Measuring and Managing Road Surface Friction Risk

RoadSafety Training Services Pty Ltd

The Problem or Initiative

Uncontrolled vehicle movements are an ever present mining hazard; be they a result of intermittent rain events or overwatering practices. Vehicle related incidents account for a large proportion of safety related reportable mine events and uncontrolled movements due to deficient surface friction.

[1]*Analysis of reported incidents and observations by inspectors during follow-up inspections has shown:*

- *Most of the incidents (59%) took place on ramps*
- *Watering or excessive watering was identified as the primary cause of such incidents (46%)*
- *Wet road conditions due to rain has been a causal factor in (8%) of incidents*

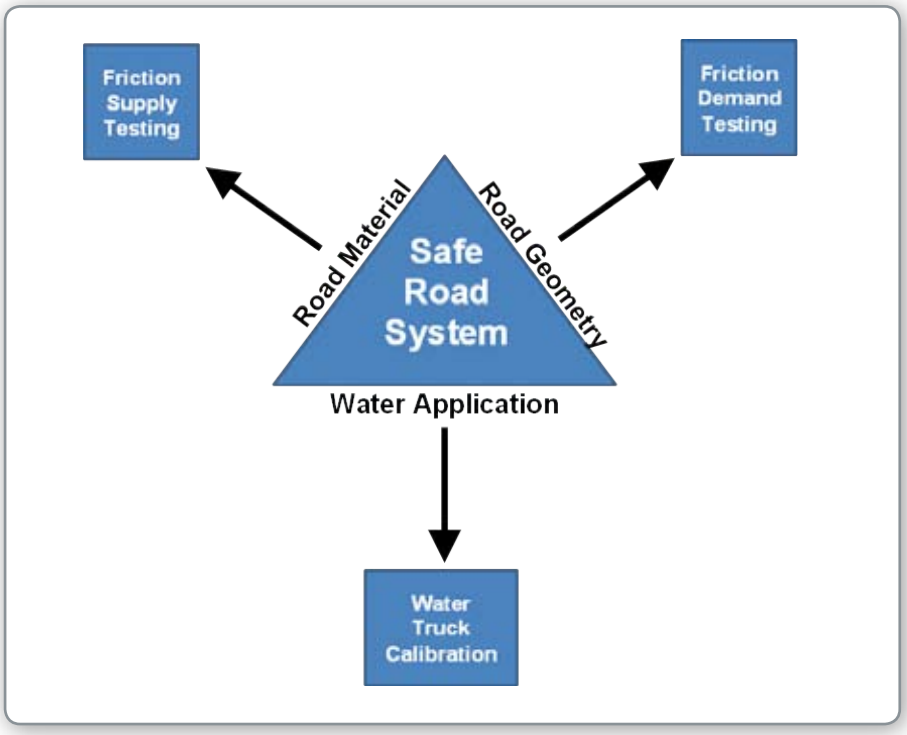
The material types used by mines for road construction, including on the road surface to provide for frictional value, require urgent review (S 128 (2), CMSHR).

The challenge confronting surface mining operators is the inherent conflict between managing dust and friction. This difficult situation is exacerbated by demanding and variable geometry combined with water sensitive clay based road materials.

Rain events pose an additional intermittent hazard for safe vehicle movement. The *Safe Road System* provides a comprehensive solution to manage this risk.

Traditionally, this risk is managed by reliance on operator experience and judgement. This *Road Safety System* provides scientific and objective friction evaluation that complements current subjective industry experience and knowledge. This is consistent with the hierarchy of control risk management methodology.

[1] Safety Bulletin No. 99 (Version 1) 23 August 2010



The Solution

The three elements of the *Safe Road System* are road material, geometry and water application. A Safe Road System can be established where the available friction supply not only exceeds the friction demand, but provides a factor of safety for safe operation of mine vehicles.

The objective was to develop a reliable and affordable method for mine operators to assess their existing road materials for friction and water sensitivity properties. By adopting this methodology, mine operators can measure and identify the risk of uncontrolled vehicle movement events. After rain events, mine operators may measure and manage friction risks. The Safe Road System complements the knowledge and experience of miners, in determining safe operating parameters.

