

Sculpting Media: An Overview

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The fact that there are so many different materials in which you can sculpt can be awfully daunting, especially for the new sculptor. “Which material should I use?” is one of the first difficult questions you face, and it is not easy to answer.

There are advantages and disadvantages to each of the materials in this document and though I’ve tried to be fairly comprehensive, there are certainly other materials and I’m sure I’ve missed aspects of the ones that I do discuss.

Unfortunately, the only real way to know for sure which modeling medium works best for you is to try them. This document will provide you with some basic information about the advantages and disadvantages of each one, which should enable you to make a more educated choice about which ones to try first, but ultimately, this is a very subjective choice and in many cases, it’s going to come down simply to which ones you like working with, which is something I can’t tell you.

Water Clay

The great-granddaddy of sculpting media is a naturally occurring substance called, simply, “clay”. However, because the term “clay” has become generic and is used to describe a wide range of modeling materials that are not actually made out of clay, it has become common practice to use the term “water clay” or sometimes “ceramics clay” to refer to traditional, good old-fashioned dug-from-the-ground clay. Technically speaking, there are several different types of water clay (about thirty in all), all of which are different combinations of silicon, aluminum oxides, hydroxides, and water. Clay manufacturers take these different types of clays and mix them together in different ratios, sometimes along with other additives, to create a stunning variety of different clay products that have different colors as well as different working properties.

When water clay is raised to a very high temperature, it undergoes a crystalline phase change that causes the clay to become very hard. At an even higher temperature, some or all of the clay *vitrifies*, which is a fancy term that means the silica in the clay turns into glass. Glass is not porous and does not hold water, but clay that has not undergone vitrification is porous and can absorb water, so the properties of the fired piece can vary tremendously based on the amount of vitrification that happens.

Because of these two heat-catalyzed reactions, clay, when fired to a high temperature in a kiln, becomes a very hard and permanent product. This is the primary reason that it has been used for so long to create both utilitarian and artistic products. Some of the oldest existing man-made objects are of fired clay.

Types of Water Clay

Although there are dozens of different kinds of natural clays, and even more formulas created by combining the different natural clays together, clays are generally classified into three broad categories based on how high of a temperature you’re supposed to fire them at. These three broad categories are *earthenware*, *stoneware*, and *porcelain*. If you’re not going to fire your sculpture, you are free to use whatever clay that you like best based on its feel and, perhaps, its color. But, if you’re going to fire the piece, then you need to consider the firing properties of the different types of clay. Although there are other factors, the essential thing for the figurative sculptor to keep in mind is that the higher the temperature you fire the clay at, the more risk you’ll face of having your sculpture break during the firing process and the more shrinkage you’re likely to see.

Earthenware fires at the lowest temperature and is the most common type of clay used in fired figurative sculpture. Earthenware undergoes almost no vitrification, and therefore does not take on a shiny surface unless you apply a glaze to it during the firing process¹. Because of this low level of vitrification, earthenware sculptures are more likely to survive the firing process than sculptures made of other types of clay when fired at their recommended temperature. Earthenware produces the softest product after firing, although fired earthenware is still a very hard and permanent substance. If you have ever seen terracotta pottery such as flower pots, you are familiar with fired earthenware. Earthenware clays come in a variety of colors from deep red to very light grey.

Stoneware can be fired at a higher temperature than earthenware and when fired to this higher temperature, it creates a stronger final form that looks like (and, in fact, essentially is) stone. Stoneware undergoes some vitrification during firing, and comes in a much narrower range of colors than earthenware; mostly shades of grey and brown.

¹ Glazes are typically applied after an initial firing. A piece of ceramic that has been fired once, but has had no glaze applied is called a “bisque”.

Porcelain fires at the highest temperature of the three types of clay. Porcelain contains very few impurities or additives and most of the silica vitrifies into glass during the firing process, giving the final product a glossy appearance even without the use of glazes. Because of the near absence of impurities, porcelain fires to a white color and is exceptionally strong, however it can be somewhat brittle due to the crystalline structure of the vitrified silica. It is somewhat rare, but not unheard of, for sculptors to work in porcelain clay directly if they intend to fire the piece, however it is a very common practice for sculptors to make a plaster mold of their original sculpture, and then *slip-cast* those molds in porcelain clay, which is then fired. This is the traditional way of making doll heads, as a matter of fact, and is still used by some high-end and collectible doll makers today.

Slip Casting is a way to create copies of an original sculpture. To slip cast, you make a mold of a sculpture out of plaster. That plaster mold is then allowed to dry completely and then “slip”, which is very watered down clay, is poured into the mold. The plaster of the mold absorbs water and a skin of clay forms on the inside of the mold. Once that skin becomes the desired thickness, the remaining liquid slip is poured out and the mold is left so the clay can dry. This creates a thin hollow copy of the sculpture that can be fired with less risk than firing the original clay sculpture. This basic technique is how many ceramic products are made.

It should be noted that it is generally inadvisable to fire a clay at a higher temperature than is recommended by the manufacturer, and there is little to no advantage in doing so. On the other hand, it is perfectly acceptable to fire clay at a lower temperature than recommended by the manufacturer. Earthenware can be fired at a very low temperature, such as cone 018, to produce a product (sometimes called *greenware*²) that is hard, but still soft enough to be sanded and cut. Both stoneware and porcelain can be fired to a lower temperature than recommended by their manufacturer, still creating a permanent sculpture while somewhat reducing the risk of breakage and amount of shrinkage during firing.

When dealing with fired clay (ceramics), you will often see the term “cone” used when referring to firing temperature. The term comes from a small cone of material that was traditionally used to shut off the kiln. These cones are inserted into a hole in the kiln and bend at a certain temperature. When the cone bends, the kiln switches off. The lowest temperature cones are preceded by a zero. Cone 022 (pronounced “oh-two-two” or “oh-twenty-two”), is the lowest temperature cone, melting at around a thousand degrees Fahrenheit. As the number gets smaller, the temperature gets higher, so cone 021 melts at a higher temperature than 022. That is true until you get to cone 0. The next cone up from cone 0 is cone 1 (with no zero before it). When you are dealing with cones that are not preceded by zero, the situation is reversed and the temperature gets higher as the number goes up, with cone 10 being the highest, and the temperature at which porcelain is usually fired.

