BIG WHEELS KEEP ON TURNING

A well-designed wheel washer can keep your tyres clean and your neighbours happy, writes **Mark Kestner.**

Aggregate operations must endeavour to prevent track-out of mud, dust, and dirt onto public roads. This is mainly due to the fact that fine particulate and fine respirable particulate are now regarded as top health hazards in urban environments.

Encroaching residential and commercial development around industrial sites has led to an increased demand for wheel washes.

Many companies, particularly stone quarries, have installed wheel washes to demonstrate their willingness to be good neighbours.

The costs of pollution control equipment are difficult to recover and, because of this, affected facilities have a real incentive to develop affordable and effective technology to prevent carryout.

WHEEL WASH DESIGN

There are basically four types of wheel washes:

- Flooded basins
- Countercurrent channel
- Low-pressure inundation
- High-pressure cleaning

All of these will do an effective job of cleaning tyres if they are properly designed, operated, and maintained.

Flooded basins - Basin-style washes are the simplest in design. They consist of a shallow basin, long enough to permit at least one tyre rotation through it. Typical basin washes are six to 18 metres in length. The bottom of the basin may be equipped with rumble strips to improve tyre agitation. For best performance, fresh make-up water should be supplied to flush dirty water from the basin for collection and treatment.

The main advantages of a basin-style wash are that they are low in cost, do not require nozzles, operate continuously without automation, and do not get the trucks wet. Their disadvantages are that they require daily cleaning for optimal performance, do not wash mud flaps or wheel wells where dirt can accumulate, and require a large land area (more than 100 square metres).

Countercurrent channel washes - The countercurrent channel design consists of long, shallow inclined channels for left and right-side tyres. Water continuously flushes the channel countercurrent to the direction of traffic. Dirty water drains to a sump where it is collected for disposal or treatment. Channel washes require a great deal of space. A typical channel wash may be 30 to 90 metres long, requiring 140 to 420 square metres of space. Channels can include rumble strips or other texture to agitate or open tyre treads.

The main advantages of a channel wash are that they are low in cost, do not require nozzles, operate continuously without automation, and do not get the trucks wet. Their disadvantages are that they require daily cleaning for optimal performance, do not wash mud flaps or wheel wells where dirt can accumulate, and require a large land area.

Low-pressure inundation washes - Inundation washes are designed to clean the tyres, mudflaps, and undercarriage, using large amounts of low-pressure water. Water consumption may range from 4000 to 11,000 litres per truck, depending on the size of the trucks and duration of the spray cycle. These washes generally use multiple pumps capable of handling dirty water and, because of the high water consumption rate, require a large reservoir.

A typical inundation wash uses sprays directed at the truck from the sides and bottom, and may be combined with a rumble grate. Inundation washes operate intermittently, and use one or more sensors to detect when trucks enter and exit the wash zone. The wash zone is located over a catch basin that directs dirty water into a reservoir, where it can be collected and treated.

The main advantages of an inundation wash are that they wash tyres, mud flaps, and the undercarriage, and they require a small land area (less than 75 square metres, excluding the reservoir). Their disadvantages include that they feature high water consumption, require sensor and controls for automatic operation, and may remove lube oils and greases from the undercarriage. Also, spray nozzles can plug or wear out if the water is dirty.

High-pressure cleaning washes - High-pressure cleaning washes use water at pressures in excess of 10 bar, to promote cleaning efficiency and reduce water consumption. Water consumption may range from 150 to 380 litres per truck, depending on the speed of the truck through the wash zone. They are designed to wash tyres and mud flaps, and are usually not used to wash the undercarriage because sprays designed to shoot up under the truck may obscure the driver's vision.

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A typical high-pressure system consists of 570 to 750 litres per minute pump, surge tank, and two or more vertical spray nozzle manifolds that are sufficiently separated to permit at least one full tyre revolution. High-pressure systems require cleaner water because the abrasive effect of sediment wears pumps and nozzles out more quickly.

The main advantages of a high-pressure cleaning wash are that they wash tyres and mud flaps, require a small area and consume low amounts of water. Their disadvantages include that they require sensor and controls for automatic operation, and the spray nozzles can plug or wear out if the water is dirty.

SENSORS FOR AUTOMATIC OPERATION

Basin and channel type washes are designed to operate continuously and require no automation. Low-pressure inundation and high-pressure cleaning washes are designed to operate intermittently, to conserve water and reduce wear and tear on equipment.

