

APPENDIX 3

GLOSSARY OF TERMS

Accelerator Also called catalyst; chemicals added to accelerate the curing/crosslinking of thermoset materials

Achromatic Colour A neutral colour that has no hue (white, grey or black).

Achromatic Pigments Pigments of low refractive index. Often called extenders as they do not add significantly to the hiding power of the coating but serve to "bulk-out" the coating, thus reducing cost See *pigments, extenders*.

Acrylics Resins resulting from the polymerisation of derivatives of acrylic acids, including esters of acrylic acid, acrylonitrile, and their copolymers. Also known as acrylic resins and acrylate resins.

Adduct A chemical addition product which, in the case of monomers and polymers, provides cross-linking to produce higher molecular weight polymers.

Adhesion State in which two surfaces are held together by interfacial forces which may consist of valence forces or interlocking action, or both. See Lesson 7.

Aliphatic Compounds A class of organic compounds which are composed of open chains of carbon atoms. These include paraffins, olefins, etc.

Appearance An object or material's manifestation through visual attributes such as size, shape, colour, texture, glossiness, transparency, opacity, etc.

Aromatic Compounds A class of organic compounds which contain an unsaturated benzene ring of carbon atoms, including benzene, naphthalene, anthracene and their derivatives.

Atom The atom can be considered as the smallest particle of matter though it is composed of electrons, neutrons, and protons.

Atomisation the production of a spray pattern of air and powder during spray application of coating powders.

Back Ionisation The phenomenon of "pock-marking" that occurs in the powder deposited by corona-charging electrostatic spray guns. It is caused by the back emission of ions from the deposited film. The film is disrupted as the ions leave the surface.

Binder The resin component of a coating powder.

Blast cleaning Removal of surface contaminants by use of high pressure air containing abrasive particles.

Chalking The formation of a powdery surface due to the disintegration of the polymer at the coating surface due to weathering. Many epoxy powders will chalk on outdoor exposure.

Chemical Conversion Coating A treatment, either chemical or electro-chemical, of the metal surface to convert it to another chemical form which provides an insulating barrier of exceedingly low solubility between the metal and its environment but which is an integral part of the metallic substrate. It provides greater corrosion resistance to the metal and increased adhesion of coatings applied to the metal. Examples are phosphate coatings on steel, chromate coatings on aluminium, zinc and zinc-coated materials and anodised films on aluminium.

Contaminants Unwanted material, such as dirt and oils, that are on the coating surface or within the coating.

Corrosion The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, chemicals, or other agents in the environment in which it is placed. The term environmental degradation is often used to embrace corrosion, as defined here, and environmentally induced breakdown of polymeric components and coatings.

Chroma/Chromaticity The intensity or saturation level of a particular hue, defined as the distance of departure of a chromatic colour from the neutral (grey) colour with the same value. In an additive mixing-mixing environment,

Chromatic Perceived as having a hue - not white, grey, or black.

CIELAB (or CIE L*a*b*, CIE Lab) Mixing space in which values L *, a* and b* are plotted using Cartesian co-ordinate system. Equal distances in the space approximately represent equal colour differences. Value L * represents lightness; value a* represents the red/green axis; and value b* represents the yellow/blue axis. CIELAB is a popular colour space for use in measuring reflective and transmissive objects.

Cohesion Propensity of a single substance to adhere to itself; the internal attraction of molecular particles toward each other: the force holding a single substance together.

Colour One aspect of appearance; a stimulus based on visual response to light, consisting of the three dimensions of hue, saturation, and lightness.

Colour Attribute A three-dimensional characteristic of the appearance of an object. One dimension usually defines the lightness; the other two together define the chromaticity.

Colour Difference The magnitude and character of the difference between two colours under specified conditions.

Colour Measurement Physical measurement of light radiated, transmitted or reflected by a specimen under specified condition and mathematically transformed into standardised colourimetric terms. These terms can be correlated with visual evaluations of colours relative to one another.

Colour Specification Tristimulus values, chromaticity co-ordinates and luminance value, or other colour-scale values, used to designate a colour numerically in a specified colour system.

