

# CSRP'08 conference

18-19 November 2008

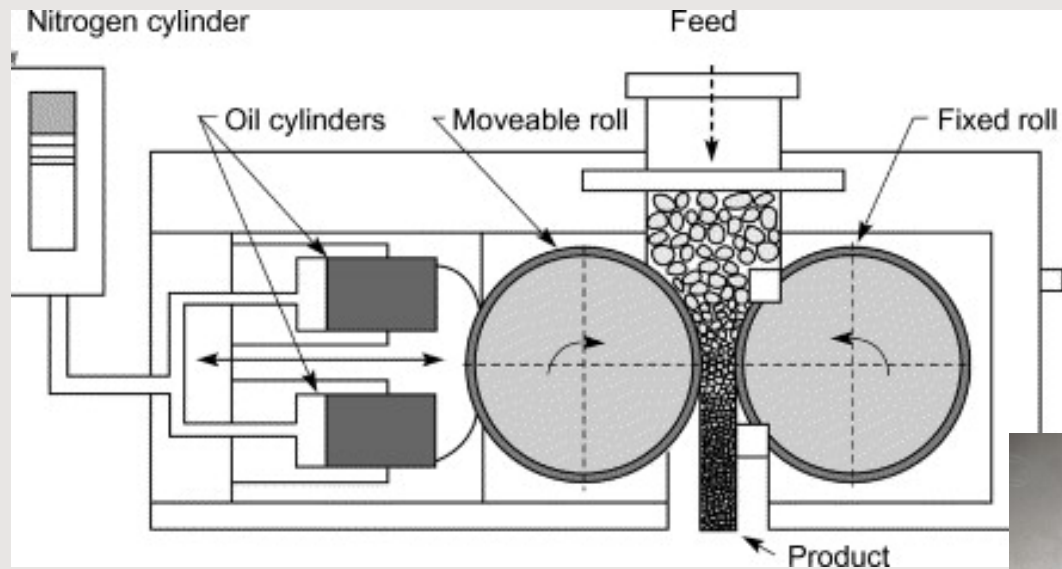
Customs House, Brisbane, Queensland

## Multiple-Pass High-Pressure Grinding Rolls Circuits



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# High Pressure Grinding Rolls



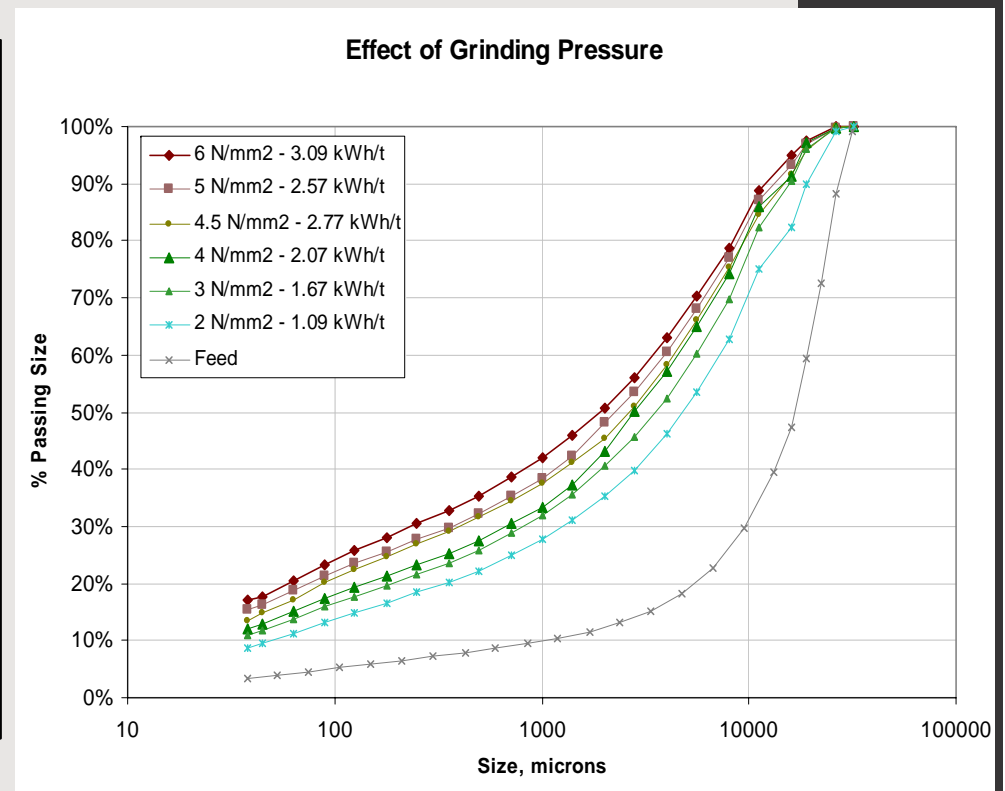
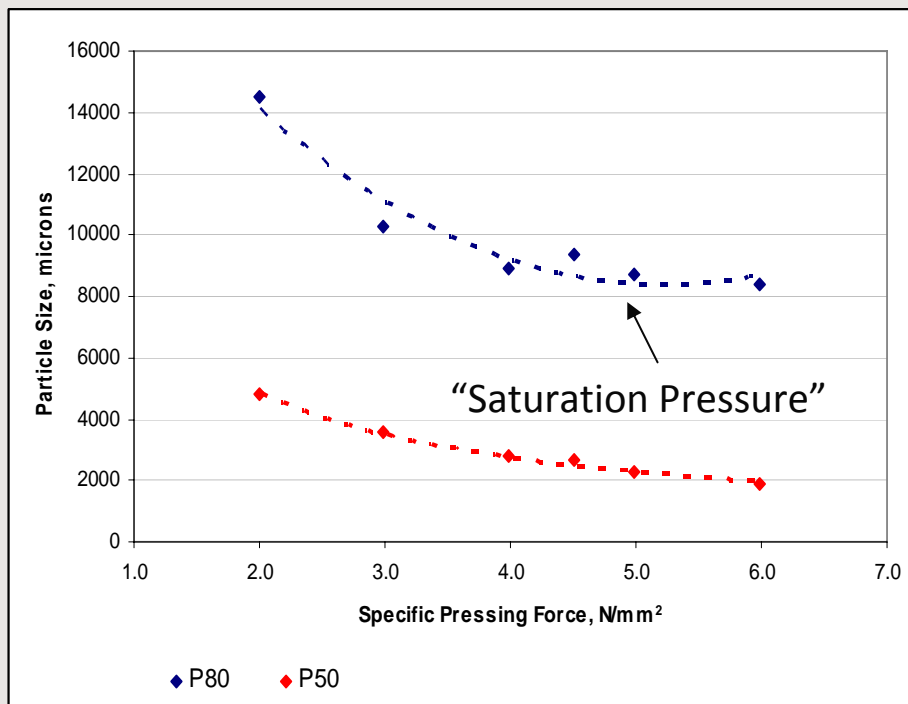
Napier-Munn et al., 1996



