Smectite Clay Products Teaching Materials

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Objective: Students will be able to match cards that tell smectite clay properties and uses with corresponding clay products to demonstrate their awareness of the uses of smectite clay.

Preparation of Materials

1. Print the accompanying pages on a printer (in color, if possible).
2. Cut out the card fronts and backs from the printed pages. Use a paper cutter if possible so that the edges are straight.
3. Cut 18 squares of mat board measuring 3 1/2 x 3 1/2 inches. Glue the card fronts that list swelling clay properties to the fronts and the corresponding product pictures to the backs.
4. Obtain a plastic shoebox. Use wide clear package tape to affix the label “Uses of Smectite Clays” to the outside of each end of the box.
5. Cut out the “Directions” card and glue to a mat board rectangle somewhat larger in dimensions or tape into the lid or bottom of the box.
6. Find an example of each of the products that will fit into the shoebox.

Lesson Instructions

Show a hand specimen of clumping kitty litter in a clear glass. Then add water to it. Ask students to brainstorm its properties (tan, granular, swells, forms clumps, forms a gel, etc.)
Then ask students to suggest uses for this mineral group (students will probably recognize it as cat litter.) The photographs at the end of this set show some applications of smectite clays.
Finally, allow students to work in small groups to match cards that list properties of smectite clays with corresponding products. They will probably be surprised at the many uses of smectite clays.

Properties of Smectite Clay

Layer structure on atomic scale with wide “interlayer” areas.

Smectite clays are a group of clay minerals that are able to expand and contract their structures in one dimension as they adsorb water or dry, like a stack of papers that can become taller.

The structural layers of swelling clays have a small negative charge and therefore attract H_2O molecules or other polar molecules into the interlayer area, causing expansion.

These H_2O molecules are generally aligned around positively charged ions or cations such as sodium or calcium (the interlayer cations) and next to the layers.

If large amounts of H_2O molecules enter the interlayer, these additional molecules are less aligned but do not behave like liquid water within the interlayer.

The amount of swelling is related to the type of interlayer cation present: sodium-rich smectite clays expand more than those containing calcium.

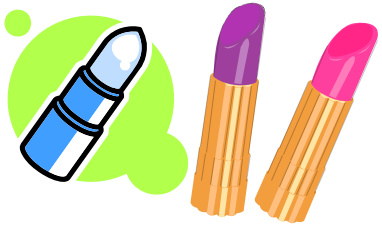
Properties of Smectite Clay

Continued

Smectite clays also have high cation exchange capacities and can be used to remove toxins or impurities from liquids. Smectite clays can also absorb oil. Swelling clays can absorb urine (as in cat litter) and prevent it from forming ammonia. All wet clays flow under pressure, becoming solid again when the pressure is removed, and making them easy to mold into shape. Smectite clays have greater plasticity than other clays. They also form smooth gels when mixed with sufficient water or other liquids. Smectite clays form from the weathering of soils, rocks, or volcanic ash.

- Holds moisture; stays moist.
- Smooth-textured gel that can be applied to a surface.
- Holds colors.
- Does not support bacteria growth.
- Nontoxic; small amounts can be ingested (swallowed).

Lip Gel or Gloss



Smectite clay (hectorite) is used to make a smooth gel. It forms a base for color.

- Dry, granular texture, similar to desert soils, the habitat of wild cats.
- Absorbs liquids quickly, preventing breakdown of urea into ammonia.
- Forms gel clumps that can be removed with a slotted implement.
- Inexpensive material that can be supplied in large quantities.

Cat Litter / Kitty Litter

Smectite clay (sodium bentonite) absorbs urine and prevents formation of ammonia. Cats accept its granular form that mimics desert soil of wild cats.

- Smooth gel that can be applied to the skin.
- Forms a smooth surface when dry.
- Absorbs oil.
- Does not support bacteria growth.
- Can be combined with other clay to conceal blemishes

Acne Medication

The smectite clay (bentonite) gel in acne creams is pure and bacteria-free, absorbing oil to help blemishes heal.

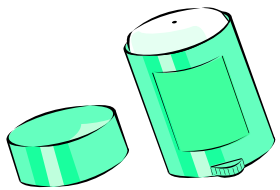
- Smooth texture.
- Forms a gel that thickens the mixture and prevents dripping.
- Mixes with water and water-based paints.
- Dries to form a flat surface.
- Holds color.

