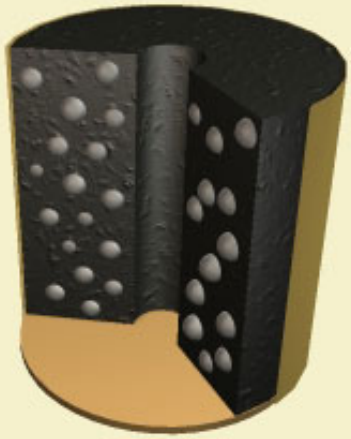
Build This...

4" Matrix Comets



Summary:
Matrix comets are simply an aggregate mixture of stars within a fast burning comet mix. The effect is to have colored micro stars streaming behind the comet head, which is usually gold so as not to distract from the colored stars.

The large size and hollow core featured in the comet described here works quite well for making attractive matrix comets.

Comet Formula: Gold Comet
Microstars: AP Red, AP Blue, AP Green, Red Strobe, Green Strobe

Materials:

- (1) 3-1/2" disk.
- (1) 4-1/2" x 24" strip of 60lb kraft
- (10) 1" square pieces of burlap
- 2/3 cup of 1/4" round or cut stars
- 400g comet composition
- 35g water containing 5% alcohol

Tools:

- 4" comet pump with 3/4" core
- hydraulic press
- hot glue gun

Unmeasured Materials:
hot glue, 2FA, quick match, twine

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4" Matrix Comets

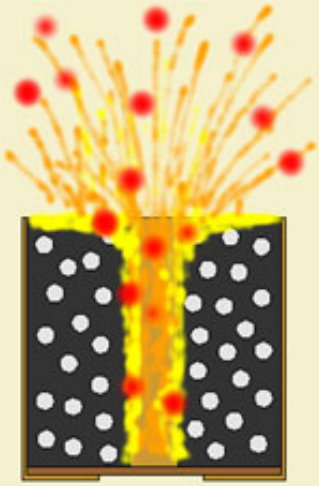

Figure 1: Flame front of a hollow comet.

Introduction:
I have tried many methods of producing matrix comets. Pasted, unpasted, different sizes, different binders etc. The design described in this article has given me the best results thus far. It is based around the comet design described by Bill Ofca in his TIF Volume 7, "The 4 inch Golden Column Comet."

Ofca's comet had a hollow core down the center, which helped increase the burn rate of the comet in order to compensate for the fact that it only burns from one end. The rest of the comet is pasted in and fitted with an end disk in order to help prevent it from cracking apart during lift.

I believe it is because of this hollow core that it performs so well as a matrix comet. While solid matrix comets seem to just drop their stars behind them in the tail, the jetting forces caused from the hollow core in these comets act as a sort of gerb that throws the stars out away from the comet (see Figure 1). Since the comet spins quite rapidly during flight, the effect is that of a bushy gold comet with stars flying out much wider than the tail itself.

Figure 2 shows the type of pump used to create this comet. For details on how to build this pump yourself from readily available materials, click here.

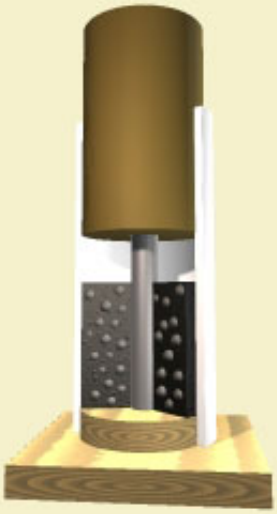

Figure 2: Comet pump component cross section.

Making the Comet Mixture:
It will take 400g of the golden comet mix referenced on the title page to make one comet. If you just want to make a solid comet with no microstars, then 500g will yield the same size comet.

Note on the formula page for the gold comet mix that it indicates to mix the KNO3, sulfur, dextrin and airfloat charcoal in a ball mill for a few hours. The remaining charcoal is mixed in by hand. I use a mesh size ranging from 30 all the way to airfloat for the remaining 16 parts of charcoal.

