

## **A mechanical renaissance?**

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### **How dust emissions legislation favours mechanical sweepers**

*Thanks to the need for large, expensive filter systems on vacuum sweepers, it's possible that mechanical sweepers — regarded by some as old-fashioned — could provide a more cost-effective alternative to meeting future environmental standards. At least that's what expanding Italian sweeper manufacturer Dulevo International and the US-based filtration specialist Gore Corporation suggest.*

If there is a key to success in the marketing of waste handling and highway cleansing equipment, it is knowing what each national market requires. Whatever the politicians might have us believe in respect of us all being part of the same world community sharing a common economic destiny, the truth is there are often completely different ways of undertaking the same task in neighbouring regions of the same country — so it's no great surprise to learn of distinct differences across different continents. And nowhere are these differences more obvious than in the world of highway and precinct sweeping.

We've touched on these differences before in Waste Management World. But whereas in the past, those of us with a Northern European perspective, safe in our belief that 'vacuum is best', might have raised a self-righteous eyebrow at the 'crudity' of the mechanical sweepers used in North America, recent research undertaken by universities in Germany and Italy suggests that this might have been a short-sighted view. Indeed, 'mechanical' could well be the system of the future. So what are the issues here?

From an engineering viewpoint, there can be little doubt that the use of a large engine-driven fan to create enough vacuum to suck up the debris from the road, or pavement surface, works exceptionally well. It's fast, versatile and, unlike some cheaper 'through-the-fan' designs, relatively reliable. If there are criticisms, they tend to be based on the complexity of modern designs, their need for regular maintenance and — from an operational viewpoint — the need for large quantities of water in order to damp down the dust.

On the plus side, the regular use of vacuum sweepers could be said to be one of the key triggers in increasing tourism in any given city, while also giving residents pride in their local area. This also drives down vandalism, graffiti and fly-tipping. The inference here is that 'vacuum is modern', while mechanical sweepers are 'crude and old-fashioned'.

But is this perception wrong? And could increasingly tougher dust emission standards force a rethink over which system is best equipped to meet the challenges of the future? Has there perhaps been an element of complacency from the manufacturers of vacuum machines? Or pressure on the industry to keep dust emissions standards as low and 'easy' as possible, in order not to increase costs? And, if this is indeed the case, have we all missed a trick by underestimating the mechanical alternatives?

### **The mechanical alternative**

Having previously examined research data by Leipzig University in Germany and the dust filtration studies on vacuum machines gathered by Helmut Schmech and his team at Faun Viatec, I've recently been to Italy to hear the other side of the argument from a leading manufacturer of mechanical sweepers.

Dulevo International is based in Parma and has also been conducting tests on filtration systems aimed at reducing the dust emissions of mechanical machines. This includes trials of a new filter membrane produced by the Gore Corporation and incorporation of the dramatic results of tests undertaken by researchers at Pisa University and the independent test facility, Studio Alfa.

But before looking at the results, perhaps we need to remind ourselves of the key drivers in this debate, as well as exploring some of the principal differences between the vacuum and mechanical systems. Vacuum sweepers use a massive throughput of air, which draws the debris into the body/hopper unit. The action of the brushes can cause considerable dust, so in many cases a high-pressure spraybar is needed. This not only results in the need to stop and fill the water tanks, the weight of the water also eats into any payload potential. As if that wasn't bad enough, the water is then ingested into the hopper where it turns the collected debris into an unpleasant sludge, whose disposal is increasingly difficult.

Unfortunately, not all of the dust is quenched by the water spraybar system. Plus, the massive volume of air that draws all the material into the load hopper has to be exhausted again for the whole system to work. Where does it all go? Well, back into the atmosphere of course.

Until recently, while exhausted dust was seen as inevitable during sweeping, we all assumed it was better to pick it up, than not bother. However, the realization of how much damage can be done to the human respiratory system by dust particles, combined with a more detailed analysis of the particles exhausted from highway and precinct sweepers, has produced some alarming results. Put simply, the finer the particles in the air, the more harm they do to us. And there's some nasty stuff in that air...

