

A new dawn for IPCC

Paul Moore visited MMD Group of Companies in Derbyshire, UK, to get an in-depth account of the advantages and design features of the company's new Fully Mobile Low Profile Sizer Station, and to hear exclusive news of a high-capacity IPCC collaboration between MMD and Bucyrus



The Fully Mobile Low Profile Sizer Station from MMD

In today's mining world with ever declining ore grades, larger volumes of material have to be mined for operations to remain economically viable.

As a result, and as discussed many times in Mining Magazine, in-pit crushing and conveying (IPCC) options are likely to be the open pit mining solution of choice in the near future. IPCC operations offer a lower cost per bank cubic metre, increased production capacity, continuous operations, improved safety and lower environmental impact.

It can also be argued that conventional truck and shovel operations have already reached an upper practical limit due to the bottleneck of shovel to truck loading capacity rates, as well as the fact that truck loading is itself discontinuous.

The use of the new MMD Low Profile Mobile Sizer Station (hereafter referred to as the MMD Mobile Sizer) allows for continuous, uninterrupted operation as the shovel and sizer move together, and both machines are as mobile as each other operated by the same driver to ensure synchronisation.

In addition, it can be argued that today's largest shovels and trucks are

mis-matched with the largest available primary gyratories as the crusher opening is not large enough to accommodate the maximum feed sizes. The MMD twin shaft mineral sizer, the core element of the MMD Mobile Sizer, can easily handle these larger loads and feed sizes.

HERITAGE AND EXPERIENCE

The company has been designing IPCC solutions for a wide range of minerals and tonnage capacities for over 10 years, including two fully mobile machines of 10-12,000t/h, completed and delivered, in 2002 and 2006 respectively.

As a result, MMD probably rightly sees itself as having a unique level of experience in the IPCC field versus its competitors, which has allowed it to assess multiple design elements involved in mobile sizer stations, with the result that it has been possible to simplify the design of the new station dramatically.

An independent company that remains focussed on sizer solutions, MMD allocates 10% of its annual sales revenue to R&D, which is conducted continuously without waiting for customer tenders or design requests.

Not only that, but MMD are the innovators of the Twin Shaft Mineral Sizer, and for over 30 years, the company's sizer solutions have been tested and proven in practically all major ore and rock types in fixed and semi-mobile installations, from lignite to limestone, granite, kimberlite and hard copper ore.

No other sizer design or double roll crusher has yet managed to handle the hardness of rock that the MMD mineral sizer has been able to at sites such as Codelco Andina and De Beers Finsch.

The two existing mobile sizer systems supplied by MMD, at BMA's Goonyella in

Australia (MS1, coal overburden, 2002) and Suncor in Canada (OS1, oil sands, 2006), worked very well but have also allowed MMD to refine the overall design.

At Goonyella, 10-12,000t/h has been achieved at peak loading rates, with the capacity only limited by the shovel, which during normal operations can only load 6-8,000t/h.

The model's upper body was able to rotate 270° on the slew bearing assembly and the discharge conveyor 60° either side of centre. MS1 achieved between July 2002 and July 2003 the removal of 23Mbcm and the processing of over 50Mt. The system cost worked out as US\$0.80 to US\$1.01 per bcm depending on the material. This compared to US\$1.60 per bcm using the previous truck and shovel operation.

The OS1 model upper body was required to rotate 360° and had a special electrical slip ring assembly to allow the design to cope with the significant temperature extremes in that part of the world.

The Suncor machine had only a single discharge conveyor (no transfer conveyor) that could luff 12° vertically from the horizontal. This model also included a feeder foot below the hopper to provide added stability during loading, a design element that has been eliminated in the new transverse design but remains in the in-line design.

The new mobile sizer from MMD with transverse tracks allows the completion of two complete face passes, through continuous loading of the main conveyor hopper car. While the company can also offer an in-line tracks arrangement and one based on direct loading by dozer push or dragline, the transverse arrangement is the most efficient and cost effective (see tables for full description)

