Fine Coal Beneficiation and Recovery

Workshop on Coal Beneficiation and Utilization
of Rejects Initiatives, Policies and Practices
August 22-24, 2007

by

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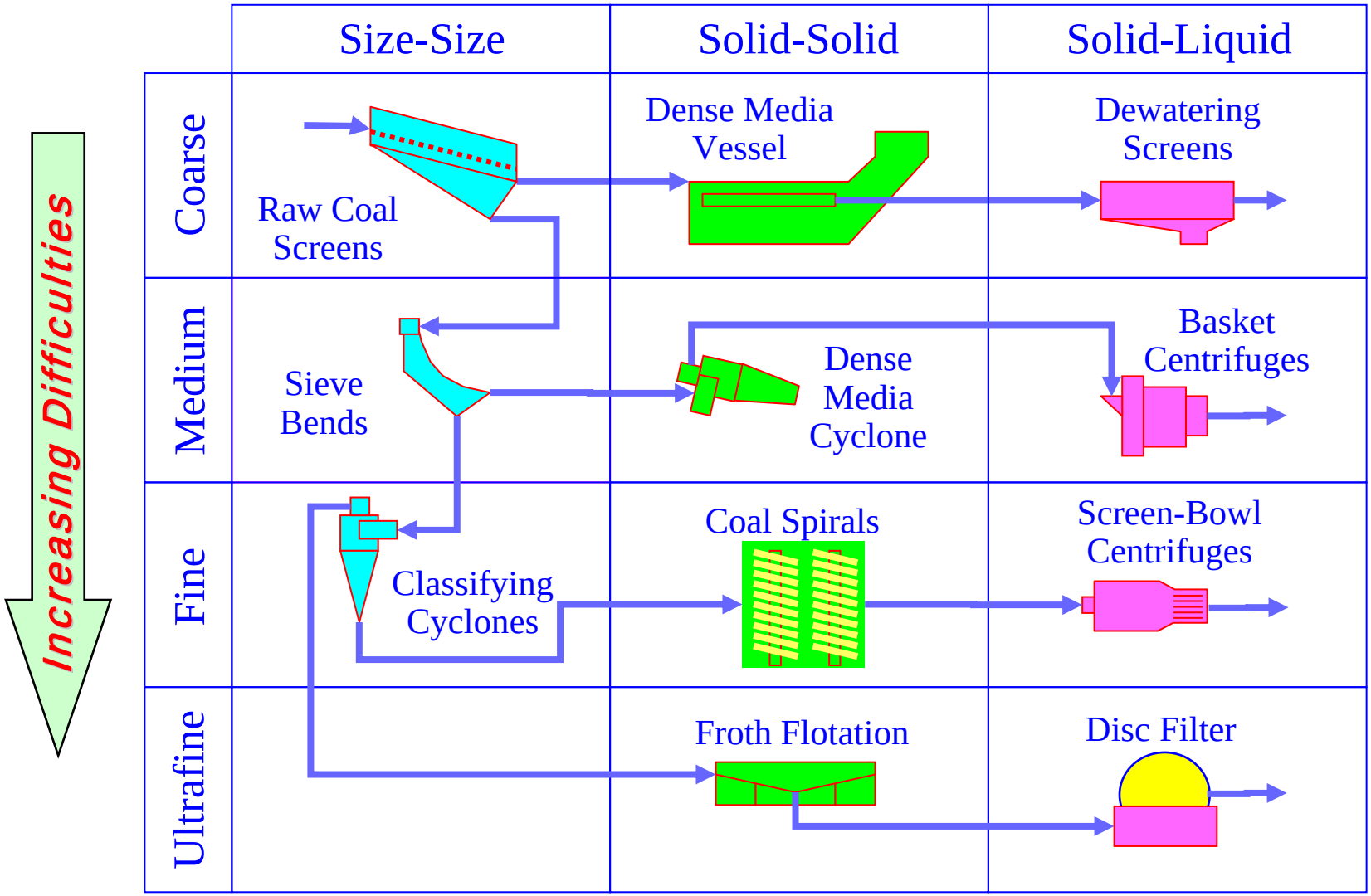
Center for Advanced Separation Technologies