# Saturation pressure in HPGR



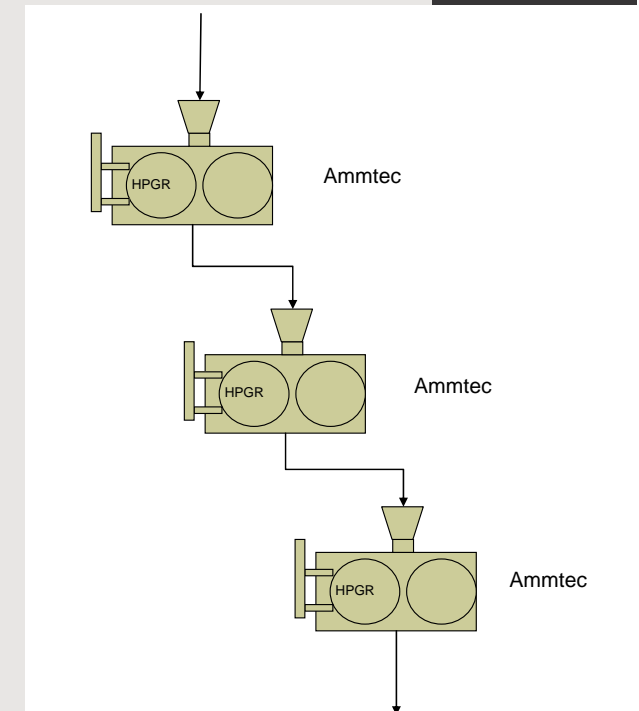
- Less size-reduction occurs above a certain pressure
- Corresponds to a maximum energy that can be imparted to the rock in a single pass of around 2-3 kWh/t