Although today, many kilns are shut off by computerized controls, we still use the term “cone” to refer to the temperature ranges when firing.

The term “greenware” can be a little confusing because it has two similar but different meanings. The dictionary definition of the term is that it is “unfired pottery”, however some people also use the term greenware to refer to slip-cast clay that has been fired no higher than cone 018, which results in a hardened, but still soft product: one that can be sanded, cut, and smoothed. It would be incorrect to refer to an unfired original clay sculpture as greenware, regardless of whether it had been fired. Because of the imprecise use of the term in the vernacular, I generally avoid it completely.

Additives to Water Clay

Two common additives to clay are sand and *grog*, and often clay is said to have a “sculpture body” if it has one of these two additives. Sand is exactly what you think it is: that stuff you burn your feet on at the beach each summer. Grog is simply clay that has been fired and then ground up very fine. Grog and sand do the same things for clay: they give the clay some texture (often call “tooth”) and they also reduce shrinkage and breakage during firing. Grog is more expensive and more effective at reducing shrinkage than sand, but creates a coarser texture.

It should be noted that just because grogged clay is described as a “sculpture body”, that does not necessarily mean that you want to use grogged clay for all of your sculptures. If you are going to fire your sculpture, then you might want to consider using a grogged clay, however, the benefits of grog come at a price. It is virtually impossible to get a grogged clay to have a perfectly smooth surface because of the tooth it gives to the clay. You can fire the sculpture to a low cone, then sand and smooth the surface, and re-fire at the recommended cone, but even that won't give you a perfectly smooth finish with a grogged clay.

² Some people use the term “greenware” differently, and feel that calling a fired piece “greenware” is incorrect. See sidebar on this page for a clarification of the two common but contradictory uses of the term “greenware”

Some people will tell you that you can't fire a sculpture made of ungrogged clay because you will have sections that are too thick to fire without breaking. This is conventional wisdom, but it is not completely correct; sculptures of ungrogged clay can be fired successfully, it is just harder and a bit more risky. If you use a low-fire earthenware clay, do a good job hollowing³, allow your sculpture to dry completely (it should not be cool to the touch), and raise the temperature in the kiln very slowly, you can successfully fire sculptures made out of ungrogged clay.

Working with Water Clay

Water clay can be worked with fingers or just about any kind of bought or made tools. You can use tools made out of almost any material, including wood, metal, and plastic, because clay is non-reactive, and you do not need to treat or prepare your tools or do anything special to them. The one quirk of water clay that really defines sculpting with it is its tendency to dry out over time. When you first open a bag of clay, it is very *plastic*, (soft and malleable). As the clay sits out exposed to air, the water in it will begin to dry out. As it dries, the clay will become less and less plastic and take on a different feel. This is an advantage and a disadvantage at the same time. On one hand, drier clay needs less support and can take crisper edges and more subtle textures. On the other hand, it means that if you don't take steps to prevent the clay from drying out, you will have a limited amount of time to work your clay before it becomes too hard to model.

Fortunately, you have a lot of control over how fast water clay dries. You should keep a spray-bottle filled with water in your studio and when you feel the clay getting dry, give it a squirt. If your sculpture becomes too dry to work, you can take wet paper towels or wet washcloths and wrap the sculpture in them and cover it with plastic. After a day or so, the clay will absorb the moisture from the towel or washcloth and become soft again. If it's still not soft enough, simply repeat the process until it is.

If your sculpture becomes too wet to work, you can simply leave it exposed to air for a while and it will dry out and firm up. You can speed the drying process using a hair dryer, heat gun, or blowtorch.

When you're done sculpting for a while, it is important that you cover your sculpture with a plastic bag. Unless you want a small amount of drying to occur (which you often will, since drier clay takes details better), you should spray your sculpture down well with water (or better yet, a weak bleach solution to stave off fungus and mold growth) before you cover it. As long as you periodically spray your sculpture and seal the plastic bag tightly, you should be able to keep working on it for weeks or months without any problem whatsoever.

Finishing Techniques

Generally the only solvent you will use with water clay is water. Water can be used with brushes to give a smooth finish or to make the surface of the clay softer and better able to take impressions. A large number of materials can be used to texture water clay while it is still wet, including sponges and stencil brushes. You can also use everyday objects to create textures, such as the peel of an orange to create a skin-like mottling. Part of the fun of sculpting is discovering new objects that can be used to lend texture to your piece.

If you intend to fire your clay, you should actively stay away from any kind of solvents other than water, as you do not know what kind of residue it might leave behind or what that residue will do in the kiln.

After clay has been fired, you can do some limited "dry" techniques, such as sanding, if you fire to a low cone. At higher temperatures, the fired clay becomes very hard and brittle and pretty much impossible to work. Generally speaking, you should use dry techniques very sparingly with fired clay and try to get the finish right before you fire the clay if at all possible.

Fired clay sculptures can be painted or given a *patina*.

A patina is a surface treatment for a sculpture. Originally, patinas were created on bronze sculptures by applying oxidizing agents along with heat. Although this is still true, in modern use, the term has become more generic and is used to describe any surface treatment you give to any work of sculpture regardless of what the sculpture is made of.

Pretty much any surface treatment that is applied to the entire sculpture or at least large portions of the sculpture can be correctly referred to now as a patina. Techniques that involve applying different colors to specific parts of the piece, like painting, are generally not considered to be patinas.

There are many ways of giving a fired clay sculpture a patina using ingredients such as shoe polish and wax, and there are now also a large number of commercial patinas that simulate stone and wood as well as those that simulate real bronze patinas.

³ Hollowing a sculpture involves removing clay from the middle of the sculpture to create a hollow piece. In some cases, you can hollow a piece from the bottom, in other cases (such as with portrait heads), it becomes necessary to cut the head apart, hollow it out, then fuse the two pieces back together. In general, you should try to hollow your piece as thin as possible—to less than an inch if you can—without affecting the structural integrity of the piece.

