



Technical Report

Pre-Feasibility Study of A Mobile Processing Plant for Bentonite Mines in South Khorasan Province

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Abstract

Bentonite is an industrial soil with thousands of applications. Most of the Iranian bentonite mines, especially the mines of South Khorasan province, which is the center of the Iranian bentonite, are operating in a semi-closed or limited operation due to lack of reserves and dispersion. The construction of mobile processing plants will boost these mines, create added value, create jobs in deprived areas and make proper use of the country's reserves. In addition, flexibility, reducing the cost of transporting raw materials, the need for low investment, quick and easy installation and improving the knowledge of equipment manufacturing and mining are also the most important advantages of these processing plants. A mobile processing plant to produce bentonite concentrate requires primary crushing (jaw crusher), secondary crushing (impact crusher), heavy intermediate separator (cyclone or Dyna whirlpool), drying (rotary dryer), grinding (roller mill), packaging, power supply and control and monitoring units, that each of them can be mounted on a trailer. Technical and economic studies show that such a mobile processing plant with a capacity of 200 tons per day requires about 0.3 billion rials of fixed capital and about 3.0 billion rials of working capital. Also, the annual operating costs of this project are estimated at about 1.8 billion rials. With these specifications, the plan will have a payback period of 1.8 years, a positive net present value and an internal rate of return of 48%, which is appropriate and cost-effective in terms of investment. Also, the most important risks of this plan in terms of investment include operating processes, exchange rate fluctuations and prices. Other parameters of this plan are medium and low risk.

Keywords

Bentonite, Mobile processing unit, Heavy media method, Economic evaluation of mining project, Risk assessment.

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1- Introduction

Bentonite is a type of fine-grained clay, of which at least 80% is montmorillonite mineral (Kogel, et al., 2006; Simmons, 2021). In South Khorasan province, there are about 126 bentonite mines with a proven reserve of about 3 million tons and a nominal annual extraction of about 1.1 million tons. Most bentonite mines in this province do not have a processing plant due to their small size or inaccessibility, and they sell their extracted ore in raw form for domestic sale or export. The low value of extractive ores in many of these mines has made exploitation uneconomical and has led to the closure or limited exploitation of these mines. While the use of mobile processing plants can make it possible to use these small and abandoned reserves (Broadbent, et al., 2019). In this research, while examining bentonite processing methods and selecting the best flowchart, a pre-feasibility study for the construction of a mobile bentonite processing plant will be presented.

2- Methods

Bentonite, depending on the nature of their formation, contains many minerals in addition to montmorillonite. These minerals may include quartz, feldspar, calcite and gypsum, which can affect its industrial value (Kogel, et al., 2006). Mineral processing of the extracted bentonite from mines for use in various industries is done in the following three levels (Boylu, et al., 2008; Boylu, et al., 2010).

1- Production of micronized bentonite powder

2- Separation of impurities and production of processed bentonite

3- Activated bentonite production

The flowsheet of the proposed mobile processing plant show in Fig. 1 that this plant includes the following units, each unit mounted on a trailer (Fig. 2):