How do these issues impact on mechanical sweepers, then? Rather than rely on the airflow to do the job, mechanical sweepers tend to rely on larger brushes and a slatted hydraulically-driven mechanical conveyor belt system, rather than a blast of air, to lift the debris up into the body/hopper. Sure, a vacuum is still created, but as a rule, the fan output and the airflow generated on a comparable mechanical machine is a fraction of that used on vacuum machines.

### **Less airflow, less dust?**

Water spraybar systems are still used on mechanical sweepers, but to reduce dust creation at the brush heads, not to damp down all the material in the body/hopper. In simple terms, less airflow means proportionally less dust created and exhausted into the atmosphere. But here's the good bit — less airflow means that it's more practical, and cost effective, to fit dust filters to mechanical sweepers than to vacuum units.

The significance of this? The mass of the filter can be correspondingly smaller — and thus cheaper to manufacture by roughly the same proportion. Filters can, of course, be fitted to vacuum machines, but if they become blocked, either the driver has to stop and manually 'shake' them (so the dust particles drop off), or a mechanical 'shaker' has to be employed. This can either be manually activated — which means the driver might forget to use it — or automatic — in which case it might fail in service.



*Among the claimed advantages of mechanical sweepers like this Dulevo 5000 is the ability to sweep large items from highway gullies effectively, at speed, without blockages. High-density filtration could be just as important an advantage in the future*

German manufacturer, Faun Viatic, has demonstrated that the latest advanced filter systems can be fitted to truck-mounted vacuum sweepers and work very effectively; effectively enough for Faun to qualify for the eco-friendly Blue Angel certification. But it's an expensive option — adding up to 20% to the list price of a truck-mounted sweeper. And with filter packs occupying the length of the entire body/hopper roof of a truck-mount, it remains a major engineering challenge on smaller vacuum precinct machines.

### **Changing fortunes?**

So does this suggest that the mechanical system is likely to stage a comeback? And that it is the most environmentally friendly way of meeting tightening dust emissions legislation, after all? Certainly, Dulevo International CEO Vincenzo Geddes, market development manager Haydn Buckland and the designers at the company's Parma HQ would like us to think so!



*Left to right Ready to meet the challenge. The new Dulevo manufacturing facility in Parma, Italy, is being extended to meet demand. The plan is to double current production by the end of 2008 The current line-up. In addition to a range of 'in-plant' industrial scrubber/driers and sweepers, Dulevo is best known as a manufacturer of mechanical municipal sweepers. But as this line-up confirms, the company also manufactures 850 Mini articulated compact (far left) and Commando vacuum machines in addition to 12-tonnes gross weight 5000 flagship (far right) and midi-sized 200 Quattro mechanical machines*

As is often the case with those of a different viewpoint, Dulevo has not been taken entirely seriously over its fervent 'pro-mechanical' stance in the past, to a point where the development of the Dulevo brand is a story that has, until now, remained largely untold. Of course it's expected that any manufacturer will have a strong share in its own home market. With the largest turnover of any Italian sweeper manufacturer, Dulevo has performed well against the manufacturers of vacuum machines in Italy.

But what isn't widely known is that Dulevo sweepers are already in operation in 55 countries around the world. Still perceived by many in the industry to be a small player, Dulevo is in fact now part of the 700 million Euro turnover Lampogas empire. Thanks to such formidable financial resources, the company opened an impressive new 25,000 square metre manufacturing facility on a greenfield site just 12 months ago and has just taken control of Salute Ambientale Srl (formally Gavia) — one of its former rivals. With an ambitious corporate plan in place, it's time Dulevo was taken seriously.

### **Pushing the benefits of filters**

While the Parma plant is still less than 12 months old, construction has already started to expand it by a further 8000 square metres. This will enable the company to double production — up to around 1000 units a year — by the end of 2008. And while senior Dulevo executives remain extremely reluctant to divulge plans for new products — or even acknowledge exactly what is currently being tested for introduction in the 2008 programme — Waste Management World has been able to piece together some of the key highlights. The headline story is that Advanced Dust Filtration Systems will be a central theme to Dulevo's international marketing campaign with a choice of standard, advanced or Gore filter pack options on every mechanical machine from next year, but new product lines are also expected.

