

## **Towards Safer Sprayed Sealing Operations - Forward moving aggregate spreading**

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### **INTRODUCTION:**

Sprayed bituminous seals provide safe, durable and cost effective surfaces to a high proportion of roads in both Australia and New Zealand.

In Victoria the state road authority - VicRoads is responsible for the management and maintenance of over 22,000 kilometres of road, the majority of which is surfaced with sprayed bituminous seals (especially in rural areas) making them a key surfacing choice for the ongoing construction and maintenance of the Victorian road network.

However, while they are being constructed sprayed seal sites are an inherently dangerous place to be with a combination of hot bitumen (up to 190°C) being sprayed under pressure and with loose aggregate chips being applied to the road surface – all under live traffic conditions. There are therefore numerous potential dangers associated with these works.

The safety of the travelling public is of course a major priority and significant work has been done in the safe management of traffic at work sites.

This work continues, but the safety of workers on site is also a major priority and it is this area that this paper focuses on.

### **SPRAYED SEAL OPERATIONS:**

Sprayed sealing operations have evolved over the last 80 plus years, especially with the availability of modern high production trucks and other plant items – but the basic operation remains relatively unchanged. A typical sprayed seal operation is shown in Photo 1.



PHOTO 1. A typical sprayed seal operation: Bitumen sprayer being followed by an aggregate cover truck (operating in reverse)

When compared to older plant some of the modern units currently used have in-built technologies that reduce the number of people required. An example of this is - modern computerised bitumen sprayers are generally driven and operated by one person – whereas 40 years ago there would typically have been three people. Also, modern aggregate cover trucks do not require a person walking beside the truck to open/shut or adjust tailgate mounted spreaders as these have now been automated. These changes have seen a significant drop in crew sizes and reduce the potential for plant/people interactions that are a significant safety risk for workers on the ground. This reduction in people on the ground is good, but ironically it may have had a negative overall effect because plant operators are not as accustomed to there being people on the ground near where they are operating. In addition with the speed of modern works there is the potential for an unexpected person on the ground not being noticed by plant operators, with potentially disastrous consequences.

Aggregate cover trucks are the most common and generally the largest plant items on a work site and spread aggregate chips to the road surface after bitumen is applied by the bitumen sprayer. The cover trucks are usually standard tip trucks that are readily available, fitted with a relatively simple rear mounted spreader box that dispenses the aggregate chips while the truck is travelling in a reverse direction. The aggregate chips are usually gravity fed into the spreader box from elevated tipper bodies. Thus the current practise means that relatively inexpensive trucks, fitted with a cheap spreader box, and utilising gravity feed (which is free) are the main technologies used in aggregate spreading operations. This is a very cheap and efficient system, but one that makes safer and more accurate technologies very difficult to introduce in a competitive contract environment.

While the current aggregate spreading operation is efficient, it relies on skilled operators who have to drive the correct line, assure that the spread rate of the aggregate chips being applied is correct; whilst travelling in a reverse direction at about or faster than walking pace: and all with an elevated tipper body. This often leads to aggregate spread rates that are not well controlled, and leaves little opportunity to notice pedestrian workers who may be in an unexpected place.

Fortunately most pedestrian workers are familiar with the operation to ensure that they keep well away from reversing aggregate cover trucks and there are not many incidents involving cover trucks and pedestrian workers. However, the potential consequences of an incident occurring are high and injuries are likely to be severe if not fatal.

From an Occupational Health & Safety approach it is best to aim for the highest level of control, such as engineering controls that eliminate risks, rather than rely on human decision making and administrative controls. Several companies already have incorporated lower levels of control in their operations such as protocols for reversing trucks, spotters, and automatic braking systems that come into effect when a person or object is detected behind a reversing vehicle. However significant risks remain if these controls are not complied with and they all fail to address the primary issue of trucks reversing on job sites.