# The Triple-pass HPGR circuit



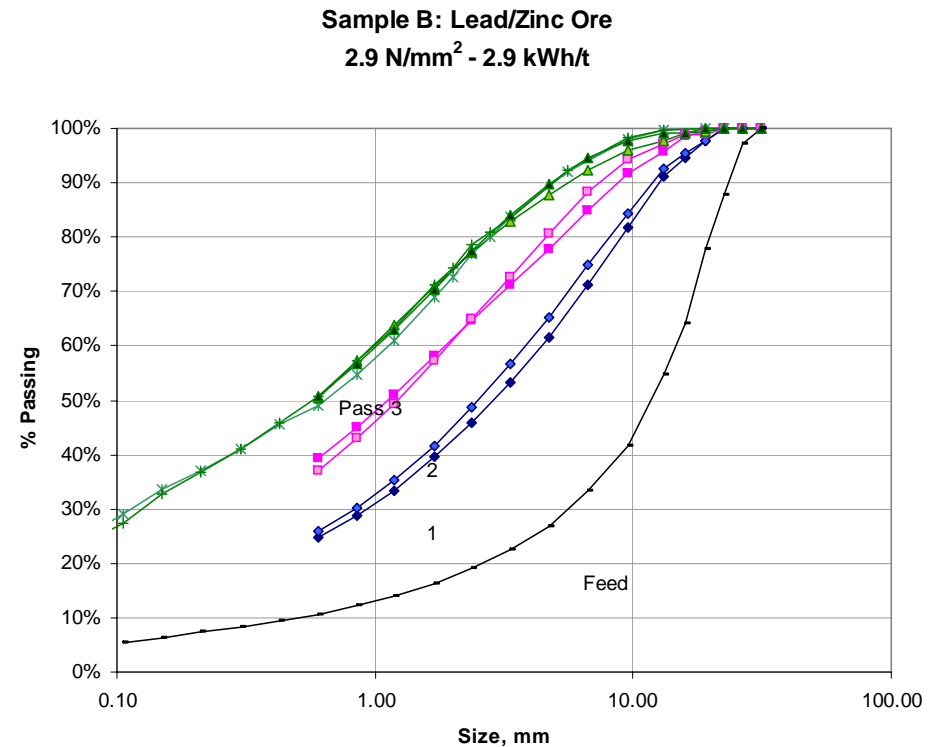
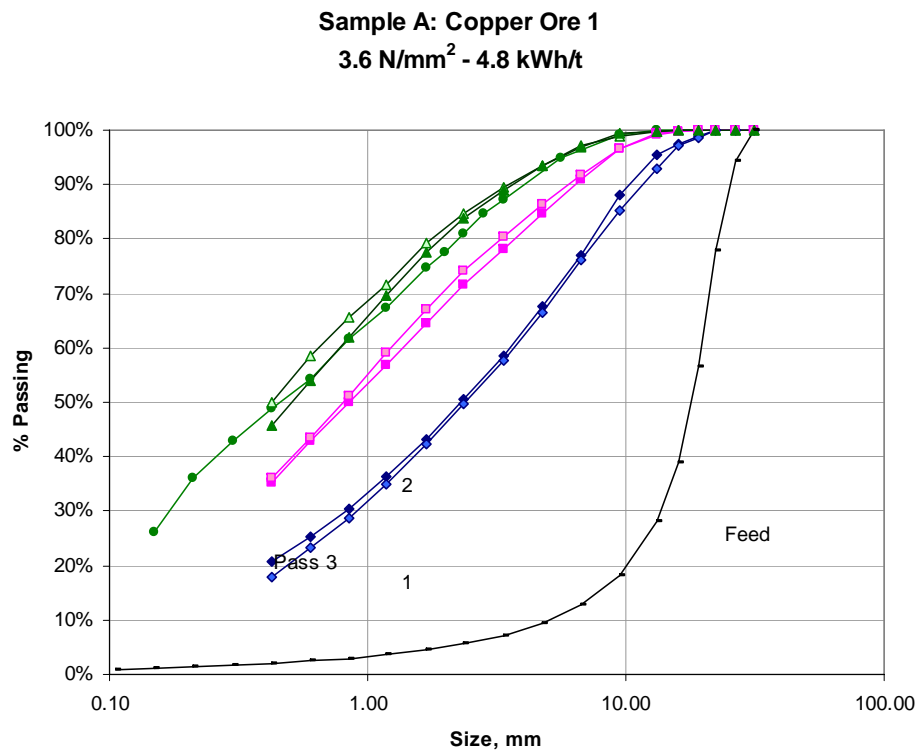
- More grinding work can be done
- Previous work on lab-scale HPGR has shown that a triple-pass circuit has potential to generate a large amount of fines
- Expectation that three passes will reduce much of the circuit product to final-product size
- Simple circuit – eliminates recycle conveyors and other equipment, easier to contain dust



# The Triple-pass HPGR circuit



- Test results from triple-pass tests in July 2007
- Sample B (a lead-zinc ore) was unable to be pressed with high grinding energy – averaging around 1 kWh/t
- Sample A (a hard copper ore) performed better