After the mix is prepared, dampen it using only 8% water. I like to add 5% alcohol to the water in order to break the surface tension, which helps make working the water into the composition easier. Such a small percentage of water is hard to work in, so you will just have to keep squeezing handfuls of comp until there is no longer any dust created by stirring the mixture.

Next you will want to add 2/3 cup of 1/4" stars of your choice and mix them in by hand. I prefer to use AP stars because of the pure color and longer burn time. However, you must make the effort to protect the AP stars from the nitrate in the comet mix. Failure to do this will result in wet globs that fail to ignite! Coating the AP stars with AP Prime using at least a 7% NC lacquer solution is absolutely necessary. It is not necessary to have a black powder prime on any of the stars used in this matrix comet, since the comet itself acts as the first fire.

Figure 3: Squares of burlap used to provide the fiber reinforcement.

Chlorate stars are to be avoided due to the sulfur present in the comet mix combined with the high pressure that will be used to press the comet. Even without the sensitivity risk, chlorate stars burn too fast and would not leave an adequate wake of microstars behind the comet.

In his booklet, Ofca describes the use of burlap fibers to both hold the comet together and provide burning embers that hang in the comets tail for an extended duration. The technique was originally employed by Legion Fireworks, a New York based manufacturer that Ofca later purchased and ran for 10 years.

I have been using the burlap fibers in all my 4" comets and have yet to see one break apart during lift. I also believe that these fibers help the comet to dry faster, as they act as channels to wick the water from the center out to the edge where some of the fibers are exposed. Despite the large mass of composition in these comets, I have been able to force dry them in a drying chamber and shoot them as soon as one week later, and never have I had a problem with them getting driven in.

Figure 4: Comet stew! Fibers and stars mixed in and ready to pump.

Burlap can usually be found at nurserys, since it is used for potting or transporting plants. The burlap fibers are prepared by cutting a sheet of burlap into 1" squares, as shown in Figure 3. It takes 10 of these squares to make one comet. It is quite easy to pull the fibers from each square when adding them to the damp composition. Since the fibers tend to want to clump together once inside the comp, I mix the batch a little by hand after the fibers from each square are added. This will result in a better distribution of fibers compared to just adding all the fibers in one big clump and then trying to work them in.

Figure 4 shows the final mix with stars and burlap worked in.

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4" Matrix Comets

Figure 5: Loading the pump in a pan to catch spills.

Figure 6: Metal plate on top of 12 ton bottle jack.

Pumping the Comet:
Figure 5 shows all the components of the comet pump. The sleeve is placed over the spindle and the pipe clamps are tightened down. I like to load the pump in a small pan so that any spill over is easily collected and transferred back into the sleeve afterwards. Note that the spindle shown in Figure 5 has a rounded base with a radius designed to fit a 6" ball shell. This is necessary if you wish to attach this large comet to a ball shell.

The comp will fill a 9" sleeve all the way to the top. You may even have to stuff the comp down by hand to get it all into the pipe. Once all the comp is loaded, insert the rammer and force it down as far as you can.

Because my home made comet pumps have a wooden base, it is necessary to support them from underneath using a metal plate. The plate should be thick enough that it won't bend under the pressure of your jack. Figure 6 shows a 12 ton bottle jack with the plate on it, sitting inside a home made press frame. To see how to build a frame like this one, click here.

Whatever type of press you choose to use, the top end of your rammer must be fully supported. Do not try to press against an object that only partially covers the top of your rammer or you may damage it. Use of another metal plate or a piece of wood on top can help give you the full surface contact you need.

Figure 7 shows the comet pump being pressed in the home made frame. I like to pump the jack until the plunger no longer goes down and then let the jack "dwell" under that pressure for 10 or 15 minutes. This is a good time to be preparing the next comet batch if you are making multiples. When I return a little later, I like to pump it a few more times and then wait a little bit longer before removing the pump.