Two mining operators participated in a field evaluation of the Safe Road System, comprising the below elements. The trial confirmed the Safe Road System to be a robust real-world solution to managing uncontrolled vehicle movements.

- Mine Friction Test Procedure
- Global Friction Template (Risk Matrix)
- Water Truck Calibration Method
- Water Application Guide

A robust standalone dynamometer (accelerometer) was selected to conduct friction measurement testing. This scientific instrument is portable, user-friendly and provides instant field results utilising readily available mine light vehicles. The device is used extensively by road authorities and law enforcement agencies to determine road friction values.

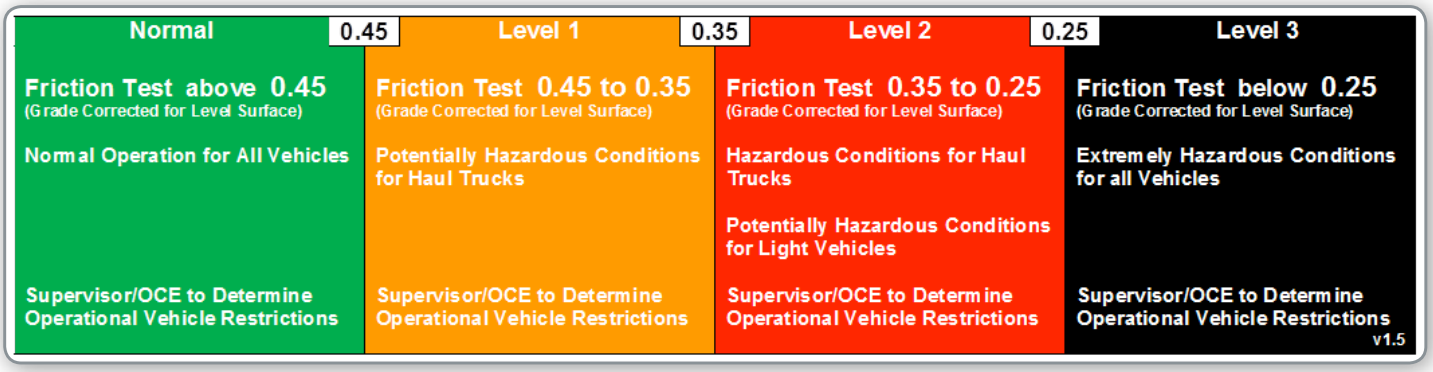
The field test procedure provides a reliable and safe light vehicle test that correlates to a mine heavy vehicle friction measurement result:

- Two pilot mines participated in field trials.
- Common on-site mine light vehicles were used for testing.
- Both antilock braking systems (ABS) and conventional brake systems were trialled.
- Mine haul truck road surface friction test results were correlated with the light vehicle by providing analogous road surface conditions.
- Water application was controlled by water to ground rate calibration of the on-site water trucks used in the procedure.
- Grade adjustments for all tests allowed for level surface comparison for road surface testing.

The implementation of the Safe Road System is a low cost, practical and technically robust measurement means to assist mine operators in determining conditions for safer vehicle operations.

Field testing provides instantaneous friction values, enabling reference to the *Global Friction Template* for both heavy haul trucks and light vehicles. The Global Friction Template accounts for demanding geometry such as 10% ramps with an inbuilt safety margin for normal operations.

The below *Global Friction Template* provides for vehicle specific risk management in all friction conditions and hierarchy of control applications can be readily matched.



