The Unvarnished Truth

Introduction

Varnishing your lovingly painted figures has to be one of the most stressful things a wargamer can do. At least that's what it seems like according to wargamers' comments on the Internet. There are numerous reports of dangers such a misting, leaving a white residue, failing to dry matt, and remaining tacky for extended periods to name but a few. This, coupled with the plethora of products available, has lead to an almost alchemical approach to varnishing; especially for producing that absolutely flat finish so popular at the moment.

Unsurprisingly, a number of varnishing myths have emerged. In general they lead to complicated, unnecessarily lengthy and expensive procedures. In some instance they tackle the wrong problem and use inappropriate products. In this article I intend to tackle a few of these myths, explain why they are unfounded, and provide some practical tips to help wargamers protect their figures during games.

The Science Bit

The basic idea behind varnishing is the production of a strong final layer, much stronger than any paint layer, that will resist handling and protect the final paint surface. This is done by depositing a coating consisting of a solvent carrying a polymer medium with or without a matting agent. In most modelling, and household, varnishes the solvent then evaporates causing the medium to cure forming the protective layer.

The wide range of polymers available has resulted in commercial varnishes for a variety of purposes. Some, like art varnishes, are designed to be removable whilst protecting from atmospheric pollutants and dirt whilst others, like wood varnishes, are designed to be permanent and protect from physical shocks and knocks. Wargamers really require a bit of both: protection from handling and the occasional dive from the table. So selecting the right product is important as not any varnish will do.

With gloss varnishes the intention is to produce a smooth top layer. A smooth layer will produce a high sheen because light falling on the subject is reflected coherently to the eye. As paint layers can be both porous and rough, depending on the paint pigment, the varnish medium must be able to coat the paint and smooth any microscopic surface roughness. This is why multiple coats of varnish are sometimes required for a truly high gloss finish.

With matt varnishes the same coating happens but the matting agent migrates to the surface of the coating during drying. This produces a final surface that is microscopically uneven by trapping the matting agent at the surface . Light falling on the subject is scattered randomly off the particles of matting agent resulting in a flat, matt, finish. This light scattering is also why matt varnishes shift the appearance of paint slightly.

All this science means that the visible result of varnishing is a surface phenomenon whilst the strength of any varnish is a bulk phenomenon directly related to the polymer medium. The choice of polymer medium also governs: whether the varnish uses water or an organic solvent; the clarity of the varnish; its propensity to yellow with age and the cost of the varnish. This difference between surface and bulk phenomena is at the heart of much of the confusion surrounding varnishing.

Varnish Myth #1 - Strength Depends On Finish

The most prevalent myth is that matt varnishes are weaker than gloss varnishes. This is not true. Varnishes from the same manufacturer typically come in a range of finishes: gloss, satin and matt. The only difference is the amount of matting agent present; the polymer medium and solvent

remaining the same. The presence of the matting agent has no effect of the bulk properties of the varnish and its strength is unaffected. So why does the myth persist?

Firstly, the view is often arrived at by comparing apples and oranges. The most common comparison wargamers would make is between a solvent based gloss varnish designed for one purpose from one manufacturer with a water based matt varnish for a different purpose from a second manufacturer. Sadly, comparisons like this can not be used to generalise for the simple reason that it's highly unlikely that any two manufacturers would use the same polymers in two very different solvents and it is the polymers that govern the strength of the varnish layer. Polymers in water based products will always be chemically different from those in solvent based products.

Secondly, the false comparison persists because it fits well with the decades old view that solvent based products are stronger than water based products. Historically, solvent based products could dissolve a wider range of polymers some of which produced stronger varnishes. Whilst this may have been true twenty years ago great strides have been made in recent years. There are now water soluble acrylic polymers that are just as strong as their solvent soluble equivalents. This is certainly true in paint for the automotive industry: whether this has completely trickled down to hobby and art products is a moot point.

Finally, some wargamers notice that matt varnished figures develop a sheen on the high points where they are handled and attribute this to the "matt varnish wearing off". Human skin produces sebum, a waxy substance, that is an excellent polish and greasy fingers will easily produce a gloss finish on matt varnished figures given enough handling. Of course, "polishing" gloss varnished figures in this way will produce little visible difference.

The consequence of this myth is that some wargamers apply multiple coats of varnish: often gloss "for strength" followed by matt "for appearance". It almost guarantees that multiple coats of matt varnish are required to ensure no gloss segments remain. Now there's nothing wrong with multiple coats of varnish to build up a strong top layer but with the right preparation and varnish this is both unnecessary and expensive.

Varnish Myth #2 - Household Varnishes do not Yellow

Commercial household varnishes, including yacht varnishes, are readily available in nearly all DIY stores. These solvent based products are commonly based on polyurethane as the polymer medium. Polyurethanes produce very strong finishes but the bad news is that the cheaper aryl polyurethanes yellow. Some wood varnishes are not based on polyurethane but on alkyd resins containing natural and synthetic fatty acids that also yellow.