When extracting your comet from the pump, first remove the pipe clamps and then twist a screwdriver blade into the sleeve gap so that it widens and can be pulled over the rammer and set aside. Next twist and remove the rammer. Gently give the comet a twist until it spins on the spindle, then carefully pull it off while being careful not to squeeze it too hard. It should look something like Figure 8 and be solid enough to handle.

If you have a drying chamber or food dehydrator, you should be able to dry this comet completely in just one week. Otherwise place it on a screen and record it's weight each day until the weight stops changing. Once it is pretty close to the weight of the components you put into it, it should be dry enough to shoot. Ofca claims it takes a month to air dry one of these, but I think a little over two weeks should do it in most cases, especially if you only used 8% moisture to wet the comp.

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Figure 7: Pressing the comet in a home made wooden frame.

Figure 8: The finished comet ready for drying.

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4" Matrix Comets

Figure 9: Hot gluing a disk to one end.

Figure 10: Pasting in the comet.

Figure 11: Lifting the comet with disk end down.

Finishing the Comet:

When the comet is completely dry, it should sound similar to a piece of ceramic when you thump it with your finger. You may occasionally find thin cracks around the outside of the comet if you pressed it too hard. These cracks are generally not very deep into the comet and will not effect it's performance. Since the sides of the comet will be protected by paper, fire will not be able to get into the cracks anyway. Clip off any stray pieces of burlap that may be sticking out from the sides of the comet, usually near where the pipe seam was.

You will need to hot glue a disk onto the bottom of the comet, as seen in Figure 9. It is important to make a small circle of glue at the center where the edges of the center hole will be. This is to prevent gasses from slipping under the comet, blowing the disk off and burning from both ends at once. Thus, the glue circle must be complete with no gaps. Another circle of glue is used only to hold the disk to the comet.

The purpose of this disk is to give the lift charge a solid surface to push against, while also strengthening the comet itself. If this comet were to be mounted to a 4" canister shell, you would want to drill a 3/8" hole in the center of the disk before attaching it to the comet.

In order to further strengthen the comet and reduce the exposed surface area, it must be pasted in with a few turns of paper. I prefer to use two turns of 60 lb recycled kraft. The comet is rolled with the edge of the paper flush to one end while the other end is pleated over the end disk as seen in Figure 10. The paper is first pasted and broken in just as when pasting a shell.

When rolling the comet up in the paste wrap, be sure that there are no wrinkles or air gaps between the comet and the paper. Such gaps allow fire to propagate down the side and diminish the burn time of the comet. You want the comet to burn from one end only, as it will also be burning from the inside out due to the center bore.

Once the paste wrap is dry, the comet is finished like a regular 4" shell. The leader runs straight to the disked bottom of the comet and it is rolled up in two turns of 30lb kraft. I like to use a few lines of white glue to help keep the kraft wrap from slipping while trying to roll it tightly around the shell, as seen in Figure 11. There is no need for a passfire to the top of the comet, as it will easily ignite from the lift gasses blowing by it. If you are concerned about this, you can always rip a small hole in your match pipe where it passes over the comet, which will blow gas and sparks into the comet as the match burns.

The comet is lifted with the standard ounce per pound rule, or 28g of lift for every 448g of comet weight. In most cases this comet will weigh about one pound so you will lift it with one ounce of 2FA. The lift and leader are tied in

Figure 12: Finished comet looks just like a 4" shell.

with a clove hitch knot in the typical way, resulting in a finished product that looks like Figure 12.

It seems to be the general nature of matrix comets to release more microstars at the last part of their flight than at the beginning. In fact, the amount of stars seen behind the comet seems directly related to speed of travel, with higher speeds resulting in less stars.

This type of comet will leave a very thick column of smoke that can sometimes obscure the microstar tail from view if it is fired in a direction directly away from the audience. The best effect is obtained when fired at a steep angle across the audience's field of view.

Falling embers of glowing burlap fibers can make this comet somewhat of a fire hazard in dry conditions. I have also seen the burning paste wrap with end disk come down and start a fire as well. Use of this comet is not recommended in dry conditions or shoot sites near dry grass.

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