Makevale

St.George Technology, Inc.

# Perfecting dipping nail systems: lessons from polymer science

Whitepaper

Makevale

# Contents


1 Introduction

2 Nail Powder Properties

4 Dipping base and top coat additives

5 Learn more about Makevale's materials


St.George Technology, Inc.

Written in conjunction with St. George Technology, a Makevale company.

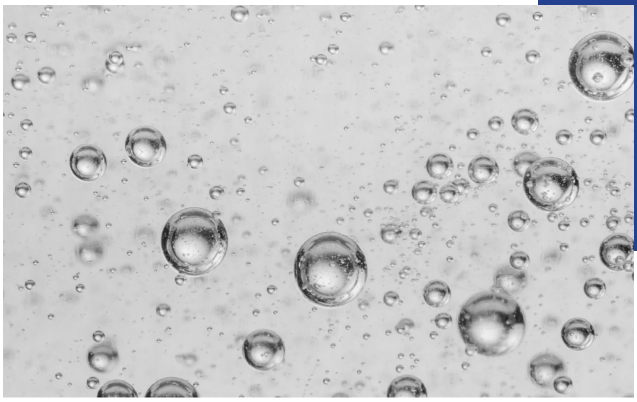
# Introduction

**Every day, in a million salons across the world, nail technicians apply acrylic nails over their customers' nails using dipping technology.**

But why can the results vary so much? This is because to ensure the process is effective and the result looks just right for each customer, the science and engineering of the ingredients must also be just right.

Thirty years on from the introduction of dipping nail systems, there is an incredible amount of science and innovation that goes into making acrylic nails look perfect. Here are just some of the factors that are important and why:

"There is an incredible amount of science and innovation that goes into making acrylic nails look perfect."



Makevale

# Nail powder properties

## Particle size

It is the particle size that determines the dissolution characteristics of the nail acrylic powder into the cyanoacrylate. Smaller particles dissolve into the cyanoacrylate more efficiently. If the particle size is too large, the cyanoacrylate will polymerise before the polymer bead has partially dissolved, leading to trapped gas bubbles.

The powder flow of nail powders is another property influenced by the polymer bead size, with larger polymer beads having a better flow compared to finer acrylics. The nail powder flow is a contributing factor to pigment dispersion and the homogeneous spreading of the powder when it is dipped. As a result, there is a trade-off: the acrylic particles must be large enough to enable good flow at the same time as being small enough to avoid porosity.

## Molecular weight

For dipping applications, a targeted molecular weight is required. If the molecular weight is too high the beads will only partially dissolve into the cyanoacrylate, which leads to porosity and a resulting hazy finish with a grainy appearance. If too low, the beads dissolve too quickly, resulting in an unmanageable mixture on the nail bed.

## Initiator

Residual peroxide initiator is locked into the polymer beads' structure during manufacture. Some nail powder producers also coat the polymer beads with initiators post-production. In both cases, the initiator facilitates the free-radical polymerisation of both the cyanoacrylate and the top surface of the dipped nail once the top coat is applied. If there is not enough initiator, the risk is that the nail will not harden. However, under certain circumstances, peroxide can cause yellowing, especially if it is expressed on the surface of the polymer beads.

## Flow modifier

The presence, dispersion and concentration of flow modifier can influence powder flow, which in turn influences pigment dispersion and how well the powder is distributed as the nail is dipped.

For dipping systems, the flow modifier also helps the cyanoacrylate surround the polymer bead, aiding the dissolving process. The addition of flow modifiers, which often express hydroxyl groups, can initiate the polymerisation of the cyanoacrylate by an ionic mechanism.

However, mixing in flow modifiers is a delicate process, if they are not mixed into the powder homogeneously, the pigmentation and flow could be affected.

## Bead characteristics

The surface of the polymer bead can contain residuals from the manufacturing process. These ionic residues can facilitate better powder flow characteristics, as well as the ionic polymerisation of the cyanoacrylate.

However, these residues could also be a source of haze that has a negative impact on the clarity of the final nail.

# Dipping base and top coat additives

## **Poly(methyl methacrylate)** (PMMA)

Cyanoacrylates are a low viscosity liquid. To modify the viscosity of the cyanoacrylate, PMMA is added as a thickening agent to enable the base coats to be applied more accurately by the nail technician. However, if the base coats’ viscosity is too high, the nail acrylics ability to dissolve may be negatively affected.

## Amine accelerators

Amine catalysts present in dipping top coats are used to accelerate the reaction between the initiator and monomer. These accelerators are toxic and cause yellowing. There is a fine balance required: there must be enough amine to ensure that the dipped nail top surface hardens, yet not so much that it causes yellowing.

Clarity and colour retention are two other fundamental factors that drive the success of an acrylic nail brand. We cover these in detail in a separate article in our insights.

The above represent only a small proportion of the factors that influence dipping nail systems. But it is clear from this small sample that so many aspects must be finely tuned, balanced between positive and negative impacts, and carefully controlled during the polymer bead manufacturing process. This ensures the correct physical and chemical properties are present in the beads, so the above challenges do not arise. And, most importantly, customers enjoy beautiful, lasting nails at the end of the process.

Makevale

# Learn more about Makevale's materials

**Acrylic nail research and product formulation is only one area of our polymer science and engineering expertise.**

---

Makevale has more than 40 years of experience in developing high-performance polymers across multiple industries, working with clients to create the perfect formulas to meet their manufacturing challenges.

For further information on our acrylic powders and liquids and how your artificial nail brands can benefit from our expertise, contact our team for free, no-obligation advice.

T **+44 (0)1920 460 641**
F **+44 (0)1920 460 642**

**www.makevale.com**
enquiries@makevale.com