In October 2014, VicRoads had a significant injury to a pedestrian worker at one of its work sites where the worker was run over by a cover truck preparing to spread aggregate. Whilst this was a serious incident with the worker suffering a fracture to his hip, the incident was a real wake-up call and highlighted the fact that accidents can and do occur. As a result VicRoads has embarked on a journey to progressively improve the safety at its sprayed sealing work sites.

While the potential for plant and people interactions is a major concern there are also other risks associated with conventional aggregate cover trucks including the potential to hit overhead services (such as power lines) and overhanging trees etc, roll over incidents often associated with hoist or hinge bolt failures on the tipper body, or other mechanical failures.

Due to the high number of aggregate cover trucks on a typical sprayed sealing site and the high risks around this operation, VicRoads is focussed on improving the safety of the aggregate spreading operation, evaluating the plant items being used, and assessing some of the risks in this operation.

The safety of other facets of sprayed sealing works such as bitumen spraying and the rolling of aggregate chips is also being actively investigated with the intent to improve the safety of all of these operations. Currently the main priority is aggregate spreading.

Alternative equipment has been used on occasions in the past (such as self propelled aggregate spreaders) to try and address the issues associated with reversing trucks. However, the complexity of the alternatives combined with their cost has seen their implementation stall in favour of persisting with the simple reversing trucks. This has ensured that the combination of reversing trucks with people on the ground remains a high risk operation on sprayed sealing sites.

## **PLANT INNOVATIONS:**

In recent times there have been significant innovations in equipment used in sprayed seal operations, in particular from Europe.

This has included a wide range of synchronised sprayers (chip sealers) that combine the spraying of bitumen and the spreading of aggregate chips in the one forward moving operation. Some of these machines do not require the aggregate holding body to be elevated, or if elevated, then to a considerably lower height. This considerably reduces the risks of rollovers.

More recently forward moving aggregate spreaders have been developed in France. These machines transfer aggregate from a truck body either under a raised cabin or beside the cabin to an aggregate spreader that is attached to the front of the vehicle, thereby eliminating the need to apply aggregate whilst travelling in a reverse direction.

Both of these plant item options operate in a forward direction which allows the operator to have a full view of the road ahead. This allows more time for the plant operator to react to unexpected situations, such as a pedestrian worker being on the ground, or another item of plant in close proximity that may not be aware of an aggregate cover truck reversing towards them. The forward moving equipment allows the operator to observe a lot more of the work site environment, compared to what can be observed from a reversing truck.

These plant items are discussed in more detail.

1). Synchronised Sprayers.

Synchronised sprayers have been available for many years mainly from Europe and America, and in more recent times from China.

Earlier models of these machines incorporated elevating tipper bodies for aggregate spreading. The most recent models generally have either no elevation of the aggregate storage hopper or minor elevation only – usually not more than the height of the cabin of the truck that the unit is assembled on.

They are available in a wide range of sizes suitable for works starting from small maintenance patches, up to units suitable for very high production highway sealing projects. Many of these units are designed for the application of emulsified bitumen, but some are capable of spraying hot bitumen.

Synchronised sprayers only operate in a forward direction, and accurately apply both bitumen and aggregate chips as part of the same operation, ensuring a controlled application of both materials.

Examples of synchronised sprayers are shown in Photos 2, 3, and 4.





PHOTO 2. Small trailer mounted synchronised sprayer that attaches to a standard bitumen sprayer and is suitable for small maintenance patches.



PHOTO 3. Medium sized (4 axle) synchronised sprayer suitable for intermediate production sealing works.





PHOTO 4. A large articulated synchronised sprayer suitable for high production sealing works.

2). Forward moving aggregate spreaders.

Plant items that discharge aggregate chips from the front of the vehicle have recently been developed in France.

Currently there are two manufacturers that have built prototype units that are being trialled and it is understood that these units are nearly ready for production.

Both prototypes are based on readily available truck platforms, but require significant modifications such as a reduced width cabin that allows aggregate to be conveyed to the front of the unit beside the narrowed cabin, or a raised cabin that allows aggregate to be conveyed under the cabin.

