RESIN**AWAY**® **-** THE WHITE **PAPER**

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Generally, 3D UV Resins are termed Non-Polar (oil-loving), while water is a polar substance where the molecule has electrical poles (water will conduct electricity whereas oil and such, i.e. 3D UV resins are far less likely to conduct electricity.) So that is sufficient enough to define the term polar and non-polar. Polar and non-polar substances (i.e., Oil into Water) will not combine or mix together.

There is another term called “Bi-Polar “, and this defines a substance that is both Polar and non-polar, examples of Bi-Polar substances are some of the more common Alcohols, i.e. Ethanol, Propanol and Iso-Propanol. A Bi-Polar solvent is one that will mix and dissolve into both a polar material and also a Non-Polar material or water and also oil equally well into each.

Looking at the principal of washing 3D printed parts in I.P.A, the residual 3D resin mixes, solvates and blends with the IPA as a compatible solution, the cleaned part remains wet with this co-solution.

Apart from changing the surface finish of the printed part to appear cloudy or frosted, This process works sufficiently well enough while working with fresh or uncontaminated I.P.A., however after repeated washing into a stand-alone cleaning bath, the surplus 3D resin quickly overloads the Bi-Polar IPA, this combination ends up leaving a greasy residue of 3D resin on the printed Part.

Following, please see further information regarding RESINAWAY®, beginning with some essential terms and necessary background.

The Words:

Hydrophilic = Water loving groups in the molecule
Hydrophobic (Lipophilic) = Oil loving groups in the molecule

Thus these two groups, when combined chemically eventually form a unique combination that is a balanced Hydrophilic, Hydrophobic (Lipophilic) balance that is termed the “ H.L.B. “ concept.
An emulsifier that is more Hydrophobic (Lipophilic) in character has a low HLB Balance whereas an emulsifier that is Hydrophilic has a high HLB value. HLB values range from 1 to 40 where the ideal balance point is 10.

RESINAWAY® has been designed around the Hydrophilic- Hydrophobic (Lipophilic) HLB principle, the concept is different from the previously discussed Polar and Non-Polar Solvents concept such as Alcohols, acting merely as diluents.

Further to explain the principle of RESINAWAY® - expanding on Hydrophilic and Hydrophobic (Lipophilic) Phenomena, we now introduce further terms, i.e. “Emulsions and Emulsifiers”.
As an analogy, look at milk, i.e. an excellent example of a stable emulsion made up of oil or fat suspended in an aqueous phase, i.e. oil in water emulsion, minute stable droplets of fat suspended in a water carrier. (This is similar to the resulting wash-up residue of RESINAWAY®).
Advancing further to another analogy, when making salad dressing, the emulsification of oil and vinegar, shake the two together and they momentarily combine and when left for a short time, the oil phase soon breaks out to form a layer on top of the vinegar but when an emulsifier is added, such as honey, egg yolk or mustard, the oil and vinegar forms a stable emulsion. RESINAWAY® is akin to an emulsifier in the oil/vinegar example.

Emulsifiers work by forming a charge barrier around the surface of Hydrophobic- (Lipophilic) droplets enabling them to remain suspended in a hydrophilic medium while preventing the droplets from coalescing.

RESINAWAY® is a composition containing both a Hydrophilic (water-loving or polar) head group and a Hydrophobic(Lipophilic) or oil loving, non-polar tail, therefore both the 3D Hydrophobic

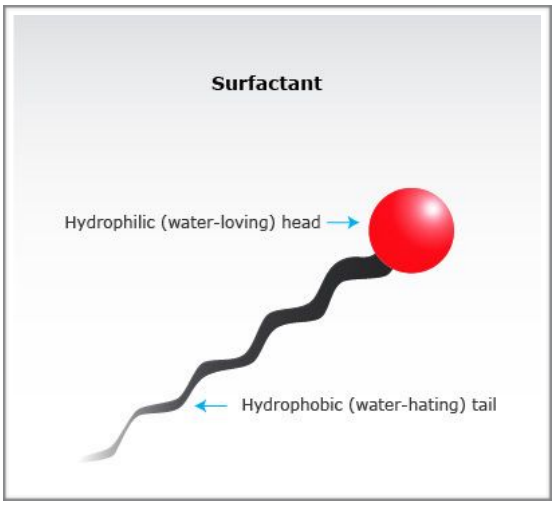
(Lipophilic) resins and the wash-up Hydrophilic component combine with Resin-Away to form a stable emulsion which requires only a very minor percentage of Resin-Away to activate the residual 3D resin remaining on the surface of a printed component, this then becomes a water-soluble Hydrophilic solution.

