Innovative Solution to Detecting the Goaf Gas Dynamics and Air-leakage in Underground Coal Mines

The Best Way to Mitigate the Risks of

-Coal Self-Heating/Ventilation Management and Gas Emission Issues

1. Introduction

Tracer gas: SF_6, is a stable inert, colorless, odorless non-flammable, non-toxic as well as zero background gas that is poorly soluble in water.

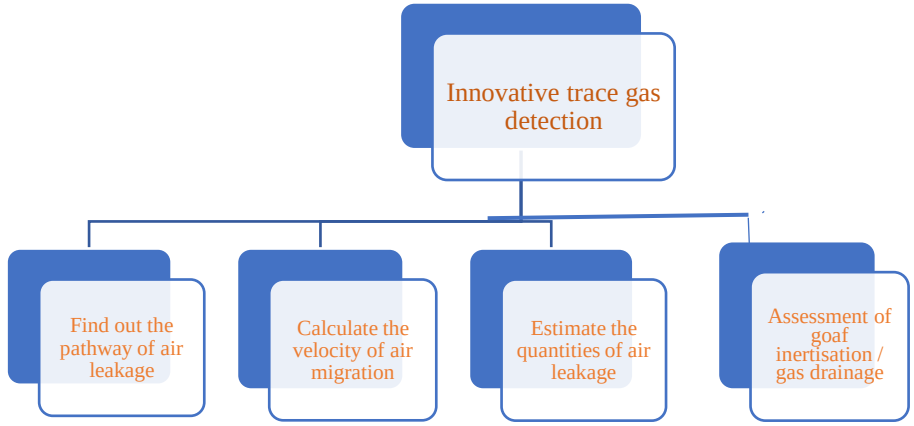
Conventional Lab Gas chromatography (CLGC)

Portable High Precision SF_6 Detector (SFD)

The innovative SF_6 tracer gas detection technique has superior advantages to Lab GC methods. It provides an effective solution to mitigating the coal self-heating and gas drainage issues, especially with its onsite higher precision and lower influence by the sampler and delay detection.

Comparison between CLGC and SFD

Index	Lab GC	SFD
Sensitivity	1 ppb	0.01 ppb
Response time	2~3 min	85% of reading <1s
Recovery time	>5 min	<2 s
Detection range	0.1~50 ppm	0.01 ~30/0 ~180 ppm
Detection	Bag sampling	Probe onsite
Productivity	Low	High
Effectiveness	Low	High
Cost	High	Low