# The Köppern HPGR at AMMTEC



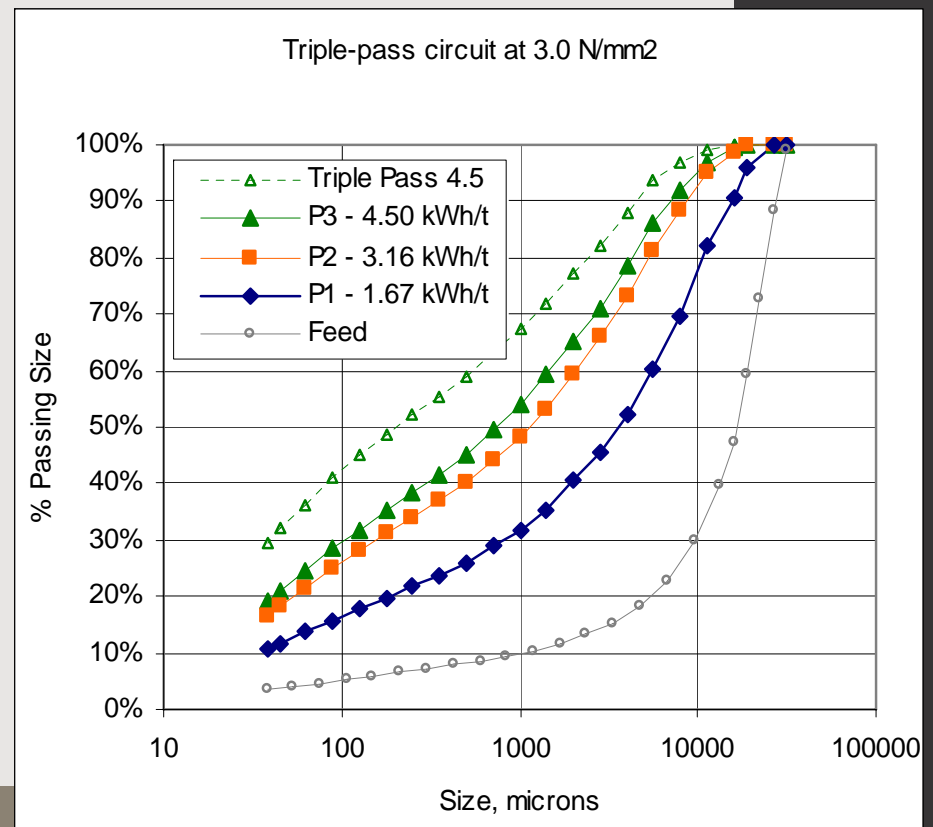
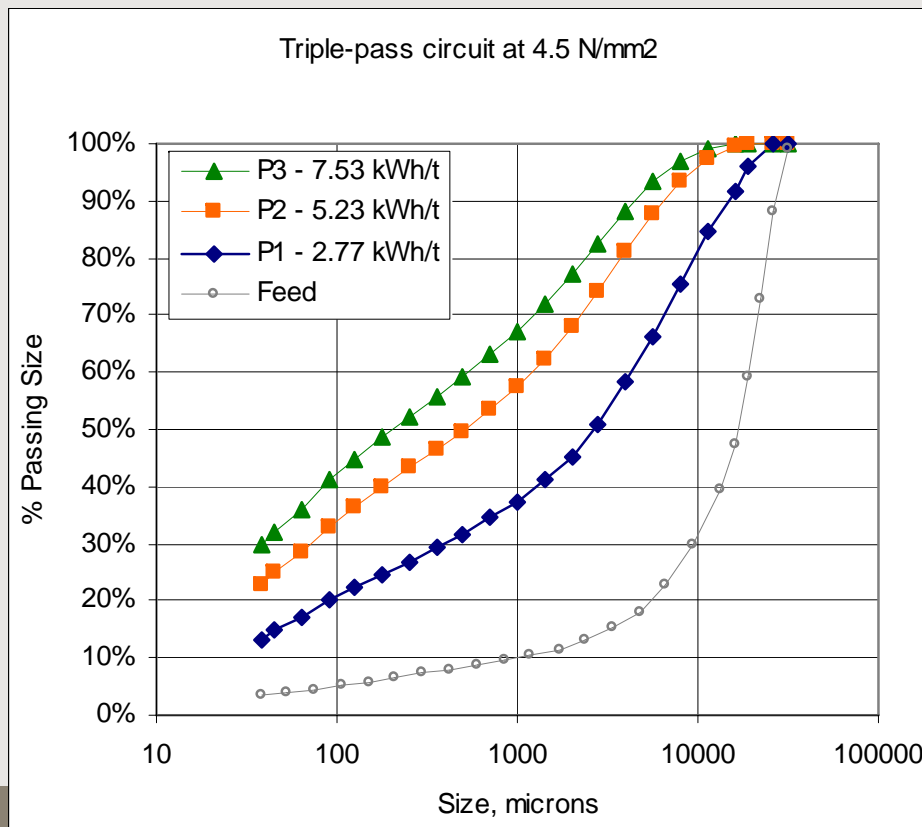
# HPGR Test work



