Dulux PROTECTIVE COATINGS

Roadmarking Paints & Coatings

There are a number of reasons why concrete or asphalt surfaces require painting or coating. These include adding lines or boundaries for parking, or demarcation e.g., for sports courts, pedestrian walkways, etc.

This Tech Note will explain the types of paints or coatings available for surface marking, the substrates upon which they are most likely to be applied over, surface preparation requirements, expected durability, slip resistant characteristics and certifications, product limitations and common mistakes leading to paint or coating failures. It does not specifically address the requirements for large surface area coating of these substrates, e.g., factory floor coatings.

SUBSTRATES

ASPHALT:

Asphalt (or more technically, asphaltic concrete) is a common name for a blend of bitumen pitch with various sizes and grades of mineral aggregates (crushed stone and sand). Bitumen is a black viscous mixture of hydrocarbons obtained naturally or as a residue from petroleum distillation. In asphalt, bitumen acts as the binder, similar to a resin material in paints and coatings. In some markets, asphalt is called "bitumen", similar to how concrete is sometimes called "cement". The term "asphalt" is preferred for the blend of bituminous resin with aggregate. Bitumen is thermoplastic, i.e., it softens with increasing heat, thus asphalt also has thermoplastic properties.

There are several types of bituminous materials used in asphalt, each with specific characteristics that make them suitable for different circumstances in road or pavement construction. The choice of bituminous material and the constitution of the asphalt mix, (e.g., sizes and amounts of aggregate; the ratio of bitumen to pigment, compaction extent and void content), depends on factors such as traffic load, climate, location, availability of resources and project requirements.

Municipal roads, footpaths and carparks, sports courts and airport runways are often made of asphalt. This is laid as a thick compacted layer, from 40mm to perhaps 120mm thick, with the same constitution and material right through. Rural roads more often use tar pitch with graded aggregate applied separately over a compacted road base, often called "tar seal". This results in a thin upper layer of exposed coarse aggregate bound on its underside only into the tar pitch.

The largest volume and quantity of asphalt is used in road and pavement construction due to its excellent binding capability, load capacity and waterproofing properties. This material is what is commonly called "hot mix". Most asphalt for paving, footpaths, roads and similar is produced in a blending plant, where specific quantities of the viscous liquid bitumen diluted with an aromatic solvent (often toluene) is blended with the pre-determined quantity, sizes and gradings of stone and mineral aggregate. The asphalt is shipped to the project site as a hot material, typically around 170°C, for the simple reason that the mixture is less viscous and more fluid at an elevated temperature which aids the process of laying (spreading) and compaction.

The laying and compaction must happen before the asphalt mixture cools and loses solvent otherwise the desired as-laid properties are not produced.

In remote areas away from batching plants, cold mix or bitumen emulsions might be used for their ease of application tailoring the choice of bituminous material to specific circumstances ensures optimal performance and longevity.

Cold mix asphalt is used when hot-mix production is not feasible, such as in remote areas or during colder weather. It can be produced and applied at lower temperatures. However, it may not provide the same level of durability as hot mix asphalt.

Bitumen emulsions are mixtures of bitumen and water stabilized with emulsifying agents. They are used for surface treatments, tack coats, and prime coats. Bitumen emulsions are preferred for areas where hot mix plants are not available, and they provide good adhesion to various types of aggregates.

CONCRETE

Concrete is a composite material, first invented by the Romans over 2,000 years ago, composed of mineral aggregates bonded together with a Portland cement paste that cures over time. Concrete is the second-most-used substance in the world after water, and is the most widely used construction material as well as for roads, footpaths, forecourts, carparks, runways, etc.

Concrete and its properties and characteristics are dictated by cement to aggregate ratios, water content, aggregate types and grades and some additives.

Finished concrete substrates vary in appearance, profile, hardness, compressive strength, permeability and load-carrying resistance. It is also common for chemicals and sealers to be applied to concrete during or after laying to add additional protective or aesthetic properties.

During the laying, compaction (vibrating), water desorption and curing, a weak, milky layer of cement dust, lime, and sand fines forms on the surface of concrete. This is called "laitance". This layer can be problematic to apply paints and coatings over due to its poor adhesive bond and low cohesive strength.

Many concrete slabs, e.g., for carparks, are rotary float finished on their working surface using what is called a "helicopter". This produces a hard, glossy, tile-like finish of compacted high-density laitance. This can often have a poor adhesive bond to the concrete substrate and will often be a difficult substrate to apply coatings to due to its low porosity and a fragile bond.

Concrete has a degree of porosity allowing moisture to enter the substrate, and, under certain conditions, will lead to evaporation of sub-slab moisture via its porous matrix. This water content and movement mechanism can make it difficult to satisfactorily apply some coatings and can cause through-service disbondment.

All too often, the implications of applying linemarking paints and coatings are not usually considered during the planning, installation or finishing of concrete.

For these reasons, due to its varying types, constitution and finishes, concrete can be a problematic substrate to satisfactorily paint or coat.

COATINGS & PAINT TYPES

A range of paints and coatings are used for the linemarking of concrete and bitumen substrates.

