



Beginner Project...

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Smoke Bombs



Figure 1: White smoke spraying from a smoke bomb.

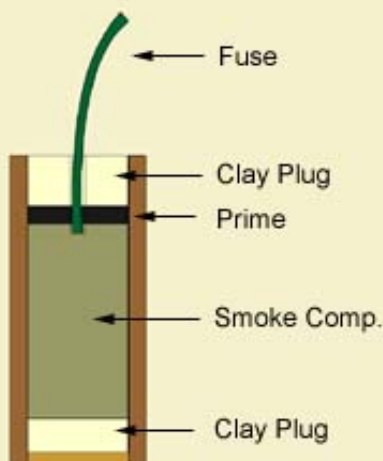


Figure 2: Cutaway showing smoke bomb components.

Introduction:

This is the first of a new series of articles intended for readers who are just getting started in pyrotechnics. The goal is to produce hands-on projects that are simple to build, require only small amounts of composition and require only minimal special tools to make. While the items described still may be of interest to more advanced builders, the experience level of the reader is assumed to be little to none.

Smoke Bombs

Many times smoke is an undesirable side effect of fireworks which tends to get in the way or obscure the display from viewers. However, as a novelty item, smoke bombs can be a fun daytime effect. The type of smoke bomb described here produces thick clouds of white smoke with a sulfurous odor that, while some find unpleasant, I think smells quite good! Perhaps the smell simply reminds me of my youth when I used these long-burning smoke generators for all kinds of mischief.

A smoke bomb thrown into a dense leafy bush can create the appearance of fog oozing from within. Throw one down a sewer grate and watch the fog spill out onto the street from below. A smoke bomb in a trash can create a "can of smoke" effect for Halloween. On a still night, several smoke bombs can be used to create an artificial layer of fog that hovers above the ground for quite a while. Care must be taken to avoid throwing the smoke bomb into flammable material however, as the initial ignition of a smoke bomb projects a blow-torch like flame for several seconds before the smoke phase starts. A smoke bomb thrown into a dry bush or trash filled can would likely start a fire, so use caution.

Figure 2 shows the basic parts of a smoke bomb. A cardboard tube is plugged at both ends with what is called "fire clay," also known as bentonite. This is a powdered clay that is rammed into the tube and compressed into a hard, solid plug that is very resistant to burning. Fire clay is one of the most commonly used substances for plugging the ends of tubes used to make fireworks. Not only does the clay resist erosion from heat, it grips the tube wall very tightly when rammed, thus giving it the ability to hold up to high pressures when composition is burning in the tube. Fire clay can actually be found in the soil of many southern states, appearing as white lumps that are pliable when wet but crumbly when dry. Commercial fire clay which has already been ground into the powdered state is commonly available from most hobby firework chemical suppliers as well as



Figure 3: Weighed out ingredients prior to mixing.



Figure 4: Smoke composition after mixing.



Figure 5: Cutting smaller tubes from a long one.



pottery supply stores. Large quantities of bentonite are also used at metal foundries for use in making casting molds.

The composition which burns to produce the smoke is a mixture of potassium nitrate, sulfur and charcoal-- the same three ingredients used to make black gun powder. Smoke bomb composition differs from gun powder in that the sulfur content is very high and the charcoal content is very low, which produces a very slow burning pile of yellowish powder. Smoke bomb powder must burn very slowly in order for it to produce smoke, otherwise it will only shoot flame and sparks out the end of your tube.

Because the smoke bomb formula used here burns so slowly, it can often be difficult to ignite. If the fuse were run straight into the smoke bomb composition, it would usually have trouble getting it to ignite. To get around this problem, a small amount of "prime" is used to start the smoke bomb. Prime contains the same three ingredients as the smoke formula, but the formula is altered to give a faster burning and easier to ignite powder. The prime takes fire from the fuse, and then the smoke powder takes fire from the prime. As the name implies, a prime is the "primary" ignition point which in turn passes fire to a secondary substance which is more difficult to ignite.

The process of building a smoke bomb thus involves charging a strong paper tube with the following sequence: clay plug, prime, smoke composition and clay plug again. The last step is to drill a hole through the first clay plug and into the prime, which is where the fuse will be inserted.

Construction

The first step is to find a suitable tube for your smoke bomb. The dimensions of the tube, or casing as it is called, does not have to conform to any specific size. The longer the tube is, then the longer the smoke bomb will burn and thus the more smoke it will produce. Long burning smoke bombs will get quite hot and eventually burn through the side unless the casing is thick enough, so larger smoke bombs will need thicker walled tubes.

The casing used here was 3/4 inch inside diameter (I.D.) with a 1/8 inch thick case wall, making the outside diameter (O.D.) equal to 1 inch. The length was 2-1/2 inches, which will give a smoke duration of one and a half minutes.

The tubes used here were hand rolled from two 14" long by 7-1/2" wide strips of manila file folder paper, with an additional two turns of 30 pound kraft paper at the end to keep the case from unraveling. The basic procedure for rolling your own tubes can be found [here](#). Since smoke bombs do not put much pressure on the tubes, you can also use dry-rolled paper or the cheaper commercial tubes made from recycled paper. However, the use of white glue when rolling your own tubes actually produces a tube that is slightly more fire resistant, so your smoke bomb can burn longer before burning through the side when using tubes made this way.

The white smoke formula used here is the [Degn White](#). The three ingredients are weighed out on a scale one at a time, which will give you relative amounts that look like Figure 3. The best way to mix

Figure 6: Tools required to charge the tubes.