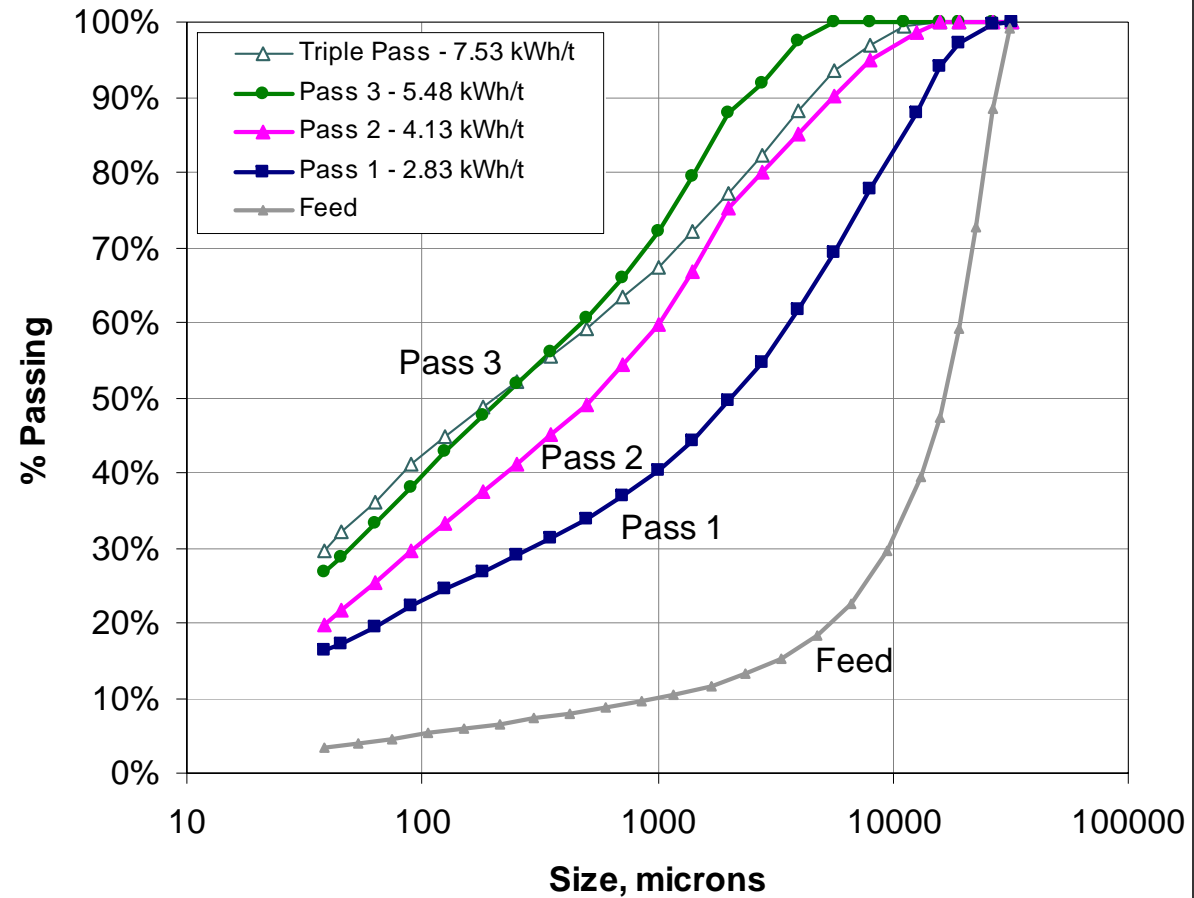
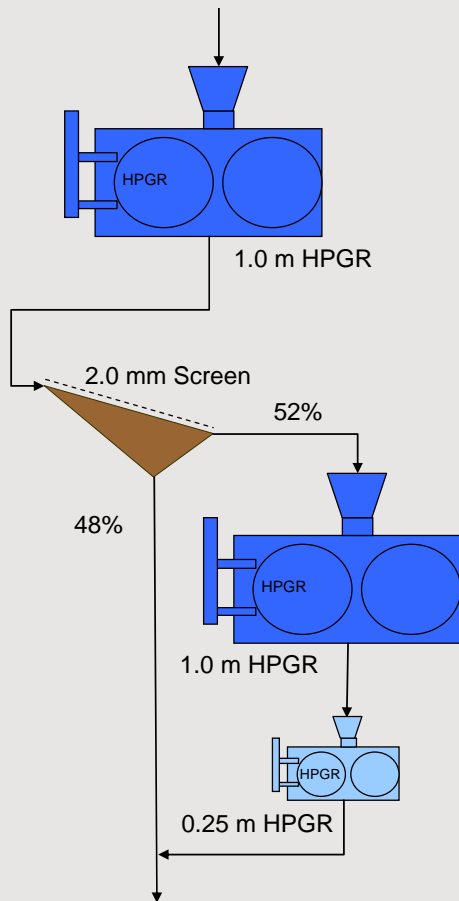
# Sample C Triple-pass circuit



- Third ore type performed similarly to Sample A
- Less size reduction after second pass than expected
- Particularly noticeable at low grinding pressure

