



Bitumen Emulsion for Chip Seals

Frequently asked questions

What is a Bitumen Emulsion?

A bitumen emulsion is a suspension of bitumen droplets in water which reduces viscosity to enable spraying at low temperatures.

For chip seals, the viscosity of the bitumen has to be reduced to enable it to be sprayed. There are two methods of reducing viscosity for spraying; one is to heat bitumen (usually to about 170°C) and the other is to emulsify the bitumen. After the emulsion is sprayed the water evaporates from the road surface and bitumen remains to hold chip in the chip seal.

How is bitumen emulsion made?

Emulsion manufacturing plants mill the bitumen into very small droplets and with the addition of emulsifiers and chemicals can suspend those droplets in the water. Droplet size, bitumen content and chemical addition are accurately controlled.

This reduces the viscosity of the bitumen enabling it to be sprayed without high temperatures. Due to the presence of water, emulsions cannot be heated past about 90°C.



HAS LESS CARBON
than hot or cut back bitumen



CONSUMES
Less energy



Contributes to
HIGHER
Productivity and
GREATER
Safety



Is Bitumen Emulsion new?

Bitumen emulsions have been manufactured and used since the early 1900s. They have been widely used for some chip seal types since. In recent times improvements in technology and manufacturing plants have meant that the properties of emulsions have also dramatically improved. Emulsion is now able to be used for all chip sealing types and is a viable replacement for hot cut back bitumen.

Where can you use Bitumen Emulsion?

Emulsion can now be used in all chip seals.

Recent advances in emulsion technology have meant the traditional limitations associated with older emulsion have been overcome. Emulsions are now able to be sprayed on steep slopes without run off, high application rates can be achieved, storage stability issues have been solved and cure times significantly improved. This means that emulsions can now be used for all chip seal types. Because emulsions eliminate the significant hazards associated with hot cut back bitumen the use of emulsion for chip seals should now be considered best practice.

What are the advantages of emulsion over cut back?

Emulsion is safer, produces less emissions and is now technically superior to hot cut back bitumen for chip seals.

Recent advances in technology mean that emulsions are now capable of being used in all chip seal types in New Zealand. The major advantages of emulsion are;

Safety, hazards are eliminated, explosions, fires and serious burns.

Environmental, emissions are significantly reduced (almost 50% less)

Application rates may be able to be reduced.

Improved adhesion means reduced chip loss and therefore reduced rework



Why should customers make the change to Bitumen Emulsion?

Emulsion is safer, produces less emissions and is now technically superior to hot cut back bitumen for chip seals.

There are many technical benefits associated with the use of emulsion which include;

Improved adhesion, less initial chip loss, reduced flushing, longer seal lives, and the elimination of kerosene. Some are more effective than others and a very conservative view would be that, emulsion seals perform at least as well as hot cut back seals and in many cases they perform better. Simply emulsion is now a viable replacement for hot cut back in all chip seals.

However, the largest benefits of emulsion seals over hot cut back bitumen seals are associated with the reduced risk of harm to people and reduced emissions to the environment.

Under the Health and Safety at Work Act (2015; 2016), there is the requirement for "a Person Conducting a Business or Undertaking (PCBU) so far as reasonably practicable to eliminate risk in the workplace".

While sealing with emulsions is not free from hazards, those hazards are significantly fewer than those associated with hot cut back bitumen and emulsion should be used instead of cut backs to comply with the Act.

What grade of bitumen is in the emulsion?

Emulsions are now made from the same grades used as hot cut back bitumen.

Recent advances in emulsion technology mean emulsions can be made for any of the commonly used bitumen base grades. If a bitumen base grade has been chosen for a region and used successfully as cut back, then that same base grade can be used for the emulsions.

How long does it take to cure?

Emulsions are 100% cured when all the water has been evaporated. This means actual cure times are affected by factors such as; application rate, temperatures, wind, and humidity. Road Science has extensively tested and researched the curing time of their emulsions in various conditions. This testing and research means curing times can be calculated if the factors above are known. The result of this work is a product performance forecasting tool (known as SIS) which provides cure time information to teams based on actual real time weather data.

Can we seal steep slopes?

Sealing steep slopes is no longer a problem for emulsions. Recent advances in emulsion technology mean that the emulsions are very thick but still able to be sprayed. This means they do not run off steep slopes any more. Application rates of in excess of 2.5litres/m² have been sprayed on grades of 1 in 8 without run off.



How much does it cost?

Emulsion is more expensive to produce than hot cut back bitumen. Some customers expect that emulsion seals may cost around 15% more than hot cut back seals. There are many factors to take into consideration. Some customers have chosen emulsion purely on health and safety grounds. Others also see technical benefits. It is difficult to provide an accurate figure for the price difference. The best, most accurate information will come from those who have chosen to use emulsion rather than cut back.

What if it rains?

Emulsion is a water based system and should not be sprayed in the rain.

While emulsion seals applied in rain usually do not lose chip they can create an unsightly wash off which should be avoided. Road Science has improved the cure time of emulsion to lessen the risk of wash off and have a product performance forecast tool to assist teams assess the risk of wash off. It should be noted that while hot cut backs have been sprayed in rain, chip will not adhere in wet conditions and stripping is a significant risk.

How storage stable is it?

Emulsions are now storage stable.

Recent advances in emulsion technology have eliminated storage stability issues of the past. Provided good practice is followed there are no storage stability issues with modern emulsion. A modern emulsion is now more storage stable than hot cut back bitumen.

Does it need kerosene?

Emulsions significantly reduce the need to add kerosene.