Figure 7: Loading 1/2 tablespoon of clay for the end plug.

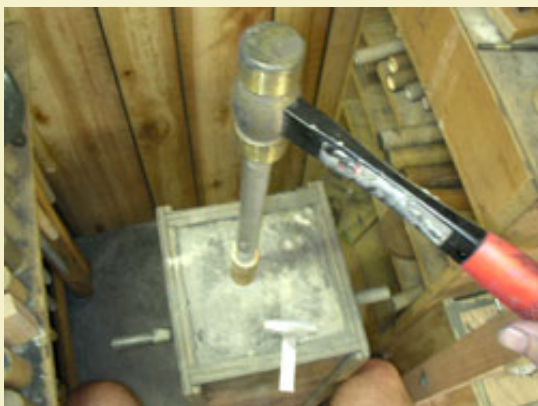


Figure 8: Ramming the clay plug.

these together is to push them through a screen three times, which will give you the finished composition seen in Figure 4. For more information about making your own screens, read [here](#). The charcoal used in this formula can be very low grade stuff. Even ground up charcoal briquettes will work.

The basic tools for loading your smoke bomb are shown in Figure 6. These include a ramming rod equal to the I.D. of your tube, and a non-sparking mallet such as the brass one shown. Note that your ramming rod needs to have a flat, squared off end, especially when ramming the clay plug. If the rammer has rounded edges, then the plug will be concave on the inside and this will result in an extended period of smokeless flame projection before the smoke effect kicks in.

[More...](#)



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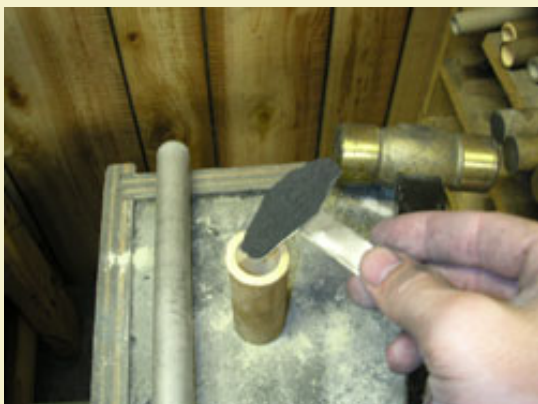


Figure 9: Loading a scoop of prime.

You will need to ram your smoke bombs on a solid surface, such as a concrete block or a thick block of wood such as a log set on end. Any vibration on your work surface will result in less density in the resulting smoke charge.

Begin by loading one half table spoon of fire clay into your case, using a funnel to help guide the powder as seen in Figure 7. This should be rammed in with seven or eight solid blows from your mallet (see Figure 8).

After ramming the plug, dump in a small increment of prime as seen in Figure 9. I use a small scoop made from a scrap of aluminum flashing to allow dumping the powder in without using a funnel. The prime formula can be "green mix," which is an unprocessed mixture of [black powder](#) that is mixed the same way as described for the smoke bomb powder. You can also use any black powder based rocket fuel or fountain mix you have laying around for the prime.

Before ramming the prime, add an increment of smoke bomb composition on top of it. By ramming both types of composition together in loose form, you will get a better fire transfer between the barrier where the two meet.

Continue adding and ramming smoke bomb composition in about 1/2 tablespoon increments until the case is filled to within 1/4" from the top. Figure 11 shows how high you want to ram the smoke composition before stopping. The increment size determines how dense the composition will be, with smaller increments producing more dense and thus longer lasting smoke bombs.

Finish loading the case by ramming in a final plug of fire clay. Fill the remaining void to the top with clay and ram the plug with about 8 blows from the mallet.

Next you will need to drill the exhaust hole in the plug on the primed end. This hole should be 1/8" in diameter, which can be drilled on a drill press with the speed set to the lowest RPM available. Black powder and smoke composition are not very sensitive to friction, so it can be drilled without worrying about igniting the composition. You still want to avoid high RPMs that could heat up the material and push the limits of friction sensitivity. The hole can also be drilled with a hand held power drill, but a cordless screwdriver is preferable for its inherently lower RPMs than a power drill.

Smoke bombs are typically fused with a stick of waterproof Visco



Figure 10: Loading a scoop of smoke composition.



Figure 11: Stopping point for smoke composition before loading clay plug.

type safety fuse measuring roughly 1-1/2" long. Black match could also be used if you have some small enough to fit into the 1/8" diameter hole.

Even though your fuse may fit snugly into the vent hole, it is a good idea to secure it in place using what is called "nosing paper" around the end of the casing. The "nosing" is simply two turns of a thin weight paper that is glued around the end of the case so that it overhangs by about 1-1/2 inches. The 30 lb kraft nosing paper seen in Figure 13 is 7 inches long by 3 inches wide. The paper that overhangs the end of the case is then gathered up around the fuse and secured with a clove hitch knot. For instructions on tying a clove hitch, refer [here](#).

The 2-1/2 inch long smoke bombs will burn for 1-1/2 minutes, which is long enough to produce quite a bit of smoke. I have tested the hand rolled manila cases up to four inches in length without getting any burn through, although the case does get hot enough to burn things so be careful where you place it.

Breathing a small amount of the smoke won't hurt you, but too much of it will likely make you feel ill so make sure you don't fire these in such a way that the wind can blow the smoke into your home and stink it up! 🔥



Figure 12: Drilling the 1/8" vent hole.



Figure 13: Applying the nosing paper.



Figure 14: Smoke bomb ready to use.