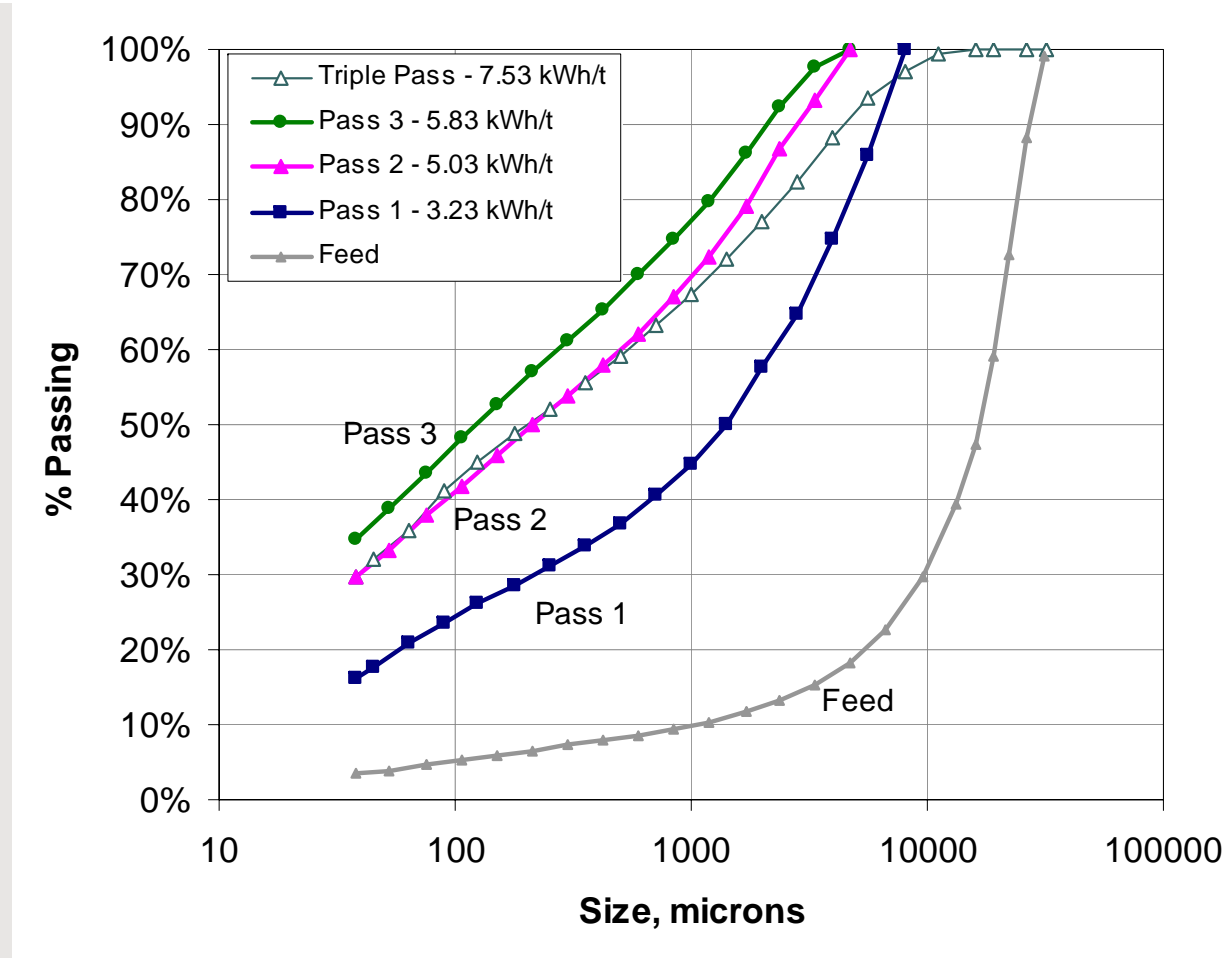
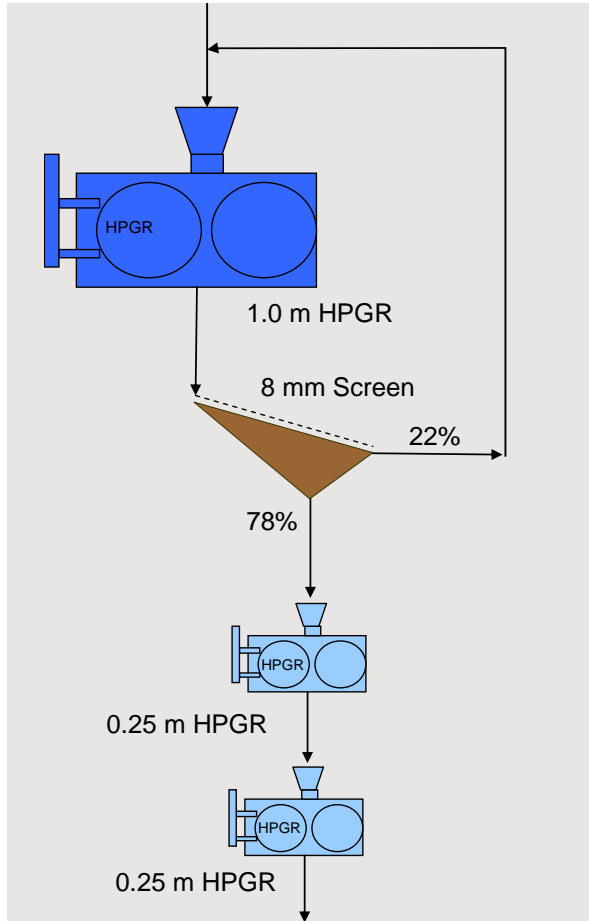