The reduction in dust emission figures looks compelling. The concerns about dust particles actually go back to the mid-1990s and studies by Berlin University. These showed the city's vacuum sweepers expelled some 200,000 kg of dust back to the atmosphere. The emergence of recent EU PM10 legislation, and the fact that in three years' time the operational criteria get more stringent, has given this research a new significance.

More recent research undertaken in Italy by the University of Pisa, the Studio Alfa test laboratory and the certifying body Det Norske Veritas has confirmed the dangers of fine dust particles and analyzed the content. Some 50% of the particles recirculated into the atmosphere by sweepers are inorganic elements such as sulphates and nitrates, while around 10% is made up of iron, calcium, chrome, titanium and silica particles. Other potentially harmful elements include textile fibres, dust from tyre rubber and even plaster dust. If all that is included in the 25,000 cubic metres of air that passes through a typical vacuum sweeper per hour, then, so the argument goes, the lower the volume of air, the easier it is to filter it — so fewer harmful particles will escape.

A self-propelled Dulevo 5000-Series mechanical sweeper has an airflow of just 5000 cubic metres. This requires a filter area of 22 square metres — a quarter of that needed on a comparable vacuum machine, Haydn Buckland informs me. Research suggests that increasing the flow from water spraybars doesn't actually solve the emissions problem — only 55 percent of the particles are stopped by water spray suppression.

### **Setting the benchmark**

To set a benchmark, the emissions from a typical 6-cubic metre capacity truck-mounted vacuum sweeper were measured, both with and without the spraybars working. The particulate levels were measured and the same tests repeated using a standard Dulevo 5000 mechanical machine. Multiplying the grams of PM10 fraction given off by each sweeper by the number of hours swept in a year of operation, enables the amount of dust in kilos expelled into the atmosphere each year to be calculated. With the truck-mounted vacuum machine, that figure was 2000kg/year with the spraybar working. The figure for a 4-cubic metre, purpose-built vacuum sweeper was 632 kg without water spray, 592.6 kg with. In contrast, the figure for a standard 'municipal spec' Dulevo 5000 mechanical machine was 2.48 kg. This is clearly a significant improvement, but it should be noted that Dulevo also offers a high-density filter pack option (HDFP), often specified in industrial situations where it is not possible to use water sprays. With a HDFP fitted, the emissions were reduced to just 2.06kg/year.

But a key reason for my visit to the Dulevo factory was to try a Dulevo 5000 sweeper fitted with the new Gore filter system. Tests confirm this reduces the emissions level to just 0.8 kg/year. The tests with the Gore filter system have been so successful that it will form part of Dulevo's marketing strategy from early 2008, making this Italian manufacturer the first to offer such an impressive filter option. Significantly, the extra cost of the Gore filter pack on a Dulevo 5000 is less than 2000 Euros and it comes with a full three-year warranty.



*Left to right What makes a mechanical machine different? This is the full-width brush and pick-up*

*trap on a 5000. The whole assembly and that of the 'cassette-style' hydraulic conveyor is built within a rigid perimeter frame. It's heavy, but strong The mechanical package. Dulevo 5000 features high-mounted transverse diesel engine behind the cab. Next comes the conveyor — not yet fitted in this picture — then counter-rotating full-width brush, which lifts debris into body/hopper, mounted on high-tip scissor-action sub-frame Contrasting environments. At present Dulevo mechanical sweepers lack the style of the company's more recently introduced vacuum machines like the 850 Mini in the foreground. But that looks set to change....*

PM10 — measuring particles of less than 10 microns diameter suspended in one cubic metre of air — is of course, just the start. What about PM7.5, PM5.0, PM2.5, right down to PM1.0? Remember, the smaller the number, the more harmful the dust particles, so we all have a long way to go on this issue. Whatever the true level of commitment by the sweeper manufacturers to meeting an ever-tougher round of emission reduction standards after 2010, it has to be said that recent announcements from Faun and now Dulevo regarding filter pack options are likely to re-focus attention on this important issue and away from simple payload-versus-unladen-weight calculations. Mechanical sweepers have a problem here. Historically, they tend to be heavy and therefore at a disadvantage when engineering a package suitable for smaller precinct designs. But new composite materials and CAD/CAM systems could help overcome this.