These include:

- Single component alkyd-modified chlorinated rubber (solvent containing);
- Single component water borne acrylic (contains some organic solvent as well as water);
- Two-pack epoxy coatings (solvent- or water-borne); and
- Two-pack polyurethane coatings (solvent- or water-borne).

There are also a number of specialty type roadmarking products that are not covered by this Tech Note.

Single component solvent- or water-borne paints are the most widely used for line and roadmarking due to their easy application and fast drying characteristics. They are generally a low-cost product and are often the most cost-effective product option.

Their fast dry characteristics can limit their ability to effectively adhere to smooth substrates and their ability to penetrate substrate such as concrete is also limited.

Their generic characteristics and lack of chemical polymerisation in curing will often lower their abrasion and wear resistance.

When required, they are readily recoatable with themselves and overall provide short- to mid- term durability depending on abrasion and environmental exposure.

Roadmarking products are manufactured in specific colours that include White, Yellow, Red, Black, Roadmarking Blue & Roadmarking Green. Tinting or changing of these colours is not recommended and alternative coatings can be considered and used.

UV & SERVICE EXPOSURE

All exposed paints and coatings will be subject to a slow but progressive degradation by UV exposure, temperature, water exposure, weathering, abrasion and substrate changes or stresses. The effects of the above in various combinations can contribute to stress on coated surfaces and/or the substrate.

The solvent content of coatings can affect the asphalt resulting in cracking beneath the coating or at the coating edge, or bleeding of the bitumen into the film.

SUBSTRATE CURING

Asphalt needs time to cure after being laid and compacted. This can take several weeks or longer. The main change is the release of the solvent diluent, often toluene, from the asphalt. Even after the solvent has been released, the asphalt can be re-solvated by some organic solvents in the applied linemarking paint. This can result in bleeding of bitumen pitch, customarily black, into the fresh paint film.

Concrete also needs to be fully cured before any coating or linemarking is applied. It takes at least a month for the hydration and related reactions to run to completion.

Expansion and contraction of the asphalt or concrete substrate can lead to cracking, delamination and damage to the substrate and the applied coating.

SURFACE PREPARATION

Correct surface preparation and appropriate cleaning of the substrate is vital. Obtain specific technical and product advice before commencing.

Asphalt usually doesn't need any mechanical surface preparation, as it typically has a surface profile with a measure of topographical amplitude after compaction. This usually provides a fairly appropriate surface profile. However, it must be clean and dry. Dust that embeds into the surface profile will comprise adhesion.

Concrete will almost always require some mechanical or chemical surface preparation, dependent entirely on how it was laid and compacted, any past use or exposures, and the nature and form of the intended coating.

Concrete substrates can contain or have been treated with bond breakers, densifiers or curing agents. Concrete surfaces in logistics or warehouse type environments that have been polished or burnished to provide a very smooth water and chemical resistant finish restrict the adhesion of linemarking paints and coatings. Without the required surface preparation, coating delamination or damage is certain.

Aged concrete that has been exposed to oil, fuel or grease, wheeled traffic, chemicals or has been previously coated or sealed will require a higher degree of cleaning and surface preparation. Multiple steps are likely to be needed to clean and then prepare the substrate including a suitable detergent.

Options for mechanical surface preparation include waterblasting, abrasive blasting, scabbling, rotary grinding and needle gunning.

There are standards and guides available, e.g., from the ICRI (International Concrete Repair Institute), that explain and depict various grades of surface profile achievement on concrete after mechanical preparation using visual ands tactile comparator coupons.

Acid etching is not favoured for concrete preparation before using linemarking paints of these types.

Burnished or polished concrete. Roadmaking coating delamination due to no surface preparation to promote coating adhesion.

Concrete surface. Roadmarking coating delamination due to poor surface preparation & surface contaminants.

COATING APPLICATION

After surface preparation and cleaning, the substrate must be dry, dust-free and clean. These conditions must exist at every recoating step and during cure.

Weather and other influences can affect coating application, curing and performance. High or low temperatures affect how coatings apply, release solvent, polymerise and cure.

Multi-component coatings such as epoxies have a lower temperature limit (both substrate and air temperatures) for application and cure. Both hot and very cold substrates are distinctly challenging.

Air movement is generally helpful during application and cure, but excessive wind can cause rapid solvent loss. Painting in enclosed spaces can be problematic if solvent release isn't vented or if CO2 or moisture vapour accumulation occurs in the vicinity of the curing coating. The latter can cause a greasy amine sweat or carbamate film to form on a curing coating, especially epoxies. Moisture vapour will cause a dulling of many convertible coatings, specifically polyurethanes.

The coating must be mixed as per the PDS (product data sheet) or as instructed by a Dulux representative for specific application conditions. The precautions contained in the SDS (Safety Data Sheet) must be observed especially in regards to safety equipment and provisions for spills and cleanup.