# Alternative flow sheet A



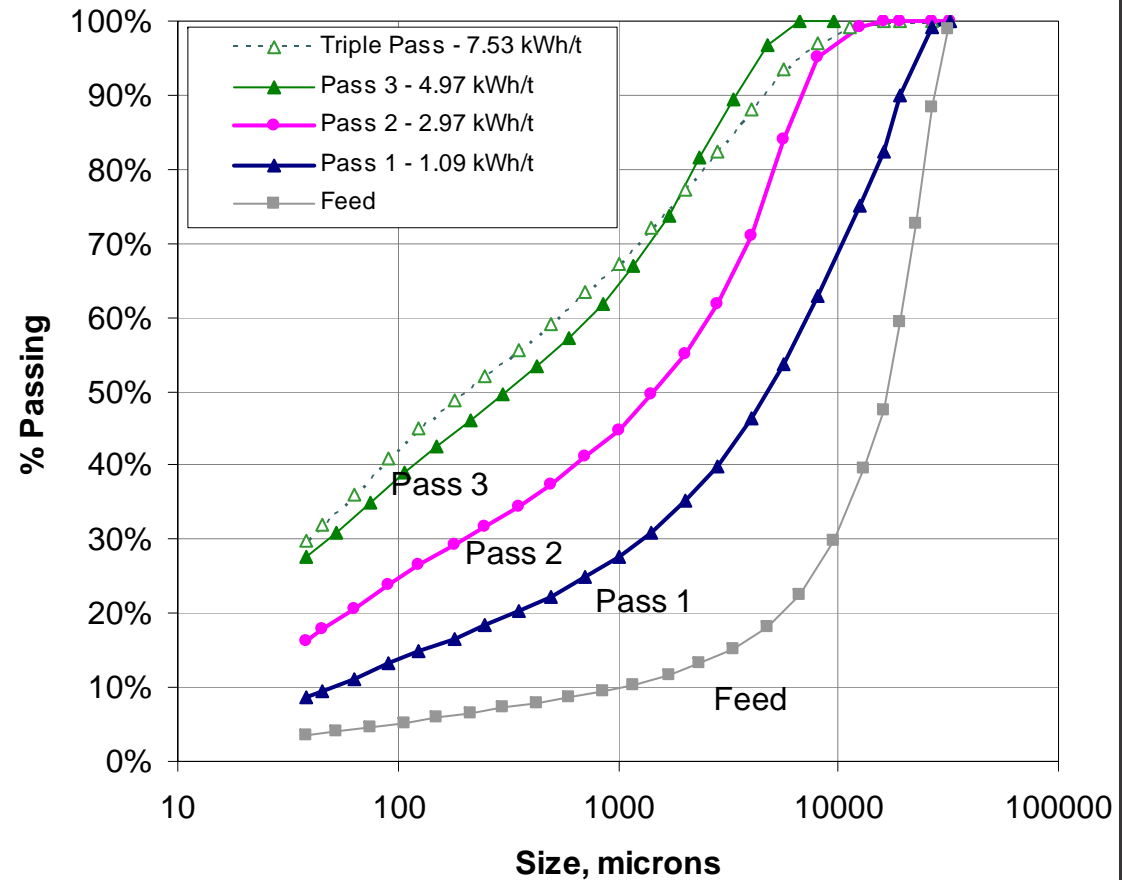
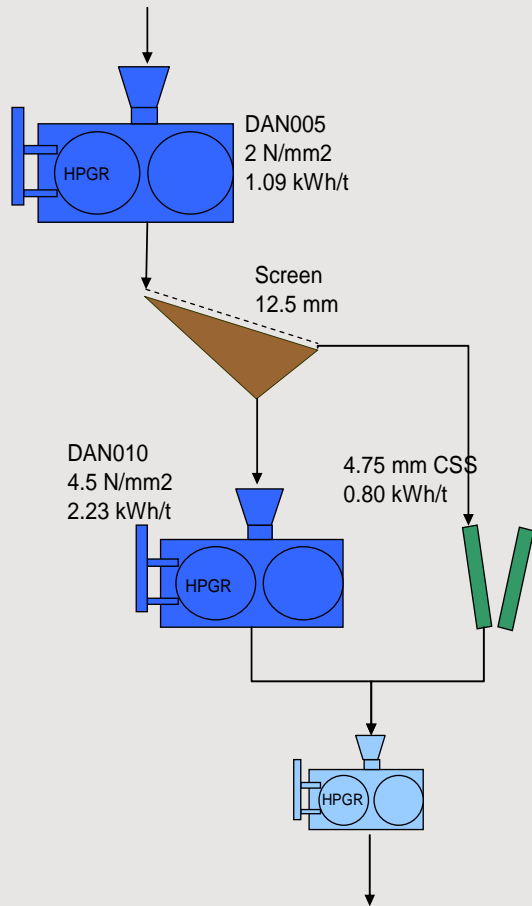
- Finer top size, steeper size distribution, 28% less energy

# Alternative flow sheet B



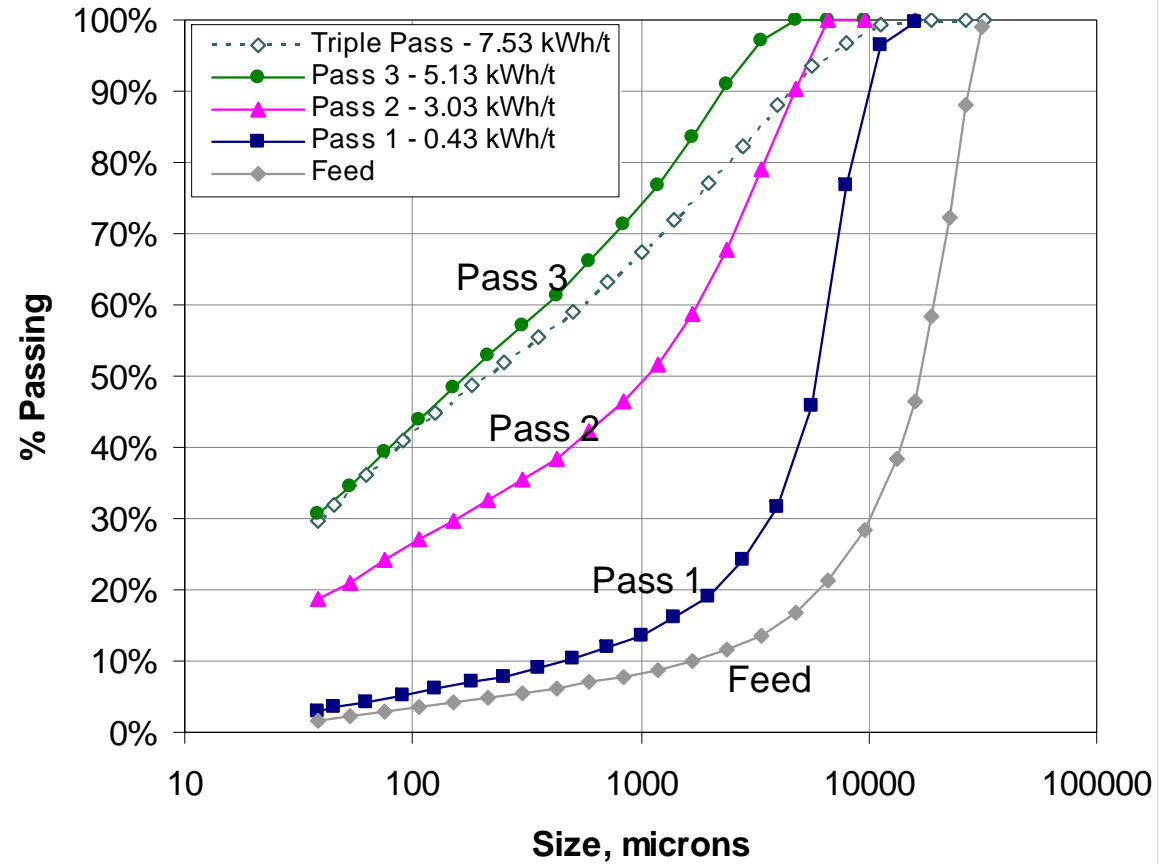
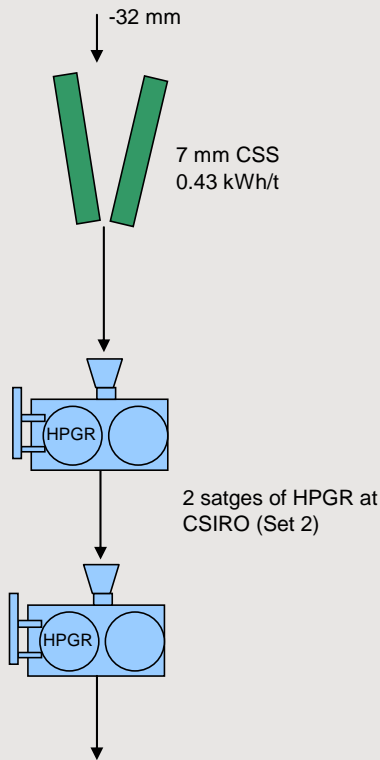
- Finer top size after only two passes, 33% less energy

