MINING TYRE SOLUTIONS

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Technical Bulletin

MANAGING TYRES IN A DIGITAL WORLD

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Managing Tyres in a Digital World

How is Digital Technology influencing Mining Tyre Management?

Introduction

Much has changed in the mining industry over the past 15 years – from a period of low commodity prices at the turn of the millennium, through the China-led boom circa 2003 to late 2011 (intersected by the 2008 global financial crisis), culminating in the post-boom tribulations (and hopes) experienced by the industry since 2012.

Over that time technology and systems have improved and been more widely adopted by the industry encompassing the whole spectrum of management activities – from enterprise level, through equipment fleets and vehicles down to individual component monitoring and control.
This article examines – from a mining tyre management perspective – the development and integration of those technologies and systems over time, how they have been employed by mining companies, and their effects on tyre life, logistics and haulage productivity.

Systems

Many technology or software based systems used by mining companies contribute to earthmover tyre management. Some are tyre specific while others are general systems which can be utilised to benefit the tyre operation.

Tyre specific

Three main systems designed specifically for tyre management and control are: TMS, TKPH and TPMS.

TMS

The fundamental system used for administering earthmover tyres is the Tyre Management System (TMS) – database/analysis/reporting software that underpins all administration and control of mining tyres by the end-user, whether at a site, regional or corporate level. TMS records every significant aspect of the tyre's journey from cradle to grave, including pricing, transporting and warehousing, vehicle and wheel position fitment, time and distance travelled, pressure and temperature, downtime, repair and retread details and much more.

This history is used by the TMS analysis algorithms to calculate key tyre management indicators – tyre, rim and chain life, fitment and operating cost, change time and downtime, percentage worn at failure, damage modes, etc. Once the performance data has been calculated, the TMS reporting module presents the processed information, usually in graphical form.

TMS is increasingly being used to improve tyre logistics and workshop efficiencies – managing inventory, forecasting tyre usage and purchasing, generating budgets, and administering preventative and other scheduled maintenance.

However, an inherent weakness of TMS is GIGO: Garbage In-Garbage Out. While some progress has been made on inter-system integration, much of TMS data collection and input remains manual – usually recorded by tyre fitters and entered by tyre workshop clerical staff, with much scope for

misreading or recording serial numbers, specifications, fitment/removal positions, hour meters and odometers. These shortcomings of TMS provide opportunities for future improvements in tyre management.

Commonly used TMS systems include: *OTRACOM, Total Tyre Control (TTC), EnTIRE, TreadStat, EM Track*.

TKPH

Tonne Kilometre Per Hour (TKPH), or Ton Mile Per Hour (TMPH), measures earthmover tyre workload capability. TKPH analysis has been routinely used since the 1970s to determine the specification of tyre required to handle the load and speed demands of a haulage application. TKPH analysis was automated in the 1980s with the incorporation of a real-time TKPH monitoring and reporting module into a Fleet Management System (FMS). A decade later a TKPH monitoring and control system was built into a Vehicle Management System (VMS).

Real-time TKPH monitoring of haul truck tyres, usually through an FMS, has been adopted by many mining companies over the past ten to 15 years. It is used to improve productivity by operating tyres closer to their workload limit while minimising the incidence of expensive low-life heat failures.

TKPM monitoring is usually incorporated in either the site Fleet Management System (FMS) or the site Vehicle Management System (VMS).

TPMS

Tyre Pressure Monitoring System (TPMS) uptake on mine sites has increased markedly over the past five years. The principal of pressure and temperature measurement and adjustment for mining tyres was established in the late 1970s but it took another 20 years for TPMS mining application development to take off. Since then many systems have come and gone, leaving a handful available at present.

The original goal of TPMS was to improve tyre pressure maintenance quality. Rather than having to rely on one or two manual pressure checks per week, TPMS continuously monitors tyre chamber pressure and temperature allowing immediate rectification of a leaking or flat tyre.

Recently, particularly with the drive for greater haulage productivity requiring higher truck operating speeds and payload, the focus for many end-users has been to use TPMS inflation temperature sensing as the primary tyre work-limit monitoring tool. It is gradually replacing real-time TKPH monitoring in this role within the industry – although the latter remains the more effective way to manage tyre workload in some circumstances. The ultimate means of predicting imminent tyre heat-related failure is the sensing of tyre tread belt temperature; at least one company is currently working on this form of monitoring.

Commonly used TPMS systems include: *TyreSense, iTrack, TTT, MEMS, B-TAG, INTREAD, PressurePro, TirePulse*.

General purpose

Apart from tyre specific management systems, there are several broad-spectrum systems used by mining companies that make significant contributions to earthmover tyre management. They include: GPS, PLM, VMS, FMS and ERP.

GPS

Global Positioning System (GPS) technology is incorporated into various monitoring and control systems used on mine sites including Fleet Management Systems (FMS) and sometimes TPMS.

This technology has been widely employed over the past decade to measure parameters that influence earthmover tyre life, e.g. velocity, distance, lateral and longitudinal acceleration, gradient and turn radius. It is sometimes paired with video cameras and is typically used to identify haul, bench and dump road trouble spots and poor driving practices. It can also be applied to tyre TKPH analysis.

The main GPS system used for mining tyre application is *VBOX*.

PLM

Payload Monitoring (PLM) is normally included in a Vehicle Management System (VMS) but can also be installed on a haul truck as a stand-alone unit. Tyres have load and work-capability limits, both of which are directly affected by vehicle payload. Payload monitoring, especially when conducted in real-time, is an important tool for maximising haul truck tyre life.

