

MULTANI MITTI (FULLER'S EARTH) ACTS AS ADSORBENTS OF TOXINS FROM SURFACE LAYER BY ALKALINE EARTH METALS OF PHYLLOSILICATE CLAY MINERAL

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ABSTRACT

Multani mitti (Fuller's earth) physically binds to and removes surface oil, dirt, dead cells, and external impurities via adsorption. However, it works strictly on the outer layer of the skin and does not perform internal medical "detoxification" or absorb deep bodily toxins. Fuller's earth is a sedimentary clay composed primarily of hydrous aluminum silicates, with major clay minerals like montmorillonite, attapulgite (palygorskite), and kaolinite. Its exact makeup varies by deposit, but it generally features a high silica content alongside metallic ions.

- Surface Adsorption: Oil and dirt molecules stick to the surface of the clay particles rather than soaking inside them.
- Oil Control: It blots up excess sebum to mattify oily skin and clear the T-zone.
- Pore Cleansing: It helps lift daily grime and debris from open pores, reducing blackheads.
- External Use Only: Never ingest multani mitti; eating cosmetic clay causes digestive blockages and risks heavy metal exposure.
- No Internal Detox: It cleanses the skin's surface and cannot pull toxins from inside your bloodstream or organs.
- Avoid Over-Drying: Leaving the mask on until it cracks can strip essential moisture, especially for dry or sensitive skin types.

KEYWORDS: Adsorption, skin layer, clay minerals, alkaline earth minerals.

INTRODUCTION

Primary Clay Minerals

Montmorillonite: The main active component responsible for oil and impurity absorption. Montmorillonite is a very soft phyllosilicate clay mineral

named after Montmorillon in France. As a primary component of bentonite, it features a 2:1 layer structure that swells significantly when wet and boasts a high cation-exchange capacity.^[1]

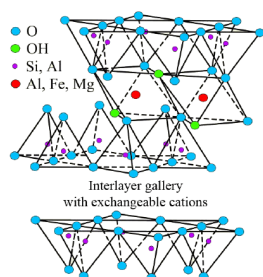


Figure 1: Montmorillonite Tetrahedral Structure and Multani Mitti.

Mineral Structure and Properties: Soft, microscopic plate-shaped crystals.

Two silica tetrahedral sheets sandwiching an alumina octahedral sheet: High surface area and strong adsorptive capabilities. Expands dramatically upon water absorption, particularly sodium variants. Montmorillonite is a 2:1 layer silicate clay mineral. Its structure consists of a central aluminum-oxygen octahedral sheet sandwiched between two silicon-oxygen tetrahedral sheets. These combined sheets form microscopic, plate-like unit layers bound together by weak forces, creating interlayer spaces that trap water and exchangeable cations.

Core Structural Layers

Tetrahedral sheet: Silicon ions bond with four oxygen atoms in a repeating layer.

Octahedral sheet: Aluminum or magnesium ions bond with six oxygen or hydroxyl groups in the middle layer. 2:1 sandwich: One octahedral sheet sits tightly packed between two tetrahedral sheets (also called a TOT layer).

Attapulgite/Palygorskite: A chain-structure silicate common in absorbent grades. Attapulgite (also called palygorskite) is a magnesium aluminum phyllosilicate clay with a unique 2:1 layer-chain (modulated) structure. Instead of forming flat, stacked sheets like other clays, its silica tetrahedral sheets invert periodically to form a fibrous, needle-like network with parallel internal channels. **Formula:** $(\text{Mg,Al})_2\text{Si}_4\text{O}_{10}(\text{OH}) \cdot 4(\text{H}_2\text{O})$

Classification: Hydrated silicate with a chain-like 2:1 trioctahedral motif:

Key Structural Features

Fiber/Rod Shape: Individual crystals grow as fine needles or laths rather than flakes.

Inverted Tetrahedra: Silica tetrahedral chains link continuously in two dimensions but flip direction regularly, creating a distinct checkerboard-like profile.

Internal Tunnels/Channels: The periodic inversion leaves empty channel spaces that hold water molecules (zeolitic water) and coordinated water bound to central magnesium or aluminum ions.

