

Safety In Mines Research Advisory Committee Project Summary

Project Title:	Inherent Respirable Dust Generation Potential (IRDGP) of South African Coals-SIM020604		
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Summary

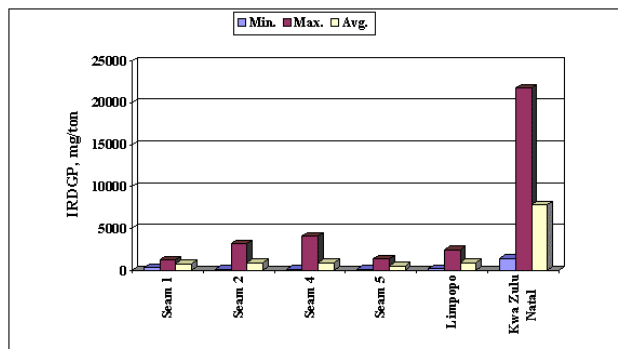
Project SIM020604 was formulated to determine the Inherent Respirable Dust Generation Potential (IRDGP) of various South African coal types from various provinces and its use in dust exposure assessment. The objective was to quantify the amount of inherent respirable dust that becomes airborne from a particular coal type, rather than the respirable crusher product or its size distribution.

The epidemiological findings on the relationship between coal rank and development of Coal Workers' Pneumoconiosis (CWP) led to numerous studies on coal types and generation of respirable dust. Internationally, a number of laboratory studies have been conducted on the relationship between coal characteristics and respirable dust generation. No literature relating rates of CWP in South African mine workers with coal rank has been found. Also, no study has yet been done in South Africa to determine the inherent respirable dust generation potential (IRDGP) of various coal seams or coal types. Therefore, any new information acquired through such a study could be used in future to investigate the relationship between the exposure levels, dust types and the disease rate among South African coal miners from a long-time perspective.

The IRDGP test facility was built at the Kloppersbos research centre. The laboratory test facility comprised a roll crusher located at the intake end of a 0.9 m high by 1.2 m wide wood framed hard board sheet rectangular wind tunnel 8.0 m long. An exhaust fan and a dust collector were located at the discharge end of the tunnel. The roll-crusher used for the study was similar to the specifications used by NIOSH in their dust generation research study. The research study carried out experimental work that resulted in critical information on dust type and IRDGP for the first time for South African coals.

Conclusions

Figure 1 shows the average IRDGP for different coal types, coal seams and mine operators during the study.



In summary, the following conclusions are made from the IRDGP data of the test coal samples:

- For the first time, a clear delineation of coal types (Bituminous and Anthracite) that possess the most inherent respirable dust generation potential was possible. Apart from a small amount of semi-anthracite found in Kwa Zulu Natal, most of the South African coal is of the semi-bituminous type. Typical range of volatile matter of coal is between 25% and 31%, while ash content is 10% to 24%.

- There is no conclusive relationship between different coal seams (1, 2, 4 and 5) and inherent respirable dust generation potential (IRDGP). The majority of the mine operators are currently exploiting coal from seam 2 and 4.
- Average coal crushing time of coal samples for the study indicated that the crushing time decreases in the order of seams 1 to 5. Kwa Zulu Natal coals took the highest crushing time during the tests when compared to the other coal seams and coal types. The reasons can be attributed due to inherent coal properties of high rank anthracite coals.
- Measured IRDGP of Limpopo coal was less than commonly occurring seam 2 and seam 4 coals in Mpumalanga province.
- Inherent silica content of South African coal seams indicated that average inherent silica for the test coals was 3.54%. Similarly, historically analysed airborne coal dust samples for quartz has indicated that they were below the limit of detection of X-ray spectrometer. However, caution must be exercised when assessing exposure specifically in the presence of sandstone bands and roof-bolt operators.
- Statistical Analysis of Variance (ANOVA) results of the study indicated that coal rank influences the IRDGP of coals ($p = 0.000$). There is no conclusive relationship between different coal seams (1, 2, 4 and 5) and IRDGP ($p = 0.373$) as they are all of semi-bituminous type.
- Based on the measured respirable dust data of the South African coals, it can be concluded that majority of the coal mining operation provinces such as Mpumalanga, Free State, Limpopo have on average similar IRDGP, while Kwa Zulu Natal coal samples which are semi-anthracite type coal have greater IRDGP.

Recommendations

The IRDGP information will be helpful as the effectiveness of a dust-control system is dependent on coal dust type in both surface and underground operations. To date there has been no clear delineation for South African workers who are exposed to different dust types. Therefore, it is recommended that a research study be conducted to investigate prevalence of CWP among workers in Kwa Zulu Natal coal mines and other provinces to assist in determining historic dose and developing a relevant dose-response curve.