PLM is normally incorporated in the site Vehicle Management System (VMS).

VMS

Vehicle Management Systems (VMS) measure a range of operating data on a haul truck. The three key parameters related to tyres are cycle payload, distance and time. These can be downloaded into custom-built spreadsheets that determine and plot the tyre TKPH profile for a truck over an extended period. VMS can also be used to monitor suspension strut dynamics during operation, producing a road condition map that identifies zones likely to damage tyres and truck componentry.

Each of the haul truck OEMs provides VMS.

FMS

Fleet Management Systems (FMS) are used to track and manage mining equipment. Their most common application in relation to tyre management is the provision of real-time TKPH monitoring of tyres on the haul truck fleet. However, even without the TKPH module, FMS records much data that is useful for managing and optimising the tyre operation, such as time and distance travelled, haul road gradient, payload, etc.

Commonly used FMS systems include: *DISPATCH, MineStar, Jigsaw, Wenco*.

ERP

Operating at the highest level is the Enterprise Resource Planning (ERP) system which covers wide-ranging aspects over the full spectrum of a mining company's processes and operations.

Commonly used ERP systems include: *SAP, Oracle, Microsoft, EPICOR, Infor, Netsuite*.

Benefits to tyre management

All the systems described in this article have contributed to an overall rise in the quality of tyre management throughout the mining industry – with the commodity boom acting as the principal catalyst. The Chinese demand for mining commodities created a near-crisis for the industry due to the rationing of earthmover tyres which manifest in late 2004. Some companies were on the brink of having to stand down rubber-tyred production equipment because of tyre sourcing difficulties. This led to an industry focus on improving tyre management – to get as much life as possible from every tyre.

The four pillars of earthmover tyre management are tyre and rim selection, maintenance, operation and awareness. The benefits derived by each, due to improvements in and increased uptake of technology systems, are summarised below.

Selection

While, during the tyre crisis, there was often limited scope for obtaining the optimum specification of tyre for each application on site, it remained crucial to identify the best of what was available and to forecast accurate usage requirements being requested by tyre manufacturers as a condition of obtaining supply contracts with them. Correct tyre recording, analysis and reporting was vital to these undertakings forcing those miners who had previously kept poor tyre life records or had done little meaningful tyre life analysis to adopt TMS. TMS developers improved the functionality of their products with emphasis on tyre usage, budgetary and purchase forecasting.

The fall in commodity demand and prices from 2012 has brought with it a change in industry focus – a concentration on cost reduction. Tyres are no longer in short supply; rather inventory minimisation and just-in-time (JIT) are now at the forefront of purchasing strategy. TMS forecasting modules are being applied to achieve these goals. TMS is being integrated with ERP systems to improve efficiencies in this and other areas.

The next challenge for TMS is in tyre batch life predictive analysis. The earlier that a mine can identify the best of the competing specification tyres that it uses, the sooner it can determine what the optimum purchase allocation should be – generating substantial savings in its tyre bill.

Maintenance

Good maintenance prolongs tyre life (the key objective during the tyre supply crisis) and reduces operating costs (important in the current climate). The most critical aspect of tyre maintenance is inflation pressure control. TPMS has made a substantial contribution in this area enabling the immediate identification and rectification of tyres that have lost inflation air or are operating at abnormally high pressure or temperature. Integration of TPMS with TMS improves analysis and reporting options and is receiving stronger consideration within the industry. TMS has also facilitated the management of earthmover rim non-destructive testing (NDT).

Mining companies have become increasingly focussed on productivity, and hence on production equipment downtime. Tyre related haul truck downtime can be reduced by decreasing the number of tyre interventions while increasing the ratio of scheduled to unscheduled tyre work. TMS based forecasting (with ERP integration in some cases) is being used by several

mining companies to streamline this process – and to optimise any trade-off between productivity and tyre life.

Operation

Tyre operation covers the working conditions to which tyres are exposed, and the role that tyres play in managing haulage productivity.

VMS and GPS based systems have been widely employed over the past decade to identify and map haul road, bench and dump under-foot trouble spots that can lead to tyre and truck damage.

Haul truck productivity is largely determined by truck payload and speed, with tyres almost always being the limiting factor. TKPH and (increasingly) TPMS monitoring of tyre work capability, together with PLM to achieve target payload, is now used on many mine sites to obtain the lowest cost per tonne of material hauled.

Awareness

Haul truck operating practices play a key role in maximising tyre life and minimising cost. GPS monitoring of truck speed, braking, acceleration and turn radius – especially when used in conjunction with video cameras – provides an effective way to identify poor operator practices, so that the learnings can be incorporated into operator tyre awareness programs.

Future

What are the main areas for improvement?

A priority is to automate the identification, measurement and input of data required by TMS, e.g. tyre serial number, specification and tread depth. This will facilitate data collection, reduce recording errors and promote standardisation – important for large mining corporations with many geographically widespread sites. Options include id tags for tyres and rim components, optical character recognition and digital (e.g. laser) measuring devices.

With the advent of autonomous truck haulage – where there is no driver to detect a ‘hot’ tyre, either visually or via smell – there is a need for tyre fire monitoring. Infrared sensing is a potential solution, as are drones which have general application for tyre emergency events.

Lastly, better systems integration – still in its infancy in relation to tyre management – offers benefits currently untapped.

Development and increased industry uptake of digital technology systems have greatly improved earthmover tyre management on mine sites over the past decade, but there remains substantial scope for further advances.

This article by Tony Cutler, Principal of OTR GLOBAL – Mining Tyre Solutions, was published in the May 2017 edition of Mining Magazine (pp 16-19).

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