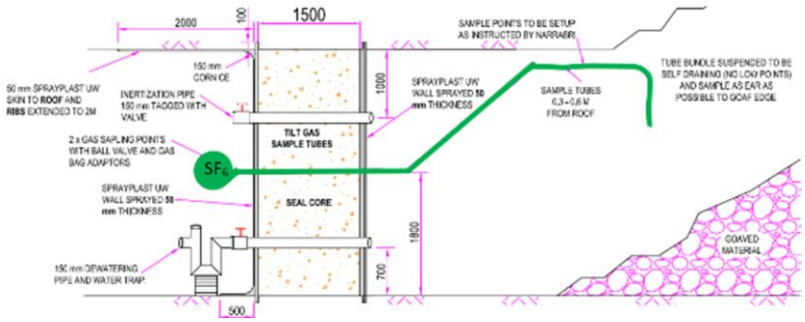


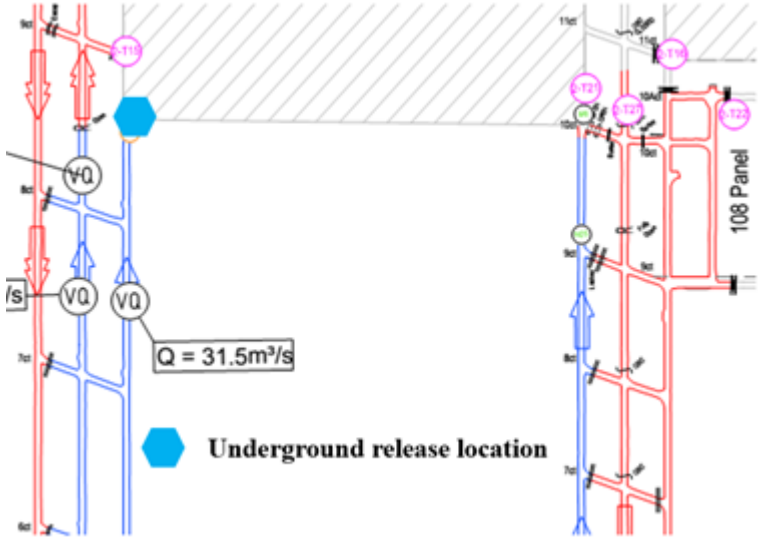
2. Release

SF_6 gas can be released from underground or surface

SF_6 quantitively release instrument

Surface Release from N_2 injection Borehole





Underground Release via CT Seal or LW

3. Onsite sampling and detection

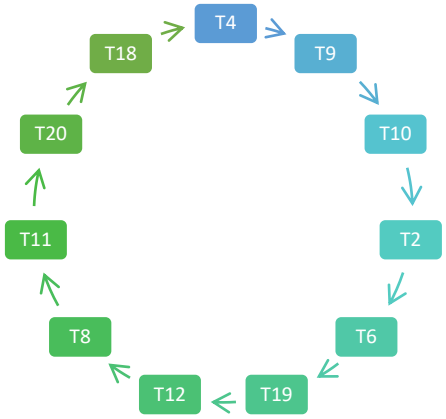
➢ Sampling from TB outlets

12 TB outlets

One **detection circle** takes around 24 mins.

2 mins/per point:

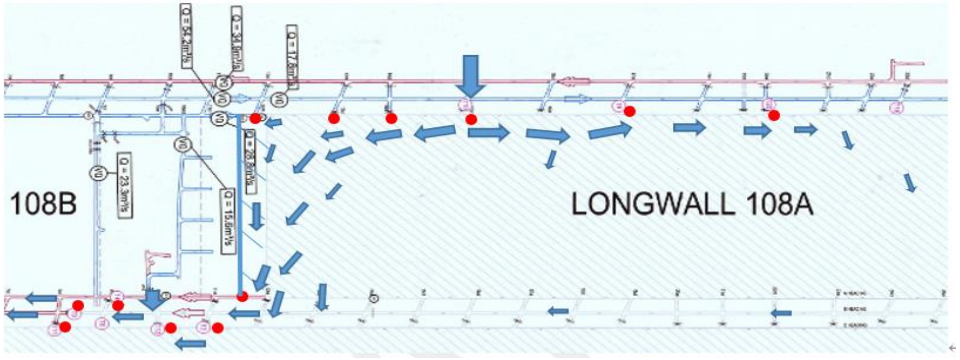
- Switch TB
- Detection
- Reading
- Recording



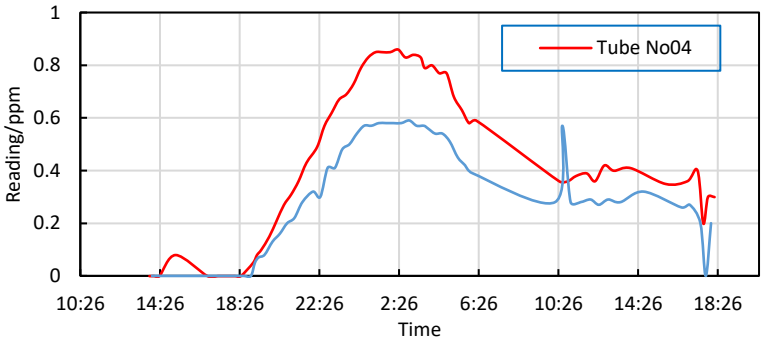
Onsite sampling and detection at surface TB hub/ bag samples from underground or TB lab