High Surface Area: The open, porous, needle layout gives it an enormous active surface area (150-320 m²/g) and strong adsorptive properties without swelling much in water.

Kaolinite: A basic layered aluminum silicate present in smaller fractions. Kaolinite is a layered silicate clay mineral with the chemical formula $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$. Commonly known as kaolin clay, it is a soft, earthy, and usually white mineral formed by the chemical weathering of aluminum silicate rocks like feldspar.^[2]

Physical and Chemical Properties

Composition: Hydrous aluminum phyllosilicate with a 1:1 layer structure of silica tetrahedral and alumina octahedral sheets.

Hardness: Very soft, measuring 2 to 2.5 on the Mohs scale.

Color: Primarily white, but can display reddish, bluish, or brownish tints from iron or other mineral impurities.

Swelling Capacity: Low shrink-swell capacity because hydrogen bonds prevent water from penetrating between its crystal layers.

Typical Chemical Range

(Oxides) Silica: SiO_2 : 50% to 68%

Alumina (Al_2O_3): 9% to 15%

Magnesia (MgO): 3% to 12%

Iron Oxide (Fe_2O_3): 3% to 5%

Trace Ions: Calcium, sodium, and potassium oxides.

Fuller's earth and multani mitti are the same substance, just known by different names in different parts of the world. Multani mitti translates to "**mud from Multan**", originating from the city in Pakistan, while Fuller's earth is the broader English term named after its historical use in cleaning wool.

Composition: Both are sedimentary clay materials mainly made of hydrous aluminum silicates and magnesium-iron compounds.

Skincare Uses: Both are famous for deep cleansing, absorbing excess oil, and helping with acne-prone skin.

Origin of Names: Both names describe the exact same mineral-rich absorbent clay used for face packs and oil removal.

Attapulgite is a natural magnesium aluminum phyllosilicate clay. Its mode of action is entirely physical and local within the gastrointestinal tract; it is not absorbed into the bloodstream. By acting as a non-specific adsorbent, it binds excess water, bacteria, and toxic substances to firm up liquid stools.

How Attapulgite Works

Water Adsorption: Physically traps free fluid in the gut lumen, which increases stool consistency and reduces water loss.

Toxin and Bacterial Binding: Attracts and holds onto gastrointestinal irritants, bacterial enterotoxins, and microorganisms, neutralizing their capacity to affect the intestinal lining. **Local Elimination:** Because the large mineral particles are insoluble and chemically inert, the bound complex passes straight through the digestive tract and is excreted unchanged in the feces. Attapulgite is a natural magnesium aluminum phyllosilicate clay mineral

that acts locally in the gastrointestinal tract. It functions primarily through physical adsorption—nonspecifically binding fluids, bacteria, and enterotoxins to its extensive internal and external surface area, thereby rendering bound toxins inactive and firming loose stools.

Mode of Action

Local activity: It is not absorbed systemically into the bloodstream; its entire therapeutic effect occurs inside the lumen of the intestines.

Physical adsorption: The microscopic layered structure of the mineral provides a large surface area that traps molecules. **Fluid binding:** It absorbs free water in the digestive tract, which increases fecal consistency and reduces stool water content.

Attapulgite (also known as palygorskite) is a hydrated magnesium aluminum phyllosilicate with a unique 2:1 layer-chain crystalline structure. Unlike flat or flaky clay minerals, it features needle-like, fibrous rod shapes that form a porous, open lattice network responsible for its high absorbency and thickening properties.

Chemical Composition: Formula

$(\text{Mg,Al})_2\text{Si}_4\text{O}_{10}(\text{OH}) \cdot 4(\text{H}_2\text{O})$ (approximate half-unit cell formula).

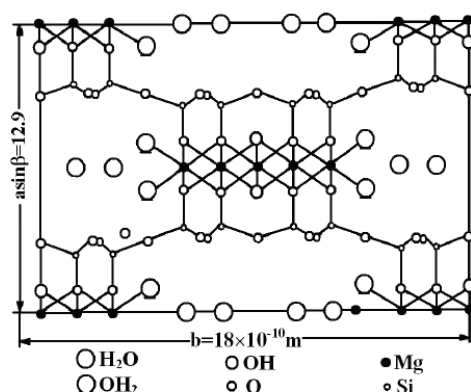


Figure 2: Attapulgite Structure.

