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Dust control feature

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EnviroMist busts dust problem at Karara Mine

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Development of a new dust suppression system for the ROM Bin at Karara Mine

By Dr Peter Wypych, Bulk Materials Engineering Australia (BMEA) and Vitold Ronda, EnviroMist

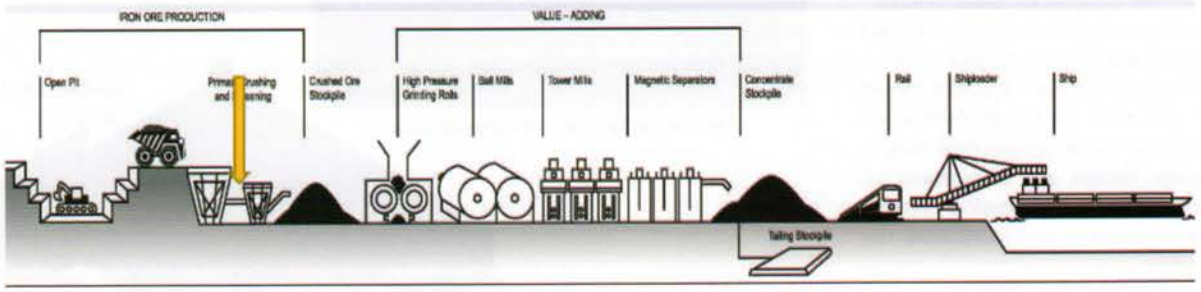


Figure 1: Process schematic (ref.: http://www.kararamining.com.au/).

1. Background

This world-class Karara Mining Project is located 200km east of Geraldton in Western Australia. It consists of a substantial, long-life, magnetite concentrate operation plus a smaller-scale hematite operation.

As part of the development, Karara has invested in new common-use infrastructure in the Mid-West region, including a new 85km rail line, a dedicated 16Mtpa export facility in Geraldton Port, a 330kV power line, and a 140km water pipeline.

Karara is a significant project, which is expected to deliver long-term benefits to the state of Western Australia through the provision of job opportunities, export revenue taxes and royalties.

Karara recognises the value, qualities and biodiversity present within the Mid-West region of WA in which it operates. Through stringent environmental practices and a keen understanding of the local and regional landscape, Karara aims to be a leader in the Mid-West through industry best environmental practice.

The Karara magnetite concentrator is designed to process 20.3 Mtpa of 36% magnetite ore to produce 8 Mtpa of magnetite concentrate (+65% Fe). ROM (Run of Mine) ore is crushed and ground down to a particle size whereby the magnetite in the ore can be recovered via processes such as magnetic separation and flotation. The final magnetite product is then filtered and placed on a train to be exported overseas. The schematic in Figure 1 provides a basic overview of the process.

Figure 2: Excessive Dust Emissions with Existing Water Spray System (1000 L/min).

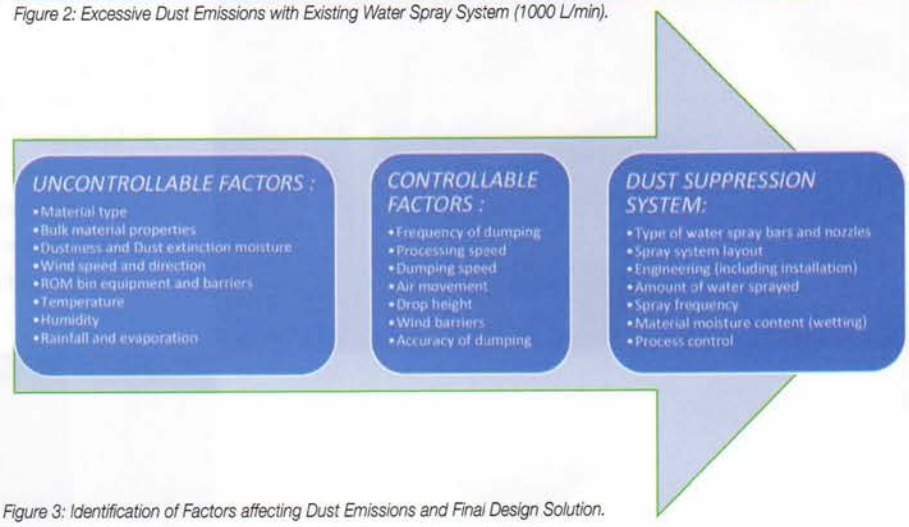


Figure 3: Identification of Factors affecting Dust Emissions and Final Design Solution.

