Optimum Inertisation Strategies

by

Rao Balusu, Patrick Humphries,
Paul Harrington, Michael Wendt and Sheng Xue

(CSIRO & Newlands Coal, Australia)

Acknowledgements

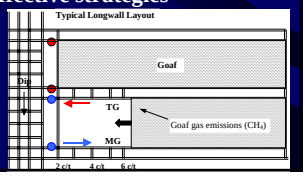
- ACARP project C9006
- Newlands mine management and staff
- SIMTARS
- Mines A, B and C management and staff
- Co-authors, reviewers and others involved

Presentation outline

- Introduction & problem
- Approach/ Technologies used
- Review of traditional practices
- Development of optimum strategies
- Field demonstration studies
- Conclusions

Introduction

- Longwall mines > 30 (so around 30 sealing operations a year)
- Panel sealing – Major safety issue (Explosions possibility)
- Control – to inertise the goaf after sealing
- Inertisation method – inject inert gas through MG/TG
- Need for optimum and effective strategies



Approach/ Techniques used

- Detailed monitoring and review of the effects of traditional inertisation schemes
- CFD (Computational Fluid Dynamics) modelling
- Development of optimum inertisation strategies
  - Based on both field and modelling studies
- Field demonstration studies

Review of traditional inertisation schemes

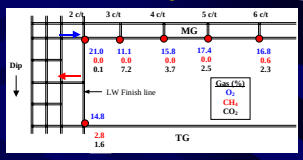
- Previous research on – Inert gas sources
- Inert gas through MG or TG
- Over 10 applications during longwall sealing
- Review – data from 6 cases – three mines
- Typical case study
  - MG intake at higher elevation
  - Boiler gas through MG seal

Inertisation – during longwall sealing operations

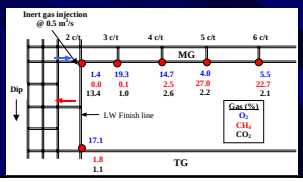
Review studies – typical case study

Goaf gas distribution

(a) just before sealing



(b) 6 hours after sealing
(boiler gas through MG)



Inertisation – during longwall sealing operations

CFD modelling studies

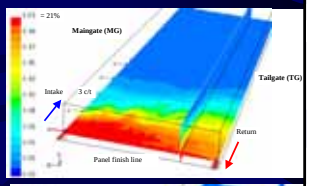
- Field studies to obtain basic data
- Construction of 3D model + setting up flow
- Base model simulations
- Model calibration and validation
- Extensive parametric studies
- Development of optimum strategies

Inertisation – during longwall sealing operations

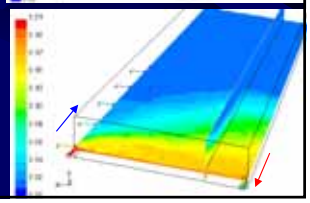
Base model

Oxygen distribution in the goaf

(a) with 50 m³/s airflow



(b) with 10 m³/s airflow

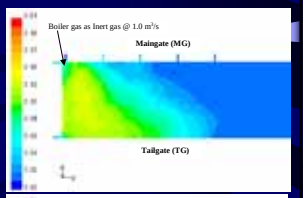


Inertisation – during longwall sealing operations

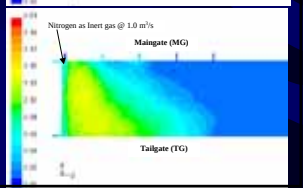
Parametric study-1

Oxygen distribution in the goaf

(a) Boiler gas



(b) Nitrogen

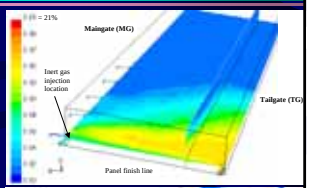


Inertisation – during longwall sealing operations

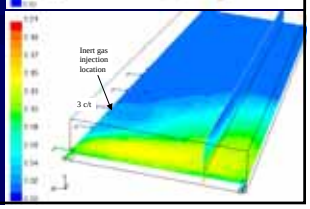
Parametric study-2

Oxygen distribution in the goaf
(1 day after sealing)

(a) Inert gas through MG



(b) Inert gas through 3 c/t



Inertisation – during longwall sealing operations

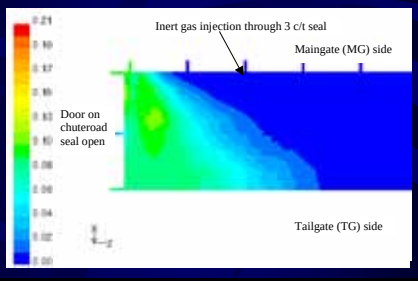
Innovative/ Optimum inertisation strategy

