PERFORMANCE OF WASTE ROCK COVERS – RUM JUNGLE

G.F. Taylor, A. Spain, A. Nefiodovas
J. Bennett, G. Timms, V. Kuznetsov
Mining Activities at Rum Jungle
Location map for the Rum Jungle minesite
RUM JUNGLE MINE

Mined for uranium and copper 1952-1971

Three open-cut mines on site

Other small mines within 10 km

Four waste rock dumps

Three open pits

TSF

Heap leach piles

Acid dam
WHITE’S OVERBURDEN HEAP

7.1 mt; 26.4 ha; 4 x 10^6 m^3

Consists of shales and slates with minor dolomite

Main sulfide is pyrite

IOR = 1.3 x 10^{-8} kg (O_2)m^{-3} s^{-1}

Left for 26-30 years prior to covering
REHABILITATION

Drainage
REHABILITATION

Revegetation
MONITORING

Instrumentation
Water quality in Finniss River
Water infiltration rate
Oxidation rates
Vegetation
Erosion
Weeds
Wildfires
WATER INFILTRATION

![Graph showing water infiltration rate and annual rainfall over years.](image)
To ascertain what factors led to a deterioration in performance of the cover on White’s overburden heap

Field observations
Field tests
Laboratory tests / analyses

End of ‘wet’ season – April 2002
End of ‘dry’ season – October 2002
Field tests
RESULTS

Vegetation

Cover characteristics
- surface: litter, cryptogams, stoniness, macropores, micro-relief, termite mounds, erosion
- profile: thickness, layer properties, depth distribution of roots, infiltration, oxygen flux

Laboratory testing
- moisture content, particle density, bulk densities, void ratio, saturation, dispersivity, liquid and plastic limits, shrinkage, particle size analysis

Laboratory analyses
- mineralogy, composition, leachate composition
DISCUSSION

Design:

- Low permeability to reduce infiltration to <5% incident rainfall
- Well drained with no ponding
- Erosion resistant
- Minimum thickness compatible with performance objectives
- Simple construction using local materials
Zone 2A – Erosion resistant

Zone 1B – Moisture retention

Zone 1A – Moisture barrier
  Compacted clay layer

Compacted waste rock
Construction / Materials

Water-shedding / erosion prevention features satisfactory

Zone 2A much thinner than specified

Some materials fell outside specified designed limits

Insufficient material meeting specifications

Tests indicated Zone 1A material would shrink during ‘dry’ season
Physical / chemical changes

Minimal erosion or slumping

Bare patches have been acid burned (pH=3.7)

Pedological changes

Zone 2A has cloddy structure penetrated by roots and termite / ant galleries

Zone 1A developed polygonal blocky structure with coarse material in voids

Zoning of soluble elements suggests ‘biological pumping’
Biological changes:

- Root penetration into waste rock
- Termite / ant galleries
- Both have increased permeability
- Future biological development dependent on plant communities
- Native species adapted to prevailing conditions will replace agriculture species
Oxygen flux

Cover reduces oxygen flux to 20% - 23% of exposed bare rock

Reduction proportional to cover thickness

Flux 4x higher at end of ‘dry’ season

Difference due to moisture content
CONCLUSIONS:

Storage-release, water-shedding design appears appropriate

Cover design based on material availability and cost not necessarily appropriate

Adequate supervision and quality control essential during construction

Monitoring instrumentation installed during construction necessary to determine performance
Colonisation by termites (and ants) is inevitable

Cover design must accommodate their impact on soil hydraulic properties

Penetration by roots probably unavoidable – impact presently unquantifiable

Oxygen flux limited by covers
RECOMMENDATIONS

Detailed modelling using characteristics of available materials essential

Make allowances for changes in permeability

Comprehensive testing / analysis of potential cover materials

To reduce long-term maintenance, cover should be planted to native flora

Consideration of capillary break