When You're Done

Water clay, as we've mentioned, can be fired and turned into a permanent sculpture. Unfortunately, this requires access to a kiln and there's some risk of having your sculpture break. In most areas, you will be able to find a pottery or ceramics studio that might be willing to fire your sculpture for you, but be forewarned that most ceramics studios will not be used to firing original sculptures which need to be fired differently from other types of pottery and ceramics. Many such studios will refuse to fire your work for you because of the risk of damage to other pieces in the kiln (or the kiln itself) if your piece doesn't survive the firing process.

If you are going to fire your sculpture, you should hollow it out to minimize the chance of it breaking, and you must be sure that you don't have any foreign objects mixed in with the clay, otherwise it will explode in the kiln, which not only destroys the sculpture, but can damage the kiln and other pieces fired along with it. Remember that there must be no bits of plaster or other materials in the clay, and you must not use an *armature*.

An armature is a type of internal support for the sculpture usually, but not always, made out of metal.

If you don't have access to a kiln or simply don't want to fire your sculpture, you can always make a mold of your water clay sculpture when you're done.

The Final Word

Water clay is a great sculpting medium. It is the least expensive medium we'll cover, and it's readily available and comes in a wide range of colors. It can be fired to make a permanent sculpture, and you can control the consistency of the clay by controlling how fast it dries out. You can use any tools you want to work with water clay, and do not need to do anything special with it other than keep it moist and covered. It is also non-toxic and almost completely devoid of health risks, although dried clay dust can cause minor respiratory problems, so it is advisable to wear a respirator while sanding or filing fired or unfired clay.

There are some disadvantages to water clay, however. Kilns are expensive and firing sculptures is an art in and of itself; even experienced sculptors occasionally have a piece shatter in the kiln (sometimes taking out other pieces with it). It's also necessary to let water clay dry for weeks before firing, so it's not the best choice for the impatient sculptor or when you need the final product quickly. Because water clay's plasticity depends on the amount of moisture in it, metal tools and other metal objects in your work area will be prone to rusting due to constant exposure to water unless you are diligent about drying them when you're done sculpting. Finally, water clay is the heaviest sculpting media we'll talk about and even a medium-sized water-clay sculpture will be quite heavy.

Oil Clay

Oil clay is a substance that goes by many other names including *oil-based clay*, *modeling clay*, *plasticene*, and *plastilina*. Oil clay is made of exactly the same natural materials as water clay, except that the water has been replaced with other substances, usually a combination of waxes, oils or greases. The key difference between oil clay and water clay is that oil clay does not dry out, no matter how long you leave it. You don't need to cover your oil clay sculptures between sessions and you don't need to be constantly spraying your sculpture with water.

There are a number of manufacturers of oil clay including Chavant, Roma, Kleen Klay (which is typically used more in mold-making than in modeling), Jolly King, and AMACO. Historically, oil clays contained sulphur which can irritate some people's skin and can affect the curing of certain types of mold-making silicones, so nearly all companies now sell sulphur-free oil clays also. It is also possible to mix up your own oil-based clays. There are a number of recipes which you can find easily by doing an Internet search.

Since you can't control the consistency of oil clay by adding water or letting it dry out, you might think that oil clay is less versatile than water clay, but that actually isn't true. You can change the consistency of oil clay simply by changing its temperature. At room temperature, oil clay is generally harder than fresh water clay (although oil clay is available in several different hardnesses, so this isn't always true), but if you warm it up, it becomes softer and more malleable. Conversely, if you cool it down, it becomes harder and can take fine details and crisp edges more easily. This gives you quite a bit of flexibility, and you can change the consistency of oil clay fairly rapidly by applying heat or cold to it.

Prepping Oil Clay

When you first start blocking out a new sculpture, you generally want your clay to be very soft: softer than most oil clays are at room temperature. As a result, it is common for sculptors who work in oil clay to have some way of warming their clay before they begin. You can use a microwave, light bulb, crock pot, or a special warming cabinet to soften up your clay, although most sculptors simply line a cardboard box with aluminum foil, cut a hole in the top, and shine a 60-watt light bulb into the box, which is inexpensive and works just as well as fancier and more expensive options.

Other than getting your clay to the right temperature, there really isn't much you have to do with oil clay before you can start working with it, although it is important to condition your clay after it has warmed up by kneading it for a few seconds in

your hand. Be careful: sometimes oil clay can get hot enough to burn you, and sometimes it heats inconsistently, so even if the outside is only warm, the center could still be molten.

Working with Oil Clay

Oil clay works very much like water clay, although many oil clays do have a slightly different feel. Oil clay comes in a number of different hardnesses, with the softest being very much like water clay when it first comes out of the bag, and the hardest working more like a tooling wax. The defining characteristic of oil clay is that any given type of oil clay will have the same consistency and texture at the same temperature and it will never dry out. This makes it one of the favorite media of many fine art and commercial sculptors, although the fact that it cannot be made permanent makes it considerably less popular among hobbyist and sculptors who create one-of-a-kind works for sale.

Another nice thing about oil clay is that you can always alter the working consistency of the clay by either raising or lowering the temperature. You can raise the temperature using a heat gun, alcohol torch, light bulb, or butane torch, or you can choose to heat up your tools if they're made of metal for a more localized and less dramatic effect. You do need to be careful not to overdo the heat, as you can easily lose detail that you spent a lot of time creating if you have too heavy of a hand applying heat. You can also cool down a section of oil clay by taking a can of compressed air (the kind that are commonly sold in electronics stores), holding it upside down, and spraying the propellant onto the section of the sculpture that you want to cool down. Doing this creates a harder, carve-able consistency that's great for getting crisp edges and doing subtle texturing effects.

You can mix different hardnesses and even different brands of oil clay together in the same sculpture. In fact, it is a fairly common practice to use a harder clay for areas that require more detail, such as the face or hands of a sculpture.

Finishing Oil Clay

Most of the finishing techniques from water clay also work on oil clay. Raking the surface with rakes and loop tools works well. The one thing that doesn't work for smoothing or softening oil clay is adding water. There are, however, alternatives. First, you can use heat, as mentioned. An alcohol torch works really well for this, since it allows you to apply a small amount of heat in a very precise manner to a selected area of the sculpture. You do need to be careful, however, as once you've melted the oil clay, you can't get back the detail that was there before you melted it, and alcohol torches and heat guns get hot enough to melt oil clay very quickly.

