



# DIVERSE UTILITY OF CLAY MINERAL UNEARTHED FROM BIKANER DISTRICT, RAJASTHAN

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**Abstract:** The Bikaner District in Rajasthan, India, boasts abundant clay deposits that have diverse applications in multiple industries. The clay sourced from this region is highly esteemed within the construction sector due to its exceptional qualities. Its unique characteristics make it an ideal raw material for manufacturing items like bricks, tiles, and various construction materials. Thanks to its plasticity and cohesion, it is easy to mold and shape. Its natural composition ensures superb thermal insulation and durability, making it a preferred choice in building and structural projects. Bikaner's clay also has a rich history of use in pottery and ceramics, given its fine texture and malleability, making it well-suited for crafting intricate ceramic products. Moreover, this clay plays a crucial role in agriculture by enhancing soil quality through improved moisture retention and enhanced aeration. When mixed with agricultural soils, it provides a stable foundation for plant roots and aids in nutrient retention, consequently boosting crop yields. Additionally, it is utilized in creating seed balls, an eco-friendly approach to reforestation and revitalizing arid regions. In regions grappling with water scarcity, Bikaner's clay serves as a vital component in constructing traditional rainwater harvesting structures, including check dams, percolation tanks, and storage ponds. Its impermeable nature aids in retaining rainwater, replenishing groundwater aquifers, and ensuring a sustainable water supply for both agricultural and domestic needs. Furthermore, clay finds environmental applications, notably in the production of eco-friendly products like clay-based water filters, which effectively purify drinking water by removing impurities and pathogens.

**Index Terms - Construction Industry, Agriculture, Environmental Sustainability, Pottery and Ceramics, Clay.**

## I. INTRODUCTION

Bikaner is located within the Thar Desert, often referred to as the Great Indian Desert, making it an integral part of Rajasthan's arid terrain. Positioned approximately 330 kilometers (205 miles) northwest of the state capital, Jaipur, the city is enveloped by sand dunes, providing a distinctive desert encounter for tourists. Situated in the northwestern region of the Indian state of Rajasthan, Bikaner carries a rich historical legacy. It was established in the late 15th century by Rao Bika, a Rajput prince, who designated it as the capital of the princely state of Bikaner. Over the centuries, Bikaner evolved into a pivotal trading and cultural center along the caravan routes that crisscrossed the arid Thar Desert. The city's strategic location played a crucial role in fostering its economic prosperity and cultural diversity.

Bikaner is renowned for its remarkable architectural marvels, which include magnificent palaces, forts, havelis (traditional mansions), and temples. Among its most iconic landmarks stands the Junagarh Fort, an imposing fortress constructed in the 16th century, characterized by an exquisite fusion of Rajput and Mughal architectural styles. Another architectural gem is the Lalgarh Palace, which showcases the opulence of the Rajput rulers through its intricate carvings, ornate balconies, and stunning courtyards, bearing testament to the city's royal heritage. Bikaner's tourism sector thrives on its historical and cultural

attractions. Beyond the Junagarh Fort and Lalgarh Palace, visitors can explore sites like the Karni Mata Temple, renowned for its numerous resident rats, and the Gajner Palace, a tranquil lakeside retreat. The city's annual Camel Festival is a major attraction, celebrating the "ship of the desert" with camel races, folk performances, and more. Bikaner, with its rich history, vibrant culture, and breathtaking architecture, promises an exceptional and unforgettable experience for visitors, serving as a testament to the grandeur of Rajasthan.

## II. GRINDING PROCESS OF CLAY:

Grinding of clay is a common procedure in the manufacturing of ceramics and pottery. This process involves breaking down clay materials into smaller particles or powders, making them suitable for various purposes like shaping pottery, forming clay bodies, or producing glazes. Here is a basic outline of the clay grinding process:

- i. **Preparation:** The initial step before grinding is to prepare the clay material. This typically involves the extraction of clay from its natural source, such as digging or mining. The clay is usually found in the form of deposits within rocks.
- ii. **Drying:** If the clay has excessive moisture, it must be dried to achieve the appropriate moisture content. Excess moisture can hinder the grinding process, potentially causing problems like equipment clogging.
- iii. **Crushing:** Large chunks or lumps of clay are often too large to be directly processed in grinding equipment. They are initially broken down into smaller, more manageable pieces. This can be accomplished using heavy machinery or manual labor, depending on the production scale.
- iv. **Grinding:** Once the clay is in a more manageable form, it is introduced into the grinding equipment. The type of equipment used for grinding can vary significantly depending on production scale and the desired particle size. Common grinding equipment includes ball mills, hammer mills, roller mills, and various types of crushers.
  - **Ball Mills:** These are cylindrical devices that rotate horizontally and contain steel or ceramic balls. The clay is loaded into the mill alongside the balls. As the mill rotates, the balls crush and grind the clay into a fine powder.
  - **Hammer Mills:** These employ rotating hammers or blades to crush and grind the clay. They are particularly effective for coarse grinding.
  - **Roller Mills:** Roller mills consist of a series of rollers that crush and grind the clay by passing it between them. Roller mills can be used for both coarse and fine grinding.
- v. **Sieving/Screening:** Following the grinding process, the clay may require sieving or screening to ensure uniform particle size and to remove any larger or coarser particles. This step is crucial for quality control, particularly in pottery and ceramic production.
- vi. **Storage:** Once the clay has reached the desired consistency through grinding, it is typically stored in a controlled environment. This prevents moisture absorption and helps maintain its properties until it is ready for use in its intended application.

