

AUSTRALIA **BULK** **HANDLING** **REVIEW**

www.bulkhandlingreview.com
Volume 22 No 2 | March/April 2017

- Conveyors, belt scrapers, ancillaries
- Grain handling
- Container tipping

CPS Conveyor Products & Solutions

Australia's leading conveyor roller manufacturer adds FRAS composite rollers to their range

To view full digital edition of ABHR click [here](#)

Increasing safety in underground coal conveyors

By Ernest Lapornik, CPS Pty Ltd

Before the development of suitable conveyor belts in the early 20th century, coal was transported from the mine by rail transport systems, but for decades coal transport has almost invariably been by conveyor systems which have presented a unique set of challenges for mine engineers and managers tasked with minimising risks. A new conveyor roller recently developed by Perth-based Company Conveyor Products and Solutions Pty Ltd (CPS) mitigates the risks associated with composite conveyor idlers in underground coal mines and reclaim tunnels through purpose-developed materials technology.

Previously, only steel rollers have been used for underground coal conveyors, despite the health, safety, and operational risk advantages that newer composite and polymer roller designs can achieve. This is primarily due to previous concerns with fire risks of polymer and composite compounds. Therefore, elimination of these fire related risks has come into focus to allow the coal industry to benefit from composite and polymer roller designs underground.

In 2012 the Mines Safety Operations Branch of NSW Trade and Investment published a guideline for non-metallic materials for use in underground coal mines, MDG3608, which identifies the major risks presented by non-metallic conveyor idlers underground, such as:

- Initiation of a fire due to friction
- Initiation of a fire due to static electrical discharge
- Initiation of a fire due to heating or melting of materials used in the roller construction
- Propagation of fire due to the quantity of non-metallic materials
- Toxic emissions and smoke produced by products of combustion
- Manual handling injuries relating to manual lifting and installation of conveyor idlers
- Elevated noise levels causing permanent hearing loss

CPS have since used the tests and requirements pertaining to the above points, given in MDG3608, as a baseline with which to develop materials that would allow non-metallic roller advantages to be used underground.

In late 2016 CPS finalised the development of the first non-metallic conveyor roller to satisfy the mandatory tests within clause 3.4 of MDG3608.



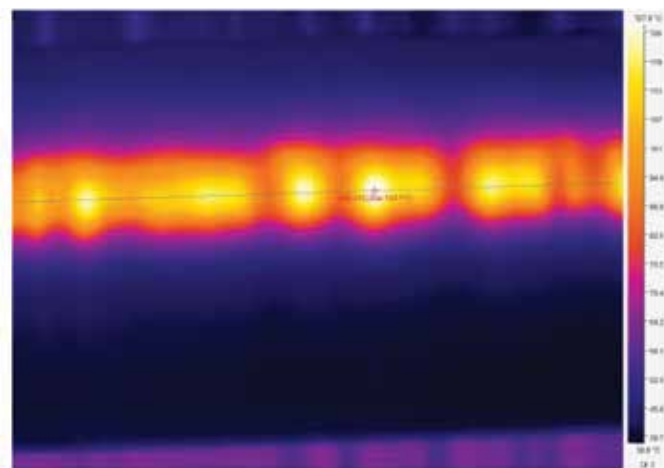
CPS HT Composite "HTC" Conveyor Rollers.

The new roller, marketed as "HTC" or "High Tensile Composite" features an innovative composite shell manufactured from a conductive thermoset resin with glass fibre reinforcement and utilises a fire resistant, conductive version of the CPS patented CBH composite bearing housing and multi labyrinth seal with a fixed face flinger covering 80% of the roller end to prevent rock jams.

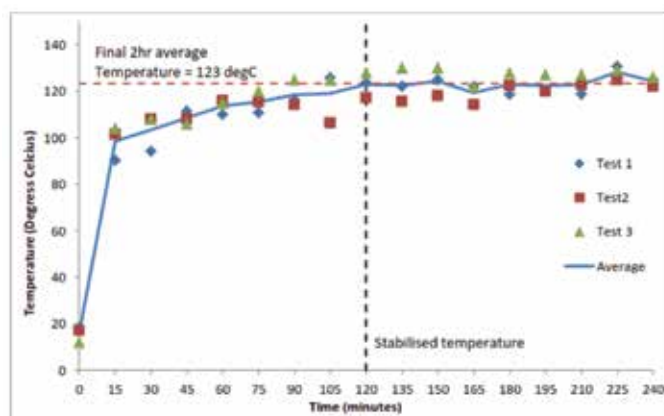
Reduction of ignition risk due to heat/static build-up

One of the biggest challenges faced in the development of non-metallic conveyor rollers for use in underground coal mines relates to minimising the risk of initiating coal dust or explosive gas fires due to friction between a non-metallic material and another surface, static electrical discharge and heating or melting of non-metallic materials. Coal dust can ignite at temperatures above 150°C with an oxygen concentration greater than 21%² and methane gas has a known auto ignition temperature of between 537°C - 600°C³.

