



Earthen Clay Plasters – Introduction

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Earthen plaster on wood frame building.
Two coats of clay plaster

1. Benefits:

- Beautiful
- Versatile
- Sustainable
- Durable
- Breathable
- Inexpensive
- Local
- Non-toxic
- Creative and fun
- Very Grounding



Earth plasters on Cob building
One coat Clay plaster
One coat Lime plaster



Clay plaster finished with milk paint
and linseed oil



Clay plasters finished
with milk paints.
Spoiled dog!



RED - Lime plaster
GREEN - Clay plaster finished with milk
paint

- **Clay** – THE GLUE. Two main types used. Any clay you can find in the soil is referred to as clay-soil. Each clay is unique and has different properties. Common pottery clay is called kaolin clay.
 - **Kaolin clay** is great for the top coat as it **shrinks less** as it dries. It is also almost white for lighter coloured plasters. Kaolin clay can be purchased as a white/grey powder from pottery supply stores. These stores may also have old blocks of kaolin clay which have set up into hard blocks. If you're lucky you can get them for free. These can be re-hydrated by soaking in water and breaking up.
- **Sand** – coarse unwashed sand for base coats and fine sand for top coat. These can be sifted out of your soil as clay/soil, or purchased from building supply/landscaping stores by the bag or by the truck load. For finishing coats it is essential to have very fine sand or sand sifted through window screen. Fine white sand can be purchased in bags.
- **Fiber** – helps to prevent/reduce cracking. It adds texture, strength and beauty.
 - For the thicker base coats you can use **straw**, using a rototiller to mix large batches. If doing small batches in a bucket with a drill mixer, use **chopped straw**.
 - For top coats we use **horse manure** or **sifted chopped straw**. Sifting is required to remove the lumpy straw nodes.
 - Can also use many other natural fibers such as goat hair, horse hair, human hair, etc. As a rule, the length of the fiber should not be longer than the thickness of the plaster layer.
- **Calcium Carbonate** – a fine, powdery white marble dust. Inexpensive and available in some larger building supply stores. (Slegg's carries it) Manufactured by IMASCO.
 - Makes top coats easier to spread, creamier, and helps with smoother harder finish. In some finish plaster recipes we use CaCO_3 instead of sand.

Finishing:

There are two ways to use clay plasters - if clay plasters are not finished or stabilized they will continue to slowly dust.

1. A finish plaster - usually has additives to stop dusting.
2. An unfinished surface will need painting, an alis or oiling if one wishes to stop the dusting.



2b. Additive Materials for Clay Plasters:

- **Boiled Linseed Oil**

- Boiled Linseed oil (Recochem Inc) is an oxidizing oil that reacts with oxygen and makes the plaster more durable and waterproof or water resistant depending on number of coats. May be used for finishing the top coat either as part of a clay paint, painted on straight, or mixed in with the plaster in small quantities. Rona will special order 18.9 liter (\$100) and also sells 1 liter jugs.
- **Using linseed oil will prevent walls from breathing.** Never use on exterior earthen walls where breathability is a must. May use on wood frame construction plasters for out buildings, chicken coops, sheds, etc. Linseed oil will always darken the finish.



- **Pigments** – Iron oxides supplied from on-line natural building supply stores or local pottery shops. Many other types of natural pigments are also available.
- **White glue** – used in some mixtures for adhesion coats on some surfaces or for attaching tile work. If used in exterior application use waterproof white glue
- **Casein** - Is a protein found in milk. It is a strong binder and can be used to make a Clay based Milk Paint or can be added to finish plasters to help prevent dusting. Use only inside. Do not use where it can get wet or life will grow.
- **Flour paste** - a cooked up mixture of white flour and water. Excellent to stop dusting but must dry quickly or it goes moldy. DO NOT USE where it can get wet.
- **Lime** - Lime plasters are not covered in this short course, however lime washes and lime paints can be used on top of some clay plasters to add colour and to stop dusting. I also use small amounts of lime putty in some of my finish clay plasters.
- **Mica** - can be added to some finish clay plasters to add sparkles or sheen
- Many other items - use your imagination, consult books, search on-line.