- Inert gas through 3 c/t on MG – i.e at 200 m behind
- Start of inertisation one day before sealing
- Return door open (with minimum/No vent.) during above pre-seal inertisation
- Inert gas flow rate 0.5 to 1.0 m³/s
- Sealing and continuation of inertisation
- Inert gas through TG during chocks recovery (Newlands case)
  - return through mid-face chute roadway

Inertisation – during longwall sealing operations

Optimum inertisation results

- Oxygen distribution in the goaf – just before sealing off



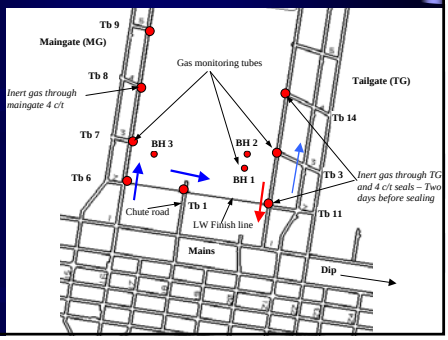
Inertisation – during longwall sealing operations

Field demonstration studies - Newlands

- Newlands Colliery – 180 km west of Mackay
- Longwall production ~ 5 Mt/year
- Longwall panel – 2,500 m x 250 m x 4.8 m (6.0 m seam)
- Goaf gas emissions – 100 to 500 l/s (ideal for trials)
- "U" ventilation system – 50 m^3/s airflow
- Improvements in inertisation over the years – reduced inertisation time down to 2 days
- Need for inertisation within few hours of sealing

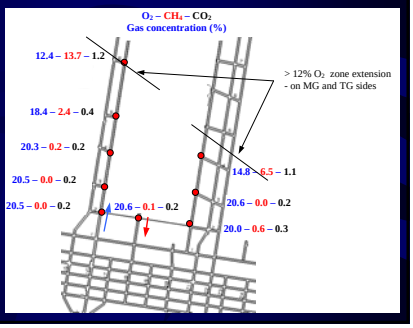
Inertisation – during longwall sealing operations

Newlands – panel layout + monitoring tubes



Inertisation – during longwall sealing operations

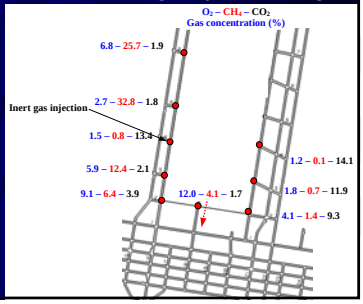
Newlands – gas distribution - normal



Inertisation – during longwall sealing operations

Newlands – Optimum Inertisation

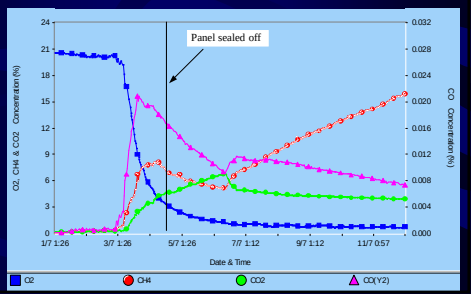
- Gas distribution – within 4 hours of inert gas injection through 4 c/t on MG side



Inertisation – during longwall sealing operations

Newlands – Optimum Inertisation

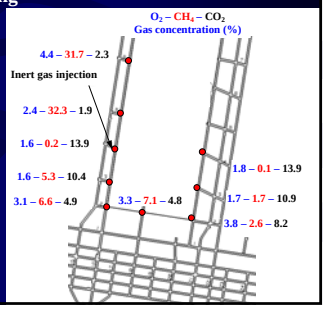
- Gas concentration profile at return seal (Chute road seal)



Inertisation – during longwall sealing operations

Newlands – Optimum Inertisation

- Goaf gas -1 hour after sealing



Inertisation – during longwall sealing operations

Conclusions

- Fundamental understanding of inertisation patterns
- Development of innovative inertisation strategies
- Highly Successful in the field (at Newlands)
- Goaf was inert by the time of sealing (O_2 < 5%)
- Major improvement in mine safety

Future

- Pro-active inertisation to control sponcom