

NEW ERA for sand and aggregate

What the Kiwi-designed Barmac has done to redefine aggregate around the world, Kayasand technology could do to revolutionise sand for the concrete industry and produce fine aggregate for other applications.
By Alan Titchall.

You will hear more about Kayasand as the international demand for quality, reduced-carbon concrete and construction material grows, as is already happening here.

Concrete can be made out of just about any aggregate if enough cement is used and, conversely, better aggregates

produce substantial cement savings. Kayasand is not the manufactured sand already produced in some quarries, but technically 'engineered' sand featuring a cuboidal shape for precise grading and consistency that, compared with natural sand, needs up to 20 percent less cement to create concrete of the same strength.

In terms of environmental credentials this product is way up there. The production process doesn't use water for washing aggregate; does not conflict

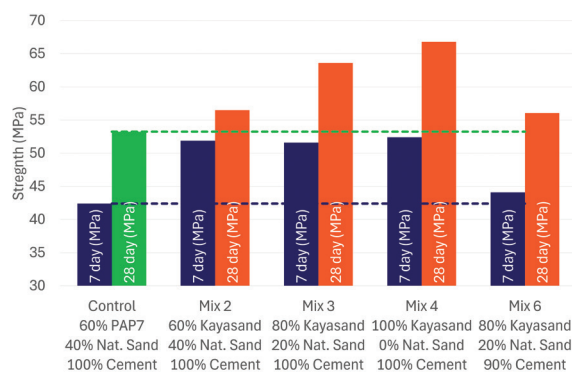
with environmentalist thinking on natural sand resources; and turns by-products and waste, such as crusher dust, PAP and crushed glass, into building products – while reducing costs.

If this sounds too good to be true – then read on.

The history of the Japanese-sounding Kayasand sand-producing technology has a strong Kiwi connection through the development of improved



Concrete engineer James Mackechnie used sand from the new Kayasand V7-40 engineered sand plant at Te Kauwhata to demonstrate the potential for the product to replace 80-100 percent of natural sand in concrete manufacturing, using a typical Auckland concrete mix design as a control. Mixes 2-4 show the increasing strength as Kayasand is used to replace decreasing amounts of natural sand. Mix 6 shows that 10 percent of the cement can be removed and the final mix is still stronger than the control.





Kayasand team at the opening of the V7-40 demonstration plant, April 2024 (from left): Frank Grech (Sales Manager), Chris Sattler (Chairman), Andi Lusty (Founder), John Howarth (Engineering Manager), Bram Smith (CEO) and Marcus MacDonell (Senior Design Engineer).

‘engineered’ aggregate here over the past four decades.

At the heart of the Kayasand production plant (of which there are now 300 covering the globe, including one in New Zealand) is a specialised crusher and air screen technology developed by Kemco in Japan; created due to a ban on dredging there that severely disrupted local concrete sand supply.

Some three decades before that, in the

small engineering town of Matamata in the centre of the North Island, the Barmac Vertical Shaft Impactor crusher was designed and developed.

The Japanese-Kiwi connection is through an Englishman called Andi Lusty who is the founder and director of Kayasand.

In 1981 Andi moved here from the UK and got a job in Matamata with industry-icon Paul Tidmarsh, who was manufacturing and selling Barmacs. Andi began marketing these machines in North America, beginning a 30-year association with Barmac and the tertiary crushing sector of the industry after becoming MD of the Tidco Group in 1987.

He held that role until he resigned in 2006, at first with Svedala and subsequently under Metso’s ownership. During this time he came across the Kemco V7 crushing technology developed by the company’s chief

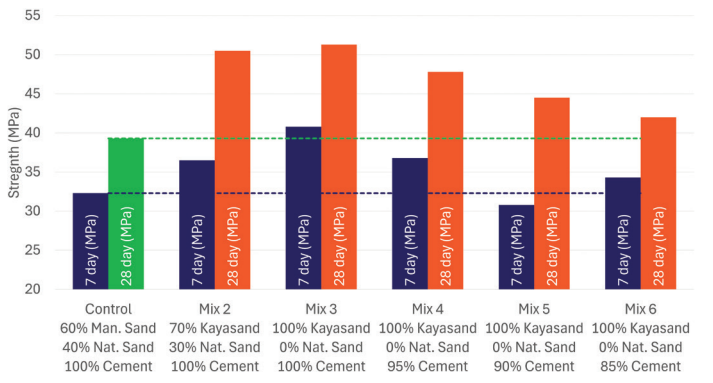
engineer, Dr Kaya.

Andi could see the potential to make an alternative to natural sand with Kemco’s technology and founded a new company to sell it called ‘Kayasand’, after the technology’s inventor.

Kayasand installed and commissioned the first V7-60 plant outside of Asia, in Holcim’s Albion Park Quarry in Australia eight years ago, to make premium sand for concrete manufacturers in the Sydney area.