To test the performance of the CPS HTC roller in relation to ignition of fires a project was established to test the ignitability and maximum surface temperature of an idler subject to friction as detailed in MDG3608 Appendix F: Non-metallic Conveyor Idler Tests, F2.1.6(a).



Thermographic Image of HTC roller face during seized idler simulation.



Graph of seized idler simulation.

Conducting the testing through TUNRA, the test apparatus consists of a belt loop (approximately 5m in length) that is installed with a Fire Resistant Anti-Static (FRAS) rated belt 600mm wide joined with a metal clip as required by the guideline. The belt speed used for the test was 3m/s and the load placed on the idler was equivalent to 104kg per 900mm belt width. After a two hour stabilisation period and additional 2 hour run period to test completion the HTC roller never exceeded a maximum surface temperature of 131°C with a mean of 123°C as shown in the table.

In a conventional steel shell roller this maximum temperature exceeds the baseline temperature for testing of 325°C with additional sparking due to the metal belt clip striking the steel shell observed. As such it can be concluded that the seized CPS HT Composite roller is less likely to initiate a fire than a conventional seized steel roller

When tested in accordance to AS1334.10 - 1994 a method to determine the ignitability and flame propagation characteristics of non-metallic materials to test the "Finger Burn" test detailed in MDG3608 3.4.4.3, and a test method outlined under ISO4589-2:1996 to determine the "Oxygen Index" was conducted. All non-metallic components of the roller were tested in this way and found to comply in the same way that FRAS conveyor belts are assessed.

Interestingly MDG3608 calls for conveyor rollers to be orders of magnitude more conductive than conveyor belts when tested under ISO2878:2011 with the pass/fail criteria being that there "must be no more than 1MΩ electrical resistance between any two points on the non-metallic idler and between the non-metallic idlers and ground"¹. For conveyor belts this criteria is set to 300MΩ.

Control of combustion bi-products

Along with heat, the burning of every combustible material produces smoke - gases and aerosols that, in sufficiently high concentration, present hazards to people in the vicinity. Products near those already burning may also contribute to the smoke as they decompose from exposure to the heat from the fire. Predominant among the hazards, which generally occur simultaneously, are the following:

- Sensory irritation of the upper and/or lower respiratory tract, which can affect speed of movement and the ability to negotiate escape and, at higher exposures, can lead to incapacitation or death
- Central nervous system depression resulting from inhalation of asphyxiant fire gases, which can, in ascending exposures, lead to impaired judgment, disorientation, loss of motor coordination, unconsciousness, and, ultimately, death
- Thermal effects, including hyperthermia and thermal burns of the skin and respiratory tract

Exposure to these hazards is often prolonged by eye irritation and diminished visibility due to smoke obscuration, which can affect the ability of occupants to see and negotiate escape routes efficiently. Survivors from a fire may also experience post exposure complications that can lead to delayed health effects or even death.⁴

MDG3608 mandates that the toxicity of non-metallic conveyor idlers must be tested under the method outlined in IEC60695.7.50-2006 *Fire hazard testing part 7.50: Toxicity of fire effluent - estimation of toxic potency-Apparatus and test method; Allied Fire Assessment Publication 3 (AFAP-3).*



Australia's first FRAS Fire Resistant Anti-Static Composite Conveyor Roller

The HT Composite FRAS Roller

Combining cutting edge composite and polymer technology has led to the introduction of the HTC FRAS roller. This super lightweight, corrosion resistant, belt friendly roller has been designed specifically for underground coal mines. The HTC roller has satisfied all test requirements of MDG3608 and is approved for use by NSW Mine Safety. The HTC roller is the first non-metallic conveyor roller of its kind to be fully fire resistant anti-static (FRAS) compliant and safe for all underground operations.

Our Rollers

Lighter. Quieter. Quicker. **Quality.**



Steel Roller



Aluminium Roller



Low Noise Steel Roller



HDPE-GF Roller



Yelroll M-PVC Roller



ECO Polymer Roller



Weigh Roller



Polyurethane Spiral Cleaning Roller



Rubber Impact Roller



Bullnose Rubber Impact Roller



Rubber Disc Roller



Polyurethane Disc Roller



A quality assured company



CONVEYOR PRODUCTS & SOLUTIONS

Call 08 9458 4366

69 Dowd Street, Welshpool WA 6106

www.cpsconveyors.com.au

Under this protocol CO₂, CO and NO_x levels were tested on each component of the conveyor roller. In addition it was decided to conduct an experiment to determine the levels of O₂, CO₂, CO, NO_x, and SO₂ during the full scale fire under controlled conditions using a FRAS conveyor belt on steel rollers comparing the results against the HTC composite rollers. The HTC composite roller emitted measurably lower toxic by-products than the control steel roller with the conclusion being that in the instance of an underground conveyor fire using HTC composite idlers is safer than using conventional steel idlers. Results can be viewed in the following tables noting that changes in SO₂ levels were indeterminable on both samples.



