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Pumping Stars with Star Plates

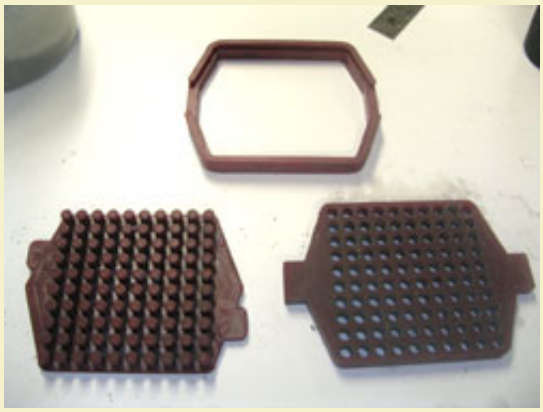

Figure 1: A low cost 3/8" plastic star plate.

Figure 2: Pushing damp comp into the plate cavities.

Figure 3: Shaving off excess comp with thin

Introduction:
Pumped stars have several unique advantages for certain applications, and the proper tools can make them quick and easy to produce in relatively large quantities. The cylindrical shape of a pumped star still provides a fine edge around the top and bottom, making them easier to ignite than round stars though not quite as ignitable as cut stars. When produced correctly, size uniformity is easier to obtain than with cut stars or round stars. The cylindrical shape is also ideally suited for fitting into tubes for such uses as roman candles, comets, scatter stars etc. Like the cylindrical shell in a mortar, a cylindrical star to be fired from a tube results in less blow by than a round star, thus the star will travel farther for a given amount of lift charge compared with a round star. For the beginner, quality pumped stars produced with a star plate are also easier to make than both cut stars and round stars.

While large pumped stars (comets) are often produced one at a with a single sleeve and piston, such a practice would be far too tedious and time consuming for producing the larger quantities of smaller diameter stars, such as those used to build a typical color shell. For producing many pumped stars at once, a star plate is used. This is a simple plate full of holes with a matching plate full of pins, as seen in Figure 1.

Two methods of using star plates are demonstrated here, each with advantages and disadvantages.

Method 1:
Figure 1 shows a plastic 3/8" star plate that will produce 100 stars per pressing. These used to be available at Skylighter some years back for a reasonable price, but I have not seen them around lately. While this type of plate is somewhat flexible and not quite as nice as a machined aluminum or brass plate, it is also several hundred dollars cheaper to obtain. The other alternative is to make your own plate, as described here.

metal ruler.

Figure 4: Compacting comp with top plate and rubber mallet.

Figure 5: Shaving excess comp from bottom of plate prior to ejecting stars.

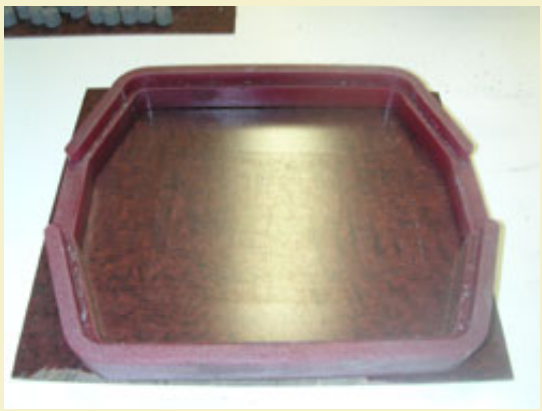

Figure 6: Standoff fixture positioned on a sheet of plastic.

The composition to be pressed must first be dampened with the appropriate binding solution. There are no hard and fast rules that apply to all compositions dictating what percentage of moisture to add. Each composition behaves differently when damp, so the amount of moisture added must be determined by practice. A good starting point is to use 10% and then increase in increments of 5% until the composition is still crumbly but will clump together if gripped in your hand. The amount of moisture will be less than if making cut stars but more than if pumping comets. A typical organic color composition might require 10% moisture, while a composition heavy in magnalium and parlon can require around 25% in some cases. If the stars are crumbly and break in half after being pumped, then you can throw them back in the bucket and add more solution. However, solution oozing out the bottom of the star plate while pressing is an indication that you added too much moisture.