Then, last year (2023) Kayasand raised \$5 million of investment, including \$3.5 million from New Zealand Green Investment Finance (which has a shareholding in Kayasand), and \$1.5m of private investment, to reduce ‘carbon’ emissions from concrete to build the first Kemco V7 high-technology demonstration plant in New Zealand – converting sand from a low quality product to a high quality one for making concrete.

In addition to James Mackechnie’s trial here in New Zealand, Jason Chandler from Concrete Insights in Australia carried out successful tests on Kayasand-produced sand made from basalt rock in NSW using a typical Sydney concrete mix design as a control. Mixes 2 and 3 show the increasing strength as Kayasand replaces the natural sand. Mixes 4–6 show that up to 15 percent of cement can be removed and the mix was still stronger than the control.





Whereas the The V7 screen only has one deck, different mesh sizes on Kayasand's RCAS screen enable extraction and processing of up to seven different product fractions simultaneously, ranging from 40mm to <0.075mm.

The technology

Unlike a 'manufactured' sand product, Kayasand is engineered to have an improved particle shape and grading for better 'distribution', so the material packs down well.

It also involves very precise control over removing contamination and deleterious materials (such as clay) using a dry process to produce a very consistent sand product.

The result is a sand product with improved packing density; less water required in the process; and less cement levels for concrete manufacturers while achieving the same strength and 'wet performance' characteristics in terms of workability, pumpability and finish.

The economic and emissions savings from reducing the amount of cement and natural sand needed in concrete are significant, says Kayasand. Cement reduction can generate savings of over \$10 per tonne compared to the typical operating cost in the \$4-5 per tonne range.

Natural sand can also be significantly more expensive than manufactured sand, depending on availability and distance it needs to be transported, whereas the V7 technology enables this engineered sand to be manufactured in quarries right alongside very clean, coarse aggregate for roading and other applications.

The plant is said to be comparatively quiet and produces very little dust. It features a Kemco VSI, a specialist fine aggregate crusher with a unique secondary impact zone with a nominal yield of 80 percent engineered sand for better concrete packing, strength and shaping.

This crusher is said to be the only one currently available that can produce a volume of well-shaped engineered concrete sand with high levels of particles in the 150-600-micron size range from an all-passing 10mm feed, while controlling the minus 75. As the company says, 150-600-micron particles are the 'ball bearings' in the concrete, and they improve the packing density, pumpability and finish that make it unique.

The crushed material feeds into a Kemco AS2500 air screen where material is separated. Ultra-fines (less than 75 micron) are sucked into the dust collector to control contamination, while oversize material (greater than 3mm) is re-crushed to optimise crusher load. A skimmer controls the amount of 150-300µm particles in the product, and a single deck screen controls fineness modulus (FM), typically targeting an FM in the 2.4-2.6 range depending on customer requirements.

Dust is extracted from one silo while ultra-fine materials are deposited into another. The dry filler can be blended and sold and there are no dust emissions as the plant operates under negative pressure. Because the process involves 'washing material without water' there are no settling ponds or sludge disposals involved.

Finally, the process is said to be an autonomous operation with 24hr/day operating potential with no operator. **Q&M**

Manufactured in Te Kauwhata

Earlier this year (2024) the first Kayasand V7-40 engineered sand plant in New Zealand opened in Te Kauwhata supplying the Auckland region.

Production followed a series of trials – carried out by concrete engineer James Mackechnie, using sand from the plant – that demonstrated the potential for Kayasand sand to replace 80-100 percent of natural sand in making concrete.

The trials incorporated a control of standard 40MPa mix using 60 percent manufactured and 40 percent natural sand, and two Kayasand materials – MS1 and MS2 from material produced in Auckland and typically used in concrete mixes in this region. Tests involved varying the amount of water to achieve a consistent slump of 120mm.

The results showed consistent strength increases with 10 percent less cement with the engineered sand, and that total replacement of natural sand in concrete is achievable, says Kayasand.

For many quarries 5-20mm-sized aggregates are their most valuable products and minus 5mm crusher dust is an inconvenient byproduct.

Kayasand's VSI crusher is unique in that it is specifically designed to process minus 10mm material and Kayasand's goal is to transform the minus 5mm material into a high – if not the highest – value product a quarry produces.

And, because the Kayasand system extracts the by-product minus 0.075mm ultra-fines using a dry process, they could become even more valuable again to be used in applications such as asphalt dust, filler materials, soil conditioning, and even carbon sequestration among other uses.

Kayasand says the "concrete guys already love this stuff" as it makes a creamy concrete that finishes well and increases compaction to maximise strength, with good particle entrainment and high flow for applications that don't use vibration. It also makes a nice paste for a good finish.

At the 2004 QuarryNZ conference in Rotorua, Bram Smith (Kayasand CEO) won the Lynn Jordan Memorial Trophy for his presentation about Kayasand called *Washing without water and without dust to produce premium manufactured concrete sand*. **Q&M**