4. Case Study (2019. NSW)–Investigation of high oxygen concentration in goaf

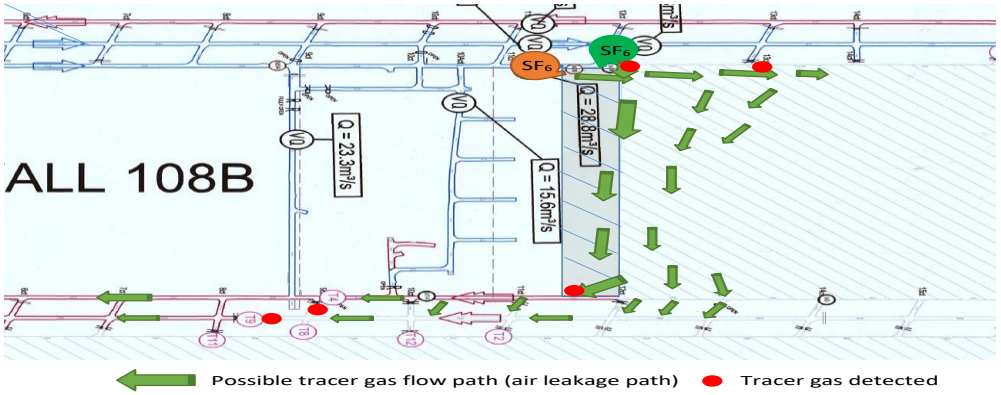
- Results of Test: SF_6 released on the surface and underground



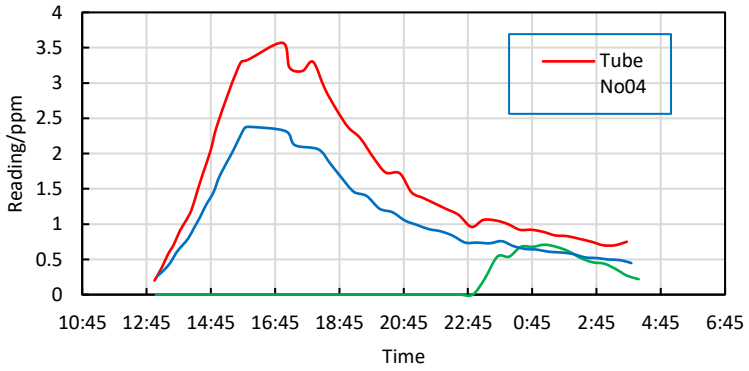
Nitrogen dispersion pattern



SF_6 reading from Nitrogen injection borehole



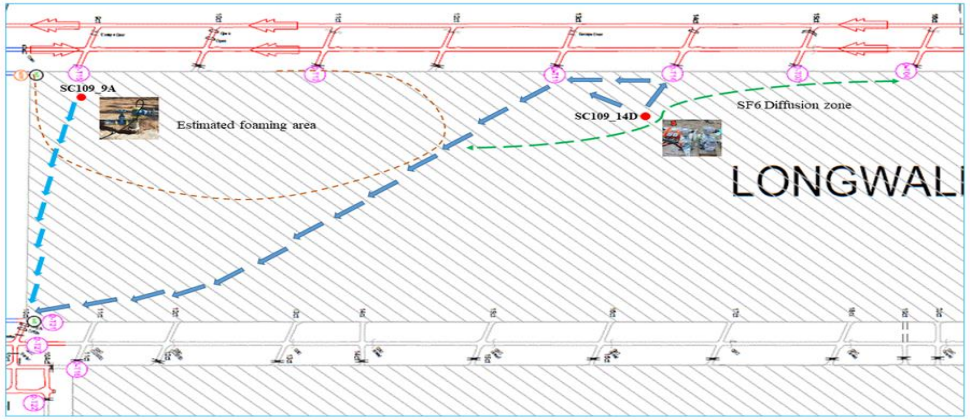
Air leakage pathway behind the longwall face