CPS HTC rollers at completion of "Gallery Test".

relating to conveyors for 2013-14, compared to 32 in 2012-13. Of these 13 were reported from underground coal mines.

In one well publicised case a former mining employee filed a suit for more than \$2 million after he sustained a lower back injury while changing trough rollers. According to the claim, the former employee injured his back when he was replacing a trough roller on a 1.8m conveyor belt that he was fixing with two other men. While he was holding the trough roller behind his head and twisting his trunk he "felt a pop in his lower back and immediately experienced severe pain". As a result of the alleged incident the former employee sustained "soft tissue and intervertebral disc injuries" that required surgery and caused aggravated pain down the back of his leg.⁵

The CPS HT composite idler was originally conceived as a solution to this very issue. A measurable reduction in mass of 40% is achieved in practice using a common 3 roller suspended set with 127mm diameter rollers for a 1600mm wide conveyor belt as an example, the mass for steel rollers would be approximately 29.5kg. For HTC rollers this would be reduced to 17.7kg resulting in an 11.8kg reduction in total idler mass.

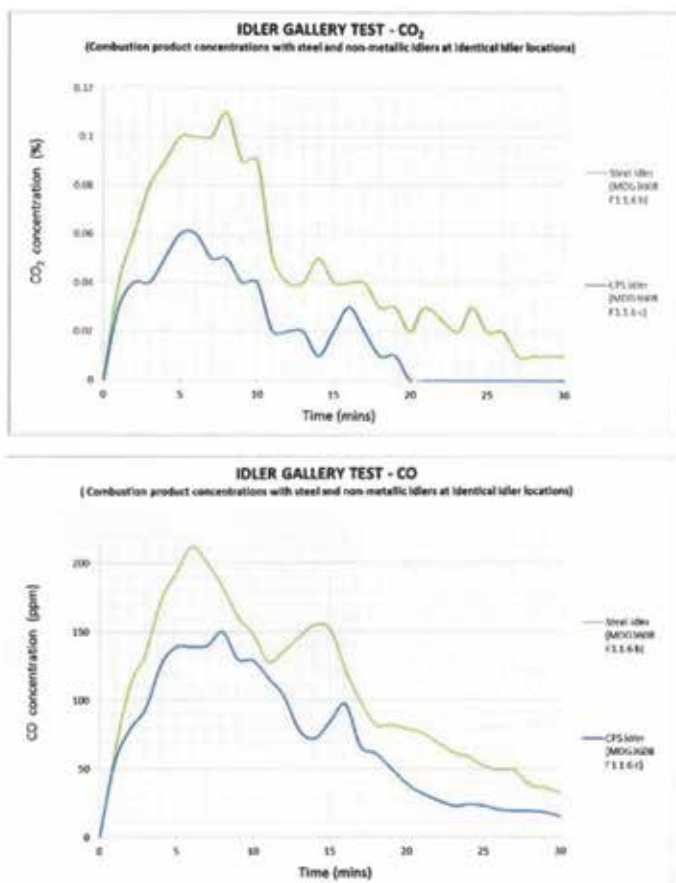
Reduction of noise and risk of hearing loss

Occupational noise-induced hearing loss (ONIH) is a significant health and economic problem in Australia. Between July 2002 and June 2007 there were about 16,500 successful workers' compensation claims for industrial deafness involving permanent impairment due to noise. The economic burden of ONIH is borne by workers and their families, business owners and managers, and the wider society.

The National Standard for Occupational Noise NOHSC:1007-2000 sets the maximum daily occupational noise exposure level at an eight-hour equivalent continuous A-weighted sound pressure level (LAeq,8h) of 85 dB(A) and, for peak noise, a C-weighted peak sound pressure level (LC,peak) of 140 dB(C). In addition, a code of practice NOHSC: 2009-2004 outlines the noise management program that workplaces need to implement when the National Standard is exceeded.

The preferred solution to excessive noise exposure is to completely eliminate the source of the loud noise. When this is not possible or practical, the legal requirement is to minimise exposure through a hierarchy of controls such as the following:

- substitute the noise source with quieter machinery or processes
- isolate the noise source from workers
- apply engineering solutions (e.g. fit mufflers, redesign the noise source, and install noise guards or enclosures)
- apply administrative solutions (e.g. schedule noisy work for when fewest workers are present, provide signs and quiet areas for breaks), and when none of the above are reasonably practicable
- provide personal hearing protectors (e.g. ear muffs and plugs).