Corona charging The process of inducing an electrical charge on coating powders by passing them through a high voltage electrical field.

Corrosion The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, chemicals, or other agents in the environment in which it is placed. The term environmental degradation is often used to embrace corrosion as defined here and environmentally induced breakdown of polymeric components and coatings.

Covalency A covalent bond is one where each atom donates an electron to form a shared pair of electrons in a molecular orbit

Cross hatch test for determining the adhesion of a coating.

Cross-linking As applied to polymer systems, cross-linking is the setting up of chemical links between molecular chains to form three-dimensional polymers of much higher molecular weight. Thermosetting powder coating materials cross-link under the influence of heat.

Cyclone A spinning mass of air used to centrifugally separate powder from air.

Density The mass per unit volume of a material, normally expressed as g/ml, g/cm³ or kg/m³.

Electrostatic coating Process for applying a charged powder to an earthed component.

Electromagnetic Spectrum The massive band of electromagnetic waves that pass through the air in different sizes, as measured by wavelength. Different wavelengths have different properties, but most are invisible - and some completely undetectable - to human beings. Only wavelengths that are between 380 and 720 nanometers are visible, producing light. Waves outside the visible spectrum include gamma rays, x-rays, microwaves, and radio waves.

Epoxy resins Cross-linking resins based on the reactivity of the epoxide group. One common type is the resin made from epichlorhydrin and bisphenol A. Aliphatic polyols such as glycerol may be used instead of the aromatic bisphenol A or bisphenol F.

Explosion limit Ratio of powder particles to air at which the mixture can explode or ignite.

Extender A specific group of achromatic pigments of low refractive index (between 1.45 and 1.70) incorporated into a vehicle system whose refractive index is in a range of 1.5 to 1.6, consequently they do not contribute significantly to the hiding power of paint. They are used in paint to reduce cost, achieve durability, alter appearance (e.g. decrease in gloss), control rheology, and influence other desirable properties. If used at sufficiently high concentration, an extender may contribute dry hiding and increase reflectance. See *pigment*.

Fan pattern Shape of the spray pattern when applying a powder coating with a spray gun.

Faraday Cage Effect The phenomenon of charged powder particles being attracted to the nearest earth and therefore a resistance to being attracted into enclosed areas such as the internal corners of a box.

Ferrous material One that is substantially iron based.

Fish eyes Coating defect appearing as a large depression usually caused by oil contamination.

Fluidised bed A suspension of powder in a stream of air. Used to apply coating powders by preheating the component and plunging it whilst hot into the fluidised bed.

Fluorocarbons Groups of compounds containing fluorine atoms such as fluoroplastics and some solvents of the halogenated type.

Free Radical A free radical or, put more simply, a radical is a fragment of a molecule which has at least one unpaired electron. Interaction between polymer radicals during curing pairs up the unpaired electrons electrically, neutralising the radicals to produce stable, larger molecules. This process is the basis of cross-linking.

Fusion The melting and flowing of powder particles when heated to form a continuous film.

Galvanised steel Steel coated with zinc, usually either by dipping in molten zinc or by electroplating.

Gloss An additional parameter to consider when determining a colour standard, along with hue, value, chroma, the texture of a material, and whether the material has metallic or pearlescent qualities. The general rule for evaluating the gloss of a colour sample is the higher the gloss unit, the darker the colour sample will appear. Conversely, the lower the gloss unit, the lighter a sample will appear.

Gloss is measured in gloss units, which use the angle of measurement and the gloss value (e.g. 60° gloss = 29.8). A 60° geometry is recommended by the American Society for Testing and Materials (ASTM) D523 standard for the general evaluation of gloss.

Hue The first element in the colour-order system, defined as the attribute by which we distinguish red from green, blue from yellow, etc.

Humidity A measure of the moisture content of air. High humidity can cause water droplets to condense onto cold surfaces.

Hydroxyl Group - OH. The chemical group characteristic of hydroxides and alcohols

Infra-red Heating This form of heat is used to cure powder coating by radiation being emitted from electric or gas heaters at a wavelength of between 1 and 100 μm .