You can also use certain solvents on oil clay the way you would use water to smooth water clay, and using a solvent with a paint brush is a common finishing technique when a very smooth surface is desired. The two most commonly used solvents for oil clay are baby oil and rubbing alcohol (90% or higher, the higher the better), although there are others including lighter fluid, white gas, mineral spirits, and paint thinner. Baby oil is the safest choice; it's the only solvent on that list that isn't flammable and doesn't give off fumes. Unfortunately, it is also the least aggressive solvent of the bunch, so there will likely be times when you need to use one of the other solvents on your oil clay sculpture to obtain the desired smoothness. If that's the case, make sure you do your work in a well-ventilated area and away from open flames. And keep a fire extinguisher in your studio. Seriously.

When You're Done

The biggest drawback to oil clay is that it cannot be made permanent. If you put an oil clay sculpture into the oven or a kiln, you will end up with a puddle of scorched ooze. In most situations, this is not the desired outcome. An oil clay sculpture will keep indefinitely as long as you keep it from getting too warm, so there's no problem if you want to hang on to your sculpture for a while, but just keep in mind that oil clay will always stay soft and can be damaged. If you really want to keep an oil clay sculpture, you should be prepared to make a mold when you're done sculpting.

The Final Word

Oil clay is quite a bit more expensive than water clay, but using it obviates the need for covering your sculptures and keeping it moist between sculpting sessions, which makes it far more convenient. There is however, more set-up involved with oil clay, since you need to make sure your clay is warmed up before you begin. Oil clay is very well suited to sculpting projects that will be worked on over a long period of time. Unfortunately, the only way to make an oil-clay sculpture permanent is to make a mold, and most good mold-making materials are rather expensive, so it's not generally the best medium if you're looking to make a single one-of-a-kind sculpture. For many projects, though, where the sculptor expects to make a mold, oil clay is the ideal balance between cost and convenience, and many sculptors really like the feel of oil clay and the amount of control it allows.

WED Clay

WED Clay is a rather unusual and somewhat obscure medium, but one worth mentioning since it is very common in a couple of sculpting niches. It's not exactly water clay, and it's not oil clay, either, but it is another natural clay product. You will

sometimes see statements that WED is an acronym that stands for “**W**ater-based **E**xtended **D**rying” or some similar nonsense. What WED really stands for is Walter Elias Disney, and comes from the fact that it was originally formulated by WED Enterprises, which was the original name for what is now called Disney Imagineering.

When the Disney Imagineers were creating the various Disney theme parks, they needed a clay for creating very large outdoor sculptures: a clay that wouldn't dry out as quickly as regular water-based clay due to the impracticality of completely covering the large sculptures that they needed to create when they weren't working on them. Oil clay would have been impractical given the high temperatures much of the year in Southern California and Florida. After some experimentation, they formulated a clay that met their need by taking stoneware water clay and replacing some of the water with glycerine. Since glycerine does not evaporate like water and is only slightly more viscous, the result is that it slows down the drying process considerably while still giving a very workable product. WED Clay will dry out as the water evaporates, but it does so more slowly than regular Water Clay.

Working with WED Clay is nearly identical to working with Water Clay; you use the same tools and finishing techniques, and can change the consistency by adding water or allowing it to dry (which will obviously take longer). One thing to note is that you do have to contend with a certain stickiness in WED Clay that comes from the glycerine. WED Clay can be fired, but it's not recommended. It won't melt into a puddle the way oil clay will, and I have heard reports (that I cannot confirm myself) that WED Clay does actually harden when fired, but the manufacturer (Laguna Clay) strongly advises against firing it and recommends that it be used only when you're planning on making a mold of the final sculpture. As a result, WED Clay has many of the disadvantages of both water clay and oil clay. It's not a great choice for many sculpting projects, but it is the best choice for some projects, especially large-scale ones being done outside the confines of a studio.

Paper Clay

I have no first-hand experience with Paper Clay, so if you've used paper clay and wish to correct or expand this section, please send me an e-mail at isculpt@isculpt.org.

Paper clay is another natural clay product made by taking water clay and adding cellulose fibers to it. The most common form of cellulose that is added is paper, hence the name. Paper clay is intended to be fired just like water clay, however the cellulose fibers burn off during the firing process, leaving small holes in the clay, resulting in a lighter final product and often giving a very interesting finish to the sculpture.

Paper clay has some advantages over regular water clay. The cellulose gives the clay more substances, and especially when it starts to get dry, can be used to create shapes that would require an armature in water clay. Sculptures that are thinner and larger can be made in paper clay when compared to working in water clay without the use of an armature or other supports.

The primary downside to paper clay (which, incidentally, is viewed as an advantage by many artists) is that there is a certain unpredictability to it. The final product that comes out of the kiln will differ from the original sculpture in ways that are impossible to fully predict.

Paper clay is a relatively new and still-evolving field, and unfortunately, an in-depth exploration of the properties of paper clay is beyond the scope of this article.

In a bit of confusing marketing, you may come across a modeling material called Paperclay®. This product is not paper clay but is, in fact, an air dry clay.

Air Dry Clay

Air-dry clay is the first medium we'll talk about that doesn't actually contain real clay. If you want to be picky about it, it's probably more accurate to describe these products as “air drying modeling compounds”, and a few materials are actually sold under that or a similar product description. In the vernacular, though, these products are almost always referred to as “air dry clays”. These products are also sometimes called self-hardening clay, although that term is also sometimes incorrectly applied to polymer clays, so to avoid confusion, we'll stick with the term “air dry clay”.

The defining characteristic of these products is, as you can probably guess, that they harden when exposed to air. In some cases, this is due to an oxygen-catalyzed chemical reaction, but usually it is simply the result of a solvent drying. These products come sealed in a plastic or mylar bag, and from the moment you open that bag, they begin to harden. The length of time, working properties, and final form vary greatly from product to product. You won't find a large percentage of serious sculptors working with air-dry clays on a regular basis, but they can be fun change, and there are some serious artists who really like certain of the air dry products. As a general rule, many of these are marketed to children and to grade school educators and aren't considered “serious” sculpting media although, of course, in the right hands, any medium can be “serious”.