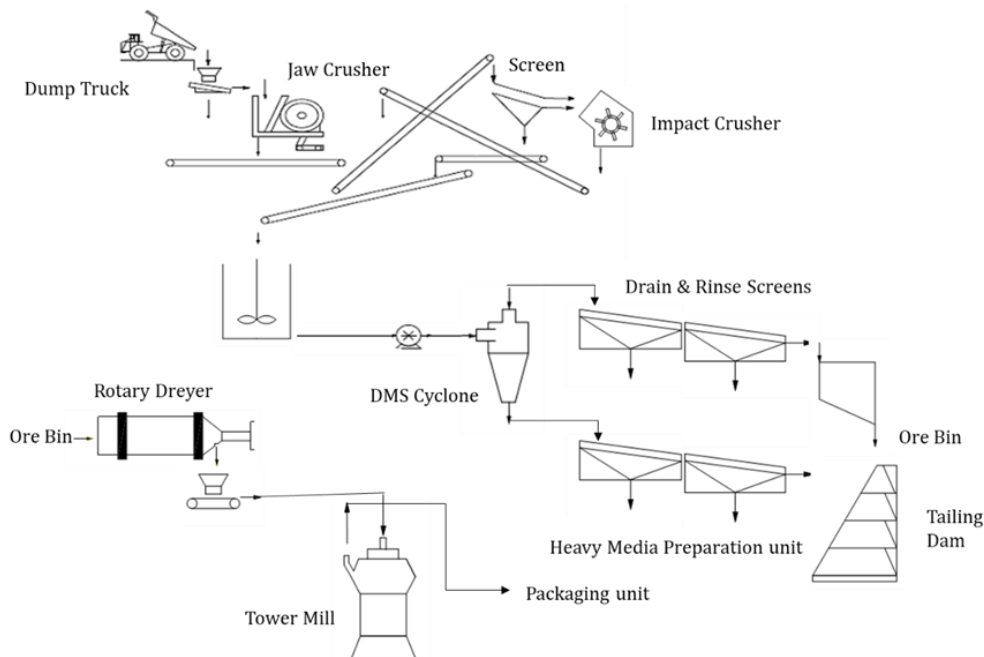


Fig. 1. Flowsheet proposed for bentonite mines in South Khorasan province.

A- **Primary crushing unit:** includes a grizzly feeder, a jaw crusher and 3 conveyors.

B- **Secondary crushing unit:** includes a 3-stage sieve, an impact crusher and 3 conveyors.

C- **Heavy media unit:** includes a preparation tank, two pumps, a cyclone or Dyna whirlpool and drain and rinse screens.

D- **Drying unit:** includes a rotary cylinder dryer, a divider and two conveyors.

E- **Grinding unit:** Includes a feeder and a roller mill with Whizzer classifier.

F- **Packing unit:** includes a tank and a packing unit.

G- **Power supply unit:** includes two similar diesel generator engines.

H- **Control and monitoring unit:**



Fig. 7. Units of a bentonite mobile processing plant.

۳- Findings and Argument

Considering the exploitation capacity of bentonite mines in South Khorasan province and the technology of manufacturing mobile processing factories in the country, the minimum nominal capacity of this project is 70,000 tons of feed per year, equivalent to 200 tons of feed per day. Tables 1 and 2 shows the amount of fixed investment and the production costs of this economic plan, respectively.

According to economic studies, the cost of each kilogram of processed bentonite is 2800 Rials and the average selling price of each kilogram of product is about 10,000 Rials. Therefore, the annual net profit of the project is estimated at about 300 billion rials. Other decision-making indicators of this plan include the return-on-investment period of 1.8 years, the positive NPV rate, which indicates the cost-effectiveness and economy of the plan, and the internal rate of return of 8%. Due to the higher rate of domestic return than bank profits, this plan will be in terms of economic investment.

Table 1. Fixed investment rate of the project.

Row	description	Value (million Rials)
۱	Land	-
۲	Landscaping	۷۸۰۰
۳	Construction	۱۷۸۸۰
۴	Facilities	۳۵۱۶۰
۵	Production line machinery and equipment	۴۱۵۶۸۰
۶	Laboratory and workshop supplies	۷۲۰۰
۷	Office equipment and services	۱۳۷۰
۸	Transportation	۳۴۲۰۰
۹	Miscellaneous and unforeseen (equivalent to ۲%)	۱۰۳۹۰

۱۰	Depreciation costs before operation	۳۸۰۰
Total		۵۳۴۸۰

Table ۲. Production costs of the project.

Row	description	Value (million Rials)
۱	Cost of raw materials and packaging	۹۳۱۷۰
۲	Salary costs	۲۰۸۳۰
۳	Energy costs (water, electricity, fuel, etc.)	۵۹۵۰
۴	Maintenance costs	۱۵۶۶۰
۵	Unforeseen production costs	۲۷۱۰
۶	Administrative and sales expenses	۴۸۰۰
۷	Insurance costs	۱۰۶۰
۸	Depreciation costs	۳۵۳۰۰
Total		۱۷۹۴۸۰

۴- Conclusions

Use of a mobile bentonite processing plant that it contains crushing, heavy media concentration, dryer, milling and packing units; It is possible to create ۸ times the added value for the mineral. The results showed that a mobile bentonite processing plant with a capacity of ۲۰۰ tons per day requires about ۵۳۰ billion rials of fixed capital and about ۳۰,۵ billion rials of working capital. Also, the annual operating costs of this project are estimated at about ۱۸۳ billion rials. In this case, the plan will have a return on investment of ۱,۸ years, a positive net present value and an internal rate of return of ۴۸%, which is appropriate in terms of investment.

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