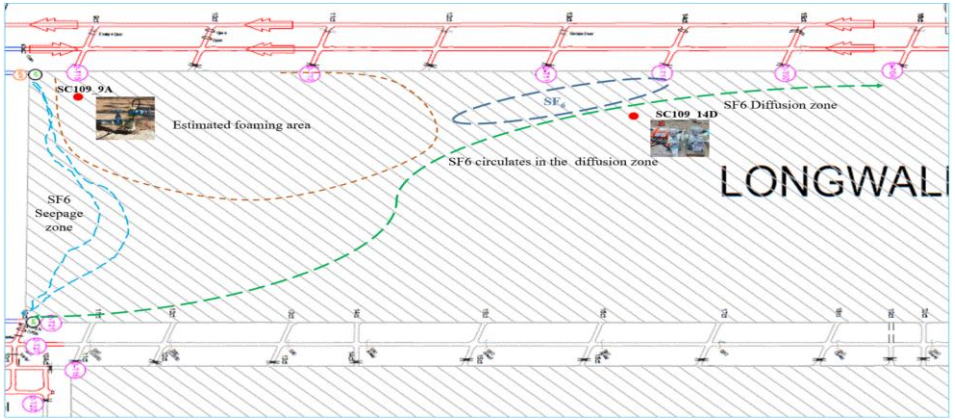
SF_6 reading from main gate conner

4. Case Study(2021. NSW) –Assessing the effectiveness of goaf inertisation

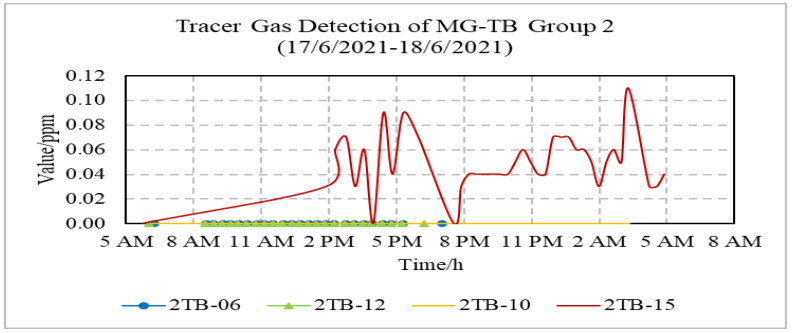
- Evaluating the effectiveness of N_2 foam inertisation

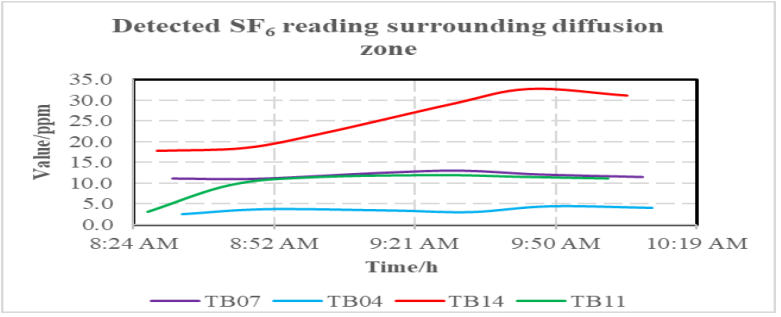


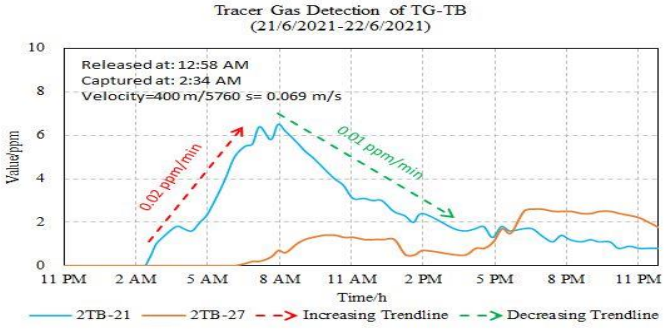
SF_6 migration patterns in the goaf area



N_2 foam change the airflow patterns in the goaf area(Diffusion/migration and foaming area)