The greatest advantage of these products is that they require no equipment or tools to become permanent; they simply need to be exposed to air. The downside is that you have a limited working time with them, and in most cases, once they have hardened, there is nothing you can do make them soft again. Many air-dry clays, when still malleable, do not stick well to dried clay, so with many of these substances, you need to be able to finish your complete sculpture within the hardening time for the medium, although there are some types of air dry clay that can be used to build in stages.

Waxes

Waxes are another of the traditional modeling media. Originally, waxes were all organic products produced by bees, but the term “wax” is a rather vaguely term that has come to mean pretty much any substance that has properties similar to beeswax. As a result, there are now many kinds of waxes that come from a wide variety of different sources, including other insects, petroleum (such as paraffin and microcrystalline waxes), or plants (such as carnauba wax, which comes from the leaves of a palm tree). There are also several types of chemically synthesized waxes.

The defining properties of waxes are⁴

- ★ They are malleable at room temperature;
- ★ They have a low melting temperature, usually around 110° - 115°F (although it can be a fair bit outside this range);
- ★ They are insoluble in, and resist water;
- ★ They have low viscosity (in other words, are very thin and water-like) when melted

Most sculpting waxes today are combinations of several different types of waxes, sometimes mixed with other ingredients to alter the feel, color, or other properties of the final product. Like oil clay, the consistency of waxes can be changed by applying heat or cold. Although wax is a less common modeling tool than water clay, oil clay, and polymer clay, it is widely used in several industries, especially in the sculpting of toy prototypes and collectibles, and many sculptors who work in wax feel very strongly that it is the best medium possible.

Of all the materials we discuss here, wax is probably the most difficult to get started with. It has a substantial learning curve, and tends to work more slowly than the other media we discuss, especially in the early build-up stages. Many sculptors are more than happy to put up with this, however, because wax has some really nice properties later. First and foremost is that it can hold tremendous detail and can be finished to a glass-smooth surface. Second, all but the softest waxes are strong enough and light enough at room temperature that an armature is often not necessary. This fact alone gives a lot of freedom to change the sculpture late in the game, and means that you are less likely to be haunted by mistakes made early on. Additionally, you can cut apart and re-join wax components very easily simply by warming the wax where the pieces meet.

It's difficult to generalize too much about waxes, because there are many different wax “recipes”. The consistency and feel of waxes at room temperature can run from hard enough to carve to soft enough to model with regular sculpting tools. This variety means that most people can find a wax they like for most purposes, but the new sculptor should be aware that it can be a frustrating first medium, especially if you do not have a wax-savvy mentor to guide you through the process.

Working with Wax

Although most waxes have a very different feel from oil clay, the two substances have a lot in common in terms of how they are worked. Like oil clay, you must warm all but the softest grades of wax before you can work with it. With most waxes, it's also important to use metal tools, especially after the wax has cooled, and to heat your tools before use. Wax can be worked with just about any kind of tools you have, but because of the ability of steel to conduct and hold heat, most sculptors who work with wax primarily use stainless steel tools called wax carvers along with cast-metal loops (as opposed to wire ones, which also work but don't hold heat as well). One thing that sets wax apart from the various clays is that by cooling wax, you can carve it, which allows you to get crisp edges and sharp details.

Finishing Wax

Again, like oil clay, you can smooth the surface of wax by applying heat from an alcohol torch, heat gun or butane torch, but you must be, if anything, even more careful not to accidentally destroy hours of work by applying heat too liberally. You can use many of the same solvents to smooth wax that are used for smoothing oil clay (alcohol, baby oil, mineral spirits, lighter fluid), and wax also responds very well to sanding, especially with warmed sanding sponges.

When You're Done

Wax is another sculpting medium that does not create permanent pieces. Generally, if you're sculpting in wax, you should be prepared to make a mold when you're done. Wax will keep indefinitely as long as its temperature is kept well below its melting point, but it will never be truly permanent unless you duplicate it with some kind of mold. One great benefit to wax when it comes to making a mold of your piece is that wax is a natural release agent, so with most mold materials, you will not need any form of release or lubricant except where the parts of a multi-part mold meet.

The Final Word

Wax is a great medium for doing fine detail work, but can be somewhat slow to work with and does have a steeper learning curve than the other modeling media discussed in this document. It is not a good choice for creating one-of-a-kind sculptures

⁴ see also <http://en.wikipedia.org/wiki/Wax>

because it can't be made permanent, but it holds great detail and can be finished to a glass-like surface. It's the only medium in this book that can truly function as either a modeling medium or as a carving medium (though harder oil clays, when cooled down, do take on some of the same properties). Wax is versatile, and there are many companies that will only give commissions to sculptors who are capable of working in wax. It can be, however, a trying medium to learn, and it works best with a narrower range of tools than the other media we've discussed.

Polymer Clay

Polymer clay is widely available substance that is sold under a number of brand names, including Sculpey, Fimo, ProSculpt, and Cernit. Polymer clays generally do not contain any of the natural organic materials that constitute traditional water clay, but rather are made primarily out of a synthetic material called polyvinyl chloride (PVC), which is a common material used to create many plastic and vinyl goods. The other primary ingredients of polymer clays (other than those used to add color and texture) are liquid plasticizers that make the PVC malleable and clay-like.

Polymer clays are one of the most popular and readily available modeling materials and come in a wide array of colors from a number of different manufacturers. Although there are considerable differences in the texture and feel of different brands of polymer clays, they are all chemically similar substances and clays from different manufacturers can generally be blended together without adversely affecting them

The primary reason for the popularity of polymer clay is the fact that they can be "fired" in an ordinary kitchen oven at relatively low temperatures. This makes polymer clay a more accessible medium than those that require a kiln or the ability and willingness to make a mold. Polymer clays can be used to create one-of-a-kind sculptures with very little in the way of specialized equipment.

An additional benefit of polymer clay is that they tend to dry out very slowly. Although, unlike oil clay and wax, polymer clays will eventually dry out as the plasticizers evaporate, those plasticizers dry out much more slowly than water. Unless there is something porous in contact with the polymer clay, such as paper or cardboard (which will cause the plasticizers to leech out), you can generally expect at least several months of working time with polymer clays even if you take no precautions such as covering your sculpture between sessions. With minimal precautions, the working time of polymer clays is virtually indefinite.