Separation Processes Used for Coal



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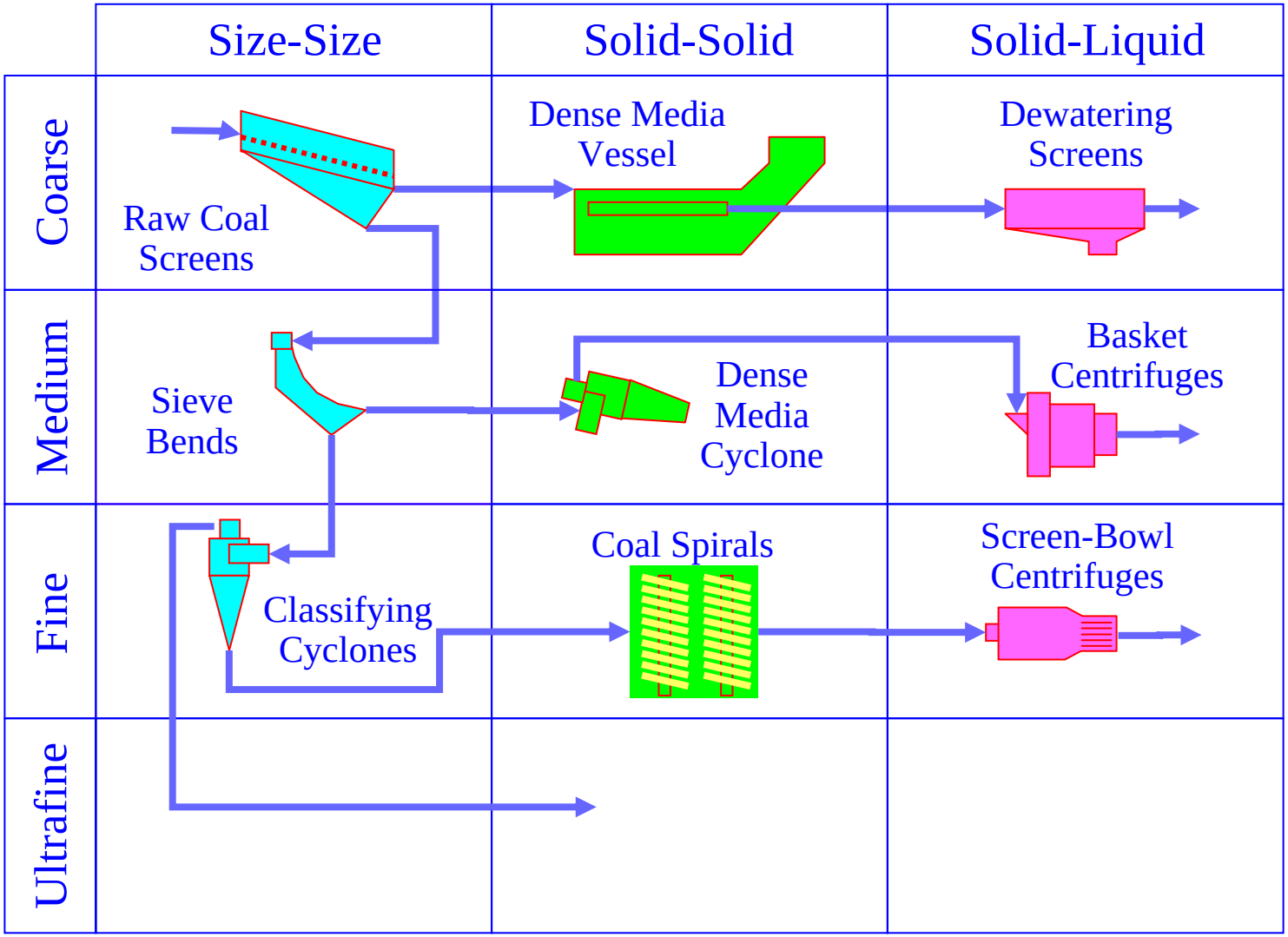
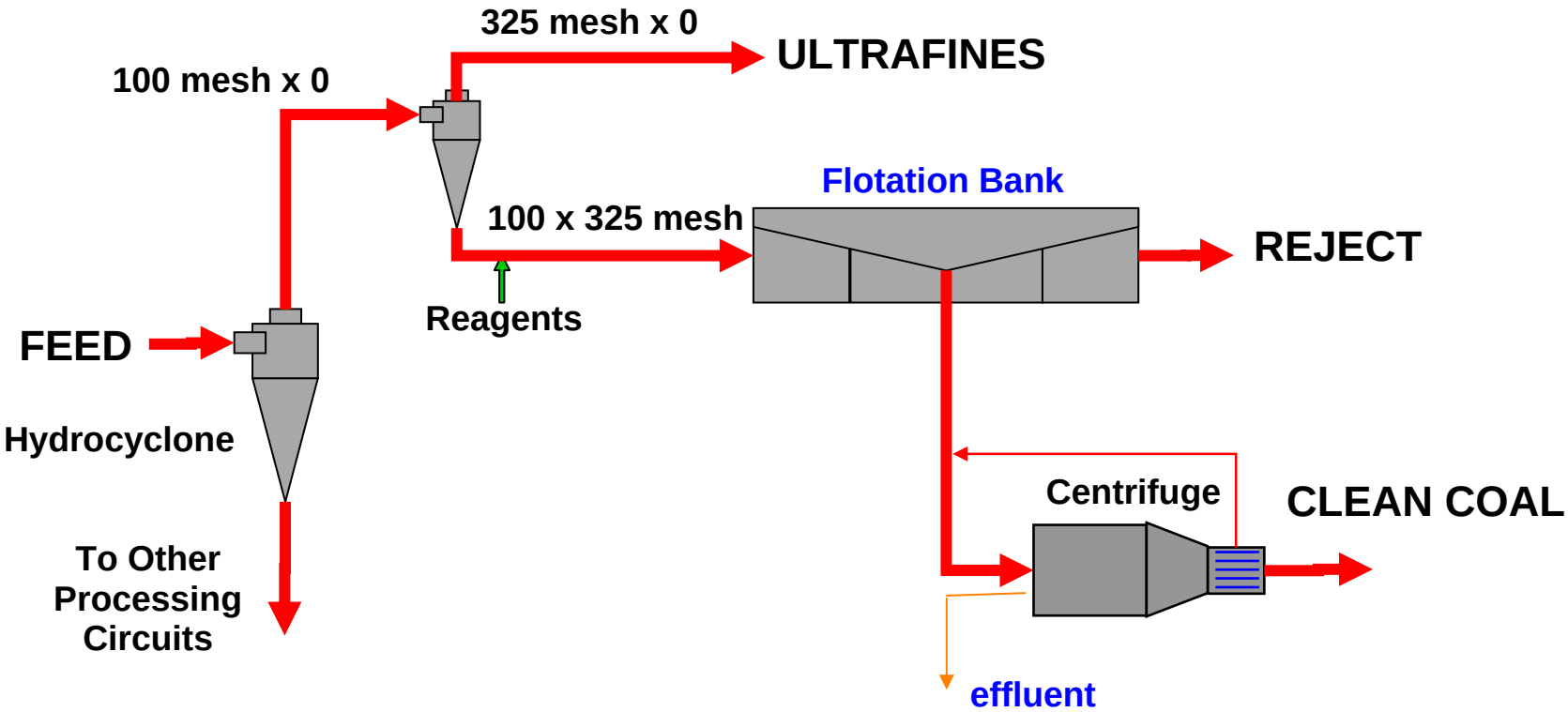