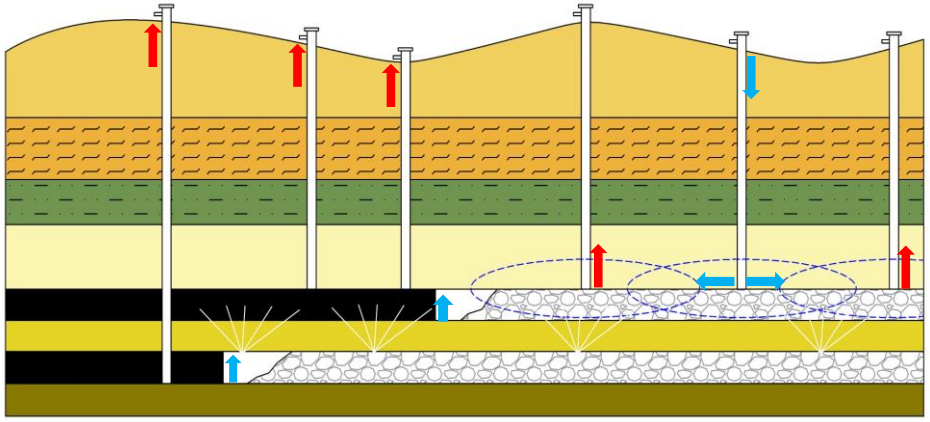


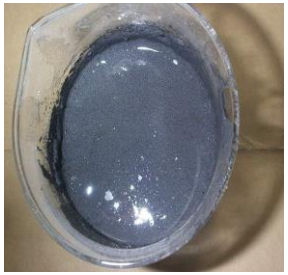




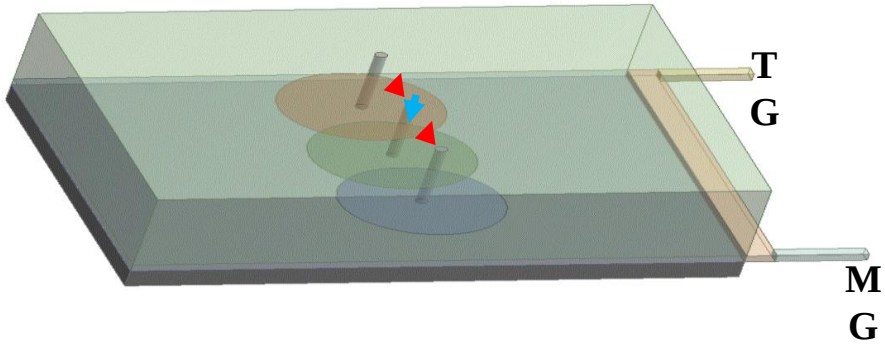
SF_6 reading and estimated air velocity in goaf

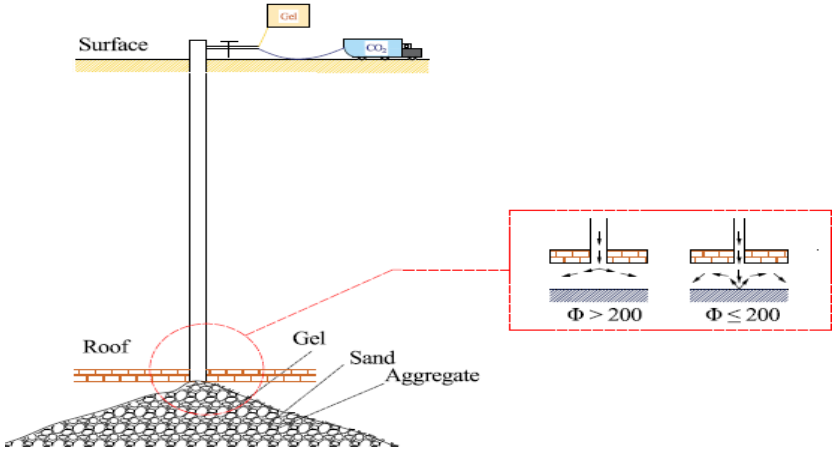
5. Further study---2022 ARC fund (IH220100002)





Safe and Environment-friendly gel material





Tracing methane sources and evaluating the efficiency of gas drainage, combined with gel injection to block the air leakage and eliminate self-heating as well as improve the gas drainage rate

6. Summary

Quick detection is crucial for tracing study, this method provides the best way to find the pathway and real migration of airflow patterns in underground goaf.

We believe this new method will be of great use and beneficial to the mining safety

A quick tracer gas detection technique can be used to assess the underground mine ventilation and identify the potential air leakage/paths.

High precision, quick response and recovery, portable and on-site use compared with GC or another instrument.

Field applications indicated that this technique can be used to provide useful information that is critical to goaf management.

Applications in various areas in underground mining.

THANK YOU

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