Once your composition is dampened to the desired consistency, you load the plate by grabbing a handful of comp and working it into the holes as seen in Figure 2. Press with your palm while sliding the comp all over the plate. Use an excess amount and don't worry about it spilling over the sides. Once the holes are all filled, use a thin blade such as the metal ruler shown in Figure 3 to shave off the excess.

Next you will place the pin plate on top and press by hand until the holes are all aligned. Use repeated blows from a rubber mallet to consolidate the composition. It helps to do this on a solid table surface so that the pounding force is not absorbed by a flimsy table top. Do not whack as hard as if you were ramming a driver, but make sure to move the mallet around the edges to be sure all the pins are compressed equally well. Failing to compress all areas of the plate surface will result in some stars breaking in half when they are ejected.

Once the composition has been compressed, flip the plate over and level off the comp flush with the plate by scraping with the metal ruler again, as seen in Figure 5. The stars are now ready to be ejected.

Figure 6 shows a plastic ejecting frame that is part of the Skylighter star plate kit. This serves to hold the plate up off the table while the stars are being ejected. If your plate does not have one of these, you can improvise one by using to sticks of wood on both edges to hold the plate up off the table. Make sure your stand-offs are thicker than the thickness of the stars you are ejecting though, otherwise you will crush the stars against the table when they are ejected!

Figure 7: Ejecting stars by tapping with a rubber mallet.

I prefer to eject the stars onto sheets of thin plastic so that I can easily move them around and transfer them to the drying screen. The plate is placed on the stand-off and the mallet is again used to tap the top plate. To not pound the plate to heavily or the vibrations could cause the stars to fracture if you are using a more fragile type of mix.

Figure 8 shows a completed batch of stars ready for drying. Pumped stars are really not damp enough to pick up meal dust, so they are first dried and then primed in a star roller later.

The disadvantage to this method is that it can be tricky to get all the stars to pump to the same height. This is because it is not easy to reliably press the same amount of comp into each hole when loading the plate by hand. The loading process is also slower than the second method described here. However, this method allows for a thinner star plate, thus reducing the cost of the tooling.

Figure 8: Finished stars ready for drying.

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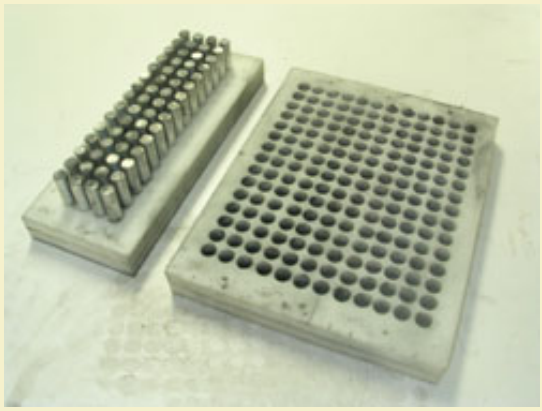

Figure 9: A thicker star plate.

Figure 10: Granulating damp composition through a window screen.

Figure 11: Filling plate holes with granulated comp.

Method 2:
This method gets around the size inconsistency problem by insuring that the same amount of composition is pressed into each plate hole. This is done by first granulating the composition, then allowing it to loosely fill each hole without any force being used when loading.

Because the granulated comp is loosely sifted into each hole, it will compress a great deal more than the solid comp pressed in by hand as previously described. This extra degree of compression, often greater than 50% of the hole length, requires a much thicker plate to be used. Figure 9 shows the thicker hole plate with the longer pin plate to match. This plate, which is 7/8" thick for pumping 3/8" stars, is almost twice as thick as the 1/2" plate used previously.

The difficulty in finding thick material to make the hole plate, be it plastic or metal, is the down side to using this method. But once you have the tooling in hand, this method is faster and produces more uniform stars than the previous method.

The composition is first dampened as described already. The dampened composition is then granulated through a window screen as shown in Figure 10. If the screen gets clogged up by the damp comp and is difficult to push through, then the composition has been over wetted.