MMD sizers have been proven in a number of hard rock applications



Transverse design MMD mobile sizer and shovel – an efficient mining method

- Ideally, any machine access ramps will be positioned away from the active mining face with the belt conveyor parallel to the mining face
- The shovel and MMD sizer enter the mine face and travel to the end where they will start work, which has previously been blasted
- For the first pass, the mobile sizer is positioned between the face conveyor and the mine face, with the discharge boom slewed over to its full extent to feed the moving hopper car, keeping the shovel at a minimum reach distance
- The sizer is loaded over the rear wall of the sizer hopper and the shovel works around the hopper to a position where it can commence digging along the whole face
- The shovel and sizer can then travel together along the face, parallel to the conveyor and keeping the shovel swing arc to its optimum
- Before reaching the end of the face, the discharge conveyor is slewed to the opposite side with the main conveyor hopper car under it. This enables the shovel to dig straight through to the full extent of the mine face
- The hopper car reaches as far as it can along the face conveyor, the shovel starts digging in an arc around the mobile sizer, which is stationary
- Finally, the mobile sizer is moved aside to allow the shovel to start digging the second pass in the opposite direction. This time the face conveyor is further away so the discharge conveyor is almost at its maximum reach.
- Behind the shovel and sizer as they proceed on the second pass, part of the new block can be drilled and blasted. When the second pass is completed, they are moved to a safe position and the rest of the block blasted, thus another two passes can commence after the face conveyor has been repositioned closer to the face
- This system can be repeated on multiple benches, meaning it can be applied in deeper open pits, as some mine faces can be 2km or more in length, the mine design has broad similarities with a continuous underground longwall system, with the main conveyor movement the equivalent to the roof support movements in a longwall set up

DESIGN ATTRIBUTES

In terms of the MMD Mobile Sizer product development, MMD chairman Alan Potts comments: "Common sense is a big factor in our R&D – you have to make sure you are starting with the right principles before moving on to detailed engineering.

The new transverse design allows the sizer station to process and be loaded simultaneously, and as a result, everything else becomes easier."

The crawler tracks are situated under the loading point at the front and towards the back of the machine, meaning that the mobile sizer has excellent stability.

The slewing discharge conveyor enables two complete passes of the mine face. And most importantly, the low angle of the apron plate feeder, as well as the position of the sizer and transfer conveyor mean that other design elements seen on in-line designs such as car body, slew table, slew bearing and slip ring can be eliminated, resulting in significant weight savings – from 2,100t in some standard in-line models, to 1,100t in the new transverse system. While the feeder is low down in the machine, it is still high enough to be clear of undulating ground.

The key point about a low angle feeder is that it will allow for a deeper bed of material to be fed to the sizer and therefore is able to cope with higher shovel loads and the resulting higher throughput tonnages.

Other IPCC mobile systems have feeder angles of 25-27° allowing for a bed depth of some 1-1.5m, whereas in the MMD system, reducing the feeder angle to 15° has allowed for a bed depth of 3m or more with the same width, effectively doubling the throughput tonnage.

This also allows for a reduction in the feeder length, which is a major contributor to the reduced weight of the

overall machine. The combination of the lower angled and shorter feeder, low sizer position, transfer conveyor under the sizer, slewable discharge conveyor and transverse tracks arrangement means a more compact, lighter and stronger mobile IPCC solution. The reduction in weight also means it is cheaper than other solutions.

The fact that the mobile sizer can be loaded and process simultaneously means that the time spent spotting trucks is eliminated.

The removal of trucks and replacement by electrically powered shovels and mobile sizers also means the removal of vast amounts of diesel consumption, making for a more environmentally friendly mine in terms of carbon emissions. Power consumption itself is

reduced as there is no transfer of power between sections. Tyre costs are also eliminated.

The only dusty area with mobile IPCC is potentially the mined face itself, and the machines can work in any weather conditions, whereas trucks are susceptible to heavy rain on grades as well as low visibility, foggy conditions – common in high altitude mines. Traffic congestion at the loading point is also removed.

THE DREAM TEAM

MMD states that its sizers' design capacity could be as high as 20,000t/h and beyond simply through lengthening of the main twin shafts and strengthening of certain components.

Throughputs of well over 12,000t/h have been achieved at Drummond Coal ▶

"The new transverse design allows the sizer station to process and be loaded simultaneously"



The collaboration between MMD and Bucyrus brings together the largest capacity mobile sizer and shovel in the world

Top: the shovel and mobile sizer station mining the first pass

Middle: the turnaround at the end of the first pass

Bottom: mining back in the other direction on the second pass, with the discharge conveyor at almost maximum reach



capacity and most proven mobile sizer in the world, with the Bucyrus 795, the largest shovel in the world. It almost doubles the tonnage capacity of existing shovels on the market. MMD and Bucyrus joining forces on this project allows us to bring high capacity sizers to the market quickly and efficiently, making true, high tonnage mobile IPCC a reality for the first time."