They both incorporate front mounted hoppers and spreader boxes and allow an uninterrupted forward view of the work site by the plant operator from the cabin of the truck. Photo 5 shows one of these prototype vehicles.

There are also several other companies (some based in Australia) that are developing alternative systems that will achieve the same end result. Some of these are subject to patent applications and details about these units are not yet available.

# GRITseal



## The first forward Chipping Spreader

Le premier Gravillonneur marche avant

PHOTO 5. One of the French built front discharging aggregate spreader trucks currently under development



## **OTHER ISSUES:**

In addition to the safety advantages it is important to consider other issues, and some of these are discussed below.

- Availability of the new plant items.

Many of these items are manufactured, or are being developed overseas and some may not yet be ready for full scale production. This is especially the case for the forward moving spreaders, however synchronised sprayers have been in production and use for many years and have been produced in Europe, America, and China.

1. Forward moving chip spreaders. While there are currently two machines being developed and tested in France, there are several other companies including some Australian companies who are also developing versions of this equipment. It is highly likely that there will be issues with axle loadings and frontal overhang with the French machines, but the locally designed units will be considering local regulations and should be able to be produced to conform.
2. Synchronised sprayers. As mentioned there are already a number of commercially available machines internationally, and three maintenance sized synchronised sprayers were imported into Australia from France about ten years ago. Whilst these units conform to local requirements, they only spray emulsion binders. Any synchronised sprayers imported to Australia in the future would be required to conform to local regulations for use on the road network, as for forward moving spreaders. There is also a local manufacturer who has built a larger sized synchronised sprayer that is able to spray hot bitumen (including polymers and crumbed rubber binders) and has variable transverse application technology included. This machine is almost ready for commissioning.
3. Self-propelled chip spreaders. These have been available for many years and of which there are some already in Australia. Unfortunately these machines, although spreading aggregate in a forward direction, are loaded by trucks reversing up to their storage hopper hence they do not qualify under the VicRoads safety initiative. However if the feeder trucks that supply aggregate to these machines are forward discharging they would qualify for use.

- Other innovations.

While the above plant options are the most likely to be introduced to Australia there will be other innovations that achieve the aim of forward moving spreading including transfer vehicles that load into self propelled chip spreaders.

- Improved quality of work.

Current reversing trucks control aggregate spread rates largely through the speed of the truck (and the skill of the operator to achieve and maintain the correct speed), and the opening to a predetermined aperture on the spreader box.

This system is imprecise and can lead to significant variations in applied aggregate rates either within a run by a truck or between trucks, which in turn has an adverse effect on the quality of completed works. Both synchronised sprayers and forward moving chip spreaders provide significantly greater control of the aggregate application rate and deliver a more uniform spread rate. This in turn leads to better quality seals for road authorities, and potentially less rework for contractors.

- Reduced aggregate usage.

Current reversing trucks are only able to spread aggregate over the width of the truck, but synchronised sprayers and forward moving chip spreaders are able to spread aggregate over widths of four metres and more by means of telescopic spreader boxes, which reduces overlaps between aggregate runs. Due to this more precise control of the aggregate application rate, it is likely that the overspreading of aggregates (i.e. applying too much aggregate) will be reduced. This should not only lead to reduced costs, but would also contribute to a reduction in overall aggregate usage, which in turn preserves and prolongs the availability of aggregates from quarries which have finite capacity.

Additional benefits of reduced aggregate usage are;

1. Safety on site, with less loose aggregate for road users to either lose control or skid on, and
2. Less sweeping required to remove excess aggregate. This benefits contractors with time on site (and therefore costs), and the travelling public with less exposure to the risks of loose aggregate.

- Some implications of this project

As with all significant changes in equipment or work practices that achieve benefits, there are also potential adverse impacts, some of which are listed below.

