



Hypertufa: Creating simulated-stone containers, grown-up mudpies



Summary

Hypertufa is a cast "rock-like" material that can be used for relatively inexpensive pots for

plantings or sculpture. It looks like rock, can be cast into almost any shape, is very lightweight and also can also withstand freeze/thaw (up to a point). They can be textured anywhere from very smooth to a rough rocky look depending on the mixture. This method produces a more natural looking container. Hypertufa is a really simple project that can be used with varying age groups. It's best for people who like making mudpies or like crafting things to accompany their plants. It's very messy and works best with a space outdoors near a water hook-up for mixing and close by a workspace to form the planters and leave them for a minimum of two weeks. A patio outside a basement is good.

Objectives

1. Students will learn about concrete throughout history, how it is used today, and the safety precautions to take when working with it.
2. Promote belonging by working together to mix and share hypertufa mixture.
3. Promote independence by allowing each teen the options of what they want to create. Many things can be made out of hypertufa, this just shows you how to make planters.

Before you start working:

1. Talk about the history of concrete and cement
2. Ask students where they have seen uses of concrete and cement in general and everyday
3. Talk about the caustic nature of Portland cement. Specifically, gloves should be worn to avoid contact with the cement, which causes burns. This project should always be done in a well-ventilated area and masks and eye protection should be worn because the materials are fine and become airborne easily.

Ages: 7th grade and up

Setting: Public gardens, 4-H groups, science museums, and other informal educational settings.

Prep Time: 1 hour for buying materials and getting them to the project site.

30 minutes for set up.

Activity Time: 1 hour

Safety: Rubber gloves, masks, and no contact lenses.

Materials: (available at home improvement stores and garden centers)

Large tub or wheelbarrow for mixing

Small shovel or hoe for mixing

Empty coffee can or small pail for measuring

Masks and goggles

Yellow rubber dishwashing gloves (1.00 each reusable)

Wire bristle brush (optional)

Polyethylene sheeting or garbage bags

Molds (cardboard boxes, dishpan, mixing bowl)

Masking tape

Water

Portland cement (7.00/100lb bag)

Sieved peat moss (3.00/25lb bag)

Sand, vermiculite or perlite

Any other additives like fiber mesh or chicken wire for support and concrete color or stones for decorative purposes. Ask students or parents to help out and bring their own gloves, masks, 2 large garbage bags and molds.

Other things to discuss while working:

1. Talk about mudpies as children or other memories that might be related to the project.
2. Talk about what kinds of things the students want to plant in their planters.
3. Talk about the other things you could make with the hypertufa mixture. Don't be confined to the garden, maybe you could make a dog bowl (coat with paraffin wax to prevent water loss) or a model of something for school.
4. Who would appreciate this project? Maybe the student wants to give it to a relative after planting it with flowers or herbs.
5. What happens when you change the forms, the ratio of mix or the ingredients?

Instructions for making a planter: (for anything else the same general rules apply)

1. Cover your mold with the plastic on the inside or outside depending on which side you want to use. Tape the plastic down and if using a box use the tape to reinforce any weak edges.
2. Put on gloves and masks!
3. Mix 2 parts peat moss with 1 part vermiculite, sand, or perlite. Use the small pail for measuring.
4. Mix in 1 part concrete
5. Add water slowly and mix until you get a cookie dough-like texture. You should be able to squeeze the mixture together without dripping water or falling apart (the mixture, not you). The mixture should be workable for about 30 minutes.
6. Working from the bottom up (the bottom if working on the inside and the top of the sides if working on the outside of an upside down container. For a small container (1-2 gallons) the bottom of the finished container should be about 1.5" thick and the sides about 1". If you want drainage, add them at this point by making a hole in the bottom with a screwdriver, dowel, or your finger. You can also drill holes with a masonry bit after taking the container out of the mold.
7. When you are done shaping the container, cover it in plastic.
8. At this point the container needs to cure. Leave it for one week (two, if the temperature is lower than 55) in the mold. Keep the container in a cool shady spot. Do not let the container freeze at this point.
9. Remove the container carefully from the mold. At this point the container is still fragile. Rough edges can be smoothed and using a wire brush or screwdriver grooves or lines can be added for decoration or for moss and algae to grow on.
10. Let the container cure for another week. At this point the students can take them home. Make sure to tell them to leach the containers by leaving them out in the rain or continually filling them with water so that plants that are sensitive to alkalinity are not harmed by the lime content.