### **Global ambitions**

It would be easy to dismiss these arguments as points scoring by both sides — along the lines of 'vacuum offers better payloads', versus 'mechanical offers better filtration'. It's worth pointing out that Dulevo not only has mechanical sweepers in its line-up — it now has compact vacuum sweepers too and the company is thought to be looking at adding truck-mounted vacuum sweepers to its range shortly as well. This is partly, but not solely, as a result of the troubled German manufacturer Schmidt leaving a gap in the market by pulling out of a partnership with an Italian manufacturer — but it also acknowledges the fact that Dulevo has ambitions to offer a complete, 'one stop shop' range of sweepers to meet global requirements. Dulevo contends the best way to do that is by offering a mix of both vacuum and mechanical options.

While that is an impressive ambition, the Dulevo design team still has some work to do. While the current 850 Mini and Commando compact vacuum machines are on a par with the competition, the driver environment, styling and image of the two mechanical machines in the range are still some way behind current design standards. But that is not entirely bad news in my view...

Certainly one of the largest chunks of any development budget needed to produce a new purpose-built sweeper of any kind is likely to go in the design, testing and construction of the driver's cab and control systems. While different-sized machines will need cab variations, Dulevo has shown that it is not frightened of investing in the future. If there has been a problem, to date, it is perhaps that the company's products have tended to reflect Italian operational and legal criteria — rather than look to a wider global perspective. It is within this context that the flagship 5000 Series and the mid-sized 200 Quattro models have been conceived — and where some fresh Italian style could dramatically improve the image of mechanical sweepers in wider EU and world markets.

For example, the large Iveco-powered, 12 tonne gross weight 5000 Series model can currently be specified either in four-wheel steering Evolution, or front-axle steering Veloce versions. The standard Evolution model is clearly the most manoeuvrable, but due to Italian regulations, it is restricted to a top speed of 42kph. Using the same basic chassis format, 5-cubic metre hopper and running gear layout, the unrestricted Veloce model has a transit speed of 70 kph. While the sweeping speeds of both machines are the same, there is no technical reason why the rear steering axle cannot be locked-out in high speed mode (where it would have no practical benefit anyway), leaving the full four wheel steer

facility to be used only in sweep mode. In other words, consolidating the key specification options into one new model would increase the market potential, while probably simplifying production and spares stocking as well. As the 5000 competes directly with vacuum truck-mounts in world markets, it needs to be just as fast and comfortable.

The fact that senior sales and technical staff at Dulevo were at least prepared to take such constructive criticism was a positive sign that the company is now on the right track. But the most dramatic boost to Dulevo's fortunes could come from a redesign of its smaller 200 Quattro machine. Currently produced primarily for the Italian market, this compact 2.5 cubic metre hopper capacity machine is smaller than the 5000 Series, but still features the design format of the larger machines. The space needed for both the main brush and the conveyor and pick-up trap requires a 2.6 metre wheelbase. To overcome this, it might be expected that the 200 Quattro features a four-wheel steering mode — especially as its maximum travel speed is only a slow 30 kph. In fact, it doesn't have this feature — an extra sharp steering lock angle on the front steer axle is used instead.

Looking at the overall design of the 200 Quattro however, it's clear that a faster version with a new cab and more ergonomic controls, a larger 3-cubic metre capacity hopper within a gross weight of 7.5 tonnes — and the four wheel steer (in sweep mode) it desperately needs — would provide the market with a unique mechanical package. It might be that an all-new 4-cubic metre capacity mechanical machine would also be needed to compete directly with existing vacuum machines like the Mathieu Yno Grand Azura, but a three-model line-up would really put mechanical sweepers on the map.

The good news? Dulevo is known to have prototype machines currently running, a new cab has been designed and, in between increasing production generally, additional new products are expected during 2008. It could be an exciting year.

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