For stationary wheel washes, an in-ground magnetic induction loop is preferred. This is the same type of sensor used to activate traffic signals. It consists of an approximate 1x2.5m loop of braided wire that establishes a magnetic field at the entrance of the wash zone. When a large metal object, such as a truck, perturbs this field, the sensor activates the spray nozzles. At the exit, a second sensor can be used to turn nozzles off. However, it is more common to use a single loop in conjunction with an adjustable time-delay to control the duration of the wash cycle.

The main advantage of the magnetic loop is that it requires no maintenance and is extremely reliable. Because it is

placed in the pavement, it cannot be damaged or vandalised.

For portable washes, there are two basic types of electronic sensors - electric eyes and proximity switches.

Electric eyes use a transmitter and receiver to establish a solid beam of light. Spray nozzles are activated when a passing truck breaks the beam. When the beam is re-established after the truck exits the wash zone, nozzles are switched off.

While these detectors are highly reliable, they require periodic cleaning and maintenance. The receiver and transmitter also need adjustment to keep the beam targeted. And, like any above-ground sensor, they are susceptible to accidental damage or vandalism.

Proximity switches - the type of switch that opens your supermarket door - also use focused beams of light. Though, these combine the transmitter and receiver into a single unit, which substantially reduces the requirement for cleaning and maintenance. They are very reliable, but can also be damaged or vandalised.

Either type can work well, but care should be taken when locating the detector. If it is installed too close to the wash zone, mist from the spray nozzles may interfere with the beam and cause the system to run on. Sensors should be located in protected positions, and armoured or set in concrete to protect them.

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LOCATING A WHEEL WASH

The two most important considerations when deciding where to install a wheel wash are its distance from the exit of the plant, and the proximity to water and drainage.

Locating the wheel wash as far a possible from the plant exit will help tyres to dry before trucks leave the plant.

If possible, the wheel wash should be set back at least 450 metres. Although tyres may appear clean, trucks track water out of the wash and onto the pavement.

When this water evaporates, a residue of very fine dust is left on the road surface that can be re-entrained by passing traffic. Because the finest particles are the best light-scatterers, the haze over the road appears out of all proportion to the tiny amount of the dust that is actually in the air - especially at sunrise and sunset.

Many plants have scales located at the exit, with less than 30 metres of paved surface, before trucks go on the road. At construction sites, there is often no paved surface, and trucks often exit over a bed of rip rap at the curb. In either case, the residue left by 'clean' trucks has to be swept or flushed from the road. A wet vacuum sweeper is the preferred method of removing silt and uses spray nozzles in front of the brooms to prevent emissions. An alternative to a wet vacuum is flushing, where men with hoses or mobile tankers with spray nozzles are used to wash silt off the road.

Proximity to water and drainage is another important factor. At large quarries with more than 500 trucks per day, for example, an inundation wash that uses 4000 litres per truck is going to require two megalitres daily.

Even a pressure wash at 400 gallons per truck is going to need 200,000 litres a day. Whether the plant is large or small, the wheel wash has to drain somewhere. Because it is easier to pump fresh water to the wheel wash than to drain dirty water from it, try to locate the wash close to a retention pond.

If no pond exists, the wheel wash will require the construction of an 85 to 140 cubic-metre settlement pit.

Portable plants and construction sites rarely have access to a pond or pit and have to use a temporary collection basin.

This could be as simple as a pre-cast concrete sump or as sophisticated as a

dewatering bin that uses a liner and filter.

Another important factor to consider is traffic pattern. A big problem is drivers trying to bypass the wash.

Consequently, truck traffic must be funnelled into the wheel wash, using concrete blocks or other barricades.

Likewise, traffic from unpaved areas on the site must be prevented from entering the paved road leading from the wash to the exit.

Moreover, drivers should not be allowed to trim their loads on clean paved surface when it can aggravate trackout.

Try to take advantage of the topography. If there is a long incline up to a scale, for example, this might be an ideal location for a channel wash where wash water flows countercurrent to the direction of traffic.

Locating the wash where there is natural drainage to a sump or pond can save a great deal of money.

RECYCLING WATER

Stormwater regulations in most parts of the country require that no water be discharged without collection and treatment.

Recycling dirty water can easily triple the cost of a wheel wash.

Large stationary quarries are fortunate because they generally have large retention ponds that can be used to recirculate water to the wheel wash. However, construction sites, recycling plants and other smaller facilities do not.

In the absence of a retention pond, stationary plants have to construct and install a sump or settlement pit to collect dirty water.

Their size depends primarily on the number of trucks washed in a day, and they are often equipped with one or more wiers that allow 'clean' water to overflow into a sump where it can be recirculated.

Many washes employ pumps that can handle this muddy water, but using it to wash tyres can aggravate silt carryout.

