

Features | 16 December 2014 | Story: Shreejit Changaroth

THE SCIENCE OF ROAD CONSTRUCTION IN SINGAPORE

The “road” to enjoyable driving begins with a “clean” surface. If it’s “dirty”, even driving a good car on it would be a bad experience. Speed limits and traffic jams already spoil much of our motoring enjoyment, and it’ll be even worse if motorists also have to deal with potholes.

Singapore has over 3400 kilometres of paved roads and they’re generally among the world’s best in surface quality. Those rough and uneven sections around MRT tunnelling works are only temporary – everywhere else, our roads are kept up to scratch by periodic maintenance.

BLACKTOP BASICS

What is frequently and erroneously referred to as tar is, in fact, asphalt, which is a mix of aggregate (usually granite) and a petroleum derivative called bitumen, the final distillate of crude oil. Tar, on the other hand, is a coal derivative, and even though its characteristics are similar to bitumen’s, tar is excluded from use in road surfacing these days due to its carcinogenic properties.

Asphalt is what we see on the road surface. Constructing a road begins with the “Sub-Base”, comprising large granite stones that provide the foundation. Next up is the “Road-Base”, which is another layer of stone, this time made up of slightly smaller pieces so that it compacts easily on the base layer. The first of two asphalt layers, known as the “Binder Course”, comes next and forms the structurally sound, load-spreading substrate. Made up of a homogenous mixture of stone and bitumen that functions as the binder, it possesses a certain degree of flexibility and resists cracking under load.

The finished surface is made from another asphalt mix, which can be tailored to suit different applications. Using a vibratory sieve, the size of stone used is selected for mixing with the bitumen, itself also customisable.

“BLACK” OPS

Samwoh Corporation, probably Singapore’s largest road construction company, produces a wide range of asphalt grades. According to Samwoh’s senior technical manager Dr Kelvin Lee, “A variety of asphalt grades are possible with our in-house developed PMB, which stands for Polymer Modified Bitumen. In addition, we are heavy users of recycled aggregate from other sectors of the construction industry, even though we have our own offshore granite quarry.”

The industry refers to the top layer of the road surface as the “Wearing Course”, for obvious reasons. This is the asphalt pre-mix which is in direct contact with vehicle tyres. It would be easy to engineer a resilient pavement using hard-wearing PMB, but that would affect the level of grip and thereby compromise road safety. The available surface friction between tarmac and tyres is a critical parameter. It is determined according to the road’s designated speed and expected traffic load, so the asphalt formula used for, say, Kranji Way is very different from that of Kranji Expressway.

A few years ago, Samwoh was tasked to formulate a new asphalt with some peculiar specifications. It’s a high-performance grade with very high friction properties. The company eventually labelled it the “F1 Asphalt” and continues to provide the material whenever there is a requirement to resurface our Marina Bay Street Circuit just before the Formula One race weekend.

ROAD “WORKS”

On the subject of road maintenance, Samwoh’s Dr Lee told us that they work closely with the Land Transport Authority (LTA). “We own a series of highly specialised laser and sonar equipment to analyse surface thickness, transverse and longitudinal deflection, 3-D profile, friction coefficient

and wear pattern. The data we acquire is provided to the LTA for their input into the Pavement Management System or PMS”.

Thanks to the PMS, Singapore’s islandwide road maintenance is scheduled long before the road surface wears to a point where holes and ruts begin to appear. “Corrective road maintenance is an extremely rare occurrence in Singapore”, added Dr Lee.

The road’s “Wearing Course” must be removed prior to any resurfacing. Those machines we often see with a long conveyor belt in front, following a tipper truck and spewing waste into it, are called milling machines. They grind off only the top of the blacktop, so to speak, leaving the other layers as they are.

All the material that is ground and removed isn’t dumped as waste. Instead, it is reused as aggregate in new asphalt mix. A mixing-and-batching plant prepares the premix according to the required specifications for the particular road being repaved. Samwoh’s latest asphalt factory is designed to reuse the milled surface from roads undergoing refurbishment.

The final task is for the road-laying machine to fill up the milled sections with a fresh, clean, black and grippy “Wearing Course” for that smooth and comfortable ride.