You can tell if yellowing is likely because, in the can, the varnish will be slightly yellow already, or even brown, and contain a UV absorber. The latter is there to inhibit the degradation of the polymer film caused by daylight and gives the surface of the neat varnish an "oil slick" look when viewed in daylight.

The more expensive varnishes, based on aliphatic polyurethanes, are much more light stable but a coat of cheap household varnish will, over months, develop a yellow, or light brown, caste most visible on white areas. The colour will develop slowly but will develop quicker if models are left on display as the process is initiated by the UV component of daylight . The change is quite gradual, but relentless, and wargamers are unlikely to notice the changes at first: doubtless sustaining the myth.

Although the above focuses on household varnishes the comments also apply to conventional

polyurethane based enamel varnishes used by modellers. For instance there are lots of reports on the Internet of Humbrol Enamel Gloss Varnish #35 yellowing over time.

Varnish Myth #3 - Even Varnishes Rub Off Metal Figures

This is a variant of "matt varnishes are weaker" myth except it applies to gloss varnishes too. Varnishes are often seen as wonder products capable of compensating for many shortcuts taken during model preparation and painting. Even so, I have often read comments that the varnish has worn off and there is bare metal showing through.

Painting a figure is a layering process. The strength of the final set of layers, varnish layer and all, is governed by how well they bind to one another. Proper preparation of a lead surface is vital as the overall strength of the paint work is very dependent on the strength of the first bond between the primer and the metal. If bare metal is showing then the bond between the metal and the first paint layer has broken down. This is very unlikely to be the fault of the varnish: it is much easier for varnish to bind to paint than is it for paint, or primer, to bind to bare metal.

Getting painting to adhere to Lead, Tin, and Brass is difficult. At the microscopic level, these metals have much smoother surfaces than Iron and Steel making it difficult for paint to bond with the surface. Specialist primers are available, and, according to the manufacturers, are formulated with additional binders, or acids in etch primers, to ensure that the first layer is strongly bound. Yet I have seen all sorts used to prime metal figures from diluted acrylic paint, through car sprays designed for ferrous metals to gesso.

We all know preparation is a chore but there is a world of difference between priming a lead figure and applying any old paint as an undercoat. Most paint will act as the latter to some extent but it will struggle to stay bound to high points subject to lot of handling. The use of the correct primer will pay dividends in the long run as it will produce the strongest base for the paint and varnish layers.

Tips & Techniques

So apart for choosing the right products and avoiding unnecessary steps what can you do to ensure varnishing always produces the right results? What follows is a series of practical tips that I have used successfully for a number of years. They are focussed on acrylic paints, brush on varnishes and other products. I will leave the use of enamels, airbrushes and aerosol sprays to others.

Tip #1 - Upgrade A Commercial Varnish

Commercial modelling and art varnishes often are not quite flat enough for current tastes. However, solvent based varnishes like Humbrol Matt Cote or Daler Rowney Soluble Matt Varnish can be significantly "improved" with a little preparation to produce an effective one shot matt varnish. These excellent non-yellowing varnishes contain a suspended matting agent and the best way to produce a true flat finish is to increase the concentration of the matting agent. This can be done in two ways:

1. Allow the matting agent to settle for a week or ten days. Carefully decant some of the clear liquor into a clean container: an old glass paint jar is ideal. Put this aside. Thoroughly stir the remainder of the varnish and test the finish on an old model or shiny piece of scrap plastic or vinyl. Repeat the process if necessary until the finish is to your taste. If the varnish leaves a white residue reintroduce some of the clear liquor until the residue disappears.

2. Add talc to your varnish. Most matting agents are very fine silicates and cosmetic talc is just another form of silicate. Buy plain, uncoloured and unperfumed talc from your local pharmacy. I bought a 250 g bottle for a few pounds and this is going to last me a lifetime. Carefully add small amounts of talc to the varnish: I use enough to cover 5mm of the end of a wooden coffee stirrer. Mix thoroughly, test as above and repeat until the finish is truly flat. With this method you run the risk of adding too much talc so it's a good idea to decant some of the varnish first so you can reintroduce it if the varnish leaves a white residues.

Of course you can combine both methods. Either way the amount of matting agent suspended in the varnish is increased and so is the amount of surface disruption caused by the matting agent once the varnish has dried.

However, both of the above methods, and normal use of the resultant varnish, rely on excellent mixing to properly disperse the matting agent. Shaking is not always enough, but you can improve the mixing efficiency of simple shaking by adding a few 2-3 mm diameter glass beads. I have also used a basic ultrasound clearer, sold to clean jewelry, which is very useful for ensuring that any added talc is properly dispersed when first added.

Finally, varnishes improved in this way have one drawback. Over time the varnish loses solvent due to evaporation from the bottle and at some point this will cause a previously matt varnish to produce a satin finish. This is because the polymer medium and the matting agent form a gel which is not broken up by normal mixing. Sometimes you can see a residue of gel on the bottom of the bottle immediately after the first few shakes especially if the varnish has not been used for a while.