Inorganic Compounds Designation of compounds that generally do not contain carbon. Exceptions are carbon monoxide and carbon dioxide and their derivatives. The source is matter other than vegetable or animal, in other words matter of mineral origin. Examples are sulphuric acid and salt (sodium chloride).

Ionic Bond Ionic bonds are held together by the attraction of opposite electric charges. A metal will lose electrons to form positive ions, a non-metal will gain electrons to form negative ions, and thus there will be ionic attraction.

Infra red curing Method of curing powders by exposing them to infrared radiation.

Iron phosphate A conversion coating to promote adhesion of powder coatings and inhibit underfilm corrosion.

Isocyanate Resins These resins are based upon the reaction of isocyanates (- N = C = O) and alcohols (- OH) to form a urethane linkage. See *polyurethane*.

Isomerism The existence of two or more chemical compounds with the same molecular formula but having different properties, owing to different arrangement of atoms within the molecule, e.g. ammonium cyanate NH_4CNO and urea, $\text{CO}(\text{NH}_2)_2$ are isomers.

Kelvin (K) Unit of measurement for colour temperature. The Kelvin scale starts from absolute zero, which is -273° Celsius.

Light Electromagnetic radiation of which a human observer is aware through the visual sensations that arise from the stimulation of the retina of the eye. This portion of the spectrum includes wavelengths from about 380 to 770 nm. Thus, to speak of ultraviolet light is incorrect because the human observer cannot see radiant energy in the ultraviolet region.

Adjective meaning high reflectance, transmittance, or level of illumination as contrasted to dark, or low level of intensity.

Light source An object that emits light or radiant energy to which the human eye is sensitive. The emission of a light source can be described by the relative amount of energy emitted at each wavelength in the visible spectrum, thus defining the source as an illuminant. The emission also may be described in terms of its correlated colour temperature.

Lightness Perception by which white objects are distinguished from grey, and light-coloured objects from dark-coloured.

Masking Technique for covering an area of a component to keep it free of the coating.

Melting Point This is the transition temperature at which a powder changes from a solid to a liquid. In powder coating this will occur over a temperature range except in the case when fairly pure polymers are used, i.e. Nylon 11 will melt at 184°C .

Metamerism A phenomenon exhibited by a pair of colours that match under one or more sets of illuminants (be they real or calculated), but not under all illuminants.

Mill scale Thick oxide on steel produced during hot processing, e.g. hot rolling.

Molecules Molecules are compounds made up of specific combinations of atoms. Familiar substances may theoretically be divided into single molecules but no further. Like a strict recipe in which atoms are the ingredients, each molecule has a chemical formula. If any ingredients are subtracted or changed, the molecule becomes something completely different.

MSDS Material Safety Data Sheet

Non ferrous A material that does not contain iron.

Nylon Resins Polyamide resins made from the interaction of diamines and dicarboxylic acids. Hexamethylene diamine and adipic acid are typical reactants. These resins are composed principally of a long-chain, synthetic, polymeric amide that has recurring amide groups as an integral part of the main polymer chain.

Orange peel Coating defect exhibited as an uneven rough surface

Organic Compound Designation of any chemical compound containing carbon, usually combined with elements such as hydrogen, oxygen and nitrogen. (Some of the simple compounds of carbon such as carbon dioxide, are frequently classified as inorganic compounds.) Over eight million synthetic and naturally-occurring organic compounds are known. (There are approximately 100,000 known inorganic compounds.) Organic compounds are not usually ionised in water and frequently show the phenomenon of isomerism. The molecules of organic compounds used for powder coatings are usually very complex, containing large numbers of atoms.

Overspray Powder that does not coat the component when spraying.

pH Measure of the acidity or alkalinity of a solution.

Pigment Finely ground, natural or synthetic, inorganic or organic, insoluble dispersed powder particles which, when dispersed in a liquid vehicle to make paint, may provide, in addition to colour, many essential properties of the paint such as opacity, hardness, durability, and corrosion resistance. See *extender*.

Phosphating Process for producing a conversion coating by immersing components in a solution containing phosphate chemicals.

Pinholes Coating defects appearing as small holes through the coating.

Polyamide Resins Condensation resins of an amine and an acid, the repeated structural unit in the chain being of the amide type.