Deslime Flotation Circuit

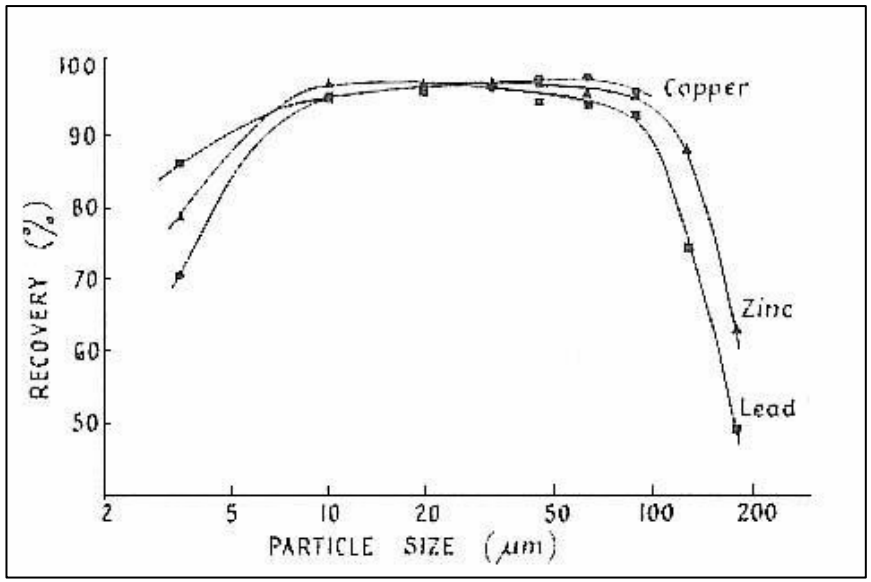


Fine Coal Impoundment

- 2.5 to 3 billion tons of fine coal
  - *In 713 impoundments*
  - *Mostly in Central Appalachia.*

