosine oil | Liter | 10,000 | 100 | 10000 |
| 6 | Communications | --- | --- | 60 | --- |
|  | Total | | |  | 1550 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| # | Description | Time (days) | Total Costs (Million Rials) |
| 1 | Raw material storing costs | 30 | 468 |
| 2 | Petty cash | 30 | 1270 |
| Total | | | 1740 |

**4- Investment Table**

|  |  |  |
| --- | --- | --- |
| # | Description | Total Costs (Million Rial) |
| 1 | Fixed investment | 69818 |
| 2 | Pre-operation costs | 1058 |
| 3 | Circulating capital | 1740 |
| Total | | 72616 |

**5- Annual Production Costs**

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

|  |  |
| --- | --- |
| Description | Total cost |
| Raw material | 5626 |
| Energy and fuel | 1550 |
| Personnel expenses | 9240 |
| Annual wear and tear, repair and maintenance costs | 4094 |
| **Total** | 20508 |

**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 | Amount (ton) | Unit Value  (Rial) | Total costs (Million Rial) |
| 1 | Antique rock | 3,000 | 18000000 | 54000 |
|  | Total | 3,000 |  | 54000 |

**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 |
| 19416 | 0.27 | 3.74 | 5452 | 5586 |

**8- Profit and Loss Calculation Table**

\* All figures are in million rials

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Profit and Loss Forecast Table | | | | | |
| Description | 1st year | 2nd year | 3rd year | 4th year | 5th year |
| Production Amount | 4200 | 4800 | 5400 | 6000 | 6000 |
| net sales | 37800 | 43200 | 48600 | 54000 | 54000 |
| Production Costs | | | | | |
| Raw material | 3938 | 4500 | 5062 | 5626 | 5626 |
| Production staff salaries | 3926 | 4488 | 5048 | 5608 | 5608 |
| Energy Consumption | 1084 | 1240 | 1394 | 1550 | 1550 |
| Maintenance | 1274 | 1456 | 1638 | 1820 | 1820 |
| Unexpected | 256 | 292 | 328 | 364 | 364 |
| Wear and Tear | 1592 | 1818 | 2046 | 2272 | 2272 |
| Total production costs | 12068 | 13792 | 15516 | 17240 | 17240 |
| The finished price of the sold product | 12028 | 13752 | 15476 | 17200 | 17200 |
| Gross profit | 25772 | 29448 | 33124 | 36800 | 36800 |
| Operation Costs | | | | | |
| Office staff salaries | 3632 | 3632 | 3632 | 3632 | 3632 |
| Administrative and sales costs | 378 | 432 | 486 | 540 | 540 |
| Total operating costs | 4010 | 4064 | 4118 | 4172 | 4172 |
| Operating Profit | 21762 | 25384 | 29006 | 32628 | 32628 |
| Non-operation Costs | | | | | |
| Pre-operation depreciation | 212 | 212 | 212 | 212 | 212 |
| Fixed asset insurance | 142 | 142 | 142 | 142 | 142 |
| Total non-operating costs | 6740 | 6740 | 6740 | 6740 | 6740 |
| Pre-tax net profit and net loss | 15022 | 18644 | 22266 | 25888 | 25888 |
| Net profit | 11266 | 13982 | 16700 | 19416 | 19416 |
| Annual profit | 0 | 11266 | 25250 | 41948 | 61364 |
| Gross profit on sale | 0.96 | 1.36 | 1.36 | 1.36 | 1.36 |
| Net profit on sale | 0.42 | 0.64 | 0.68 | 0.72 | 0.72 |

**Pre-Feasibility Summary**

|  |
| --- |
| **General Specification** |
| Project Name: Stone recycling |
| Project Capacity: 3000 tons |
| Number of Personnel: 13 |
| Working Days: 300 |
| Product Usage: Construction |
| Technical Study |
| Land Area: 10,000 square meters |
| Building Area: 2490 square meters |
| Main Raw Materials: Scrap stone |
| Supplying Method of Raw Materials: Internal |
| Power Requirement: 432,000 kwh annually |
| Water Requirement: 3,000 cubic meters annually |
| Fuel Requirement: 90,000 liters of diesel |
| Economical & Financial Study |
| Fixed Investment Cos: 70876 million rials |
| Working Capital: 1740 million rials |
| Total Investment: 72616 million rials |
| Annual Sale: 54000 million rials |
| Net Present Value(NPV): 20600 million rials |
| Break Even Point(BEP): 38% |
| Internal Rate of Return(IRR): 27% |
| Investment Return Period: 3.74 years |