Polyester Resins Group of synthetic resins which are polycondensation products of dicarboxylic acids with dihydroxy alcohols. They are therefore a special type of alkyd resin. Oil-free alkyds are a class by themselves. Often these resins are dispersed in a suitable monomer.

Polymer A substance, the molecules of which consist of one or more structural units repeated any number of times. The name often applies to large molecules produced by any chemical process.

Polyurethanes Type 1, one-package, prereacted-urethane coatings characterised by the absence of any significant quantity of free isocyanate groups. They are usually the reaction product of a polyisocyanate and polyhydric alcohol ester of vegetable oil acids and are hardened with the aid of metallic soap driers.

Type 2. one-package, moisture-cured urethane coatings characterised by the presence of free isocyanate groups and capable of conversion to useful films by the reaction of the isocyanate groups with ambient moisture.

Type 3. one-package, heat-cured urethane coatings that dry or cure by thermal release of blocking agents and regeneration of active isocyanate groups.

Type 4. two-package, catalyst-urethane coatings that comprise systems wherein one package contains a prepolymer or adduct having free isocyanate groups capable of forming useful films by combining with a relatively small quantity of catalyst, accelerator or cross-linking agent such as a monomeric polyol or polyamine contained in a second package. This type has limited pot life after the two components are mixed.

Type 5. two-package, polyol-urethane coatings that comprise systems wherein one package contains a prepolymer or adduct or other polyisocyanate capable of forming useful films by combining with a substantial quantity of a second package containing a resin having active hydrogen groups, with or without the benefit of catalyst.

Type 6. one-package, non-reactive lacquer-urethane solution coatings characterised by the absence of any significant quantity of free isocyanate or other functional groups. Such coatings convert to solid film primarily by solvent evaporation. See *urethane coatings* and *isocyanate resins*.

Polyvinyl Acetate A colourless thermoplastic, water-insoluble, resinous high polymer derived from the polymerisation of vinyl acetate with a catalyst; used as a latex polymer in certain paints. Abbreviation: PVA and PVAc.

Polyvinyl Chloride A hard and tough plastic solid. Stabilisers are necessary to prevent discolouration from exposure to light and heat. Used for plastics and coatings. Commonly known as vinyl. Abbreviation: PVC.

Powder Coating A 100% solids coating applied as a dry powder and subsequently formed into a film with heat.

Pre-polymer A material at an intermediate stage of polymerisation between that of the monomer and the final polymer.

Pretreatment Process of preparing a part for coating, usually involves cleaning and conversion coating processes.

Refractive Index A number which provides a measure of the refraction or "bending" of light when it passes from one medium to another. When light travels from a less dense medium to a more dense medium, e.g. air to powder coating, the refractive index is greater than 1. The denser the polymer coating, the greater the value of refractive index. A good use of this measurement is seen in the difference between the use of a pigment and an extender.

Reclaim powder Oversprayed powder that has been recovered for reuse.

Recovery system Separators, e.g. filters and cyclones, that recover oversprayed powder from the air stream.

Rheology The science of deformation and flow of materials. It is more than just viscosity and deals with the effects of energy applied to materials.

Salt spray test Accelerated corrosion test for assessing the corrosion resistance of coatings.

Saturation The attribute of colour perception that expresses the amount of departure from a grey of the same lightness. All greys have zero saturation (ASTM).

Silicone Resins Group of resins containing a substantial amount of silicon, distinguished by their outstanding heat resistance, high water repellence, and chemical resistance. They are made by preparing dialkyl dichlorosilanes from silicon tetrachloride and the corresponding alkyl magnesium bromide. The disilanes are converted to silanediols, which are polymerised into resinous products. Mixtures of silanediols and triols are copolymerised to yield thermosetting resins.

Specific Gravity Weight of a given volume of any substance compared with the weight of an equal volume of water. See *density*. Note: in SI units the term "relative density" is preferred. It is expressed purely as a number, it has no units.

Specular Gloss Relative luminous fractional reflectance from a surface in the mirror or specular direction. It is sometimes measured at 60° relative to a perfect mirror.