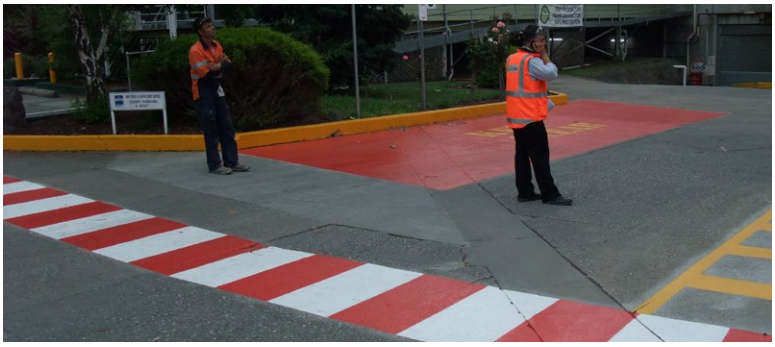
Application should be performed using the recommended coating application equipment and technique as described in the PDS or other reliable source. Recoat times – both minimum and maximum – need to be observed.

Film build achievement per coat and for the entire system are important and need to be monitored strictly. Using a WFT (wet film thickness) gauge during application is a useful method of ensuring conformance.

Excessive coating film build during application or continued reapplication over existing painted lines can lead to product failures due to overbuild and cumulative stress.

Bright colours can require multiple passes or applications to achieve a satisfactory result of opacity and coverage. It is critical to not over-apply the coating which will lead to solvent entrapment, wrinkling and damage.

The addition of approved non-slip aggregates can improve the slip resistance of these products for both internal and external environments. The inclusion of aggregates, their type and size can greatly reduce the product's longevity due to its exposure to abrasion and impact. Aggregate addition must be strictly controlled as this changes the resin to pigment ratio, potentially leading to cohesive fortitude loss.



2 Pack polyurethane coating applied to external asphalt surfaces. Suitable for broad surfaces.

QUALITY CONTROL

Like all coatings-related works, it is important to follow the PDS's instructions and the SDS to ensure safe use during mixing, application and equipment cleaning.

Accessing project-specific advice or specifications from Dulux can help to identify substrate or environmental challenges and to provide information on expected product performance.

Quality control records will assist with the recording of surface preparation works, mix ratios, thinning percentages, coating application times along with the environmental conditions during the works and through curing. Hot, cold, wet or contaminated substrates all have an affect on product performance.

Seek advice from your Dulux Protective Coatings Representative for all information required.

It is common for coating contractors to apply or use various generic types of roadmarking products, and when performing maintenance new paint materials inevitably get applied over existing lines.

For example, water-based and modified alkyd chlorinated rubber type products should not be applied over each other as they are not compatible. Epoxy coatings cannot be applied over chlorinated rubber materials, irrespective of the age of the latter.

Industrial-grade roadmarking coatings are manufactured with certain application and drying characteristics and should only be used by experienced coating applicators.

DURABILITY & PERFORMANCE

The durability of roadmarking coatings is affected by the environment, exposure to abrasion, substrate preparation prior to application, contractor experience, film build achievements, application equipment and other factors. It is to be expected that roadmarking coatings will require regular maintenance and recoating.

Performance warranties can not be provided.

Roadmarking coatings can be subject to dirt pickup immediately after application. Dirt or staining is difficult to remove.

Linemarking coatings may conform to a slip resistance standard, but for flat surfaces only. Linemarking coatings are often applied to raised pedestrian walkways making the ends or edges a hazard for foot traffic.

Abrasion of the coating product can result in fine dust particles that can be easily detected and can be spread throughout out the area requiring extra cleaning.

Roadmarking coatings are most suitable for line marking, pedestrian crossings and specialised parking areas requiring specific identification patterns, stencils and colours. Roadmarking coatings are not recommended for full coating of broad areas.

General example of Roadmarking coatings applied to bitumen road surfaces.

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The following prints show various forms of wear, breakdown, bleed-through, inadequate surface preparation, differences due to substrate, lack of adhesion retention and inadequate film build leading to poor opacity. Careful attention to the key factors that are important to durability and performance are essential.

External concrete surfaces. Roadmarking coating wearing away due to no surface preparation prior to application.

Wrinkling of Roadmarking coating due to excessive application.

Not all of the paints and coatings used for line and road marking are cross compatible. It is very important to establish exactly what the generic nature of any existing lines or markings are before attempting recoat works.

Roadmarking coating applied to both concrete and asphalt surfaces. No surface preparation applied to concrete surface & asphalt cracking highlighted by coating.

Raised pedestrian crossing coated with Roadmarking coating showing asphalt cracking. Raised surface can increase slip hazard to pedestrians.

Dry film build testing of over applied Roadmarking coating. Still soft after 3 weeks of application and not curing.

Polyurethane 2-pack coating samples being applied to burnished or polished concrete surfaces to assess adhesion and suitability.

Roadmarking coating applied to concrete warehouse surface. Broadcast aggregate applied to coating for non-skid purpose.

Heavy forklift traffic and exposure crushed the aggregate resulting in excessive wear and tear of coating. Roadmarking coating not suitable for this type of exposure & abrasion.

Roadmarking coating applied to external exposed concrete surfaces. Coating applied to wet surfaces resulting in delamination.

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