First Line of Defense

An Overview of Paints and Elastomeric Coatings

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This article is a "skin deep" look at protective paints and coatings for buildings. The article is intended to help architects understand and select appropriate materials. It addresses the basics of paint and coating ingredients, and some of the primary types of coatings applied to buildings. The article does not address chemical names, ingredient sources, details of how different resins cure, or specialized industrial protective coatings.

The most important issues affecting coating selection are the type of substrate and the kind of protection desired, which in turn will affect the choice of materials. Few decisions during the course of a construction project have greater consequence than the selection of materials which are exposed to the weather. Protection from the elements is the first purpose of a structure, and exterior finishes are the first line of defense.

PAINTS & COATINGS:
The terms "paint" and "coating" may be used interchangeably, but "coating" has become more commonly associated with specialized applications, such as waterproofing or corrosion protection. Almost all paints and coatings contain **pigments** for color and hiding power, and a liquid **vehicle** containing non-volatile oil or resin **binders** that form a film when cured and volatile **solvents** that keep ingredients liquid and aid application. **Additives** enhance or alter the properties of the pigments, solvents and binders.

The most significant difference in paint or coating systems is the type of resin (binder) that holds the film together. There are dozens of resins used in paints, but here are a few most commonly found on buildings:

Alkyd Resins: The most common resins for oil-based paints, enamels, and varnishes are alkyds (natural oils). For many years, alkyds set the standard for high-quality exterior paint. Alkyds are commonly used as exterior primers and enamels, have good surface penetration and adhesion, can be applied on a variety of substrates, but are not as resistant to wear and moisture, nor as color fast as many of the newer resins. They make excellent wood primers. They continue to cure and shrink over a prolonged period, however, adding stress to the paint film, which can contribute to problems if the substrate is not sound or if there are many layers of old paint under the new coat. Alkyds also tend to absorb moisture, and are not alkali resistant, which is a potential problem on fresh concrete surfaces.

Epoxy Resins: Epoxy resins form a hard, durable finish which is highly moisture and alkali resistant, with excellent adhesion to most surfaces. Epoxies cure chemically, by a couple of different methods which can result in more brittle films or more flexible films. Epoxies typically have low water vapor permeability, though more permeable formulations are available as primers. They can provide good corrosion protection for steel, durable protection for interior concrete floors, and make good primers for concrete. They are not normally used as finish coats on exterior concrete or wood because of their relative impermeability, and they should be topcoated in any other exterior applications because they chalk with exposure to ultraviolet light. Their slick, hard surface, can interfere with adhesion of subsequent coating systems, so topcoats are best applied before the epoxy has fully cured.

Vinyl Resins: Vinyl latexes are "water-based" paints. Vinyl resins include polyvinyl acetate (PVA) styrene and PVA butadiene copolymers. Droplets of the plastic binder float in a water emulsion. When the solvent (water, in this case) evaporates, the droplets merge and polymers cross-link to form a paint film. PVC is highly resistant to chemicals, acids, alkalis, and solvents. Vinyl stabilizing additives are required to gain resistance to ultraviolet light. PVA has poor chemical and ultraviolet resistance and does not weather well. These are poor quality latex coatings for exterior applications: look for 100% acrylics instead.

Acrylic Resins: Acrylic latex may mean a blend of acrylics and vinyls or styrenes, or may be 100% acrylic. Use only 100% acrylic for exterior applications if given a choice. Like other "latex paints", they are suspended in an emulsion of water, and cure by merging and cross-linking of polymers as the water evaporates. Acrylic resins are among the most reliable for resistance to fading and chalking, and for maintaining a flexible paint film. Acrylics are also highly vapor permeable, making good finish coatings for wood and concrete (where you want moisture to be able to pass out of the structure). Acrylics make a good all around choice for finishing of most exterior building surfaces, and the water based solvent makes them useful where volatile organic solvents (VOCs) are a concern.

Urethane Resins: Urethanes and polyurethanes have been developed into a wide range of products. They are basically very long chain polymers that can be formulated to extremely durable finishes (from gymnasium floors to exterior coatings for jet aircraft). Early polyurethanes based on aromatic materials deteriorated badly in ultraviolet light (but are still in normal use in deck coating systems). Newer urethanes based on aliphatics are much more durable, with better ultraviolet resistance. There are several methods for curing different urethanes and polyurethanes, which may result in single component or two component systems. They make excellent clear sealers and finishes for wood, and are extremely useful in elastomeric formulations for waterproofing concrete decks. The moisture curing varieties utilize hazardous solvents, effectively limiting their use to outdoor or very well ventilated areas.

