

Concrete Floors – Tyre Staining

Staining on coated concrete floors from vehicle tyres is a localised discolouration process that can leave a black, brown or perhaps a yellow stain in the tread pattern of the tyre on the painted finish of a light-coloured floor coating. The cause is a leaching of some materials used in the manufacture of the tread part of tyre onto or into the coating material, sometimes across the surface where a rolling tyre has traversed, but more specifically where it rests when parked.

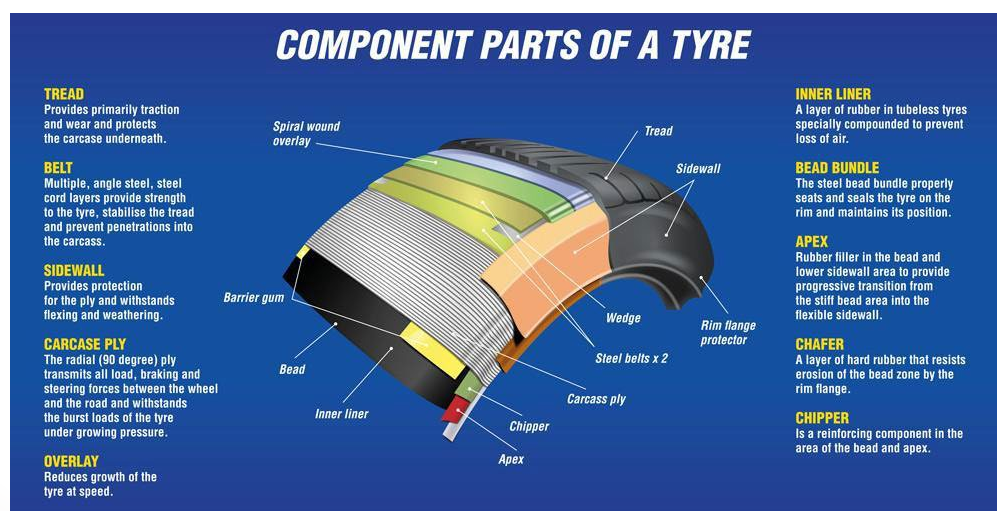
Vehicle tyres are manufactured from a mixture of natural, manufactured and synthetic rubber compounds with various fillers, pigments, oils and additives including plasticisers, stabilisers and antioxidants. Two of the major filler materials are carbon black and silica. Steel mesh (belts) and cord, nylon bands and other structural materials are used in the carcass of the tyre, but not on the exposed and wearing surface of the tread, which is where any staining emanates.

Typical materials and compounds used in vehicular tyres include: carbon black, natural rubber, synthetic rubber, accelerator, silica, activator, butadiene rubber, stearic acid, antioxidant, light shield wax, zinc oxide, sulfur, rapeseed oil and mineral oil.

Carbon black not only provides tyres with their distinctive dark colour, but is also used as a contributor to strength and durability.

The stain usually materialises when the tyres are at rest on the painted surface for some duration. This is different from a “skid mark” where there is a relative difference in velocity between a tyre and its contact surface, either from hard braking or rapid acceleration. This latter form of marking is not the subject of this Tech Note.

Tyre stain is usually due to the progressive release of one or more of the additives used in the formulation of the tyre tread. One common ingredient is called 6PPD¹. Another is called IPPD². Both 6PPD and IPPD protect the rubber from cracking and deterioration as well as providing temperature stability and resistance to flexure cracking. These are organic chemicals widely used as stabilising additives in rubbers, such as NR (natural rubber), SBR (styrene-butadiene rubber) and BR (butyl rubber); all of which are common in vehicle tyres. Although these are effective antioxidants, they are primarily used because of their excellent antiozonant performance. 6PPD and IPPD have been found to progressively migrate through the rubber matrix and onto the surface of the tyre where they react with ozone (O₃) more readily than the ozone can react with the rubber. 6PPD has a slightly slower migration or leaching rate than IPPD, hence is favoured by some tyre manufacturers. Some tyre brands use both compounds. Once these materials leave the tyre and make contact with the floor coating, they oxidise, which is why the colour develops.



Above:
An example of tyre stain on a coated floor. This shows a single-contact stain. Parking in much the same location over time will give a less defined pattern

Left:
Major components of vehicular tyres.
Courtesy: Goodyear

1 6PPD. N-(1,3-dimethylbutyl)-N'-phenyl-1,4-benzenediamine

2 IPPD. N1-Phenyl-N4-(propan-2-yl)benzene-1,4-diamine

The tendency of the tyre to stain the floor coating depends on the age of the tyre, the nature of the tread compounds, the duration of the contact, any temperature implication from the tyres, and the generic type, the state of cure and colour of the coating. Lighter colours tend to show staining to a greater extent.

Another partly related occurrence is softening or some de-constitution of the coating. Catalysed coatings such as epoxy and polyurethane are generally resistive to any softening due to the release of the antiozonants or oils; but other coating types such as vinyls, chlorinated rubber, acrylics, alkyds and single-pack polyurethanes – some of these often used as light industrial or decorative paints for concrete floors – can sometimes be softened or affected by the additives or oils.

The state of cure of the floor coating is one important aspect. Even catalysed coatings such as epoxies and polyurethanes are only partly cured several days after application, even though they appear to be quite dry. Often a week or more is required before the crosslinking reactions run to effective completion. Vehicles should not be parked on floors before the cure is essentially complete, typically around seven days.

There isn't anything a vehicle owner can do that will change the rate of progressive release of chemicals from the tyres that could cause staining. To minimise its visual extent, choosing floor colours in a darker shade will cause less contrast. Using mats or an impermeable sheet material in the position where the vehicle tyres will be when parked is another useful measure. Avoiding parking whilst the tyres are at elevated temperature and/or are wet after driving can also minimise staining.

Disclaimer of Warranty and Liability

Due to the wide variation in tyre composition, age, and chemical formulation, Dulux makes no warranties – express or implied – regarding the performance of its floor coatings in relation to tyre staining.

While Dulux coatings are formulated to provide high durability and chemical resistance, the interaction between tyre compounds (including those such as 6PPD, IPPD and aromatic oils) and floor coatings is highly variable and can be influenced by numerous uncontrollable factors, including but not limited to:

- Tyre brand and formulation;
- Age, condition and temperature of the tyre;
- Environmental exposure (UV, ozone, humidity);
- Floor temperature and coating cure time; and
- Vehicle weight and the duration of contact.

Accordingly, Dulux will not be held liable for any claims, damages, or losses arising from tyre staining, including discolouration, surface degradation or aesthetic changes to the coating.