You can disperse the gel with enough shaking but not break it up so the varnish looks the same but once on the model the presence of the dispersed gel means not enough matting agent migrates to the surface.

The solution is simple: add 2-5 ml of white spirit and shake. You are not thinning the varnish merely replenishing lost solvent so less is more. If you look closely you'll see the nature of any residue change almost immediately.

Tip #2 - Upgrade Commercial Paints

We've all got acrylic paints that no matter what we do to mix them they still dry satin or even gloss. Sometimes they have separated and, despite our best efforts, they will not mix properly. Sometimes it is because they always dry like that.

In my experience this mainly affects the brighter yellows, reds, red browns and lighter browns but I have also seen it with blues and bright greens. Frequently, these colours present a real problem when it comes to varnishing as no varnish, or combination of varnishes, seems to flatten them. This puzzled me for years. Only recently have I tracked down why this happens.

The problem colours often contain high levels of mixed pigments (for the bright colours) which have a very high surface area and contain organic, as opposed to inorganic, pigments. The high surface area means that any varnish is readily absorbed and there is some chemical interaction with the organic pigments. The overall effect is of the varnish penetrating the paint layer rather than remaining on the surface. The effect is greatest, and therefore most obvious, with solvent based varnishes and will continue coat after coat due to repeated penetration of the paint layers.

Thankfully the solution is really simple. The addition of small amounts of talc to the problem paint has

two beneficial results. Firstly the finish of the paint layer is flattened as the talc acts as a matting agent as described in Tip #1. Secondly, the talc seals the paint preventing the varnish penetrating the final paint layer.

The talc can be added to the paint in the bottle but I prefer to add it via the palette. I keep a 20 ml jar of talc on my painting desk and add small amount to my palette wells with my paint brush. The talc sticks to the wet paintbrush and so you not have to worry about contaminating the paint or the talc. I have learnt to add just enough talc to visibly thicken part of the paint and then restore the flow properties by mixing in the remainder or adding a “brush full” of water. One word of warning: the use of talc can thicken the paint leading to a visibly rough surface on the model so adding just enough is far better than adding too much.

Tip #3 - Disaster Recovery

There are a number of simple ”mini-tips” that are worth repeating here as they can save you a lot of time and significantly reduce your stress levels when things go wrong:

1. If there is a white residue after using a matt varnish then, as this is a surface effect, applying a thin coat of any gloss varnish should hide the reside. Once dry the model can be re-varnished with a second coat of a properly mixed, or diluted, matt varnish.

2. If small areas dry satin after matt varnishing simply repaint, if possible, adding talc to the paint. Once dry re-varnish the small areas only.

3. Use “Flat Future” as a last line of defence when repainting is not an option. This is a mixture of household floor polish and Tamiya Flat Base X-21. I use a 70:30 mix to get a super flat finish and paint it onto the affected areas with a fine paintbrush. An internet search for “complete flat future varnish” will bring up lots of sites with useful tips and brand names for the floor polish. One word of caution the mix should be applied very thinly as the floor polish can pool in the crevices of models.

Tip #4 - Preparation, Preparation, Preparation

When priming, note not undercoating, white metal figures use a primer designed for the job. To repeat, almost any paint will coat lead and tin but they will vary considerably in their long term ability to bind to the metal especially on high points that are subject to a lot of handling.

To prime all my metal figures I use a “Special Metals Primer” from International Paints. Other brands are available but I use so little of the stuff I am only on my third 250 ml tin in over fifteen years and have had little need to seek out an alternative. Irrespective of the manufacturer they will all say something like “suitable for lead, tin, copper and brass” somewhere on the tin. This is your guarantee that the primer contains the additional binders required to bond to these smooth metals. I add cheap acrylic black paint to the white product to produce batches of grey primer which I then undercoat with a thin coat of black acrylic paint. The primer is water based and brushes can be cleaned in water as you would expect.

For those of you who prefer to spray prime then I suggest you consider using etch primers rather than standard car primers. Popular with railway modellers for painting brass parts, these contain acids which react with the surface creating a microscopically rougher surface that aids adhesion. The phrase to lookout for is something like “ideal for improving adhesion to problem substrates: aluminium, galvanised steel etc“. When buying do be aware they have a use by date and allow for

a much longer drying time than standard primers. Etch primers are also available as brush on products.

Final Thoughts

As I said in the introduction, varnishing has an almost alchemical aura. So if you have a set of products, from primer to varnish, that works for you please not feel you have to change it because of this article.

You may have settled on the perfect combination of products. However, if you have not and see scope for improvement I hope I have provided some “food for thought”.

Either way, I hope you have enjoyed reading this article and that it will help you produce more durable wargames models by understanding a little more of what varnishes, and primers, actually do and how they do it.