ELASTOMERIC COATINGS:
The combination of frequent rainfall, humid air, strong sunlight, and a salty environment in Hawaii can result in leaks or corrosion of reinforcing steel in concrete and masonry structures. Elastomeric coatings have come into widespread use to protect roofs, walls, parking and pedestrian decks from moisture related problems. Elastomeric coating systems tend to be grouped into two primary categories: wall coatings and deck coatings. The wall coatings are predominantly acrylic, and are used on vertical surfaces where standing water will not occur; the deck coatings are predominantly urethane, and are used on horizontal surfaces where standing water might occur and greater wear resistance is required.

100% Acrylic Elastomeric Wall Coatings: Acrylic elastomerics share the vapor permeability, durability and flexibility characteristics of acrylic latex, with but are thicker and more flexible. This makes them an ideal coating for waterproofing wall surfaces while still allowing them to breathe. Early formulations had problems with dirt retention due to the tacky surface, but new resins develop a harder surface "skin", making them easier to keep clean. They are softer than normal paints, however, and should not be used where abrasion resistance is desired. Select the toughest, stretchiest, most tenaciously adherent elastomeric system available. Look at the manufacturer's technical literature for "peel adhesion" and "elongation at break" to compare products (check test methods to be sure they are the same). Make sure you find out how the manufacturer achieves flexibility in his coating. Some add plasticizers during the manufacturing process to get high scores in the elongation tests, but these plasticizers leach toward the surface as the coating ages, resulting in a sticky, dirty surface. The best acrylic resins are "internally plasticized", in other words, the elastic properties are integral to the polymers, and are not "mixed in" during the manufacturing process. Material is commonly applied in dry mil thicknesses of 8 to 10 Mils per coat, for a total dry film thickness of 16-20 dry mils. A 5 or 10 year warranty is obtainable for a two coat system, and can be extended with the application of another coat.

Silicones: Both paint and waterproofing formulations of silicone modified polymers are available. They can be formulated to be highly elastic and ultraviolet resistant, and to maintain their elastic properties in temperature extremes. They are highly vapor permeable, making them excellent waterproof coatings for concrete, however, they tend to have a tackier, stickier surface than current pure acrylic formulations, which causes them to retain more dirt. They also tend to be expensive, but should last longer than other coatings. Application is similar to the acrylic coatings, but silicones can achieve similar performance in a thinner application. A major concern is that you can not coat over the currently available silicones with more common paints, so once you coat your building with silicone, you are married to silicones forever. Silicone based elastomeric coatings aren't yet widely used in Hawaii.

Urethane Deck Coatings: Aromatic urethanes are typically used for base coats, which are then topcoated with a more expensive (and more ultraviolet resistant) aliphatic urethane. Thickness is important; a good system should be a minimum of 60 dry mils overall. The thicker the coating, the more movement it will accommodate. Normally, do not allow more than about 30 mils in a single coat, or "gassing" will result (the effect of solvent trying to escape, resulting in blisters and pinholes). Anticipate substrate movement, and provide for it with sealant joints. The sealant provides distance for the coating system to stretch (300% elongation across a 1/4" wide sealant joint theoretically will allow 3/4" of movement, but the same material will only allow 3/1000" across a 1/1000" wide crack).

Sealants: Virtually all waterproof coating systems require the use of sealants. Though acrylic caulks are fine for filling holes and joints for painting, urethanes are the best choice of paintable sealants for exterior wood and concrete when accommodation of movement is anticipated. Again, the method of plasticizing the polymers is critical. Use of a sealant with added plasticizers will eventually lead to leaching of the plasticizers through the now coating, resulting in discolored stripes on your nice, freshly coated walls.

Surface preparation is by far the most important single aspect of a successful coating application. More than 80% of paint and coatings failures can be attributed to what is done, or not done to the surface before the coating is applied. The requirements for preparation depend on the nature of the substrate and the applied materials. Manufacturer's written recommendations are the first place to check for leads on appropriate cleaning techniques and primers, but don't stop there. Manufacturer's technical representatives can be very helpful with identifying specific job conditions you are dealing with.

As the project specifier, the ultimate product and surface preparation requirements will be your decision. Gain an understanding of the substrate conditions, the desired results, the effect of different primers, and especially appropriate levels and methods of surface preparation. If you are faced with difficult or unusual applications or problems, hire a coatings consultant to help you with choices. Establish high standards for surface preparation and material performance, and you will have established a good first line of defense against the elements for your clients and valuable protection for your buildings which goes more than skin deep.