Substrate The material being treated or coated.

Subtractive Primaries Cyan, magenta, and yellow. Theoretically, when all three subtractive primaries are combined at 100% on white paper, black is produced. When these are combined at varying intensities, a gamut of different colours is produced. Combining two primaries at 100% produces an additive primary, either red, green or blue:

100% cyan + 100% magenta = blue

100% cyan + 100% yellow = green

100% magenta + 100% yellow = red

Surfactant or surface active agent Compound that alters the surface tension of a liquid.

Surface Tension The property arising from molecular forces of the surface films of all liquids which tends to alter the contained volume of liquid into a form of minimum superficial area. Surface tension is the reason why some liquids, e.g. water, show a concave meniscus (surface shape) and others, e.g. mercury, show a convex meniscus.

Suspension A mixture of fine particles in a liquid or gas where the particles only settle very slowly.

Thermoplastic Capable of being repeatedly softened by heating and hardened by cooling.

Thermosetting Having the property of undergoing a chemical reaction by the action of heat, catalysts, ultraviolet light, etc., leading to a relatively infusible state.

Thixotropic Adjective which describes a full-bodied material which undergoes a reduction in viscosity when shaken, stirred or otherwise mechanically disturbed and which readily recovers the original full-bodied condition on standing. Non-drip paints are thixotropic.

Transfer Efficiency The application transfer efficiency of materials is important to reduce waste. The higher the transfer efficiency, the better. It is calculated in powder coating by measuring the amount sprayed compared to the amount applied.

Tribo-charging The process of producing an electric charge on coating powders by friction.

Tribo-electricity The phenomenon of producing static electricity by friction, rather like the spark one can create by rubbing one material against another.

Tristimulus Of, or consisting of, three stimuli; generally used to describe components of additive mixture required to evoke a particular colour sensation.

Ultraviolet radiation Radiation with a shorter wavelength than visible light and is capable of breaking chemical bonds. Can cause fading of coloured coatings but can also be used for rapid curing of thermoset materials.

Urethane Coatings Coating vehicles containing a polyisocyanate monomer and reacted in such a manner as to yield polymer containing any ratio, proportion, or combination of urethane linkages, active isocyanate groups, or polyisocyanate monomer. The reaction products may contain excess isocyanate groups available for further reaction at the time of application or may contain essentially no free isocyanate as supplied. See *Polyurethanes*.

Vehicle The portion of a powder or paint in which the solids are dispersed. In the case of a powder this will be the polymer.

Venturi A device which creates a forced airflow within a chamber and therefore suction. The principle is similar to that of a vacuum cleaner. A powder-pumping device uses this method of siphoning powder from a fluidised bed of powder and then propelling it towards the application device.

Vinyl Acetate Plastics Plastics based on resins made by the polymerisation of vinyl acetate or- copolymerisation of vinyl acetate with other unsaturated compounds, the vinyl acetate being in greatest amount by mass. See *polyvinyl acetate*.

Virgin powder Coating powder that has not been previously used.

Viscosity The inbuilt resistance to flow which a fluid (i.e. liquid or gas) possesses. Water pours easily, it has a low viscosity. Treacle has a much higher viscosity. Viscosity is caused by the frictional forces created between molecular layers of a fluid when the fluid moves. If the different layers of fluid are moving with different velocities, viscous forces come into play, tending to slow down the faster moving layers and to increase the velocity of the slower moving layers. A coefficient of viscosity is defined which is measured in Newton seconds per square metre (SI units); the older (c.g.s.) unit is the poise. 1 centipoise = 10^{-3} Ns/m².

Undercured Coating that has not been heated for longer enough or to a high enough temperature and consequently is not fully cured and exhibits inferior properties.

Viscometer An instrument for measuring flow properties. The chief types of viscometers are: capillary, rotational, outflow or efflux (BS, Ford or Zahn cup, usually called orifice type), falling ball, bubble tube.

Volatile Organic Compounds (VOCs) Solvents, thinners and diluents based upon organic liquids that rapidly evaporate.

Zinc phosphate Conversion coating used to enhance adhesion of powder coatings and inhibit underfilm corrosion.