Evaluation of a Citrus Based Oil as a Coal Flotation Reagent

Tim Baitch – ACPS Scholarship Holder
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australian coal preparation society

"... distinguishing and consolidating the profession of coal preparation in Australia and abroad ..."
The Idea

- NSW Branch of the Australian Coal Preparation Society (ACPS)
- Dr Tony Partridge
The Motivation

- Increased efficiency in Coal Prep
- New market for Citrus industry
- Environmental factors
- David Elsey’s previous research – please note results shown include work from both Theses
Froth Flotation

- Fine particles less than 0.5mm
- Hydrophobic – scared of water
- Air bubbles, contact between air and particles
Preliminary Research

- Flotation cells
  - Types used in Australian Prep Plants
  - Experimental Denver cells
  - Importance of chemical additives
Preliminary Research

- Contact angle
Preliminary Research

- Frothers (not used for research)
  - Stable froth
  - Non-collecting
  - Lower surface tension of water to decrease size of bubbles (more bubbles = more surface area)
Preliminary Research

Collectors

- Absorb to the surface of coal
- Make more hydrophobic
- Easy to store/transport and cheap
- Selective
Preliminary Research

**d-limonene**
- Made from orange peel
- Smells strongly of oranges
- Used as a solvent in cleaners etc
- Safe, used as a food additive
Collecting Samples

- Direct approach to Prep Plants
- Contacts through Dr Partridge and ACPS
- Dartbrook, Westcliff and Macquarie Coal Preparation Plants
Samples

40 Litre Bulk Sample From Mine

Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6
Sample 7
Sample 8
Sample 9
Sample 10

d-limonene

Proprietary Reagent
In the Lab - Sampling
Comparison

- Between d-limonene and proprietary reagents, 5 different dosage rates
- 30 Flotations carried out in all (10 for each coal type)
In the Lab - Flotation

• Each float broken into five time fractions to make analysis easier and more informative
In the Lab – Drying ~100°C
In the Lab – Ash Determination
Results – Dartbrook

Cumulative Floats 1.63kg/tonne Reagent Dosage

Yield %

0% 20% 40% 60%

Time (minutes)

00:00 02:00 04:00 06:00 08:00

d-lim
Dartbrook reagent
Results - Dartbrook

Cumulative Ash % 1.63kg/tonne
Reagent Dosage

- Ash % d-limonene
- Ash % Dartbrook Reagent

Time (min:sec)
Results - Dartbrook

Yield Ash Curve 3.23kg/tonne
Reagent Dosage

- Ash %
- Yield %

Graph showing the yield ash curve for Dartbrook reagent dosage with data points at 7%, 12%, 17%, and 22% ash.
Results - Macquarie (Courtesy of D.Elsey)

At 0.461 kg/tonne
Results - Macquarie (Courtesy of D.Elsey)

At 1.74kg/tonne
Results - Westcliff

Cumulative Floats 0.26kg/tonne Reagent Dosage

Yield %

Time (minutes)

00:00 02:00 04:00 06:00 08:00

0% 20% 40% 60% 80% 100%

d-lim
Westcliff Reagent
Results - Westcliff

Cumulative Ash % 0.26kg/tonne Reagent Dosage

- Ash % d-limonene
- Ash % Westcliff

Time (min:sec)
Results - Westcliff

Yield Ash Curve 0.26kg/tonne
Reagent Dosage

Yield %

Ash %

6% 7% 8% 9%
Conclusions

- Enough evidence to suggest further research into d-limonene
- Positive results for Dartbrook coal
- Low ash product for all coals tested
- Not analogous results with work done previously
If I had my time over....

- Fewer samples, redundancy involved
- Dewatering
Further Work

- Fine coal flotation using d-limonene – from Dartbrook results
- Dewatering
- Duplication of results
- Froth stability for d-limonene
- Using d-limonene in a mixture with known collectors to test its frothing ability
Thanks to...

- Dr Tony Partridge
- The NSW Branch of the Australian Coal Preparation Society
- UNSW Mining Engineering Laboratory