Assessment of Underground Thermal Environments and the Prevention of Heat Illness

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1 Occupational Heat Illness
- Fatigue
- Dehydration
- Heat stroke, heat exhaustion

2 Climate where study conducted
- Surface (ambient) maximum temperatures:
  - 35°C (95°F)
  - 40°C (104°F)
- Body globe temperatures:
  - 36°C (97°F)
  - 37°C (99°F)

3 Underminers’ conditions
- Workplace conditions typically:
  - Average temperature: 36°C (97°F)
  - High levels of humidity
  - Extensive use of electrical equipment
  - Poor ventilation

4 The Problem
- Increased levels of heat stress due to global warming
- Changing business needs of mines & social needs of workers
- New working hours and work shifts
- Increased use of technology

5 Preliminary findings - Fatigue
- Average heart rate for all but one was below ILO standards
- 15 (35%) remained the same during their shift
- 8 (19%) actually hydrated during their shift

6 Preliminary findings - Dehydration
- Urinary refractometer: one study measured TBWL (50 g)
- Measured hydration: before, during, after shift – Urinary
- Measured fatigue: before, during, after shift – Monark cycle
- Continuous measurement of ‘core’ temperature – during shift

7 Program of fast test
- Three days (MON, TUE, WED) – 30 min, 50 min, 30 min
- Heat stress test
- Fatigue test

8 Program of studies
- Study 1 – Existing medical tests
- Study 2 – Preliminary findings
- Study 3 – Heat Illness
- Study 4 – Dehydration
- Study 5 – Mine Rescue
- Acknowledgements
- Final Thoughts

9 Heat Stress Meter
- Body Temperature
- Dry Bulb Temperature
- Wet Bulb Temperature
- Barometric Pressure

10 Preliminary findings – Heat Rate and Core Temperature
- 28 individuals studied
- Average heart rate during shift at 30°C to 35°C with core temperature of 38°C to 39°C
- Each individual worker averaged 36°C or less
- Average heart rate of the group was 160 bpm (±5)
- Dehydration protocol

11 Thermal Work Limit
- Derived from “Air Cooling Power” study
- Adapts to mining conditions
- Exposure to body cooling required
- Use of cold water and protective clothing

12 Preliminary findings – Fatigue
- Group average: 32 workers in group
- 60% of workers with heart rate above ILO standards
- Average heart rate was 184 bpm
- Average heart rate of the group 184 bpm
- Average heart rate of the group 184 bpm
- 14% were between 30 and 35 (obese)
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13 Preliminary findings – Dehydration
- Mean sweat rate of the group 2.4 l/h
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14 Summary of findings – BMI and VO2max
- 48% of workers screened
- 3% were over BMI of 35 (morbid obesity)
- 9% were between 30 and 35 (obese)
- Average BMI of 23.25
- Average VO2max was 39 ml/kg/min
- 13% were below 30 ml/kg/min VO2max

15 Summary of findings – workplace environmental conditions
- 74% of workers were measured where heat illness occurred
- Of these, 30% were in “hot job” conditions but heat illness not granted because of self-paced workers
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- Of these, 30% were in “hot job” conditions but heat illness not granted because of self-paced workers

16 Problems with Rational Heat Stress Indices
- Need to measure metabolic rate
- Need to measure clothing effectiveness
- Self-diagnosis of the first behaviours change under heat stress
- Need to measure the influence of clothing
- Need to measure the influence of clothing
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17 Interventions
- Use of air conditioning systems
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18 Final Thoughts
- Up to 250,000 Australian mine workers work in hot environments
- Heat stress is a major concern
- Health and safety issues are paramount
- Heat stress should be addressed
- Heat stress should be addressed
- Heat stress should be addressed

20 Conclusions
- Advise consequence of heat stress is becoming more prevalent
- Need to address the need to prevent heat stress
- Need to address the need to prevent heat stress
- Need to address the need to prevent heat stress

21 Acknowledgements
- Mount Isa Mines Limited, sponsor of the work
- Dr Michael Donoghue, formerly Chief Occupational Physician, Mount Isa Mines
- Mr Wally Sinclair, formerly Occupational Physician, Mount Isa Mines

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