Adhesive “Re-Emulsification” Myth

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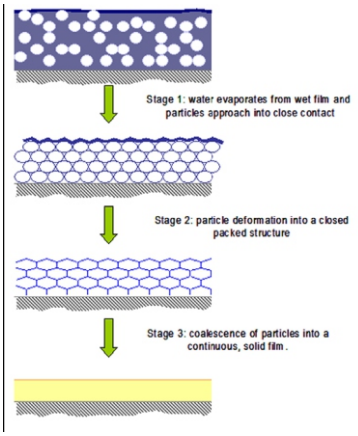
Contrary to popular belief modern adhesives do not re-emulsify...

When an adhesive is formulated, the base polymer is supplied in an aqueous emulsion at around 50% solids. The emulsion is created in a reactor under a chemical synthesis referred to as emulsion polymerization. Modern acrylic resin polymers and their copolymer adjuncts are carboxylated to enable ionic/covalent cross-links to form upon drying. As the formulated adhesive dries water is evaporated and the carboxylation reaction propagates, enabling cross-link formation. This chemical reaction is not an equilibria or in other words is not reversible. The polymer cross-links essentially have a multiplier effect on the molecular weight of the adhesive developing a cross-link lattice that decreases the volume of the adhesive product and increases the polymer/film density. Upon cure the dried adhesive material has reduce water solubility and when formulated correctly will exhibit water resistant properties.

Process of Film Formation

The process by which latexes turn into solid continuous films can be simplified as a series of events occurring during three main stages, as shown in the figure. During the first stage, water evaporates from the film while particles come into close contact. The second stage is characterized by deformation of particles into a closed packed structure. In the third stage, individual entities are no longer defined due to sintering of particles into a solid, continuous film strengthened by inter-diffusion of chain segments. The actual film forming process is really not as simple as described above, but involves a number of complexities. Combinations of physical forces dependent on time, pressure and temperature all interplay and are a subject of active research.



In many commercial formulations of thermoplastic and thermosetting latexes, (a common term for aqueous polymers referring to the appearance of rubber latex extracted from trees), the most common functional groups introduced are carboxylic acids and hydroxyl groups. Carboxylic acid groups are usually incorporated in the latex via co-polymerization of Acrylic or Methacrylic Acids. Carboxyl groups usually improve mechanical and shear stability of latexes, film hardness and adhesion to substrates. Cross-linking is possible ionically and/or covalently,

Adhesion Loss to Water Vapor Migration

The observational result of white soft adhesive found under resilient tile in flooring applications is more accurately described as a re-wetting process. Where the dried adhesive has regained a measure of liquid water content due to the migration of water and/or water vapor from the concrete slab, (particularly noticeable in resilient flooring installations). As the adhesive and subsequent flooring materials are installed, the dynamic force driving water vapor emission from the slab is cut off. Moisture vapor emission measured by Calcium chloride (ASTM F-1869) provides a rate or velocity to this migration. The evaporating effects on the slab surface create a water/water vapor gradient within the slab. Higher concentrations of moisture are obviously found closer to the ground with less concentration at the surface. By measuring the *insitu* %RH we develop a value closely related to the equilibrium humidity in the slab, or in other words the humidity that would exist within the entirety of the slab layer under static conditions without the moisture gradient. This equalized humidity is the direct cause for “rewet” of the cured adhesive. A penetration of moisture into the dried glue. Realistically, it is impossible for the glue to attain the same level of moisture found at install due to the high cross-link lattice density (ie. reduced volume) developed from cure.

Caution: For low cost adhesive materials containing carbonates, clay and cellulosic additives this re-wet phenomena can be disastrous due to the hygroscopic nature of these additive materials and a resulting loss of internal strength and bond, (cohesive and adhesive failure).

A Caveat: Re-emulsification is a process used liberally in describing the penetration of water to a water soluble salt or mixture containing hygroscopic materials such as surfactant or clay. The loss of asphalt volume to improper formulations containing higher HLB surfactant is an example.