Latex Paint

Smectite clay (bentonite or hectorite) creates a gel texture to thicken paint and keep it from dripping.

- Smooth gel that can be applied to skin.
- Pure and bacteria-free.
- Dries clear and smooth.
- Absorbs water and sweat.
- Helps prevent odors by stopping bacteria from breaking sweat into odor-causing compounds.

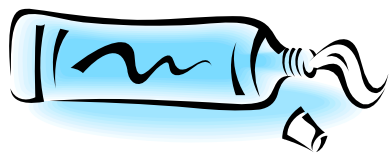
Deodorant



Smectite clay (hectorite) provides a smooth gel to be applied to the skin. It absorbs sweat, preventing bacteria from creating odor.

- Forms a gel that can be squeezed from a tube.
- Disperses in water or saliva.
- Carries flavors.
- Odorless, pure, doesn't support bacteria growth
- Smooth, fine particles that can be mixed with abrasive particles for scrubbing surfaces.
- Nontoxic; small amounts may be ingested.

Toothpaste



Smectite clay (hectorite) forms a gel that holds its shape when squeezed out of the tube and dissolves with saliva in the mouth.

- Binds other ingredients such as grasses and grains so they can be formed in to pellets.
- Doesn't support bacteria growth.
- Nontoxic; can be ingested.
- Odorless.

Animal Feed Pellets

A small amount of smectite clay (bentonite) is added to animal feed to bind the ingredients and produce more durable food pellets.

- Deforms easily when wet and pressure is applied.
- Can be molded into intricate shapes.
- Binds to other clays.
- Hardens into a strong solid when fired.
- Mixes well with other clays.

Ceramic Bowl or Pot

A small amount of smectite clay helps a mixture of non-swelling clays behave more plastically to be molded into intricate shapes.

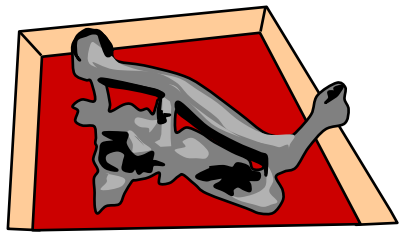
- Doesn't support bacteria growth.
- Nontoxic substance.
- Forms a smooth wet gel that can be smeared onto the face.
- Dries to form a layer that can be peeled off.
- Absorbs oils and dirt from skin.

Clay Mud Facial Mask

Smectite clay (bentonite) is used in mud mask skin treatments.

- Blends well with sand.
- Retains some moisture.
- Deforms when something is pressed against it.
- Holds its shape when pressure is removed.
- Holds shape at very high temperatures (when molten metal is poured into it).

Foundry Casting Mold



Smectite clay (bentonite) is mixed with sand. An item is pressed into the sand to form a mold for metal casting.

- Has high cation exchange capacity and absorbs impurities.
- Mixes with oil.
- Is pure and bacteria-free.
- Nontoxic.

Purification of Edible Oils such as Canola Oil

Pure smectite clay (calcium bentonite) is mixed into the oil, removing impurities and clarifying the oil. Then the smectite is removed.

- Doesn't support bacteria growth
- Forms a gel that thickens the liquid to stop drips.
- Forms a base for color.
- Mixes well with isopropyl alcohol and ethyl acetate.

Nail Polish

Smectite clay (bentonite) forms a pure, thick, gel-like base for nail polish.

Uses of

Clay Minerals:

Smectite Clays

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Directions

- Lay out all of the smectite clay products.
- Turn the cards over so that the statements on the colored mat board sides face up (photos or drawings on undersides).
- Read the purposes/ functions of using smectite clay in each product.
- Match each set of statements with the correct product.
- Look on the back of the card to check your work.
- Did you know smectite clays were so useful?

Uses of Clay Minerals
Smectite Clays

Uses of Clay Minerals
Smectite Clays

Additional Uses of Smectite Clay

Lining waste water lagoons or landfills with smectite to prevent toxins from leaking through and contaminating the ground water.

A natural deposit of bentonite (the gray pie-pan shaped outcroppings).

Photograph to the left:

Using smectite clay (Sodium bentonite) as drilling mud when drilling a water well (far left) and when using a drilling rig with horizontal directional drilling holes to install pipe lines or telephone cables.

Photographs courtesy of Wyo-Ben, Inc.