There are a few disadvantages to using polymer clays, however. The first, is that polymer clays tend to be more expensive than the other media we've discussed. The price of polymer clays can vary greatly depending on brand and where you purchase it, but generally speaking, it is probably the most expensive media we cover in this chapter⁵.

There are also some potential health risks with polymer clay, although there is some dispute as to how severe those risks are. If you bake polymer clay at too high of a temperature for too long, it will release hydrochloric acid in gaseous form. In most instances, this will be an irritant and nothing more, however in larger quantities it can be a serious health risk, so it is important not to exceed the manufacturer's recommended temperature, and keep in mind that kitchen ovens are not precision instruments, and the temperature inside your oven can vary from the temperature you set by as much as 50°F. Additionally, most, if not all, of the brands of polymer clay use a combination of chemicals called *phthalates* as plasticizers. Many of the phthalates that are used are known human carcinogens; most of the others are suspected carcinogens. It is nearly impossible to work with polymer clays and completely avoid exposure to phthalates.

The industry groups that represent the manufacturers of polymer clays claim that their products are non-toxic and perfectly safe, and have commissioned studies(need citation) to prove that the exposure levels from their products are low enough to pose no meaningful risk when used according to the instructions on the packaging under normal conditions. There are other non-industry sponsored studies (need citation), however, that have concluded that polymer clays are not quite as benign as their manufacturers claim, and point out that the "Non-Toxic" seal applied to their products are self-applied by the manufacturer with no regulatory oversight and based on safety guidelines set out in the 1970s, long before the health risks associated with PVC or phthalates were even suspected.

So, what's the bottom line?

Unfortunately, right now, we just don't know. There is evidence of a number of health risks linked to both PVC and phthalates, but there has been no conclusive finding about how substantial those risks are from using polymer clays under ordinary conditions. My recommendation is that if you're going to use polymer clays, take some simple precautions, such as not eating or drinking where you sculpt and making sure that any items or tools that you use with polymer clay are not also used in any way during food preparation or service.

Although some people will disagree with this, I also advise baking at a lower temperature than the manufacturer recommends. Generally, the manufactures instruct you to bake at 270°F and claim that there is no danger until 360°F.

⁵ Some of the epoxies are actually more expensive by weight, but these are generally epoxies that are intended for use creating very small sculptures.

While it is true that under ordinary conditions Hydrochloric acid is not released in substantial quantities until you reach 360°F, of the phthalates volatilize at less than 300°F, and the higher temperature you bake at, the higher concentration of phthalates you'll be exposing yourself to. Polymer clays will harden fully as long as the temperature of the clay (all of the clay, not just the outside layers) gets above about 211°F, so I recommend using an oven thermometer and baking at 225°F for at least two to three times as long as the manufacturer suggests, then turning off the oven, but leaving your work in the oven to cool down slowly as the oven does; the slow cooling will minimize the chance of cracks and also provide additional hardening.

This approach minimizes your chance of exposure to hydrochloric acid and also keeps the concentrations of the free-radicals from the phthalates in the air down while still giving you a fully-hardened product.

Make sure you have good ventilation both where you sculpt and where you bake.

Working with Polymer Clay

Before you start working with any polymer clay, it's important that you *condition* the clay. Conditioning the clay is accomplished by kneading the clay for several minutes to work the plasticizers through the PVC. If your clay is older and too crumbly to work properly, you can purchase liquid softeners from manufacturer of your clay (usually called something like "clay softener" or "diluent", it's simply the combination of plasticizers used in your clay) and work some of this into the clay while you are conditioning it. It is important that the clay be thoroughly conditioned before you start sculpting with it. Conditioning clay manually will make your hands extremely tired because it takes a lot of kneading to get polymer clay properly conditioned. As a result, nearly all serious polymer clay artists use a pasta machine to make conditioning their clay faster and easier. Make sure you don't use the pasta machine for actually making pasta once you've used it to condition clay, however!

One trick that you can use to make sure that your clay is completely conditioned is to take equal amounts of two different color clays and knead until you've got a single consistent color. This won't work for you if you've bought and intend to use specific colors in your final piece, but it is a good way to easily tell if your clay is ready to be used. If you are conditioning a single color, make sure you err on the side of over-conditioning rather than under-conditioning.

If you're not using the color of the polymer clay in your final piece, it's a good idea to use (or create) a neutral color clay for sculpting, such as grey or dark green. The translucent pink and tans that many polymer clays come in (which are designed to give a good simulation of skin) make it very difficult to see surface imperfections that will stand out when the piece is later painted or when a mold is made then cast. If you intend to use one of the translucent clays without painting, you will have to be aware of the fact that it is hard to gauge the surface smoothness and make sure you periodically rotate your sculpture under a strong directional light, which will help make the imperfections stand out a bit better.

Many sculptors have a specific blend of polymer clays that they usually use, and they mix the different components in small batches when they're ready to sculpt. These recipes are usually designed to create a good neutral color and help ensure that their clay is always fully conditioned and as fresh as possible.

A common clay blend is:

*1 box (1 lb) Super Sculpey
1 package (2 oz) Sculpey III White (**not** transparent)
1/2 package (1 oz) Sculpey III Black*

Some sculptors use FIMO instead of Sculpey III for the white and black components, and some people vary the proportion of the components. There is, of course, an endless variety of polymer clay blends that you can use, but this is a common one that yields a color and texture that many people like.

A similar formula that is becoming popular is to mix Super Sculpey (the translucent pink compound) with Super Sculpey Firm (the newer grey compound). I've seen either a 50/50 or a 70/30 mix (using more Super Sculpey and less Super Sculpey Firm) recommended. You should feel free to experiment with mixing different clay to find a color and consistency that works well for you.

You can alter the consistency and firmness of polymer clay to some degree by changing the amount of plasticizer in the product. To make a softer clay, you can add additional clay softener during conditioning. To make a firmer clay, you can leech out plasticizers by laying rolled out sheets of the clay between sheets of paper and leaving over night. Be careful: firmer clay can become crumbly and hard to use, but if you use too much softener, the clay can become mushy and difficult to use for details.