Background Information:

What does the word hypertufa mean?

Hypertufa is the inexpensive man made replacement for old stone watering troughs that were popular among gardeners in England before they became hard to find. Natural tufa rock is a rough textured lightweight rock. Hyper means something 'more than'. When the two are put together we get 'something more than tufa' or fake tufa rock.

Extension:

1. Play with mixture before hand, everyone mixes up what they think will work. Change the ratio of materials or try different materials.
2. Make other things with hypertufa.
3. Design your own planters and grow the plants you want in the containers. This works well if there are plants readily available to propagate or just use seeds.

Timeline of Concrete:

12,000,000 B.C.E. - Reactions between limestone and oil shale during spontaneous combustion occurred in Israel to form a natural deposit of cement compounds. The deposits were characterized by Israeli geologists in the 1960's and 70's.

3000 B.C.E. Egyptians used mud mixed with straw to bind dried bricks. They also used gypsum mortars and mortars of lime in the pyramids.

Ancient Chinese - Used cementitious materials to hold bamboo together in their boats and in the Great Wall.

800 B.C.E. Greeks, Crete & Cyprus- Used lime mortars which were much harder than later Roman mortars.

300 B.C.E. Babylonians & Assyrians- Used bitumen to bind stones and bricks.

300 B.C.E. - 476 A.D. Romans- Used pozzolana cement from Pozzuoli, Italy near Mt. Vesuvius to build the Appian Way, Roman baths, the Coliseum and Pantheon in Rome, and the Pont du Gard aqueduct in south France. They used lime as a cementitious material. Pliny reported a mortar mixture of 1 part lime to 4 parts sand. Vitruvius reported a 2 parts pozzolana to 1 part lime. Animal fat, milk, and blood were used as admixtures (substances added to cement to increase the properties.) *These structures still exist today!*

1200 - 1500 The Middle Ages- The quality of cementing materials deteriorated. The use of burning lime and pozzolan (admixture) was lost, but reintroduced in the 1300's.

1824- Joseph Aspdin of England invented portland cement by burning finely ground chalk with finely divided clay in a lime kiln until carbon dioxide was driven off. The sintered product was then ground and he called it portland cement named after the high quality building stones quarried at Portland, England.

Manufacturing Process:

Portland cement, the fundamental ingredient in concrete, is a calcium silicate cement made with a combination of calcium, silicon, aluminum, and iron. Producing a cement that meets specific chemical and physical specifications requires careful control of the manufacturing process. The first step in the portland cement manufacturing process is obtaining raw materials. Generally, raw materials consisting of combinations of limestone, shells or chalk, and shale, clay, sand, or iron ore are mined from a quarry near the plant. At the quarry, the raw materials are reduced by primary and secondary crushers. Stone is first reduced to 5-inch size (125-mm), then to 3/4-inch (19 mm). Once the raw materials arrive at the cement plant, the materials are proportioned to create a cement with a specific chemical composition.

Two different methods, dry and wet, are used to manufacture portland cement. In the dry process, dry raw materials are proportioned, ground to a powder, blended together and fed to the kiln in a dry state. In the wet process, a slurry is formed by adding water to the properly proportioned raw materials. The grinding and blending operations are then completed with the materials in slurry form. After blending, the mixture of raw materials is fed into the upper end of a tilted rotating, cylindrical kiln. The mixture passes through the kiln at a rate controlled by the slope and rotational speed of the kiln. Burning fuel consisting of powdered coal or natural gas is forced into the lower end of the kiln.

Inside the kiln, raw materials reach temperatures of 2600°F to 3000°F (1430°C to 1650°C). At 2700°F (1480°C), a series of chemical reactions cause the materials to fuse and create cement clinker-grayish-black pellets, often the size of marbles. Clinker is discharged red-hot from the lower end of the kiln and transferred to various types of coolers to lower the clinker to handling temperatures. Cooled clinker is combined with gypsum and ground into a fine gray powder. The clinker is ground so fine that nearly all of it passes through a No. 200 mesh (75 micron) sieve. This fine grey powder is Portland cement.



Sources:

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