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Jewelry Manufacturing Methods and Techniques
http://www.ganoksin.com

In association with MJSA Journal

Detail Oriented - Testing new HD Patterns in the shop Palry

By Linus Drogs, September 2006

I've been working in the jewelry industry for more than 20 years, and in that time I've seen many improvements in manufacturing. New materials, such as Precious Metal Clay, and new technologies, such as CAD/CAM, have changed the way we make jewelry, allowing us to do it faster, easier, and with better quality.

I was fortunate to stumble onto a new material that I would add to this category at the JCK Las Vegas show in June. I was told that this material would make injecting difficult pattern molds more successful. It's not a new wax. In fact, it's more like olive oil.

Invented by Victor Joyner, a Chicagobased manufacturing jeweler, patented High Definition (HD) Patterns are made of a light-curing polymer material that can he injected into a silicone mold with very low pressure at room temperature. After hearing about the exceptional detail achieved by these patterns, and the subsequent clean burnout, I decided to put the material to the test in my shop.

Injection properties

My staff and I tried several techniques of hand injecting and found that a simple micro-oiling bottle worked best. Because the material stays liquid throughout the injecting process, it doesn't chill or shrink like wax, resulting in a complete fill.

In addition to hand injecting, we tried automating the process by using a Yasui Vacuum Injector. Although productivity was five times faster with the Yasui, the machine needed to he heavily modified to do simple injecting; all of die brass parts in the injector needed to be replaced with stainless steel parts (or nickel-plated) to prevent a reaction between the pattern material and the metal.

When working with this material, your mold choice is limited to clear silicone because the pattern requires contact with light to change from a liquid to a solid. We tried several molds currently on the market, including Shin-Etsu and Zero-D products. All of the molds performed well, which would suggest that most clear silicones available will be suitable for use with HD Patterns. However, it's important to note that this material does not perform well with urethane molds.

Once we had injected enough HD material into the mold cavity, we found that a small amount of air usually got trapped in the pattern at the corners or in the undersides. We were able to remove the air by using two different techniques. First, we tried a hand-spinning device that uses centrifugal force to push the air out through the parting lines in the mold. This method seemed to also force more material into the vents, creating some flashing in the injection.

The other method we tried was to simply add pressure to the entire mold. By placing the filled mold into an empty cold wax pot and applying 20 psi for five minutes, the trapped air was forced through the vents and created less flashing.

It's important to note that, unlike on wax, the flashing that occurs on HD Patterns is minimal and does nor leave parting seams.

Once we were satisfied with the fill of the molds and no trapped air was visible, we moved on to the next step in the process: curing the pattern material with light. Cure time depends on the light source; for example, it takes several seconds to cure in ultraviolet light and 10* minutes to cure in natural sunlight. After curing, the material's consistency resembles that of plastic rather than wax. The material handles well—it is very durable anti has lots of memory—and its properties indicate that it should have a good shelf life, providing casters with the flexibility to hatch-inject for future casting needs without having brittle patterns that can break during investing.

One slight inconvenience we encountered is that wax doesn't bond well with the HD'material for sizing or for attaching pieces to a tree assembly. We found that sticky wax worked best for bolt applications. After injecting several molds, I was impressed with the fill and detail achieved in the patterns. I was able to inject patterns such as a heavy 12 mm bar stock cross that wax can't fill in a rubber mold successfully due to the excessive sink when the coax cools. Because HD Patterns have zero percent shrinkage from model m casting, we were able to cast this complicated cross successfully to scale.

In addition, I achieved a greater degree of detail in molds made from RP models -- a level of detail that is difficult to achieve with most waxes. This is clearly an important advantage, considering the growing popularity of CAD/CAM. Also, as intricate relief engraving of dates and verses continues to become more prevalent in wedding bands, crisp reproduction of these details in models will be critical to achieving a high quality product.

Casting properties

No matter bow good a pattern is, the material it's made of needs to be tastable. We started our casting experiments on HD Patterns using basic gypsum-bonded investments to cast sterling silver using a top-end burnout temperature of 1,350°F/732°C, and we achieved good results. A small amount of finning was visible on some of the sharp edges, but the surfaces of the castings were comparable to castings of wax models. It seemed to us that a higher top-end temperature would provide better results and less finning.

We decided to increase the burnout temperature to 1,450°F/788°C and switch to an investment designed for higher temperature white gold alloys, which contains proprietary ingredients that make the plaster mold stronger. When we inspected the flasks before pouring the metal, there were no residuals and burnout was complete. We cast a 400-square sterling grid and a 0.5 mm sterling place and achieved good fill on both. During these trials, the casting results improved; we bad slightly smoother surfaces and less finning than with the gypsum-bonded investment.

We also tested the material with our proprietary shell casting system, using a burnout temperature of 1,350°F/732°C, and got successful results—very smooth finishes and no finning.

That said, the main limitation of this material is its ability to successfully cast pieces with high mass and low surface area, or low mass and high surface area. Our tests on cube- and sphere-shaped pieces with masses between 12 and 14 dwt resulted in rougher and voided 14k gold castings.

A replacement for wax?
Considering its current casting limitations and its relatively high price compared to wax (see Supplier's Noce) this material will not replace wax. However, as an alternative for specific projects, HI) Patterns have some excellent applications. For example, manufacturers looking to produce highly detailed patterns with basic rubber molds in limited production will find the materials high quality detail and durability appealing. Also, manufacturers who mold RP models in wax may find the replication quality unmatched.

Second Opinion

Jason Borgstahl of Casting House in Chicago was one of the first casters to experiment with HD Patterns. He shares many of Drogs's opinions about the advantages of the technology. Below, Borgstahl describes three areas where these patterns excel, with examples from his own shop.

Improved Resolution. Even at injection pressures of 10 lbs. or more, it is common for small but crucial detail to be incomplete or softened in wax, usually due to air lock or insufficient pressure. Raised wording on the pattern, for instance, may appear less crisp to downright rounded off. Injection pressure may be increased to offset this, but distortion of piece thickness, inconsistent casting weights, and flashing are likely to occur. The only other options are to cut vent lines across the offending mold section, or to experiment with different types of wax, wax additives, and wax-pot temperature. Time-consuming and often fruitless solutions like these can make jewelry manufacturers and their employees go gray early. In contrast, HD Patterns provide resolution so precise a 10x jeweler's loupe is needed to fully appreciate its impact. The overall crispness of detail, however, is clear in the pattern, casting, and finished product as viewed by the naked eye.

Flatter Spans. Flat areas in a model that is to be reproduced in wax are prone to cupping or sinking when injected. The thicker the area, the more concave it is likely to become. This undesirable effect is due to the fact that wax is injected hot and pulls back during cooling. Not only is the integrity of the piece compromised, but time-consuming and wasteful filing is often necessary after casting to re-create the desired look. Since HD Patterns are made without heat, flat areas remain flat, preserving the integrity of the original and ensuring consistent casting weights.

Shrinkage. One big advantage of not using pressure in this process is that there is no shrinkage in the negative areas. This means that finger sizes, areas to be set, and other open spaces remain precisely the same size. Try making one style in five to seven different finger sizes in wax and plastics and the benefit will be clear to you. I've found that the HD Patterns are the same size as the original, and stones picked using the master fit perfectly into the castings from the burned out patterns. No more guessing.