From order confirmation, the two companies state that they could deliver a mobile sizer and shovel in only 12 months, because the complete designs are already in place and ready to go.

Of course, the Bucyrus 495 models, and other shovels, remain good matches for the new MMD Mobile Sizer, but the 795 will bring the step change in capacity.

GOING FORWARD

Commonly, mines will explain the continued use of truck and shovel mining rather than opting for IPCC in the belief that they need the flexibility to blend. This is certainly the case, for example, in gold operations with highly variable gold ores.

However, for high-tonnage operations with more homogenous deposits, differences of a few % make little difference when you are talking about stockpiles of many millions of tonnes.

Fundamentally, the mining industry is conservative, and many groups see trying something new as too risky, even though it may be proven on paper or in a complex simulation. MMD sees its advantage as being able to point to already proven real examples, from which the new model is simply an evolution.

The savings are potentially huge. In one study based on a real mine; to achieve the removal of 1Mt of overburden per day necessitated operating 20 shovels and 145 trucks of varying capacities. Whereas the MMD fully mobile IPCC method can achieve the desired daily overburden removal by the use of just 5 systems.

This massive reduction in plant results in a large reduction in specialist ▶

in Colombia through dragline and dozer loading of sizers. Conveyors are easily capable of achieving higher tonnages – the examples at Drummond can handle 20,000t/h.

One of the main limitations in the IPCC market currently is the lack of larger loading tools beyond the P&H 4100 and Bucyrus 495 series of shovels. However, MMD is now working closely with Bucyrus on matching the MMD Mobile Sizer with its 795 model of shovel, which has a 122.5t capacity and would be able to four pass load 454t class trucks.

Bucyrus has had the model design completed and ready to build for a number of years, but the 363t capacity trucks are currently the largest available and models larger than this that would ideally match with it have yet to materialise.

The new MMD Mobile Sizer represents a new opportunity for the Milwaukee-based company to press on with the 795 shovel, to which it will be also be able to add key design improvements made in the past few years including the Latch-Free Dipper and HydraCrowd.

Alan Potts, MMD chairman comments: "We are talking about major industry shift – bringing together the largest

Transverse MMD mobile sizer design – key points

- One crawler track is positioned under the loading point, with the other widely spaced to achieve an optimum centre of gravity and added stability, with no need for stabiliser jacks. This is a key point in allowing for continuous loading and processing while the machine is moving. The wide spacing of the transverse tracks allows for easy spot positioning of the mobile sizer
- The main chassis beams are positioned directly on the track frames, meaning there is no need for a car body, slip ring, slewing table or slew bearing. The apron plate feeder is at a low angle of enabling a high bed depth and tonnage throughput
- The transfer conveyor is positioned under the sizer and fits between the tracks. The sizer itself and its drives sit on top of the main chassis. The low sizer height enables the low feeder angle
- The feeder is perpendicular to the tracks, which moves the mobile sizer outside the swing circle of the shovel body, facilitating the continuous rear loading of the sizer station hopper and keeping the shovel swing arc at its optimum.
- The slewable conveyor allows the crushed material to be delivered anywhere in a 180° arc. It is long enough to feed the main conveyor over two passes with no extra bridge conveyors

- ▶ operators; from 165 per shift for the truck and shovel method to just 25 for the IPCC method. Thus reducing training costs as well as the obvious reductions to the operating, maintenance and repair costs associated with the equipment.

Currently, MMD has advanced enquiries for the MMD Mobile Sizer from eight countries and 13 different customers, incorporating 37 units in all. Required capacities range from 3,000-15,000t/h, with the materials to be handled mainly ROM overburden and iron ore.

MMD is also now working with two software specialists, Bear Rock Solutions and Maptek on mining cycle simulations of the new system, which will enable customers to see its potential for their individual mining situations.

Due to in-place confidentiality agreements, the actual customers and countries involved have not been disclosed.

However, the Chinese market is already a large one for MMD, having numerous surface and underground semi-mobile sizer stations installed, and these existing relationships with Chinese mining groups as well as experience in doing business in China are proving important in the development of potential markets for the mobile sizing solution in the country. ▼

OS1 at Suncor's oil sands operation in Alberta, Canada



MS1 mobile sizer station at Goonyella, Australia



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