

## **Technote #10**

### **Formaldehyde or DMU? What's the Difference?**

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A protein called keratin makes the nail plate extremely tough and durable. Keratin is made from billions of amino acids in long chains, all bound together to create a tough nail plate. The toughness of the nail plate is the secret to its amazing strength! Tough nails are not as likely to break or crack when hit or snagged. Keratin strands are tough for several reasons, but mostly because of something called *cross-linking*. A cross-link is created when a chemical link is formed between two of the long protein strands- much like rungs on a ladder, cross-links join single strands of protein together like a net. The result is greater strength and harder surfaces. Nail plates and hair shafts both contain cross-linked strands of protein twisted up by the millions to create a single fiber of keratin. Then, many millions of these keratin fibers go into the making of both hair and nail plates.

The correct balance of keratin cross-links between the protein strains make nail plates tough, strong and durable. If the natural nail plate contains too few cross-links, it will be flimsy, soft and weak. The opposite happens when nail plates have excessive amounts of cross-links. Overly cross-linked nail plates are brittle and have very hard surfaces. Nail plates such as these will also be more rigid (loss of flexibility) and more prone to splitting and breaking. Of course, SolarOil™ will absorb into these damaged nail plates and can help this condition greatly, but nothing will “safely” undo the cross-links. If too many exist, the natural nail plate will not be as durable. Such a nail plate will never have the toughness of a healthy natural nail with a balanced level of cross-links.

Nail plate hardeners that rely on formaldehyde contain between ¼ to 5% formaldehyde. Solutions with less than ¼% formaldehyde will not significantly harden your nail plates. This is too low of a concentration to be effective. Above 5% formaldehyde, a product would pose a great risk of allergic reactions. The FDA has limited use to less than 5% formaldehyde in cosmetic products to help minimize risks of consumer allergies.

How does formaldehyde harden the nail plate? Formaldehyde is a protein cross-linking agent. It adds additional cross-links to the nail plate. It does this by chemically reacting to form a cross-link between two protein strands in the natural nail plate. After several treatments, the nail plate will become noticeably harder, due to the many new cross-links that have formed in the plate. But, do we really want harder nails? Maybe not! You should want tough nail plates, not hard ones! When strength and flexibility are in balance, toughness is created. Natural nails will lose toughness if their strength and flexibility are out of balance. When formaldehyde-containing nail hardeners are used excessively, the nail

plates can become overly hard, brittle and appear dry. This can happen when the nail plate becomes overly cross-linked. Eventually, the plate may become so brittle that it will shatter, split, crack or lift away from the nail bed.

Formaldehyde containing nail hardeners can also cause allergic reactions, if used excessively or incorrectly. Formaldehyde is a skin sensitizer that can cause allergic reactions in sensitive people. Unfortunately, once a client becomes allergic to nail hardeners they usually become allergic to most types of professional nail polish. Of course, if formaldehyde is kept off the skin, allergic reactions become much less likely. You need not ever see any of these problems... if you carefully and wisely manage your use of nail hardeners that rely on formaldehyde.

Clearly a need existed for a better way to harden weak or thin natural nails; one that wouldn't over cross-link the nail plate or cause client sensitivities. As part of our on-going research and development efforts, our laboratory began looking for new nail hardening ingredients. Our goal was to find an ingredient that would strengthen the nail plate without causing brittleness or sensitization. At the end of our research, we had discovered and patented a new ingredient that was everything we had hoped to find. The new ingredient is called DMU (dimethyl urea). Our new treatment, Toughen Up™, contains 2% DMU. DMU is the perfect replacement for formaldehyde. DMU has two important advantages. First and most importantly, DMU is not a likely skin sensitizer and it won't cause clients to develop nail polish allergies. Secondly, the 2% DMU found in Toughen Up™ will not make the nails brittle. DMU is also a keratin cross-linker. One of its advantages is that DMU allows for a more controlled, finely tuned level of cross-linking. DMU won't create excessive cross-linking like formaldehyde can. DMU allows the nail plate to maintain a good balance of hardness and toughness. We use one of the very best basecoat resins available in all our nail treatments. This resin is called tosylamide/formaldehyde resin. Chemical names often sound alike, so people easily confuse this resin with the same formaldehyde used to harden natural nails. It's not the same chemical! The formaldehyde used to harden nails is a colorless gas that is dissolved in water.

Tosylamide/formaldehyde resin is a yellowish solid, hard crystalline substance which must be crushed before it will dissolve in a solvent (that's how basecoats and enamels are made). If a manufacturer uses this excellent resin as an ingredient in their nail polish or basecoat, their product will contain a very slight trace amount of formaldehyde. Only 1/10% or less! Technically, such a product can't be called formaldehyde free- even though no formaldehyde was added and the concentration is **exceedingly** low. In this case, it is merely a tiny residue left in the resin. Much too low to harden nails or we wouldn't have to add DMU to our Stickey basecoat. Which is just what we did!

Since Stickey is such an incredible basecoat and DMU is such a unique and powerful solution to nail strengthening- we thought it was a natural combo! We call it Toughen Up™. It's one of the best protective basecoats we sell. Toughen Up™ has all the benefits of our basecoat Stickey plus all the advantages of DMU. It's designed for use on weak or thin nails. Why didn't we put proteins in Toughen Up? Proteins are very large molecules; much too large to be absorbed

by the nail plate. This is especially true of nail plates that have been damaged by over cross-linking. The protein molecules just sit on the surface. Besides, don't forget- SolarOil will penetrate the most densely cross-linked nail plates while those protein ingredients are still drying out on the surface!

Who should use Toughen Up™ ? Clients with thin or weak nail plates that need added strength. Give Toughen Up™ a try and see if you agree. Toughen Up™ with DMU is a solution for weak, thin nail plates. After just seven days, your clients will notice a difference. I predict, they'll have tougher natural nail plates, not just harder nails.