This same experiment was used to determine the risk of flame propagation using a modified version of the standard "flame gallery" test described under *AS1334.12-1996* with acceptance criteria being determined under *clause 6.1.2 of AS4606-2012 fire resistant and anti-static requirements for conveyor belting used in underground coal mine*. It was decided to standardise the experiment by testing steel rollers as a control and then comparing the results against the HTC roller. While both the steel and the HTC rollers passed the requirements in all instances it was observed that it took a considerably longer time for the steel rollers to dissipate any residual heat compared to the HT composite rollers. One implication derived from this observation relates to auto ignition of bearing grease which while observed after "flame-out" on all roller types was observed to persist longer in the steel rollers.

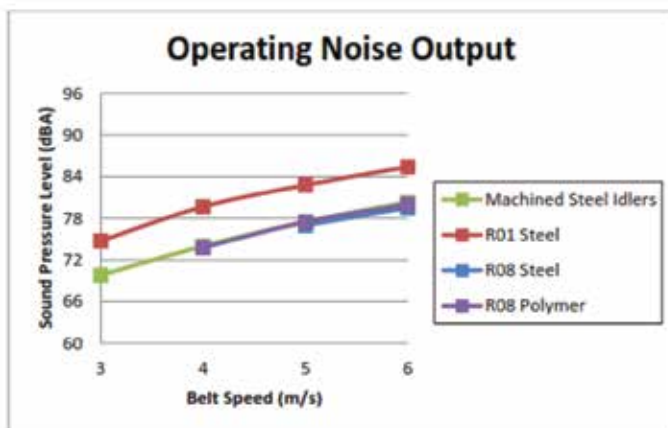
Reduction of manual handling risks

Manual handling injuries relating to physically handling and installing suspended idlers on underground conveyors has long been an issue to mine operators. Statistics published by The Department of Natural Resources and Mines' Queensland mines and quarries safety performance and health report for July 1, 2013, to June 30, 2014, shows there were 38 permanent incapacities reported

Within this hierarchy, priority is given to the source of the noise, followed by the path of transmission and, as a last resort, the exposed worker. A comprehensive hearing conservation program or noise control program should include strict adherence to the hierarchy of controls as well as assessments of noise exposure and hearing; education with respect to risks, solutions and responsibilities; and training on noise control and personal protection.⁶

Non-metallic conveyor idlers can assist in reducing the overall noise levels in an underground mine. AS 1055.1-1997, using TUNRA's *Acoustics-Description and measurement of environmental noise* provides the most accurate repeatable test method for analysing conveyor roller noise. A typical non machined and balanced steel roller has a noise output of approximately 85dB(A) while non-metallic rollers are observed to have a noise output typically in the 75 - 80dB(A) range effectively mitigating the risk to below the 85dB(A) threshold outlined in NOHSC:1007-2000. In 2016 CPS tested a number of conveyor rollers to determine noise output with the results in the graph measuring raw noise as an ambient background noise measured at 49.7dB(A) and also with the background noise subtracted in the test.

Note: CPS designates plain rollers as R01, low noise rollers as R08.



Final result summary

After a significant material and mechanical engineering development process, in late 2016, Conveyor Products and Solutions Pty Ltd finalised the development of the first non-metallic conveyor roller to satisfy all of the mandatory tests within clause 3.4 of MDG3608.

Through this technology that is now in place, it has become possible for the advantages of modern composite roller designs to be brought to underground coal mining, particularly with regards to their lower weight, lower noise, higher operating lifetime and lower cost of failure.

In addition to the above benefits, CPS has managed to exceed original requirements, and the new design has proven not just equivalent, but superior to conventional steel rollers in fire safety performance.

References

1. MDG3608: Non-metallic materials for use in underground coal mines. Mine Safety, Trade & Investment Department, NSW Government. August 2012.
2. Norman F, Berghmans J and Verplaetsen F, 2013, The minimum ignition energy of coal dust in an oxygen enriched atmosphere, *Chemical Engineering Transactions*, 31, 739-744 DOI: 10.3303/CET1331124
3. D.B. Smith London Research Station, British Gas Corporation, Michael Road, London SW6 2AD United Kingdom Received 10 May 1983, Accepted 19 May 1983, Available online 29 August 2001
4. Richard G. Gann Nelson P. Bryner Combustion Products and Their Effects on Life Safety Chapter 2 Section 6
5. Madeline McDonald, Gladstone Observer, Employee suing Anglo for \$2m, claiming back injury, published 3 Aug 2015
6. Dr Perri Timmins and Mr Oliver Granger, Occupational noise-induced hearing loss in Australia: Overcoming barriers to effective noise control and hearing loss prevention, Safework Australia published August 2010

Contact: www.cpsconveyors.com.au