Multani mitti gets its name from the historic city of Multan (in modern-day Pakistan), which was its original major trading hub and source. However, this absorbent clay—also known as Fuller's earth—is naturally found and mined in many other regions today, including India.^[3]

History and Name

Name meaning: *Multani mitti* translates to "clay of Multan".

Trade route: Ancient merchants on the Silk Road traded the clay from Multan, making the city's name famous worldwide for this specific type of healing mud.

Classification: A modulated 2:1 (TOT) trioctahedral silicate where magnesium and aluminum occupy internal octahedral sheets.

Key Structural Features

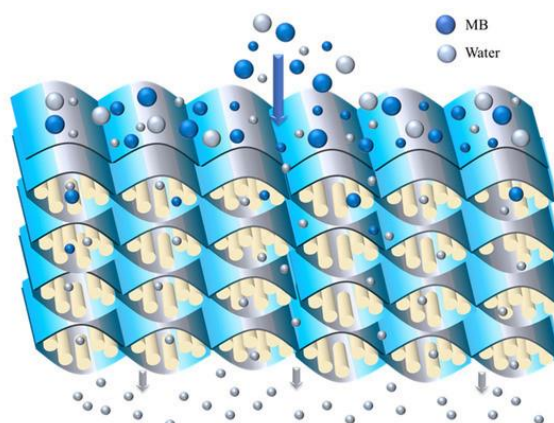
Inverted Tetrahedral Ribbons: The continuous silica tetrahedral sheets do not stretch flat; instead, they invert direction periodically in a checkerboard pattern.

Channel System: This periodic inversion creates parallel rectangular channels or tunnels running along the length of the fibers.

Types of Water

Contains two distinct kinds of water: Coordinated water bound directly to the octahedral cations, and zeolitic water residing loosely inside the structural channels.

Morphology: Forms tiny discrete needle-like crystals (typically under 2.5 microns long and 25 nanometers wide) that grant it an exceptionally high active surface area (150–320 m²/g).



Attapulgite is a natural magnesium aluminum phyllosilicate clay. Its mode of action in toxin neutralization is purely physical. It acts locally in the human gastrointestinal tract by adsorbing (binding to its large surface area) bacteria, intestinal enterotoxins, and metabolic acids, rendering those bound toxins harmless before they can irritate the gut lining or cause excess water loss.

Physical Adsorption: The fibrous, porous micro-structure of the clay creates an extensive surface area that physically traps and holds intraluminal toxins, enterotoxins (such as those from *Vibrio cholerae*), and unwanted bacteria.

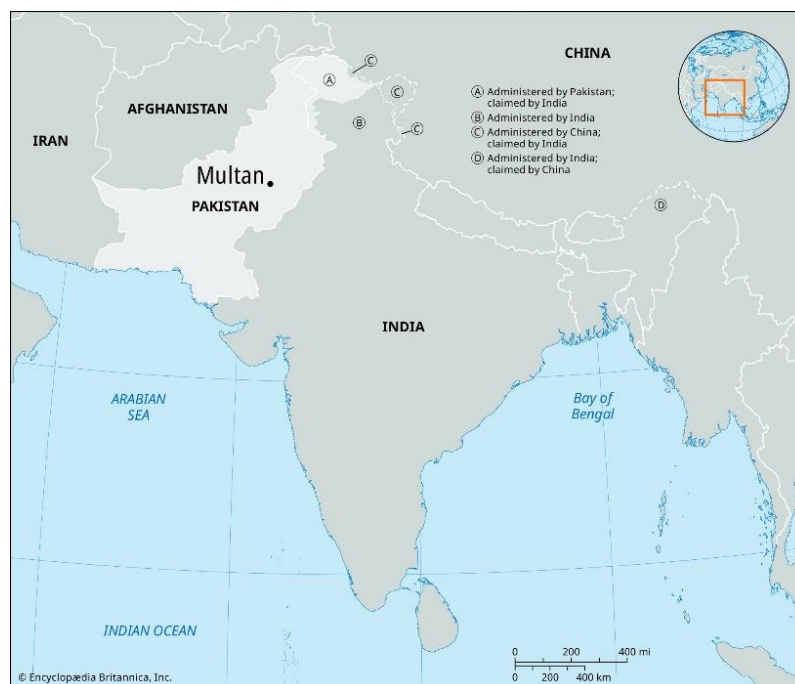


Figure 3: Multan Map.