1. An effect on manufacturers and importers whose plant items do not meet the requirements of this project
2. Some existing plant items that become redundant for sprayed sealing works. The planned five year transition period is set to reduce this impact allowing existing items to be phased out or reallocated to other works.
3. Contractors who operate across state borders may find it difficult to have one work practise in Victoria, and remain with existing technologies in other states or they may find it difficult to compete in other states using the more expensive new plant items required in Victoria.
4. Small 'Mum and Dad' subcontractors may find it difficult to invest in new plant items, potentially losing skilled and valuable personnel from the industry.

## **IMPLEMENTING THE CHANGE:**

When introducing major changes in equipment there are often significant costs to industry. These include the purchasing and maintenance of new plant, potential impacts on productivity etc, all of which deter contractors adopting new technologies. If they do invest in the new plant items it may put them at a disadvantage while trying to compete at the tender box with other companies that have not invested in the new equipment and technologies.

The new plant items that have been identified that allow forward spreading of aggregate chips are expensive, may need to be imported, and some are currently in prototype form only. Hence there are significant concerns for contractors wanting to introduce these new plant items and technologies into their sprayed sealing operations.

To address these concerns VicRoads, in collaboration with the Australian Asphalt Pavement Association (AAPA) has proposed a phased introduction of the equipment necessary to achieve this safety initiative. During this transition period there are additional payments available to contractors to recognise the value of their investment in the new technologies, and to also provide an incentive payment for early adopters of the technology.

The pursuit for implementation of safer sealing operations is also further strengthened by mandating the use of forward moving chip spreading operations for all VicRoads sprayed sealing works by 1 July 2022, providing an additional motivation for contractors to invest in new equipment before it becomes a contract requirement.

This approach represents a significant departure from previous practices. In the past where changes have been initiated by VicRoads they have generally been mandated and the financial burden of investing in new technologies and plant is left with contractors. Mandated changes may or may not include 'sunset clauses', but always leave all the risks with contractors.

In this case VicRoads is providing significant additional payments for the use of forward moving aggregate spreading plant options for a five year transition period (1 July 2017 – 30 June 2022). These payments are detailed below:

- A 'value recognition' payment.

This payment is set at \$0.50/m<sup>2</sup> for work completed using only forward moving aggregate spreading techniques.

In the case of a mix of forward moving and reversing plant items being used on the same job, the payment will be made on a pro rata basis and will apply for the full five year transition period.

Examples of 'value recognition' payments:

1. If all work is completed using one or more synchronised sprayers, then the full \$0.50/m<sup>2</sup> applies.
2. If four aggregate cover trucks are used on a job site, and only one of those is a forward spreading vehicle, the payment will be made at one quarter of the \$0.50/m<sup>2</sup>.

This payment recognises the cost imposition to contractors in purchasing, maintaining and utilising the new plant items which are likely to be more complex and less productive than current reversing trucks.

- An incentive for early adopters payment.

This payment is set at \$0.20/m<sup>2</sup> for the first two years (1 July 2017 – 30 June 2019) of the transition period. As with the value recognition payment, this is to be paid on a pro rata basis depending on the mix of plant items used on a job site.

This payment provides additional incentive for contractors who adopt the new technologies as soon as practicable.

In addition it clearly shows VicRoads' commitment to move towards safer sealing operations.

## **SOME LAST THOUGHTS:**

These innovations have provided the opportunity to remove a significant safety risk in sprayed seal operations (i.e. reversing trucks in aggregate covering operations), and represents potentially one of the most significant changes in sprayed seal operations for many decades.

The transitioned approach with financial recognition and incentives from the road authority could set a template for the introduction of major changes in technology in the future, especially for safety issues, and is a great example of what can be achieved when both road authorities and industry get together and pursue a mutual goal.

At the end of this process it is expected that we will have significantly improved safety on sprayed seal work sites, while introducing quality improvements and we will have achieved this in a fully collaborative way.

Sounds too good to be true – but it can be done if we really put our minds to it!



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