Unfortunately, once you've added clay to your sculpture, your ability to change the consistency is somewhat hampered. You can use paper towels to leech plasticizers out of your sculpture, and it is possible to add softener to the surface clay, but as a

general rule, you should get the clay to the desired consistency before you apply it, trying to predict where you'll need firmer clay (such as for the face and hands) and where you'll want it softer.

Almost any tools will work with polymer clays. It is not uncommon to see people working with metal, wood, or plastic tools of just about any sort. You can use just about any store-bought sculpting tool, and many sculptors make their own tools.

Finishing Polymer Clay

Polymer clay is water resistant, so you can't smooth it by adding water. You also can't change its consistency using heat, as applying heat to polymer clay begins the process of hardening, and if you use an open flame, you can actually scorch or burn it and release hydrochloric acid in the process. So, what finishing techniques can you use with polymer clays?

Well, of course you can use any tool-based finishing technique, such as raking the surface with loop tools, and you can get a fairly even surface just using your fingers to smooth the clay. There are also a number of solvents that you can use to get an even smoother surface than tools or fingers alone can get you.

One thing you can use for this purpose is clay softener, although it will be absorbed by the surface clay and make the clay permanently⁶ softer, which is often not what you want in the later stages of sculpting. Instead of clay softener, you'll usually find sculptors using isopropyl alcohol (90% or better), mineral spirits, or turpenoid (an odorless⁷ substitute for turpentine sold as a brush cleaner and paint solvent). Isopropyl alcohol is the least aggressive of the three, and it evaporates quickly leaving little residue. Turpenoid is more aggressive than alcohol, but it tends to take longer to dry, leaving the surface of your sculpture soft for a day or longer. Mineral spirits is the most aggressive of the three commonly-used smoothing solvents, and it also leaves the surface of your clay somewhat soft for a couple of days. Be careful not to try and do detail or texturing work too soon after smoothing with solvent, as the softened clay will not hold detail well at all and will be mushy. With the exception of clay softener, all of these solvents will evaporate and your clay will return to its original consistency, but it takes some time for this to happen. I generally plan to do any solvent-based smoothing at the end of a sculpting session so as to avoid the problems associated with the clay being too soft.

Polymer Clay, after it's been fully hardened, can also be finished using a number of dry techniques such as sanding and buffing. Fine grit sanding sponges seems to be the most popular tool for dry-smoothing, although steel wool, metal files, sandpaper are also used effectively by some sculptors.

When you're done, you don't have to be done. That is to say, polymer clay can be baked multiple times. You can add more soft clay to clay that's already been hardened and re-bake it. You can bake a portion of your sculpture, sand it, then continue adding new parts. You can drill and file the hardened clay, and can use a wide variety of epoxies to attach new parts to old. Many sculptors do multiple bakes as a standard part of their work process.

When You're Done

Polymer clay does give you a tremendous amount of flexibility. You can bake your sculpture to create a one-of-a-kind work of art. Hardened polymer clay can be painted with brushes or using an airbrush, and you can apply any number of surface treatments such as commercially produced patinas. You are, of course, also free to make a mold of polymer clay sculptures and create reproductions just as you would with other media.

Since polymer clays are baked at such a low temperature, you can use a wide variety of materials to make an armature, or even as part of your sculpture. Wood, metal, cardboard, and even many plastics can safely be heated up to the temperature at which polymer clay hardens.

The Final Word

Polymer clays are popular among many sculptors, and not without reason. Although polymer clays are somewhat more expensive than other sculpting media, that additional cost buys you a lot of convenience. Polymer clays are readily available at hobby and craft stores, and come in an assortment of colors. It can be baked in your oven and becomes permanent and quite hard. There are some potential health risks associated with polymer clays, the extent of which is not clear, but it appears to be quite safe if some basic precautions are followed.

Epoxies

Epoxies (or *thermosetting epoxide polymers* if you want to be technical about it) are a category of materials that come in two parts (a *resin* and a *hardener*) that, when mixed, harden into a solid. The vast majority of epoxies sold to consumers are sold as liquid or gel adhesives or as putties used to patch or seal holes or fix dents. Bondo is form of epoxy putty that many people

⁶ Okay, it's not truly permanent, but the plasticizers evaporate slowly enough that for practical purposes, it's going to take too long to firm up on its own, so it's best to think of it as "permanent".

⁷ Because turpenoid has no odor does not mean there are no fumes, so make sure you use any solvent other than water in a well-ventilated room.

are familiar with that is used for fixing dents and holes in car bodies. Most of the epoxies that you will come across are not suitable for sculpting, although several of them can be useful in creating armatures or repairing broken sculptures. The bulk of consumer-targeted epoxies either set too fast, or are difficult to work to work to be good for sculpting

There are, however, epoxy-based sculpting media available through art supply and some specialty shops. Milliput, Apoxie Sculpt and Apoxie Clay, Tamiya, Kneadatite Blue / Yellow, Kneadatite Brown / Aluminum, Kraftmark ProCreate, and Magic Sculp are all example of sculpting media that are epoxies. Like polymer clays, all epoxies are chemically similar, however there is an even greater range of working properties among the various epoxy-based sculpting media than there is among polymer clays. In fact, there is such a broad range of properties, that it is hard to generalize about sculpting epoxies at all.

Most kinds of sculpting putties come as two different colored components. Usually both components have a similar consistency and they are mixed together—usually in approximately equal parts—to begin the chemical reaction that will cause the product to harden. Once the two components are mixed together thoroughly, which you can typically determine by the fact that you have a single, consistent color, an irreversible chemical reaction begins and you have a limited amount of time during which the mixed components will be workable.

Unlike most air dry clays, most epoxies, once mixed, will readily stick to cured putty, so you do not have to do a complete sculpture in a single session. You can always mix up more putty and stick it to the existing sculpture, although learning to sculpt only part of your piece at a time can be hard to get the hang of.

