FEATURED ARTICLE – FEBRUARY 2019

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS

FOUNDED 1852
ROYAL CHARTER 1876

Reducing Occupational Exposure to Coal Dust

(Published online February 2019)

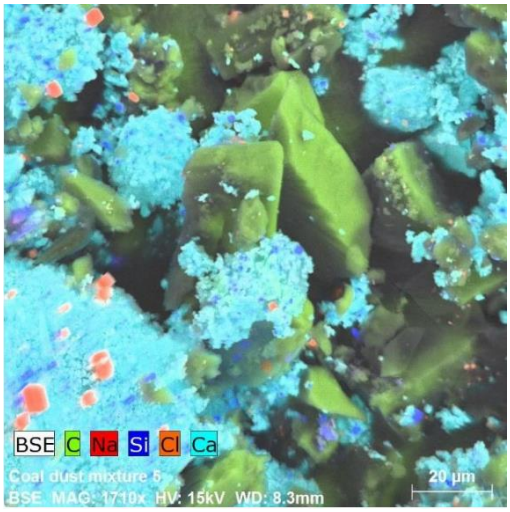
Prof Ben Williamson
Camborne School of Mines (Exeter University)

In January the Institute sponsored the 2019 Mineral Deposits Studies Group conference, this year held at Camborne School of Mines (CSM). One of the current active research projects at CSM is 'Reducing risks from Occupational exposure to Coal Dust'. In this article Prof Ben Williamson, an Associate Professor in Applied Mineralogy at CSM, writes about the aims of project.

The **ROCD** project: **R**educing risks from **O**ccupational exposure to **C**oal **D**ust, is a 3-year EU Research Fund for Coal and Steel contract (No 754205) to address concerns about the occupational health impacts of dusts in coal mines. The project, which started in July 2017, is being undertaken by a world-leading interdisciplinary consortium of 10 partners from 5 European countries (UK, Poland, Slovenia, Germany and Spain).

The need for such a project is surprising given European workplace regulations and the perceived availability of modern and efficient dust control systems and respiratory protective equipment in underground coal mines. Unfortunately, however, coal dust continues to impact the health of thousands of miners in Europe. According to a publication by the KOMAG Institute of Mining Technology, Poland, there were over 4500 cases of pneumoconiosis over the last 10 years in Polish mines. In the USA, where considerably more data is available, there has been an increase over the last ten to fifteen years in both the number and severity of coal dust-related lung diseases, despite huge efforts in the 1990s to reduce these. The rise has been variously attributed to cuts in control measures and enforcement, and, with the depletion of thicker coal units, the exploitation of thinner seams containing higher proportions of components such as quartz, which is potentially carcinogenic.

The ROCD project will address three main issues in the European coal mining industry: 1) Limited modern data on the concentrations, nature and toxicity of coal dust. This is particularly the case for the fine dust fraction ($PM_{2.5}$) which is particulate matter, nominally less than 2.5 microns in diameter, which can penetrate into the deepest, alveolar, regions of the lung; 2) The urgent need for well calibrated continuous dust concentration monitoring systems, modern quantitative physicochemical and toxicological assessment protocols for coal dusts and predictive tools to assess dust hazards in different mining scenarios; and 3) Whether dust control technologies and respiratory protective equipment adequately protect workers from $PM_{2.5}$.



BSE-SEM image of a sample of coal dust

Featured Article – February 2019

Reducing Occupational Exposure to Coal Dust

Prof Ben Williamson
Camborne School of Mines (Exeter University)

The limitation with almost all previous studies on coal mine dusts is that they have been based mainly on the coarser size fractions PM10 and/or PM4. In health studies, however, increased concentrations of ambient (e.g. urban) PM2.5 have been linked to higher rates of lung cancer as well as cardiovascular mortality and coronary events. Coal workers may therefore be suffering unrecognised health impacts (possibly cardiovascular diseases) from exposure to PM2.5, in addition to lung diseases traditionally associated with coal dusts such as coal workers' pneumoconiosis. Furthermore, few previous studies have considered the mineralogical composition of coal dust PM2.5, for example the proportion of quartz. This is mainly because of difficulties in differentiating individual coal particles from carbon-based sample preparation media. The dust assessment part of the project will therefore include the development of a new coal-dust specific methodology for automated mineralogical analysis and new assessments of the composition and toxicity of coal dust PM_{10} and $PM_{2.5}$.

The most common way to control airborne dust in underground coal mines is to use water spray systems. Currently, their main shortcomings are that water flow rates cannot be adjusted to specific dust levels and that the use of standard spray nozzles, at recommended flow rates, does not efficiently remove particles <25 µm in diameter, let alone $PM_{2.5}$. To address this, the dust control aspect of ROCD will develop and test new 'smart' dust suppression systems for coal dust.

The use of masks is vital for reducing worker exposure to coal dust. In theory, they should work well for most types of dust, including $PM_{2.5}$. Their performance in the workplace, however, is generally much poorer than suggested by manufacturers' literature. This is because their effectiveness depends on whether they are fitted and worn correctly which can be compromised if the worker adjusts the mask to make it more comfortable, to fit around other equipment such as glasses, or does not replace their mask or mask filter regularly. Another important aspect is that workers may sometimes only wear their masks when they visually or otherwise sense high dust concentrations, which will be mainly due to the presence of relatively coarse particles, and less so when there are imperceptibly high levels of $PM_{2.5}$. These issues will be tackled through quantitative performance testing and ranking of currently available RPE from different manufacturers using laboratory-based stand tests and workplace experiments.

The results of the ROCD project will be disseminated globally via its dedicated website includeing developed protocols and training modules for best practice in the use of dust control systems and masks. New dust monitoring and control devices developed during the project will be patented and prepared for commercialisation. It is hoped that these endeavours will be help reduce worldwide incidences of coal mine dust-related diseases.

For more information see:
http://emps.exeter.ac.uk/csm/rocd/

Modern Polish coal mine (Photograph by Kacek Filipiak)