The RESINAWAY® principal is diametrically opposed to that of 3D resin being washed into Alcohol – the combination fast becoming contaminated through the excess resin to alcohol ratio which soon leaves a greasy residue on freshly washed printed parts.

The RESINAWAY® principal works by dissolving itself into the residual 3D resin that remains on freshly printed parts; this combination results in a unique pre-compound which readily emulsifies in contact with water.

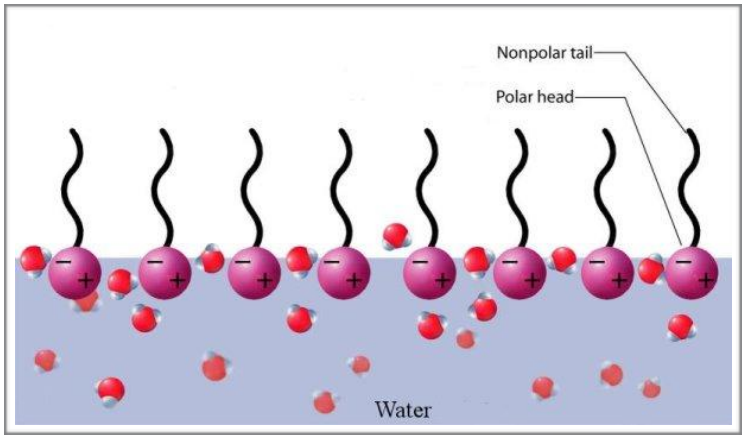
In discussion when explaining clean-up of 3D Resin with IPA, the IPA is being used as a cleanup solvent because of its ability to mix with both water and non-water soluble materials. This phenomenon was further extended during the development of “RESINAWAY®” with the inclusion of a further chemical class namely Surfactants i.e. Surface Active Agents with their abilities to blend otherwise incompatible ingredients, Fat soluble with Water soluble.

Surfactants have a tadpole-like appearance, a water-soluble (Polar) head and a fat-soluble tail, its structure allows for a lot of its functions.



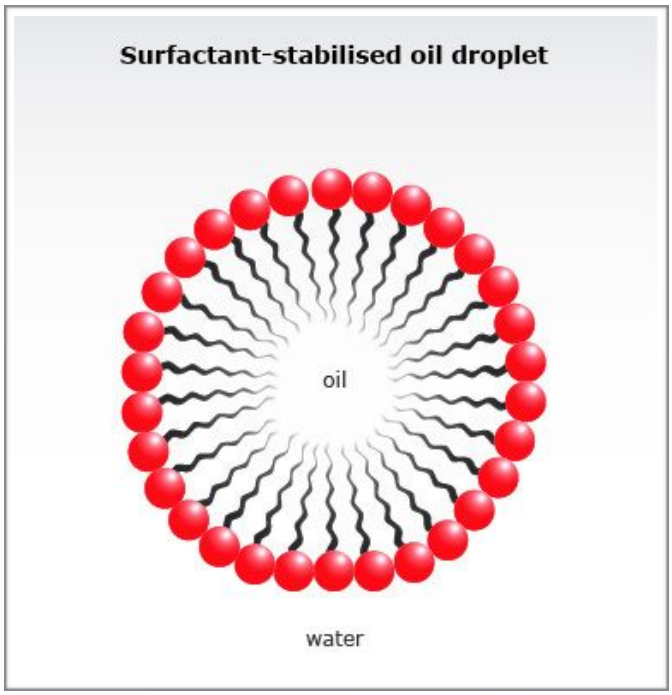
The surfactant component illustrated above combine to form a “Micelle” where a ball cluster forms with the tails facing inwards say into a droplet of hydrophobic oil like substance and the Hydrophilic water-loving Heads covering the outer surface of the oil-like droplet thus forming a contact with the surrounding water. When all the oil is taken up as above, the whole mass is then water miscible – oil now soluble in water.

Now say you had a beaker of water with or without a bit of oil in it. With just a bit of surfactant in the beaker, you would end up with the hydrophilic surfactant clustering to the top of the solution, with their heads (water-loving facing down and their tails away or opposed to the water.



When you have enough surfactant in solution, it will begin to move downwards into the water phase to create micelles – a fundamental component of any surfactant-based product. Micelles form little balls in oil at hydrophobic substances with the tails all facing inwards, trapping the once surface oil in between, to form into stable droplets as is the case in lotions when you have enough micelles in the solution.

Below is what a micelle looks like, with the head of the surfactant facing outwards and the tail inwards, trapping oil in the ball.



In the development of RESINAWAY®, we use the principal of Micelle development to produce chemistry with “Critical Micelle Concentration”, ending up with enough Micelles to create a stable emulsion of residual 3D resin that will wash cleanly off 3D printed parts.