Lime Putty - Very Corrosive to skin



Horse manure - non toxic and safe

3. Tools:

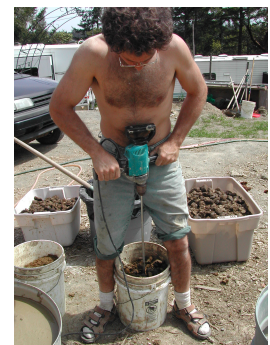
- Hands
- Float (optional; used to hold plaster)
- Plastering trowel
 - Japanese Pool Trowel



- Yogurt lids – with rims cut off to create plastic polishing disks. Pushes clay platelets in nice and tight. Commonly called closing the pores. Can also do this with a steel trowel.
- Smooth rock - for burnishing plasters to remove cracks and smooth surface while clay plaster is still leathery. Closes the pores of the plaster without rolling the sand around.
- Mixing drill - Powerful, slow spinning (high torque) with half inch shank
 - Mixing paddles – two types, one for breaking up clay (egg beater style), one for mixing up plaster (flat style that creates a vortex)



Clay slip soaking in half barrel.
Different clays can take different
amounts of time to fully hydrate



Breaking up horse manure

- 5 gallon buckets
- Masking tape
- Big half barrels are very useful to keep clay slip in
- Shovels and scoops
- Screens for sifting soil from ¼ inch down to very fine window screen
- Thick wide paint brushes for clay slip (photo on left) and linseed oil (photo on right)



4. Methods and Application Techniques:

Earthen finishing is a very creative process, and methods and materials are quite flexible. We often say to people just be happy with the end product. If you are attempting to achieve a particular colour or texture you probably won't get exactly what you were aiming for, so try to be general in your ideas of exactly what something "should" look like. Experiment and be creative. Remember, there is no such thing as failure, only learning opportunities. If things don't work out, just try again.

4a. Layers Simplified: Always paint on a layer of clay slip before each coat. With Straw bale the clay slip is often sprayed on.

- **Adhesion:** How are you going to get the clay plaster to stick? On wood frame or plywood one needs use mechanical attachment such as stucco wire. In some areas one can use an adhesion coat like a glue plaster. For cob, straw bale, or light clay, this is not necessary.
- **First Coat:** (base coat, scratch coat, or discovery coat). This coat evens out the imperfections to prepare surface for the next coat.
 - With straw bale and light clay this coat can be very messy looking as it has to push right into the straw or wood chips.
 - This coat is quite variable on cob depending on how the cob was built.
 - Base coat on stucco wire may still show the wire in some places depending on how thick the plaster is and how much fiber was used.
- **Second Coat:** Or BROWN COAT. Around here we pretty much call everything the BROWN coat. If starting surface is good, then one can go start with this coat. If your brown coat is good, one may simply choose to paint this coat.
- **Third Coat:** Or FINISH COAT. This is where the colour goes. This is the coat to make pretty.



Brown coat on wood frame construction.
Prepped with tar paper and stucco wire.
Two coats of lime plaster went on top.



Brown coat on cob. We could have quit here but added finish lime plaster coat.



Ended up just painting this brown coat with a yellow milk paint.

4b. Finishing Options:

With the first couple of coats, the most important part is to get good adhesion. Don't worry about getting it too smooth. If you get it too smooth future coats will not stick as well and you will have to rough it up.

The finish coat can have many different **textures**.

- Hand applied and finished...a gloved hand works well. As the plaster starts to dry one can use a gloved hand in circles to smooth it out and create quite a nice open pore finish. Simple and quick. (Little den/sleeping cabin and cob workshop finished this way)
- Apply with a steel trowel for a hard closed pore smooth finish. Can use a yogurt lid to smooth out trowel marks when the plaster has gone leathery, or use a sponge or brush finish.
- Sponge: As the plaster starts to dry and gets leathery, use a wet sponge in circles. gives a nice even textured finish (lime plaster on house was finished this way)
- Brushed finish: Use a clay slip brush and thin clay slip over an almost dry wall. See living room walls. If you do this same technique with water instead of clay slip the fibers show up more.

The finish coat can be painted appropriately, or oiled.

