It's Very Clear, One Sculptor's Experiences With Urethane and Acrylic

By David E. Parvin

Sculpture by David Parvin, titled "Britton"

I can not recall just when I first saw the clear acrylic sculptures of Frederick Hart and Michael Wilkinson but it must have been not long after I made the decision to become a serious sculptor myself in 1981. What I do remember is being very much taken with the ethereal quality of the acrylics. I imagined my own name etched into some icy blocks of mystical sensuality, except for two roadblocks. Number one, there was no local source for casting acrylics and I was dubious about having something produced where I would not be close enough to be involved. Secondly, considering the prices of the above artists' work, I assumed that the production cost must have been astronomical. Even some superficial research convinced me that casting acrylics was beyond my capabilities. Could there be another solution?

The quest for the holy clear began simply enough. While at my Denver area source for materials, Western Sculpting

Sculpture by David Parvin, title “Victor”

Supplies, I saw a sample of clear urethane. Eureka, it looked like just what I needed. What's more, I was assured that it was a no brainer to cast, just mix the two components and pour into a rubber mold and the trinity of clear casters would be Hart, Wilkinson, and Parvin. Amen!

The first thing I did was sculpt a small torso which I optimistically titled "The Victor" anticipating my assured triumph. I constructed a rubber mold and poured in the urethane. The unexpected result was the first of many, the urethane did not set up and all I had for my "best laid schemes" was a pile of goo. Discussions with the supplier and manufacturer assured me that the most likely problem was that the silicone rubber mold probably contained formaldehyde which inhibits urethane. The solution was to heat the mold to 175 degrees Fahrenheit for 18 hours to drive out the culprit. There were two problems. The first was to convince my skeptical wife that using the kitchen stove for this purpose was somehow in her long term best interest. The second was that it didn't work and I became the owner of a second glob of goo. Back to the phone.

It was becoming obvious to me that the people whom I would have expected to know the answers didn't. The supplier and the manufacturer of both the urethane and the rubber were at a loss. I kept searching and finally got lucky. I discovered Terry McGinnis at BJB Enterprises a supplier of polyurethane and related products. Terry was the first person I had been able to find who was an authority on urethane. If I had not found him, the quest might have ended in failure with only two globs of goo.

What I found out was that there are two types of silicone rubbers, tin cured and platinum cured. I had been using the tin which is just fine for almost all applications except clear urethanes much prefer the platinum. The good news is that platinum only sounds more expensive, in truth, they are just equally expensive as tins. The bad news is that my supplier didn't have any platinum cured silicone rubber in stock and it was several weeks before I had a new mold ready to try again. It worked, the urethane cured just fine except that "The Victor's" surface was rough and covered with small raised lines. Back to Terry who informed me that the lines are called "worm tracks." He then asked the size of my creation. When I informed him that it was small, about 6x2x1 inches, he remarked that in the clear urethane world, that was a rather large casting. The surface roughness and the worm tracks were a result of shrinkage. What I needed was a slower setting urethane with less shrinkage. After my new material arrived, I tried again. Sure enough, the surface was just fine. In fact, it was so smooth that I could clearly see that "Victor #4" was full of bubbles. So far I had two globs of goo, some worm tracks, and a collection of bubbles. The quest was about to get much more interesting.

At this point, I contemplated the mysteries of life. I thought back to college and how I had sat through two years of chemistry (you know, rhymes with mystery) and a year of physics wondering all the while of what possible use these subjects would be. It was a comfort to realize that perhaps there is a purpose after all.

There are three sources for bubbles: air trapped in the mold, air captured in the solution due to agitation, and air dissolved in solution. (A fourth would be gases produced as a by-product of a chemical reaction which is not applicable here). The first of these is the easiest to control. Major problem areas in a mold are vented to allow the air to escape. Smaller areas can usually be accommodated by carefully tipping the mold during filling. Agitation from mixing or pouring into the mold produces the bubbles that are visible. If the solution has a long enough working time or "pot life" at least the

largest of these will rise to the surface and escape. Very careful mixing and pouring into the mold helps prevent these bubbles. The dissolved air presents a bigger challenge. Fortunately, as we shall see, the solution to this problem completely eliminates the remaining bubbles from the first two as well.