2. The problem

One of the major environmental problems identified on the mine site was excessive dust generated in and from the primary crusher ROM Bin, mainly due to truck dumping as shown in Figure 2.

An additional problem was the excessive amount of water used by the existing water sprays (up to 1,000 litres/min), which were installed to reduce dust emissions. As can be seen from Figure 2, the existing dust suppression system was not very effective. In some cases, depending on wind direction, the truck becomes totally consumed by the dust cloud.

3. The solution

Joint initiatives have been undertaken by EnviroMist and BMEA to develop and establish:

- New dust suppression technologies (for both greenfield and existing mine sites);
- Use of best practice technology and innovation available for dust suppression;

- Improved pollution prevention and water efficiency for mining applications, including ROM Bins;
- Compliance with applicable legal requirements and obligations.

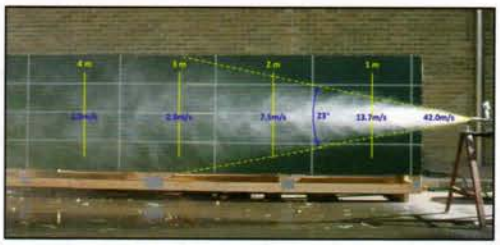
To better manage the ROM Bin dust emission problem at Karara Mining, EnviroMist and BMEA were commissioned to model, design and install a new High-Energy Micro-Mist Dust Suppression System.

The major objectives of the Karara ROM Bin dust suppression project were:

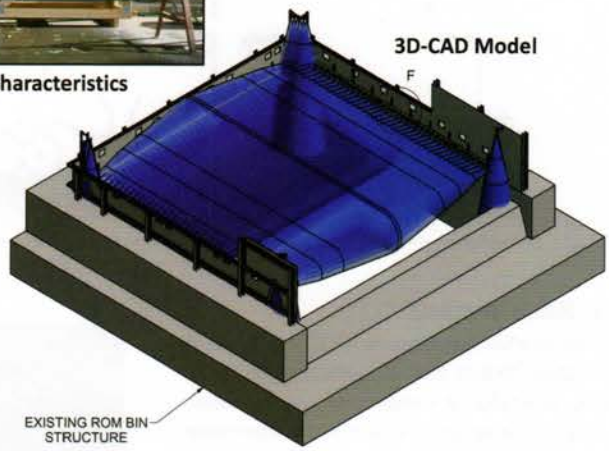
(a) Examine, record and quantify/model ROM Bin rock dumping operations (in terms of solids, air and dust flows);
(b) Develop, design and implement an effective dust suppression system for reducing dust emissions from the ROM Bin;
(c) Develop an integrated dust management system that is tailored for the primary crusher and ROM Bin area;
(d) Develop and implement an automated dust control process that is fully integrated with site process operation and management.

The complete rock dumping operation review was undertaken, identifying major dust emission contributing factors, which were grouped as shown in

Figure 4: Modelling Nozzle Performance Characteristics for Optimal Design of ROM Bin Dust Suppression System.



Nozzle Performance Characteristics



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Above: Figure 6: New Enviromist Dust Suppression System during actual Truck Dumping Operation, showing Micro-Mist Curtain (left) and special Corner Blocks (right).

Left: Figure 5: Full-Scale "Dry" Commissioning of the new ROM Bin Dust Suppression System.

Figure 3 (applicable to the Karara ROM Bin application).