# Alternative flow sheet C



- Slightly coarser product with a more complex circuit

# Alternative flow sheet D



- Replace first HPGR with crusher

# Findings - 1



- HPGR in series can be used to grind a large proportion of the feed to product size but efficiency reduces after the second pass.
- Smaller-diameter HPGR rolls can increase the breakage of coarse particles in multi-pass circuits.
  - Smaller top-size, steeper size distribution
  - Coarsest particles are not broken efficiently in a thick bed of fine particles

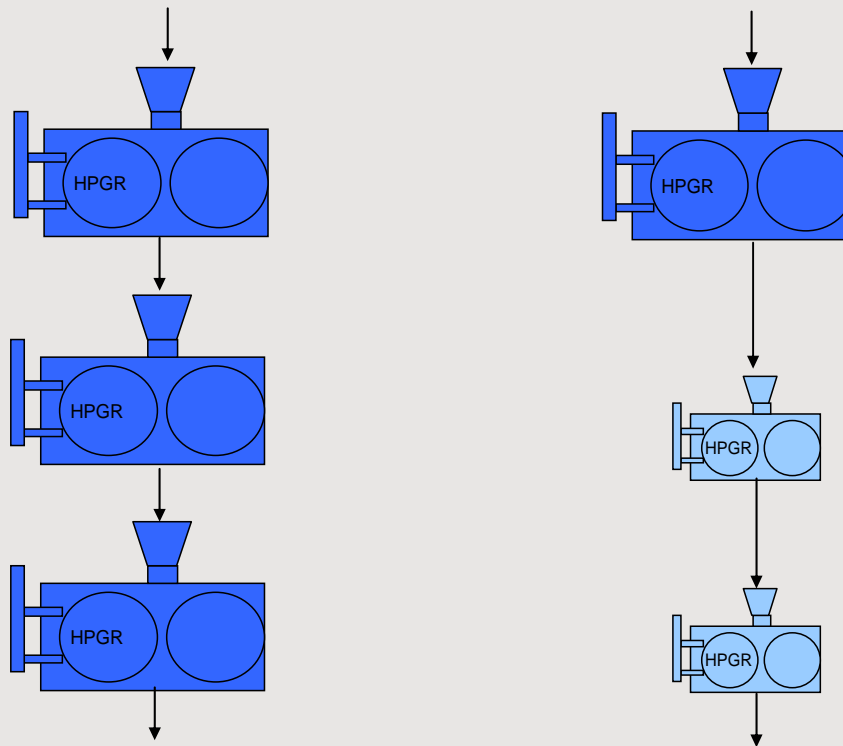
## Findings - 2



- Removing excess fines from the feed to the next pass can also improve circuit performance
  - Some fines are beneficial for performance and wear
  - Removing excess fines reduces the size of HPGR needed, and allows a smaller diameter unit to be used
  - Circuit becomes more complex

# Further work

- Additional samples for test work planned



# Acknowledgements



- CSRP
- Andrew Gardula, Stefan Nadolski & Christopher Wärnelöv (Köppern Machinery Australia, Perth)
- Steve Suthers, Jonathan Campbell (CSIRO, Pinjarra Hills)