Kerosene is added to hot cut back for two reasons, to improve adhesion and to soften the binder in the early stages of seal life. Research has shown that 20% of the kerosene in hot cut back is lost to atmosphere when spraying and another 30% within a few hours of spraying. Emulsion does not need kerosene to assist with adhesion. Therefore, any kerosene added to an emulsion should only be considered to soften the binder in the early stages of seal life. Because all the kerosene added remains in the binder, only half the amount used in cut back should be considered. During the summer months most emulsion should be sprayed with no kerosene added. In the future emulsions will contain a "greener bio" binder softening agent and kerosene will be eliminated altogether.



Do Bitumen Emulsions reduce pick up/tracking?

Using emulsion can reduce pick up and tracking.

In most situations emulsion does not require kerosene to be added to the base binder. This results in a cured binder that is more resistant to roll over, pick up and tracking on hot summer days.

How long do Bitumen Emulsion seals last?

Emulsion seals will last at least as long as the equivalent hot cut back seal.

There have been many comparisons of seal life between cut back and emulsion seals. It should be realised that in the past emulsions were mainly used for small chip sizes (texturising seals) and therefore any historic comparisons will not be accurate. Today there is no reason why an emulsion seal would not last as long as the equivalent hot cut back seal. It could be argued that in fact emulsion seals will last longer because the binder has not been oxidised as much. However, in reality this difference may not be seen because seals "fail" due to reasons other than whether they were emulsion or cut back.

Can you use emulsion for first coat seals?

Emulsion is suitable for first coat seals.

Because emulsions have superior adhesive properties and are successful in damp conditions they are especially suitable for first coat seals.

Can application rates be less than cut back?

Application rates can be reduced when using emulsion.

Because emulsions have improved adhesion when compared to hot cut back bitumen it may be possible to spray less "residual" bitumen to achieve the same result. Care still needs to be taken and as experience grows some designers do successfully reduce application rates.

Can emulsion be used for single coat seals with high application rates?

High application rates are no longer a problem for emulsion seals.

Recent advances in emulsion technology mean emulsions can be sprayed at high application rates without running off the road. There are no longer constraints of how much can be sprayed and rates of in excess of 3 litres/m² are easily achieved without run off.

Do emulsions reduce flushing?

Using emulsion can reduce flushing.

There is evidence which suggests that due to improved adhesion, application rates can be reduced when using emulsion. This in turn can reduce flushing in the future. However, most flushing is due to water induced venting and while using emulsions can reduce the effect, because there is less binder on the road, the difference may not be significant.



Do emulsions penetrate?

Emulsions penetrate and adhere to both dry and damp surfaces because they are a water based system. When compared to cut back penetration of existing surfaces it is not possible to measure any difference between the two systems. It is worth noting however that while some believe cut back bitumen penetrates base course layers this cannot be measured. In damp conditions emulsion will penetrate more than hot cut back, but again is not able to be measured.

How are emulsions sprayed?

Emulsion is sprayed with conventional bitumen spraying equipment.

Some of the more advanced emulsions require only minor modification to spray nozzles on conventional spray equipment. Emulsion can be stored and transported in conventional bitumen tanks and tankers. As demand increases for emulsion and conventional equipment is retired, the opportunity presents itself to build specific emulsion spray and transport equipment. This could mean improved efficiencies over time.

Can you seal at night with emulsions?

Emulsion can be used at night. The use of the Road Science product performance forecast tool assists teams assess the cure time in differing environmental conditions. They are routinely sprayed at night in Auckland and recently on a section of State Highway 2 during night closures.

Can you use emulsions for membrane seals beneath hot mix asphalt?

There is no real difficulty using emulsions for membranes either at night or in the day. Any water remaining in the emulsion when the mix is applied is driven off by the heat of the mix.

Emulsions have been used successfully as membranes under hot mix for the last 7 years during the day and night.

What has brought on the change from hot cut back to emulsion?

Emulsions are much safer to use than hot cut back bitumen.

Chip Sealing with hot cut back bitumen has been the method used in NZ for many decades. While emulsions have been used for a long time traditionally they have not been able to substitute for hot cut back. Recent advances in emulsion technology mean that emulsions have now become a viable replacement for hot cut backs. The new NZ Health and Safety legislation has increased the responsibility of all people involved in the industry, where reasonably practicable, to eliminate hazards. The use of emulsions eliminates the significant hazards associated with hot cut back bitumen.



What are the hazards associated with Hot Cut Back bitumen?

Fires, burns and explosions are some of the hazards associated with hot cut back bitumen.

Because hot cut back is heated to reduce viscosity to temperatures in the order of 170°C and the kerosene added to the bitumen (cut back) has a flash point in the order of 38°C this introduces significant health and safety hazards which include; Fires, Explosions, Burns (from contact with equipment and product), and Fumes. Because kerosene is emitted to atmosphere and energy is required for heating, environmental emissions are high and can be 50% more than emulsion sealing.

Where is emulsion made?

There are around nine emulsion manufacturing plants in New Zealand, and more will be established as demand grows. There are at least three companies manufacturing emulsions in New Zealand. Emulsion manufacturing plants are usually located at existing bitumen facilities.

What future developments can be expected?

Further development is already in progress to improve the performance of emulsions.

Significant advances in emulsion technology have occurred over the last few years. The performance of emulsions has improved to the extent that they are now a viable replacement to hot cut back for chip seals.

As the uptake of emulsion increases investment in further developments will follow. Already research and development projects have established what is required to manufacture and spray 76% bitumen emulsions. This next advance will shorten cure times and increase efficiencies.

Are emissions reduced?

Emissions are significantly reduced by using emulsion instead of hot cut back.

Road Science conducted an independently audited study and found that for a final section of sealed road emissions from emulsion sealing are almost 50% less than hot cut back.

More information?

Phillip Muir, Operational Support Manager
phillip.muir@roadscience.co.nz

027 496 3661