Global Friction Template

Benefits / Effects / Outcomes

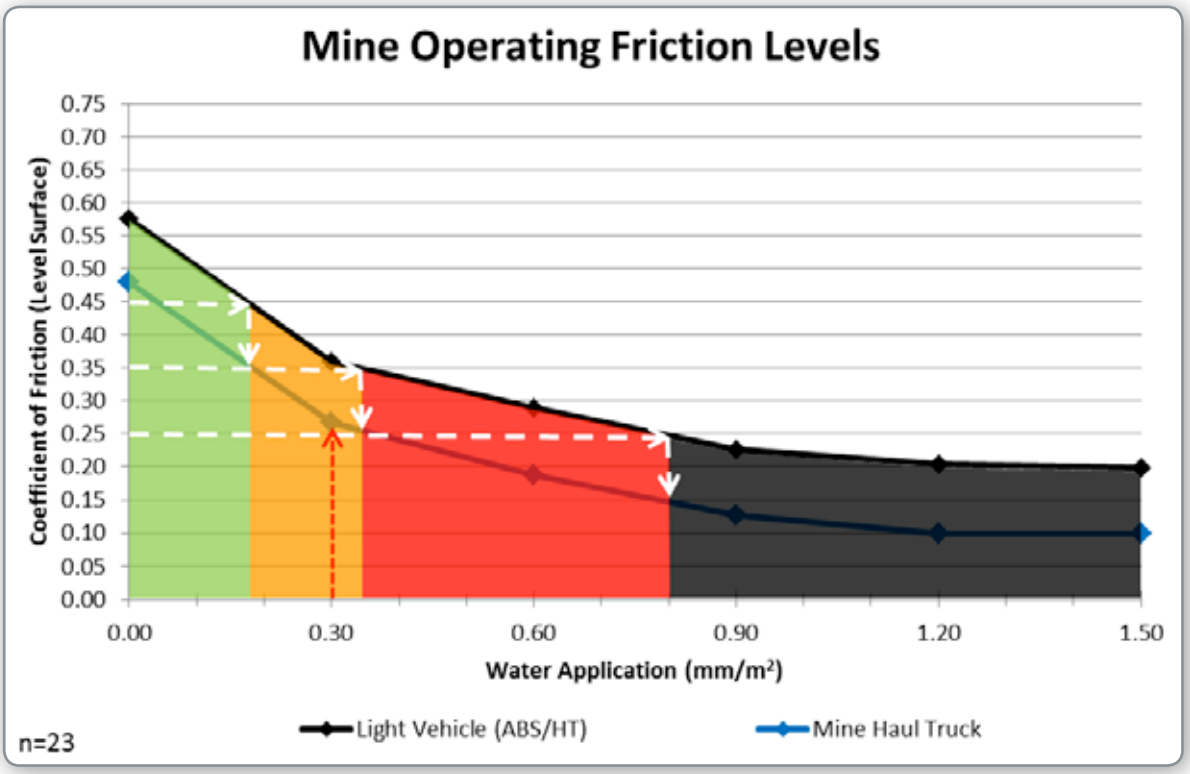
Uncontrolled vehicle movements, particularly those involving heavy vehicles are high potential incidents. Deficient road surface friction environments are common upon mine sites and typically friction values are unknown to the operator until an incident occurs.

The *Global Friction Template* provides a reliable and effective means to interpret friction values with the following road safety benefits:

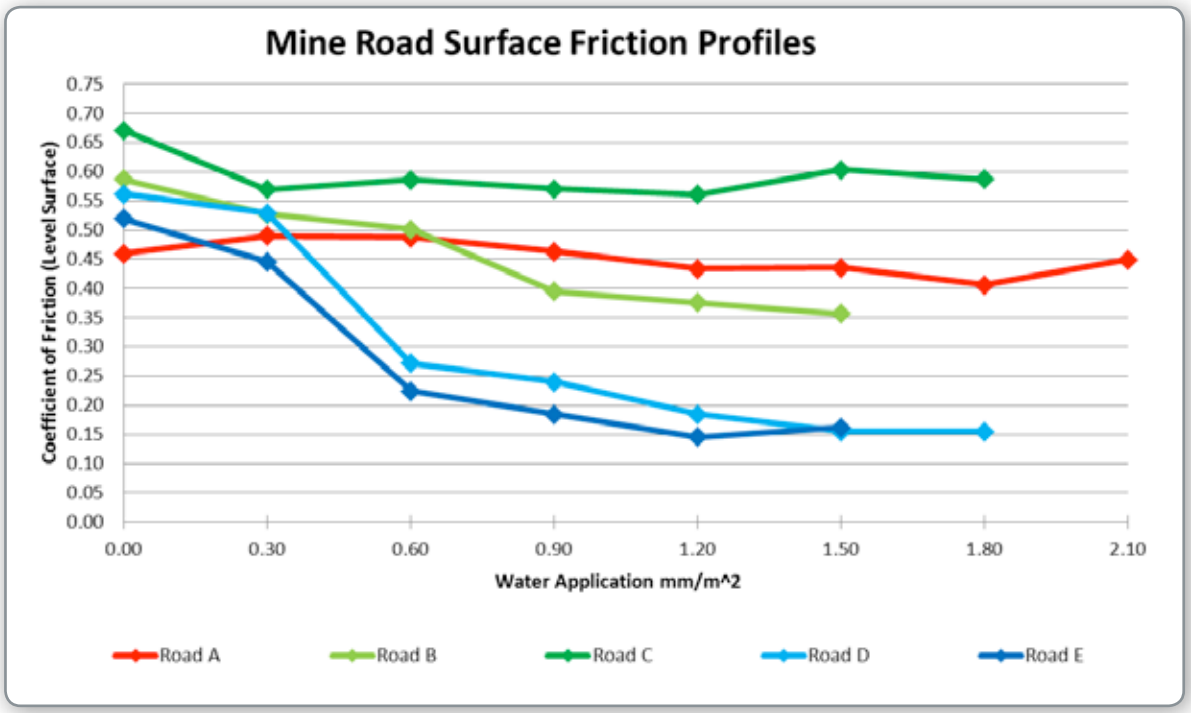
- After rain event road surface friction assessment (back to work decision)
- Road watering safety management practices (live audits)
- Road surface material friction properties evaluation (to sheet or not)
- Uncontrolled vehicle movement Incident Investigation (friction deficiency or other)

The *Mine Operating Friction Graph* combines test friction data for higher risk road surfaces from 12 operating mines. This data capture is a world first initiative that provides for direct correlation between light vehicle tests and heavy vehicle friction results. The *Global Friction Template* has been developed in conjunction with this on-site research data using operational mine vehicles on active mine circuits.

The friction results are correlated with calibrated water cart water application and rainfall events. This is an important process that allows for accurate road friction profiling of roads with diverse geotechnical road surface properties.



Mine Operating Friction Graph



Example of mine road surface friction profiling graph

This *Safe Road System* has now been adopted at three operating mines and several other mines are in the early stages of deployment across their road networks.

Transferability

The *Safe Road System* may be utilised in any unsealed road network environment. The *Safe Road System* is not limited by vehicle type, road geometry or design. This innovative safety system may be readily deployed in any mining environment.

This system adds tangible value to existing road design and associated road safety practice.
Specifically:

- Mine Friction Test Procedure
- Global Friction Template (Risk Matrix)
- Water Truck Calibration Method
- Water Application Guide

Innovation

Public road authorities in Australia do not have a system of measuring unsealed road friction as it is considered too difficult a task. Current road surface friction systems for sealed roads do not transition to unsealed road environments. The friction values ascribed to these mainstream systems are only comparable within their own system of measurement and therefore limited in their application.

The *Safe Road System* provides friction values that cross over to road design and road safety criteria. For example a 10% mine ramp requires a surface friction of (0.1g) for a vehicle to maintain a stationary position and therefore requires (0.1g) more friction to maintain safe vehicle movement than an equivalent level surface.

The *System* affords the ability to measure not only the surface friction supply but also friction demand which is a combination of vehicle speed, road geometry and operator input. These analogous (g) values enable an accurate assessment of the uncontrolled vehicle movement risk or safety margin at any location on the mine road network.

This innovative system is original in its application of the laws of physics, together with the aid of an affordable, user friendly scientific instrument and test procedure. Ready access to consistent and objective data assists mine operators make superior road safety judgements to reduce the risk of uncontrolled vehicle movements on their road networks.

Cost

The instrument used to conduct the procedure costs ~$4000. There are no other ongoing or maintenance costs as the instrument is self-calibrating and used in readily available mine light vehicles.

Road friction test Instrument mounted in test vehicle.