Skip Hire Magazine

The Voice of the Skip Hire and Waste Industry in the UK and Ireland

SORTED!
Robots revolutionise recycling

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Sorted!
Robots revolutionise recycling

Just once in a while, something very new, clever, innovative and ground breaking comes around the corner, which fundamentally changes the way we think about, manage and handle a process at the heart of our industry. The new development achieves a step change in current technology and practice ... and its impact, the implications and future potential are both disruptive and far reaching.

That has just happened in the recycling industry ... courtesy of a Finnish company called ZenRobotics, which has fully and successfully automated the process of picking and sorting mixed materials for recycling on a moving belt. SHM's Ainsley Fraser went to see it.

To put this development into context, a good manual operative will pick between 600 and 800 items per hour. Zen's new system can pick up to 2000 items per hour per robotic arm, running unsupervised, 24/7 ... and there are typically two, sometimes three robotic arms per installation. Accuracy and waste stream purity can head well north of 90%, depending on materials, with residuals as low as 5% of initial volume at the end.

Then add to that the seismic shift in operating safety – the single quantum leap improvement in de-risking a process which currently relies on the close proximity interface between human beings and moving machinery. Surely, this is a profoundly important step for our industry.

Skip Hire Magazine was fortunate enough to be one of a small cluster of industry journalists invited to Helsinki to see first hand just what has been achieved. It might sound a

bit geekish (if not sad) to describe a machine for the fully automated picking and sorting of recycled materials on a belt as 'inspirational'. But I use the word deliberately because the people are some of the most brilliant computer software scientists I have ever met ... and I've met a few. The whole system has been properly designed, developed, trialled, tested, improved, tested again and integrated over a lengthy period – before being launched to the world ... so although it's new to us, it's mature and it works.

Unsurprisingly therefore, the company and its technology has caught the immediate attention and imagination of the recycling

industries in markets around the world ... already including Japan and the United States. Europe is in there too – and to ensure that we have the same opportunities, ZenRobotics has just appointed Blue Group as its collaborative partner in the UK. That alliance is also reciprocal – which means that Zen's system can be built into a fully integrated turnkey recycling plant.

In 2007, two PhDs with a strong research background, teamed up with an entrepreneur to spin out an embryonic technology company from the University of Helsinki, to develop control software. To quote Tuomas Lukka, one of the founders, "We wanted to do something cool with robots!" And by the way, that comes from Finland's youngest ever 'doctor' – Tuomas having completed his first PhD at the age of 20.

They spent two years visiting Finnish companies looking for industrial applications with specific challenges and problems, with the idea of developing very advanced control system software and using robotic technology to break through what they described as a 'glass ceiling'.

Having looked at sectors including the automotive industry, bakeries and

detergent manufacturing, they decided that the future lay in recycling, where they saw there was an apparent real challenge, particularly identifying and gripping objects which are not the same size, shape or material. They would be able to use artificial intelligence to 'train' the robots to recognise, differentiate, select and segregate objects of varying material composition and size. Clever stuff. Now, several years of hard research and development work later, ZenRobotics today employs around thirty people, led by visionary CEO, Timo Taalas – and is owned by its management and employees, albeit with a long-term private equity partner.

The unique – and patented parts of the system are the original software and its inbuilt and developed levels of artificial intelligence... and then the gripper head – which works with most shapes of waste. So far, the system has proved most beneficial in the handling and processing of construction and demolition waste, but minerals, scrap metals and even plastic bags have proved very successful too.

In terms of scale, it is belt size which is the current constraint – not the robot – and

having seen the sheer speed at which this equipment darts about, I can believe that. On the system we're shown, a ZRR2, the running belt width is 1.5metres, moving typically at 0.5 metre per second – and the grippers are capable of picking up objects of up to 50cm in width and remarkably, up to 20 kilos in weight.

I expected to find that the entry-level volumes required to justify investing in the system would be eye-wateringly high ... but not so. The minimum throughput is probably around 20,000 tonnes per annum and the site we were taken to see, on the outskirts of Helsinki, was designed to operate with a throughput of 30,000 tonnes ... so this technology is well within scope of a wide range of companies in the sector. Obviously, these capacity numbers will vary according to the material being handled and, being in Finland, there was visibly a lot more timber going through than other construction materials – bricks being a comparative rarity.

Current iterations of the system utilise four different levels of sensors to scan and analyse the material – near-infrared spectrometry, laser, metal detection and RGB cameras. Information about the

material on the belt is captured, analysed and a robotic arm gripper is dispatched to the position on the belt where the particular fraction is located. This all happens in just milliseconds. The item is then picked and, because the system has already learned what it is, away it goes, released into the right chute for the chosen separated material... wood, stone, metal, plastic, whatever. The accuracy of this sorting can be anything up to 97% – which is frankly incredible to watch. But then you learn that these guys started with robotic systems designed to optimise the handling and placement of fuel rods in the nuclear industry, where there is absolutely no room for error, so getting it right first time is just firmly embedded in their psyche.

Another level of brave new world stuff is that the artificial intelligence which these robots possess enables them to be trained to recognise particular types of material. In one application, the robots have been trained to differentiate between A-class untreated and B-class painted timber as part of the sorting process.