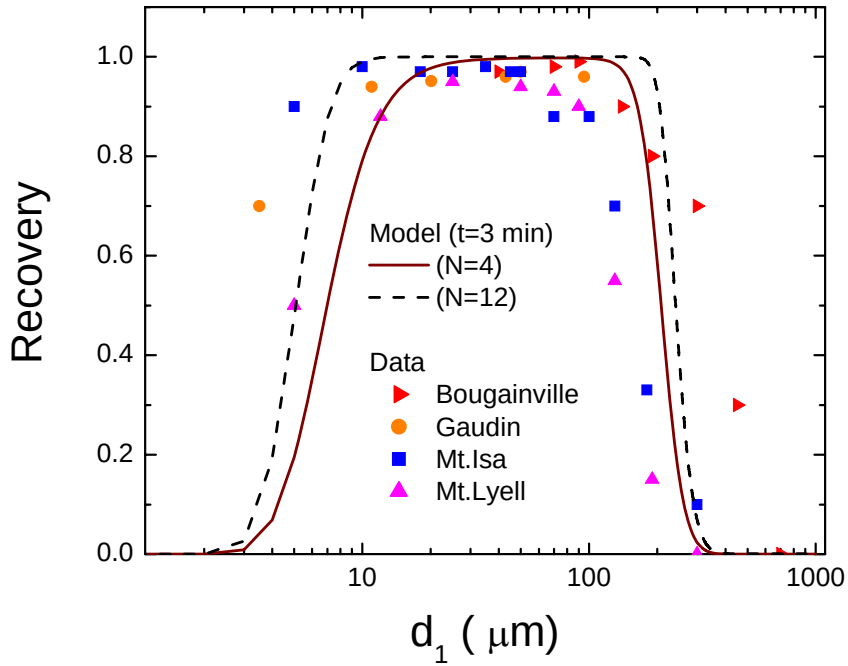
Effect of Particle Size on Flotation

Plant Practice



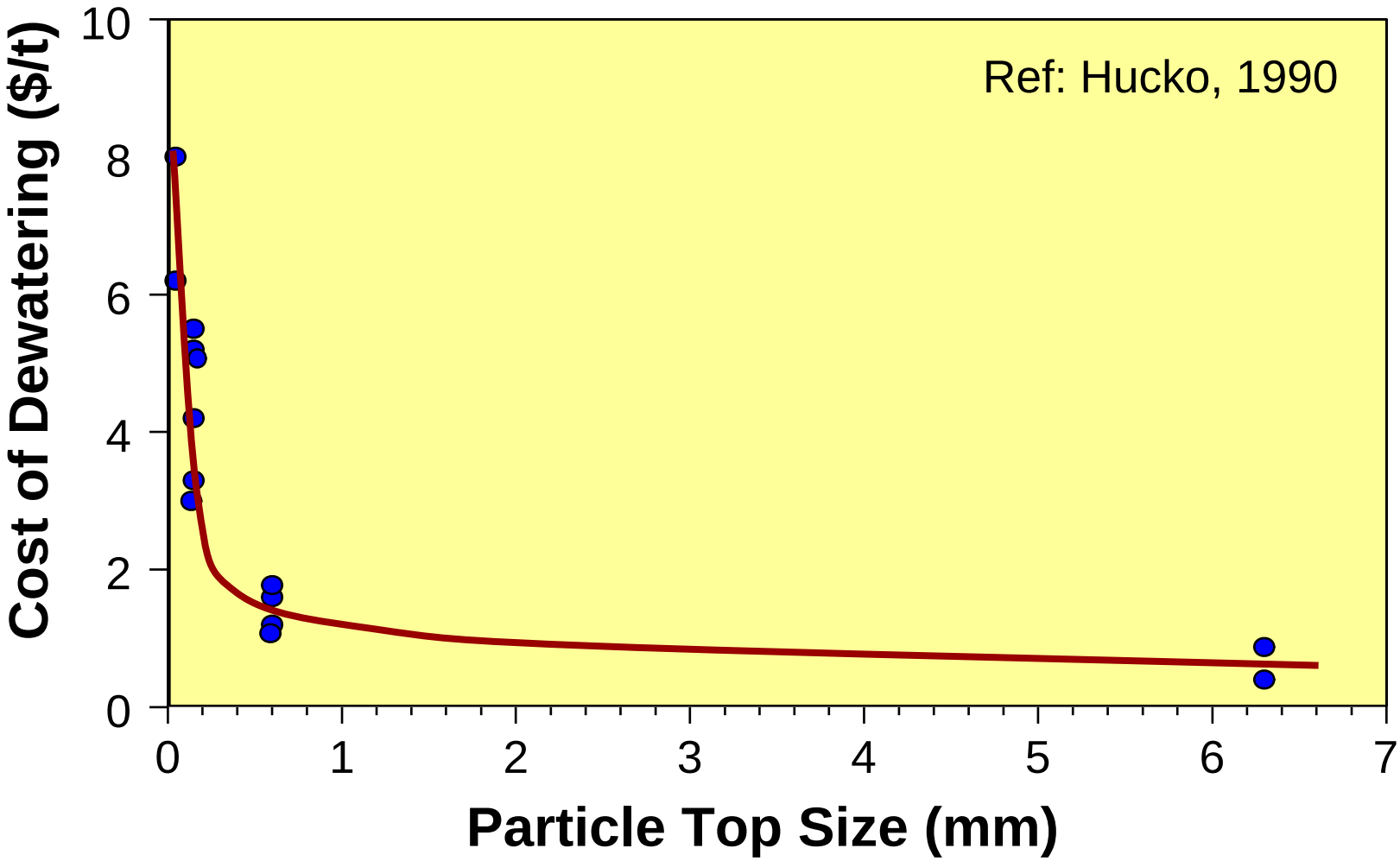
(Gaudin, 1931)

Model Prediction



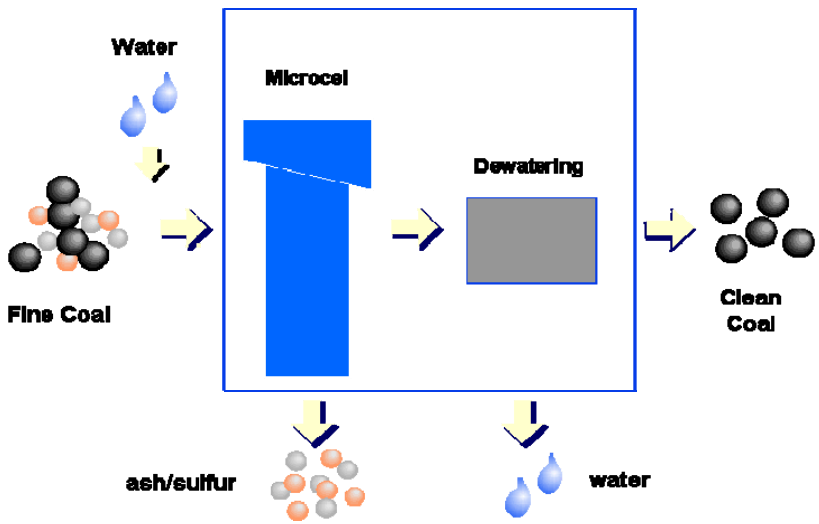
(Sherrell, Do and Yoon, 2005)