If the water requires filtration, there are two basic options - bag and sand filters. Bag filters are relatively inexpensive and are available in configurations that use two or more bags, so they can be changed while the filter is on line.

Bag filters, however, require periodic replacement and can significantly increase maintenance costs.

Sand filters are also high-capacity filters, but they can be back-flushed to keep them clean. While more expensive than bag filters, maintenance requirements are much lower.

Portable plants and construction sites can use dewatering bins to collect and filter water. These are usually 23 or 30 cubic-metre roll-off containers fitted with a mesh liner and filter.

The liner is used to keep the filter away from the walls and promote flow through it. The filter should be porous enough to allow a sufficiently high-water flow, but fine enough to capture the bulk of the dirt.

A typical filter of this type will generally remove any particles more than 130 to 150 microns in diameter.

Dewatering bins are suitable for sites handling fewer than 50 trucks a day, unless they are used in parallel so that one can be cleaned while another is in service.

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CLEANING EFFICIENCY

Of all the factors that affect the performance of a wheel wash, the speed of the truck through the wash zone is by far the most important.

The slower the truck speed, the better the cleaning. A speed of 8kmh through the wash is generally considered the slowest practical rate.

Unfortunately, most drivers are in a rush to get out on the road, and tyre washes often incorporate speed bumps or rumble strips to slow them down.

The volume and pressure of water are important determinants of cleaning efficiency. The performance of basin and channel washes that do not use spray to

wash tyres are directly proportional to the volume of water used per truck - the more, the better.

The performance of low-pressure inundation washes is also highly dependent on the volume of water used per truck because spray pressures are usually low enough that sprayed water is used to rinse, rather than blast, dirt from tyres.

In contrast, the efficiency of high-pressure wheel washes is less dependent on water flow rates and rely more on targeted sprays to dislodge material from the tyre.

Finally, the amount and type of mud and dirt on the truck affects performance. Most stationary plants, like stone quarries, generally have a stable unpaved route through the plant, while trucks at construction sites are more likely to have wheel wells and mud flaps fouled with dirt.

Mud and dirt that contains a lot of clay or reactive material, like lime or cement, can solidify into very hard deposits that are extremely difficult to remove.

Rumble grates can significantly improve cleaning efficiencies by agitating the tyres and flexing their treads to help dislodge material.

Concrete or asphalt rumble strips can improve agitation, but do not possess a sharp edge that can cause treads to deform and flex.

Although rumble grates can be effective, they become quickly fouled with compacted debris and require frequent cleaning or flushing to keep them in good operating condition.

PORTABLE WHEEL WASHERS

Many wheel wash installations are temporary and require portable equipment. While there are several styles, all feature one or more skid-mounted pumps and portable spray manifolds.

Only low-pressure inundation and high-pressure cleaning washes are suitable for portable applications. Some sites may permit use of a basin that can be demolished or abandoned in lieu of a temporary wash.

High-pressure washes, using vertical spray manifolds, are quite compact and can be housed in a trailer along with a surge tank that can be towed from site to site.

Low-pressure inundation washes use a portable spray frame that is placed onto the ground. The spray frame may or may not use a catch basin, depending upon its design and application. A retention pond or settlement pit is often not available or feasible, so some portable washes include a dewatering box or concrete basin to collect and recirculate dirty water. At sites where silt carryout is a problem or when pumps need to be protected from abrasive solids, a portable filter and other solids-handling equipment may be required.

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MANAGING COSTS

To keep costs down, determine how clean trucks have to be. If mud flaps and undercarriages do not contribute to the problem, there is no reason to clean them.

Setting the wheel wash as far from the exit of the plant as possible can go a long way to simplifying its design and maintenance.

To avoid the high costs of collecting and recirculating clean water, it may be more cost-effective to use 'dirty' water to wash tyres and operate a vacuum sweeper to clean silt from the road.

The lower water consumption of a high-pressure wash can help control costs over the long-term.

Small facilities, with fewer than 50 trucks a day, may be able to get by with a simple basin that is cleaned and flushed daily.

Larger plants handling 500 trucks a day, located adjacent to residential or commercial property, may require a substantially higher investment.

Inundation washes may require the construction of a large settlement pit as a reservoir, in addition to a concrete pad to support the spray frame and basin, which can add to the cost of the project. High-pressure washes have a smaller footprint, but still require a level concrete pad, and some means of water collection and treatment. These can add significantly to its cost.

Finally, and most importantly, institute control measures that ensure drivers use the wash properly. Erecting concrete barricades to funnel traffic into the wash zone and using speed bumps or rumble grates to slow them down will help you to get your money's worth from the investment. •

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