Using different nozzle performance characteristics (see Figure 4), a 3D-CAD model was developed for the ROM Bin to optimise nozzle type, size, layout, spacing and mist curtain efficiency. Additional design considerations included cross-wind effects and also reducing water consumption.

The final design of the dust suppression system is shown in Figure 4, which shows special "corner spray blocks" to neutralise the high-velocity dust-air flow coming out of the corner areas of the pit. All the critical nozzles, spray bars and blocks were manufactured in Australia and full-scale "dry" commissioning was undertaken (see Figure 5) to confirm mist curtain performance and efficiency prior to installation (eg. cross-wind effects).

Figure 6 shows the micro-mist curtain in the ROM Bin during a truck dump operation, and also a close-up of one of the corner blocks in action. No dust can be seen coming out of the ROM Bin, which is a dramatic improvement compared with the quite visible dust emissions shown in Figure 2.

A "side-by-side" comparison (Figure 7) demonstrates the effectiveness and success of the new dust suppression system. Water consumption also was reduced by over 60%.

4. Intelligent Dust Suppression System

The design of the spray bars, nozzles and pressure booster pump system for the ROM Bin dust suppression system was based on the requirement to have the system fully incorporated into the mine process control system. The pump set (see Figure 8) was designed as a high quality standalone system with control connections to the master plant via Modbus TCP with the following system features:

- Auto-sensing truck movements at the ROM Bin dumping area
- Local/remote control (from the main office) including remote start/stop
- Hard-wired master plant interlock
- Hard-wired and software emergency stop interlock
- Modbus TCP interface to Master plant including control and SCADA information
- Pump motor soft starters and sequenced start-up, including fault identification
- Current information for all motors
- Pressure display of high pressure outlets and low pressure manifold/pump inlet
- Filter status
- Level display of header tank
- Instantaneous flow rates for high pressure pumps
- Totalised flow rate for high pressure pumps
- Low pressure pump flow rate calculated value
- Low pressure pump totalised flow rate calculated value

The key objectives of the system control and information flow were achieved by tailoring it specifically to the site conditions and client requirements.

About EnviroMist

Australian-owned, located in Brisbane and operated since 2009, EnviroMist is a provider of turn-key dust control and dust suppression engineering solutions.

EnviroMist provides specialised services to clients in the mining and manufacturing sectors across Queensland, NSW and, internationally, in markets like New Zealand and China.

"Our clients are all major Australian and overseas mining and material handling companies for which we have completed a number of Rom-bin, crushers, longwall, rotary car dumpers and other projects," explained Mr Vitold Ronda of EnviroMist.

"Recently, in China, together with our partners Bulk Material Engineering Australia and Fujian Longking Co.Ltd, we have installed dust suppression systems on rotary car dumpers, ship unloaders, and gold mine loading facilities.

"Our mission is to help create a dust free working environment and to provide our clients with innovative and sustainable dust suppression systems. Our systems are extremely durable and require very little maintenance and replacement parts."

Figure 7: Comparison of old Water Spray System (left) and new Enviromist Dust Suppression System (right).

Below: Figure 8: Pump Set for new ROM Bin Dust Suppression System.

5. The end result

The new EnviroMist and BMEA high-energy micro-mist dust suppression system was installed and commissioned at Karara Mine and is now fully operational in auto control, as shown in Figure 6.

100% success has been achieved with all dust emissions being suppressed and contained inside the ROM Bin, as shown in Figures 6 and 7. This excellent result has continued over time, even with strong cross-winds. Water consumption also has been reduced by over 60%. The success of this project has been fully endorsed and praised by Karara Mining and its mining project leader, Denis Boska.

The Department of Mines and Petroleum (W.A.) also recently carried out an inspection of the ROM Bin area and was amazed with the performance of the new micro-mist dust suppression system. It gave it a comprehensive "tick of approval" and also praised the innovative aspects of the new technology.

This successful project demonstrates how a large and difficult problem can be solved using innovative technology and design/modelling methods that incorporate all relevant factors. The benefits to the environment are significant with dramatic reductions in workplace/plant dust emissions, and also water consumption. ■

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