Surface Neutralization: Once bound to the particle surface of attapulgite, the toxins lose their ability to interact with or damage intestinal epithelial cells.

Local Action Only: The mineral is completely non-absorbable and chemically inert; it is not taken up into the bloodstream, remaining in the digestive tract until it is excreted in the feces.

Water Binding: Alongside toxin trapping, it simultaneously adsorbs excess free luminal water, which helps firm up loose stools during acute, mild-to-moderate diarrhea. Fuller's earth is a fine-grained, natural clay material made mostly of hydrous aluminum silicates. It gets its name from historical textile workers called "fullers" who used the clay to soak up oil and dirt from raw wool. In South Asia, it is widely known as multani mitti.

Composition and Properties

Minerals: Contains montmorillonite, attapulgite, and palygorskite.

Absorption: Soaks up oils, grease, and liquids very well.

Texture: Soft, earthy, and crumbles into mud when wet.

Common Uses

Skincare: Used in face masks to absorb extra oil and clean pores.

Industry: Filters and purifies oils, greases, and petrochemicals.

Pets: Used as a base for absorbent pet waste and cat litter.

Other: Acts as a carrier for farm chemicals and creates dust effects in movie.

Fuller's earth does not have a single chemical name or exact chemical formula because it is a mineral mixture of

natural clays. Its main chemical components are hydrated aluminum magnesium silicates or hydrated aluminum silicates (often composed of clay minerals like attapulgite/palygorskite or bentonite/montmorillonite).^[4]

Composition and Properties

Main Class: Hydrated aluminum silicate/Aluminum magnesium silicate

Common Minerals: Attapulgite, palygorskite, montmorillonite, or bentonite:

General Formula (Attapulgite-based):

$(\text{MgAl})_5\text{Si}_8\text{O}_{22}(\text{OH})_4 \cdot 4\text{H}_2\text{O}$; CAS Number: 8031-18-3.

Other Name: *Multani mitti* or *Solum fullonum*

CONCLUSION

Multani mitti (Fuller's earth) acts like a sponge on your skin. It pulls out extra oil, dirt, and surface impurities through a process called adsorption, where molecules stick to the clay's surface. However, it only cleans surface grime and does not absorb toxins from inside your body. Oil Control: It soaks up excess sebum from oily skin and unclogs pores. It draws out trapped dirt, dead skin cells, and light environmental pollutants. Cooling Effect: It naturally cools and soothes heat rashes or skin irritations. Safe Usage Tips: Limit Dryness: Do not let the mask crack completely or dry too stiff, as it can strip away essential moisture. Frequency: Use it once or twice a week, especially if you have oily or combination skin. Dry/Sensitive Skin: People with dry or sensitive skin should avoid or limit use, as it can cause extra dryness or irritation. Using Multani Mitti (fuller's earth) daily is generally harmful because it strips away natural oils, leading to severe dryness, irritation, and a damaged skin barrier. Instead of using it every day, you should limit application to 1 to 3 times a week depending on your skin type. Multani mitti (Fuller's earth) acts as a

powerful natural skin detoxifier. It deeply cleanses pores, absorbs excess oil, pulls out trapped dirt and impurities, and cools the skin. It is strictly meant for external use on the skin and scalp, not for eating. Multani Mitti Detoxifies: Absorbs oil and sebum: Acts like a sponge to soak up extra oil that clogs pores. Removes deep impurities: Pulls out pollution particles, sweat, and dead skin cells. Improves blood flow: Boosts circulation as the mask dries and tightens. Cools and calms: Reduces heat, minor inflammation, and sun tanning. Safe External Usage Tips: For oily skin: Mix the powder with rose water or plain water into a smooth paste. For dry skin: Mix it with milk, honey, or curd so it does not dry you out too much. Frequency: Use it once or twice a week. Do not let it crack completely dry on sensitive skin. Warning: Never ingest multani mitti, as eating clay harms digestion and can cause severe internal blockages or toxicity.

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