Notice that I used the word “cured” there. Epoxies do not dry, they cure. They undergo molecular changes that cause them to harden, a process that will happen even under water. The working time of the epoxy will vary based on a number of factors, the most important of which is the temperature. The warmer it is, the faster the epoxy will cure. This trait can be used to speed up or slow down the curing of the epoxy by applying heat or cold to it, but even putting mixed putty in the freezer will not completely stop the chemical reactions that cause it to harden.

Epoxy putties appear to be relatively safe to work with. The most common health risk associated with epoxies is that some people have a skin-sensitivity to the hardener. Usually it’s a mild reaction that goes away once your skin becomes accustomed to the material, although a small percentage of people who are more sensitive have to wear gloves or forego using epoxies altogether.

Epoxy sculpting products can be divided up into a few broad categories, including hard putties, flexible putties, and clay-like compounds. The putties are generally used for smaller scale work; they tend to be less versatile than the clay-like epoxies, but excel at holding very fine detail. The primary difference between the two categories of epoxy putties (hard and flexible) is that the flexible putties, such as Kneadatite Blue / Yellow (which is usually referred to as “Green Stuff”) and Kraftmark’s ProCreate, maintain some flexibility when they are fully cured. This trait can help them survive the process of making a vulcanized rubber mold, and makes flexible putties the preferred sculpting medium for a great many sculptors creating pieces that will be rotary-cast in metal, such as wargame miniatures and pewter collectibles. Hard putties cure rigid and are more prone to breaking under the high pressure used in a vulcanizer, but they can be filed, sanded, and cut much more easily, so are better suited to creating certain shapes, such as the hard edges of machinery and weapons.

Working with Epoxies

The first thing you have to do with epoxies is to mix the two components. The exact method for doing this will vary from product to product, and you should read the manufacturer’s directions. It is important that the two components be mixed completely. With some the putties, it can be tricky to mix the component without mixing in excessive amounts of air, which can form bubbles that come to the surface later and cause problems, both in trying to get a smooth surface and in trying to make a vulcanized rubber mold.

A few of the epoxies can be thinned with water, but most of the epoxies are water resistant and cannot be diluted or thinned at all. You can raise the temperature of the water-resistant epoxies and that will make them softer and easier to work, unfortunately it will also reduce your working time substantially.

Many of these products can be very sticky, especially the putties. Some of them will stick aggressively to just about anything, including your tools and fingers, so many sculptors take to lubricating their tools with water, vaseline, or some other material to counter this trait. The downside of using a lubricants other than water is that in addition to keeping the epoxy from sticking to your tools, it can also prevent the putty from sticking to other putty (in other words, to your sculpture), so if you do use a lubricant other than water, you may need to wash the lubrication off periodically in order to be able to securely add more epoxy to your piece.

Metal tools seem to work best with epoxies, especially the putties, but the more clay-like products such as Magic Sculp and Apoxie Clay can be worked with pretty much any sculpting tool you would use with clay. Clay shapers seem to work especially well achieving a smooth surface with the epoxy putties.

All epoxy products change consistency over the course of curing. When first cured they will be the most plastic and malleable; as they cure, they will generally become firmer, although some epoxies will get softer for a while after first mixed. The consistency change actually works out fairly well since in the early stages you are generally blocking out the piece and

want a softer medium; as the putty cures, you will start getting into detail and texture work, for which a firmer media is more desirable.

Finishing Epoxies

Generally speaking, once your epoxy hardens, you are done. Hard putties and some of the clay-like epoxies can be sanded, filed, and cut, giving you the option to smooth your surface after curing has completed, or to create crisp edges by cutting and filing. With flexible putties, you shouldn't expect to do any finishing work after curing has completed, so will need to acquire the ability to get a smooth surface using only tools. It is sometimes possible with flexible putties to use an ultra-fine grain sanding stick or sponge to remove fingerprints or minor surface imperfections from the cured putty, but I would encourage you to experiment before trying it on a finished piece.

Epoxies can be painted using acrylic paints and tend to cure to a very hard and tough final product, making epoxies well-suited to one-of-a-kind sculptures that have to survive some handling, and also make an excellent choice for sculptures that will be used as a master for a vulcanized rubber mold, such as is commonly used in jewelry-making and rotary casting of pewter.

The Final Word

There are many great epoxy-based sculpting compounds, but there is so little in common between them that it's hard to generalize. The only consistent trait of epoxies is that you have a limited working time and generally need to learn to accommodate that fact by either working fast, or working in pieces, finishing small parts of your sculpture completely before even beginning other parts. Cured epoxies tend to be very hard and resilient, and are a good choice for making one-of-a-kind pieces, especially pieces that need to survive a certain amount of handling or abuse.

Plaster

Most people know plaster as the material walls used to be made of, and also as a casting and mold-making material. It is also possible, though it's somewhat tricky, to direct build sculptures out of plaster. The process involves mixing up plaster using a fairly strong mix (using a high plaster-to-water ratio), then waiting for the plaster to start to thicken. When first mixed up, the plaster will have the consistency of a heavy cream, but after a short period of time, it will begin to thicken. Unfortunately, the length of time between when it starts to thicken and becomes workable and when it becomes too hard to work is not very long—20 minutes or thereabouts—so you generally will need to learn to sculpt fast, or sculpt in pieces.

Plaster is not an easy material to work with. It changes consistency fairly quickly from a soupy liquid to goopy sludge to rock-hard in a fairly short period of time. The advantages of plaster are that it is fairly cheap and creates a relatively permanent final product, making it particularly well-suited to large scale, one-of-a-kind sculptures.

Also be aware that plaster gets hot while it is curing: hot enough to give you second degree burns if you're not careful.

You need to be very careful when working with plaster in your studio, especially if you work in water clay and intend to fire it. Plaster is your worst enemy if you use a kiln to create your sculptures, and even a small amount of plaster in your clay sculpture can cause it to explode. The risk is so great, that many art schools have separate clay and plaster studios, and allow no plaster work in their ceramics and clay work areas.

If you don't have the luxury of multiple work areas, you should consider placing down heavy plastic over your entire work area when doing work in plaster, especially the messy process of direct building with it. Then when you are done, roll up the plastic and get rid of it, being careful not to allow any of the cured plaster to harden.

Yep, there's that word again: cured. Just like epoxies, plaster cures, it doesn't dry.