One of the characteristics of liquids is that they are capable of dissolving other substances including gases. This takes place on a molecular level and often the dissolved substance is totally invisible. Much of what is known about this phenomenon is attributed to Jacques-Alexandre-Cesar Charles (1746-1823) who being French was especially interested in hot air. What J.A.C. Charles would have told us is that the amount of gas that can be held in solution increases with pressure and decreases with temperature. Releasing the pressure from a container of carbonated drink causes fizzing, the bends results from nitrogen bubbles forming from rapid decompression, and bubbles will appear on the sides of a cold glass of water warming to room temperature. The setting up of urethane is an exothermic reaction. What had happened to my last "Victor" was that as it warmed up, bubbles formed which could not rise and escape because of the simultaneous thickening of the solution. Had I de-aired the urethane with a vacuum chamber, any existing bubbles would have enlarged (Boyle's law) and joining with air coming out of solution escaped the mixture leaving little or no air to form bubbles. And/or if I had cast the piece under pressure, the air would have stayed in solution. It is curious that reducing pressure and increasing pressure produce the same result.

I have noticed that there is some confusion about using vacuums as a casting tool. The general idea is that if you have a mold in a vacuum chamber, the casting material will be able to completely fill every nook and cranny. This is true with molten metals but not with most anything else. De-air the urethane in the vacuum chamber and then bring it back to atmospheric pressure, the urethane will have less air in the solution than it can hold. If you pour it into the mold in a de-aired state, no bubbles will form as the solution heats up. Also, any small bubbles that might be trapped in the urethane as it is poured into the mold should dissolve and disappear.

Pressure works in the same way only better. Casting under a pressure of only 50psi will not only insure that no bubbles form as the urethane heats up and will dissolve any bubbles trapped by agitation but will also force the urethane into every nook and cranny.

I was able to construct both for a total investment of less than $400.00. Both have served me well and are still used at least weekly. In addition, I have acquired another six pressure vessels including one large enough to climb into.

I was confident that the next "Victor" would be bubbles free, and it was. However, it was covered with little bumps as if she had the chicken pox. What I hadn't taken into account was that the rubber in the mold had not been de-aired and when pressurized, the tiny bubbles in the rubber collapsed causing dents in the rubber surface. I constructed a new mold only this time I de-aired the rubber prior to application and cured the mold under pressure. Since then, I have always de-aired rubber for any application and cured it under pressure when feasible. De-airing and/or pressure curing increases the rubber's density and extends the life of the mold in addition to reducing the number of bubbles on the mold's surface.

Back to the quest, I cast my first "Victor" that set up, had a smooth surface, and was bubble free. What I wanted next was a more highly polished surface. I tried several buffing compounds and quickly discovered that polyurethane is easy to melt if aggressively attacked. I was able to do only a fair job of polishing, not the end result that I wanted. In frustration, I abandoned the quest and pursued other interests.

Several years later, I was shooting the bull with my sculpture supplier and the conversation got around to polishing clear urethane. It was suggested that I try buffing compounds made for automobile finishes which are polyurethane paints. This rekindled my interest and I sculpted a new piece titled "Britton" with five flat surfaces and the figure hollowed out as a negative in the back surface. The paint polishing compounds work very well though it is extremely tedious. A piece no larger than "Britton" can take 15 to 20 hours to polish.

There were other problems. For example, some clear urethanes have a slight yellowishness. This can be compensated for by adding a drop of blue dye to the mixture. Careful, two drops in even four or five pounds of material will turn the casting blue. A continual concern is contamination which shows up as spots. I always work in a clean area and carefully filter the solution.

Loveland, CO, Mitch Meisner of Meisner Acrylic Casting approached me about producing my pieces in acrylic. I was skeptical for the reason stated earlier but decided to let him do one as an experiment. It is more expensive though not excessively so, the cost is comparable to casting a similar size figure in bronze.

I have no plans to try to cast acrylics myself. Mitch and I have discussed and compared the two materials. According to him, to be successful, one would need a definite knowledge of polymer science and some very expensive equipment. The learning curve is very long. He recalls that it took him over five years to get a decent casting and another three for a great one. From what I went through, I have no reason to doubt this.

There are some advantages to clear urethane compared to acrylic. For example, urethane can be cast in silicon rubber molds which can be very flexible allowing for more intricate forms than can be attained with acrylics which require a stiffer mold material. Urethanes are more receptive to dyes. But the greatest advantage for me is the ability to cast in my own studio. I have enjoyed the quest and will continue to experiment with and cast in urethanes. But for the production of editions of "Britton," "Emergence," Dancing With the West Wind," and others, I will leave it to the foundry.

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Sculpture Journal – January 2002