## III. STUDY AREA:

Kolayat is situated in the Thar Desert region of Rajasthan, characterized by its dry and sandy terrain. It is located approximately 50 kilometers (31 miles) to the south of Bikaner, one of the prominent cities in the state. The Kolayat area in Bikaner is renowned for its extensive reserves of ball clay, with mining operations established in several villages including Nal, Golery, Chandi, Khari, Indo ka Bala, Kotri, Marh, Jogira Talaab, Sankhlaun ki Basti, and Guda near Kolayat. These mines collectively contribute to approximately 80% of Rajasthan's total ball clay production.

Kolayat's ball clay finds applications in various industries, including pottery, ceramics, paints, varnishes, rubber manufacturing, firearms production, and electronics. It is globally recognized for its exceptional quality, characterized by its high whiteness, elevated viscosity, and minimal impurities. Owing to these qualities, Kolayat's ball clay is not only utilized within India but is also exported to international markets.

Private enterprises operate the ball clay mines in Kolayat, holding mining leases granted by the Government of Rajasthan, typically lasting for 30 years. These mines play a significant role in the local economy, providing job opportunities and fostering economic growth in the region.

#### IV. METHODOLOGY:

In order to compile comprehensive information about clay mining activities within the Bikaner district, the author conducted a thorough investigation involving visits to numerous clay mines operating in Kolayat and the Bikaner tehsil of the district. Additionally, the author reached out to various industries involved in clay minerals. This research endeavor included conducting interviews with numerous industrialists, mine proprietors, and laborers employed in both the mines and clay-related industries. These interviews were instrumental in acquiring in-depth and practical insights into the utilization and various factors associated with clay.

To enrich the theoretical understanding of clay properties, the author undertook an extensive review of different articles and research papers published in various research journals. The scholarly work contributed to a comprehensive grasp of clay characteristics. Moreover, collaboration with professors from diverse universities aided in comprehending the clay deposition processes. Technical experts engaged in laboratory work within the ceramic industry shared their expertise on the distinct properties of clay.

Following the meticulous collection of information, spanning from the extraction of clay minerals in mines to the final product generation in industries, this paper presents the culmination of this research effort.

#### V. PHYSICAL PROPERTIES OF CLAY:

Clay is a fine-grained natural soil material composed primarily of minerals such as kaolinite, illite, and montmorillonite. It finds extensive use across diverse industries, including ceramics, construction, agriculture, and geotechnical engineering. Below are some key physical properties of clay:

- **Texture:** Clay particles are exceptionally fine, with sizes less than 0.002 millimeters (2 micrometers). This fine texture imparts a smooth and cohesive quality to clay.
- **Color:** The color of clay can vary widely, contingent on its mineral composition and impurities. Common hues include white, gray, brown, and red.
- **Plasticity:** High plasticity is a defining characteristic of clay. When moist, it can be molded and shaped, and it retains its form upon drying or firing. This makes it an ideal material for pottery and ceramics.
- **Cohesion:** Clay particles exhibit a strong attraction to one another, resulting in substantial cohesion. This enables clay to adhere together and maintain its shape, even in a moist state.
- **Shrinkage and Expansion:** Clay experiences significant shrinkage as it dries and expansion as it absorbs water. This property is crucial in construction and soil engineering, as it can lead to ground movements and cracking.
- **Permeability:** Pure clay boasts low permeability, meaning it resists the easy passage of water. However, permeability can fluctuate depending on the type of clay and its compaction.
- **Density:** The density of clay can vary but generally exceeds that of sandy soils. It relies on factors such as moisture content and compaction.
- **Porosity:** Moist clay soils tend to have high porosity, enabling them to retain substantial water. When dry, they become less porous and denser.
- **Conductivity:** Clay exhibits low thermal conductivity, making it a poor conductor of heat. This property is valuable in pottery and construction applications.
- **Stickiness:** Clay can become exceedingly sticky when wet, posing challenges in certain situations.

- **Hardness:** Fired at high temperatures in ceramic production, clay can attain significant hardness and durability.
- **Electrical Properties:** Clay can conduct electricity when moist, with its electrical characteristics dependent on its mineral content.
- **Sound Absorption:** Clay can serve as an effective sound-absorbing material in construction, capable of dampening sound waves.

These physical attributes render clay a versatile material with wide-ranging applications, spanning from pottery and construction to agriculture and geotechnical engineering. However, a thorough comprehension and skilled manipulation of these properties are imperative for the effective utilization of clay across diverse contexts.

## VI. CONCLUSION:

The clay extracted from Rajasthan's Bikaner District serves as a cornerstone in multiple industries and sustainable initiatives. Its adaptability, spanning from construction to pottery, agriculture, water management, and environmental pursuits, positions it as a valuable asset for fostering both economic growth and environmental preservation within the locality and elsewhere. Effectively utilizing this natural resource holds the promise of substantial benefits for the local community's prosperity and the advancement of sustainability practices across diverse sectors.

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