Cost of Dewatering



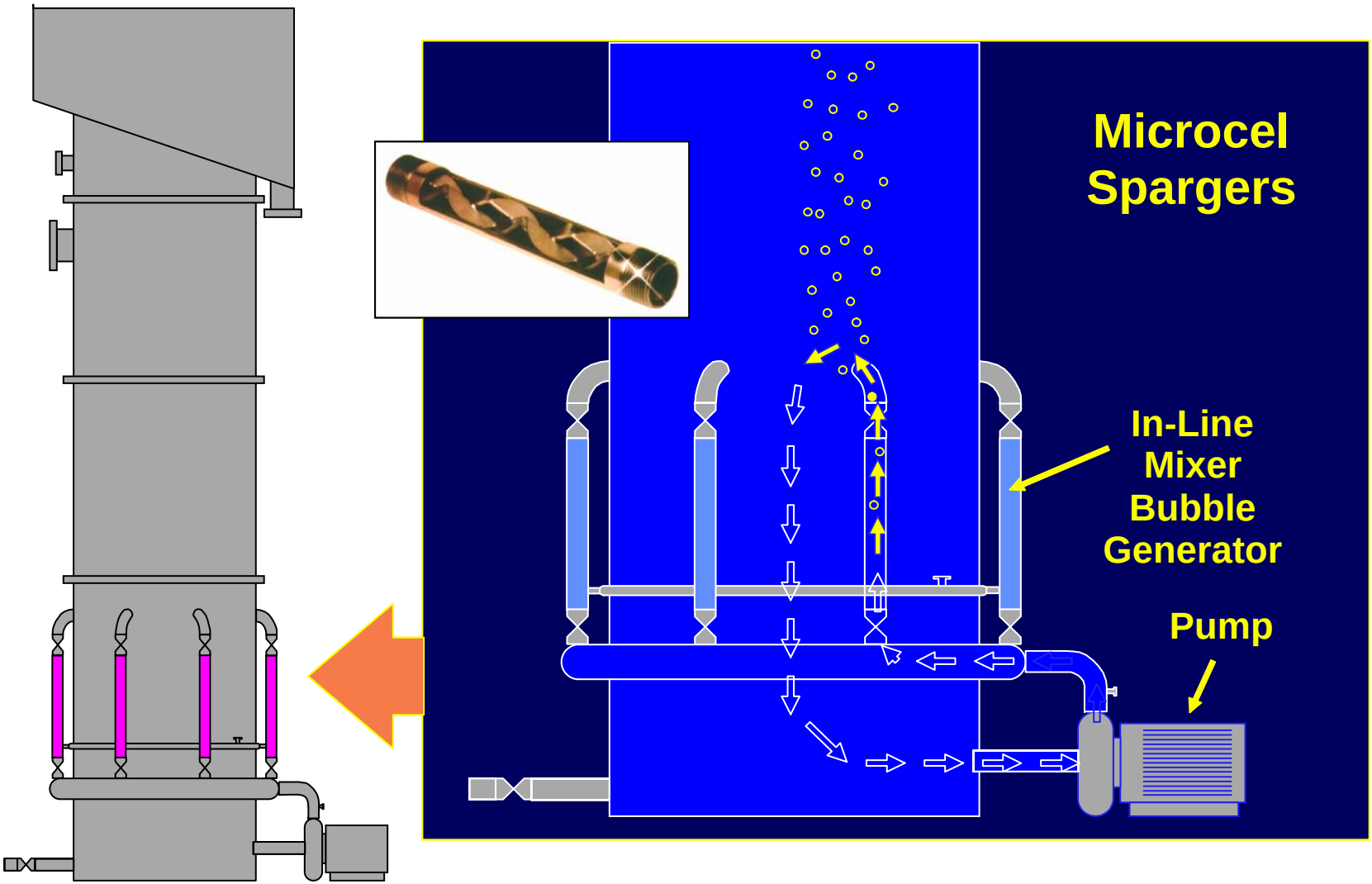
Advanced Coal Processing (1)