ZenRobotics Sales Director Dr. Maciej Borkowski, known universally as Mac,   >

explains that we are at the first plant to be purpose built from the ground up. It is in the countryside – actually next to a nature reserve and it's comparatively unobtrusive ... and it's not noisy. We are in an enclosed industrial building and, with a footprint of 42metres by 25metres, it is probably smaller and more compact than I was expecting. Apparently, it needs about 60Kw of 3-phase to operate – and therefore could run on an on-site renewable source if required.

Mixed material arrives in containers, much as it would here in the UK. Large oversize items are mechanically removed in the normal way and then unsorted bulk material is grab loaded into a hopper and conveyored to a ballistic screen area where initial, say 100mm materials and fines are removed. Depending on the type of material, some will go for re-use or further reprocessing ...and combustible residue can be redirected for instance, as energy generating RDF.

Just before the start of the picking line a vibrating screen removes further loose material before mixed items drop onto the picking belt ... all pretty much as would happen normally ... except that the belt now passes through the fully safety caged robot operating area. It is an operative-free zone. The Helsinki installation incorporates three robots – all with names and lively personalities!

The control panel for the system, which Mac refers to as the 'user interface', seemed comparatively straightforward... just like any other menu driven screen. Naturally, there are all sorts of manual overrides – but, left to their own devices, the robots will sense the volume throughput for themselves and adjust the speed of the belt accordingly ... it's all very predictable. Then Mac starts to show us a range of selectable options, all of which can be chosen whilst the belt is running. Without any perceptible change of tempo, he simply logged in on his tablet and changed the control settings – remotely. At a single manned location, we were told, the grab operator would be able to monitor operations from his cab and intervene as required, if necessary from his smart phone. One noticeable omission from the plant was a shredder – which is logical when you have the ability to pick and separate comparatively large items.

So far, ZenRobotics has sold a total of fourteen systems into six countries. The company's ambition was to develop a compact, modular and expandable plant which could offer optimum flexibility, improved efficiency and low operating costs. Based on what we were shown in Finland, they have delivered on that ... big time. In-service support arrangements are also expectedly robust – with the software license charged out monthly, including
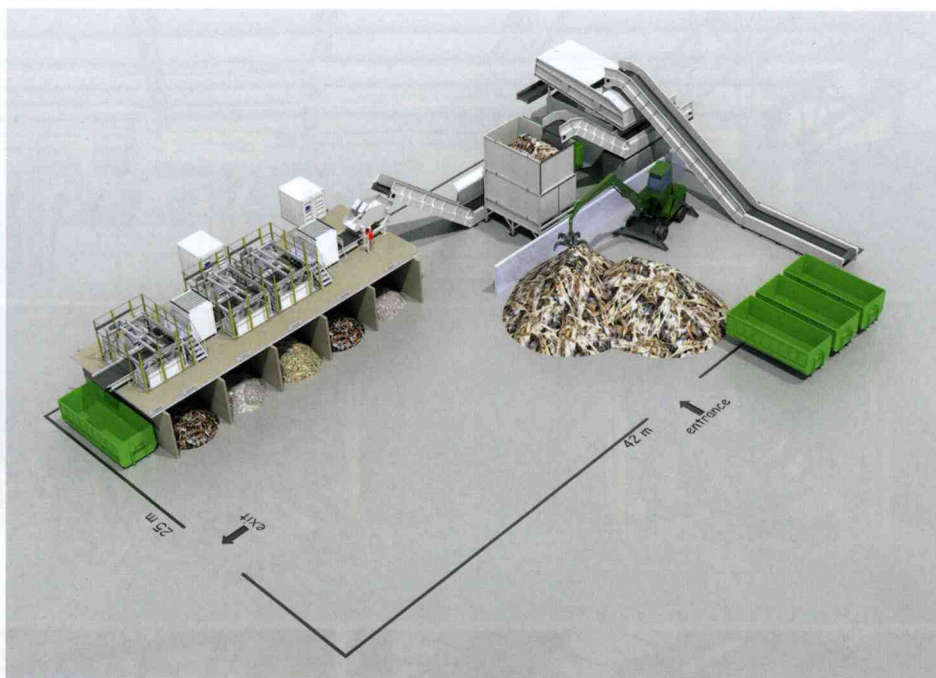
updates and 'trainability' features, which enable end customers to 'train and educate' their own robots. The latest versions of the system have been further developed also for ease of maintenance, for instance replacement of gripper plates – and a lot of the hardware is based on standard, commercially available componentry.

I asked two obvious questions – how much ... and what is the anticipated payback period. I was quite surprised by the reply. Setting aside land, the building and the basic plant – i.e. just taking the sorting belt, automated robotics and attendant control systems, a typical two arm system could cost just heading north of £1/2million. Based on the observable plant and equipment at the operation, one might then 'guesstimate' the all-in cost of creating a similar facility at probably between £2 and £3million. Payback period? Mac smiled ... "Depending on individual operating circumstances, the system could pay for itself in two years or less". What else can it do? "New sorting requests come from our customers", says Mac. "We just provide the solution."

Still not convinced? Have a look at Zen's new online video at www.youtube.com/watch?v=X_1sOPqM_VA . Also, Zen's Dr. Maciej Borkowski will be one of the keynote speakers at the Future Technology and Innovation Showcase, one of the conference sessions at WASTE 16, SHM's must attend one-day exhibition at the AJ Bell Stadium at Salford on 9th June this year. Also, you can talk to ZenRobotics on Stand A59 or Blue Group on Stand B3 at the show. **SHM**