Non convertible and convertible polymers

Philip Green, Paint Technology Consultant, comments on the definition and practical usage of physical attributes that are commonly used for the characterisation of coatings.

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For a non convertible polymer or coating, the aged/dry film remains completely soluble by the solvent or group of solvents in which it was originally dissolved, i.e. the film, which is made up of the solids of the polymer/coating formulation, does not undergo any chemical change upon drying.

For a convertible polymer/coating the dry film is not soluble in the original solvent. i.e. the polymer/coating undergoes a chemical change/reaction upon drying, which makes it no longer soluble in the solvents, in which it was originally carried.

There are many different chemical reactions which can give rise to such a conversion. They can be divided into distinct groupings:

a) two component (pack) systems:
   The chemical reaction or conversion only takes place when the two components are thoroughly mixed together. The two unmixed components do not dry or convert when drawn down separately. When the two components are mixed, they chemically react. This can happen both in the mixing vessel and in the wet/drying film. The mixed components have a pot life after which the mixture can no longer be used. In most systems, the pot life is very temperature dependent.

b) One component (pack) systems:
   The chemical reactants are present in the liquid coating but only start to react when the coating is applied in a thin film. This type is the most widely used type of decorative solvent based coating.

As a rough guide, convertible polymers are often solvent borne coatings. However, that is about to change, as we commence to widely utilise one and 2 pack crosslinkable water borne systems.

(There is a widespread misconception that latex based systems are convertible coatings, because after drying they are not “soluble” in water - in fact the latex was never dissolved in the water in the first place, it was emulsified.)

Practical Usage

The type and chemical nature of a polymer used in a coating have a great influence on many different characteristics of the coating, including mechanical and chemical resistance/durability properties. Thus, it is essential for a coatings formulator to be fully aware of what type of polymer he is dealing with.

Examples

1. non convertible, solventborne:
   - chlorinated rubber, vinyl, solution acrylic, styrene acrylic, epoxy ester and nitrocellulose/short oil alkyd mixtures.
2. non convertible, waterborne:
   - polyvinyl alcohol, hydroxy ethyl cellulose, xanthane gums, some alkali swelleble thickeners (start off as dispersion polymers but when neutralised become water soluble solution polymers), pure acrylic, styrene acrylic, vinylacetate homopolymer, vinyl acetate/ acrylic, vinyl acetate/veova, ethylene terpolymer, vinylene chloride latices, emulsions
3. convertible, 2 pack, solventborne:
   - epoxy (cured with polyamide, polyamine or isocyanate), polyurethane (hydroxy acrylic cured isocyanate), 2 pack acid catalysed (modified UF/alkyd with acid)
4. convertible, 2 pack, waterborne:
   - aziridine cured water dispersed polyurethanes
5. convertible, 1 pack:
   - alkyd (long/medium oil, modified with PU, Phenol, styrene, vinyl, chain stopped, etc). All need catalytic driers/oxidants present in the drying film to promote the crosslinking reaction.