A final finish coat clay plaster can be applied:

- Can buy pre made "American Clay" plasters
- Can make your own from regular clay/soil or Kaolin clay. Add very fine sand or Calcium Carbonate, and what ever else you want...pigments, fiber, protein stabilizers, flour paste, etc.
- Always test your experiments first

4c Recipes - The options are endless

Basic Brown coat Recipe:

- 16 cups thick clay slip. (poured through 1/4 inch screen)
- 2 cups calcium carbonate powder
- 3 shovels +/- of regular fill sand
- 4-6 cups fluffy horse manure – dry or fresh
- Mix and adjust sand/clay/water – if slightly too wet add a bit more dry manure. This will take time to get the feel of it. All materials are not uniform and therefore it is not easy to exactly repeat the results. We usually make a bunch of buckets at the same time. Should be very thick...almost too thick to spin.



- **Options:**

- Use sifted white sand for a lighter top coat
- Use white or coloured Kaolin clay
- Experiment with more/less manure/ fibers
- The amount of clay required is directly proportional the the amount of surface area of all your other materials.

- **Tips:**

- Keeping edges wet with spray bottle makes edges less visible
- Always clay slip before applying the next coat – clay slip is the glue to adhere one layer to the next. Use just regular clay.
- Very thin top coat will go into a “leathery” stage as it dries, from minutes to up to an hour or so. This is when you can steel trowel, brush, or sponge.



Eco-Sense CaCO₃ Clay Plaster Recipe:

- 2 cups water
- 2 cups casein base see below
- 4-5 cups powdered kaolin clay
- 12 cups CaCO₃
- 1.5 cups mica
- 1 cup flour paste (cooked white flour and water)
- 1/2 cup lime putty
- 3 Tbsp yellow iron oxide

• Mix in 5 gallon bucket with a drill and plaster beater...add more water as required, but be careful not to add too much. Plaster should be

quite thick and not runny...a lump holds it shape.

- Pigment added last and mixed with the lime putty so that the pigment is evenly mixed. Make sure the plaster is a bit dry prior to adding this last bit of lime/pigment. May use a bit of water to rinse out container with lime and pigment.
- Adjust clay depending on whether you use mica (fine or coarse), and how much pigment you use. You can always add a bit more clay at the end if plaster is not sticky enough.
- Apply with steel trowel and use plastic lid to smooth when leathery. Goes on thin. Might try using a stone to burnish to make seems easier to hide. If you burnish too much with a lid the CaCO₃ will come to the surface and start to look powdery or milky.
- Plaster must dry quickly as there is flour paste and casein in it. If you think you have a lot of mold spores on the underlying plaster, spray peroxide bleach on the wall to kill the spores and let dry. The lime and Borax will help inhibit any growth as plaster dries.

Casein Base (Milk Protein base)

- This can be used in plaster, as a base for milk paints, or diluted 1:1 and used as a clear top coat paint to stop dusting and give a slight sheen.
 - 1/2 cup casein powder mixed with 2 cups water in a glass jar
 - 1/4 cup Borax powder mixed with 2 cups water in a saucepan
 - Let both mixtures sit for an hour or two
 - Pour casein mixture into saucepan with Borax mixture and let sit for another couple hours
 - Heat to 60-70 deg Celsius - DO NOT BOIL - stir while heating
 - It will become almost clear. Let cool and refrigerate for up to a week.

Clay Milk Paint: Used in circle room for burgundy curves

Mix with a single egg beater in a variable speed drill. Keep stirring while painting your wall as pigments are heavy and may settle. Paint will thicken as it sits...will need to add a bit of water as you go. Usually require two coats. Finish with a clear coat of casein base diluted 1:1. Paint keeps in the fridge for a week.

- 1/2 cup casein base
- 1 cup thick white kaolin clay slip
- 5 Tbsp red iron oxide
- 2 Tbsp black iron oxide
- (or for yellow paint use 2-3 Tbsp yellow iron oxide.)

5. Resources

❖ **Books:**

- The Natural Plaster Book by Cedar Rose Guelberth - this book is a must!
- Building Green by Clark Snell and Tim Callahan

❖ **Materials:** Here are a few places but you may also find many more local sources

- <http://www.buildingforhealth.com/>
- <http://www.greenworksbuildingsupply.com/>
- <http://www.americanclay.com/>