Screening too much comp at once can sometimes cause clumping due to the weight of the screened pile compressing itself. Overly damp composition will also result in clumping, which makes it difficult for the material to flow into the plate holes. It is best to screen only enough to do one or two pressings, keeping the remainder of your comp in a closed container so that it does not lose moisture and become too dry.

The granulated composition is now poured onto the hole plate and leveled off with a straight edge until all the holes are filled to the top. This stage is much

Figure 12: One of three pressings required for this plate.

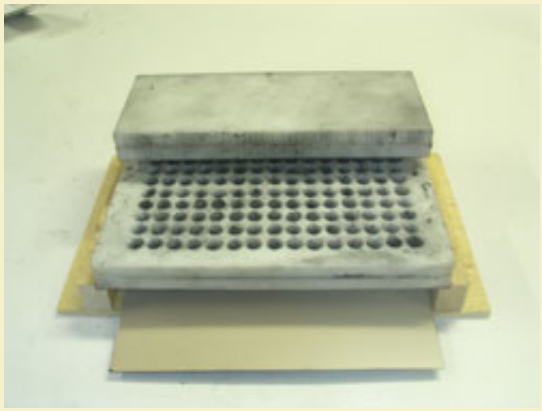

Figure 13: Ejecting the stars using a wooden holding fixture.

Figure 14: 180 stars ejected onto a removable sheet of plastic.

faster and requires less physical effort than method one, so the extra time spent granulating the composition is made up for with faster loading times.

At this point the process is finished out identical to the previous method. Note that the pin plate used here only fits into a third of the holes on the hole plate. This is a design used to save time and money when fabricating your own star plate such as I have done here. Since the pin plate is the most costly and time consuming component to make, creating a partial sized pin plate that fits into identical sets of holes saves a lot of time and effort while still allowing you to build a high capacity star plate. It also results in a pin plate that is easier to remove, since pin plates tend to bind as their size increases (especially pin plates made using only a drill press!).

While the pressing operation with partial pin plates requires multiple pressings (three in this case), the increased process time is not significant. I have seen this method used to produce star plates with a 400 star capacity that required four separate pressing operations per plate. A full sized pin plate of this size would be pretty much impossible to use due to binding problems, but a partial plate makes such a large star plate practical and highly efficient for large volumes.

Figure 13 shows a wooden stand-off fixture used to hold the plate while the stars are ejected. A removable sheet of plastic is used to catch the stars as they drop form the plate. The stars will be ejected in three separate groupings due to the partial pin plate. Sometimes a few ejected stars will bounce and turn on their sides, with the potential to roll under the plate where the next group of stars will be ejected. Sliding the plastic sheet back in order to move the ejected stars a short distance away from the next pressing helps insure that you don't press the next batch on top of some stray stars from the previous batch, thus crushing some stars.

Regardless of which method you use to make plate stars, you will find that the technique is easier to learn compared with round or cut stars, and the end results are always nice looking stars. Plate stars are also ideal for converting small test batches or leftover material into useable stars, since the minimum batch size to produce plate stars is very small compared with cut stars or round stars.

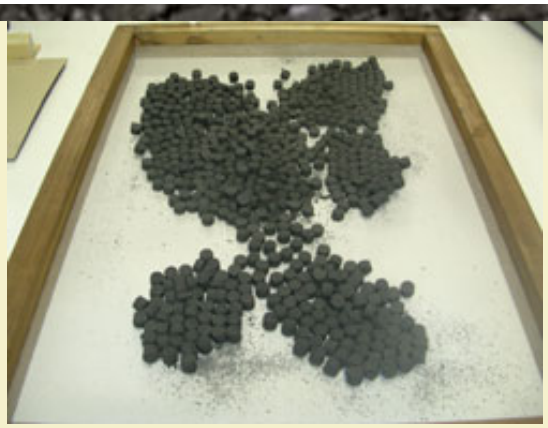

Figure 15: A screen full of pumped stars ready for drying.