- Advanced Flotation
  - *Microcel Flotation*

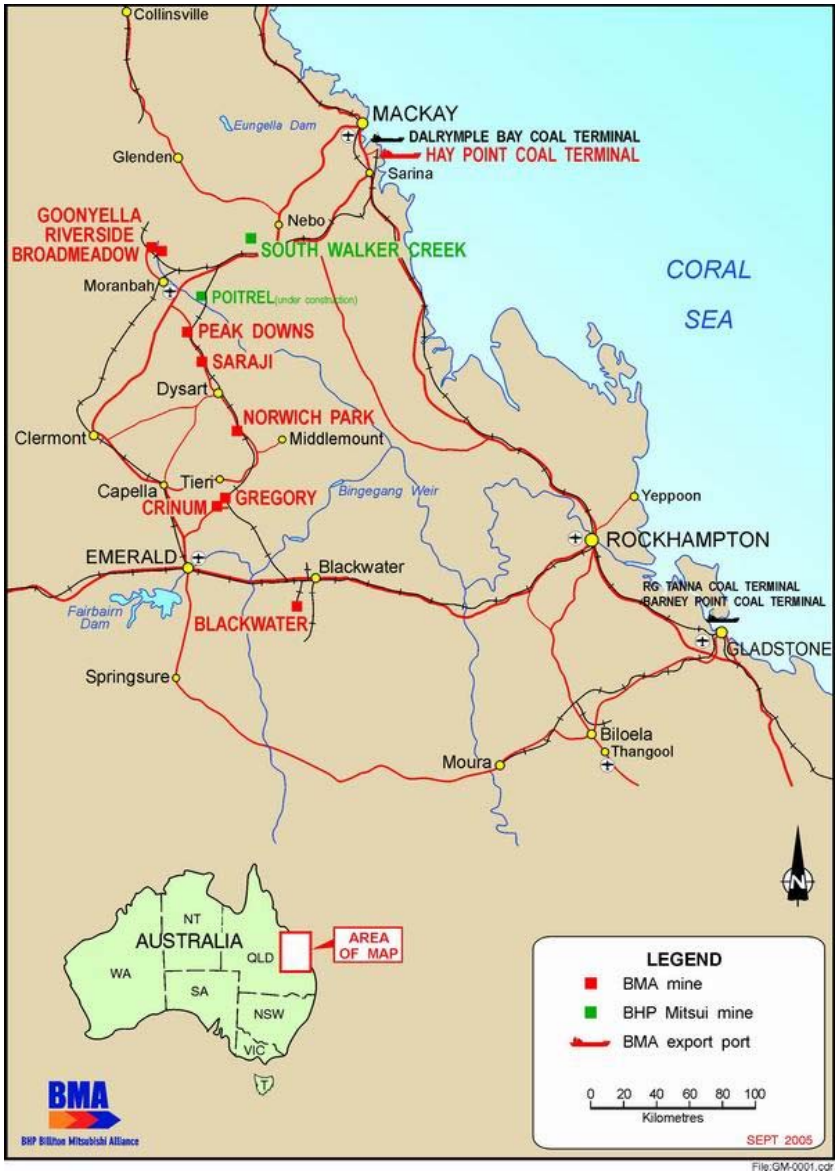


- Advanced Dewatering
  - *Dewatering Aids*
    - *Licensed to Nalco Chemical*
    - *Commercialized at Pinnacle*
  - *Hyperbaric Centrifuge*
    - *Licensed to Decanter Machine*
    - *Pilot-scale tests ongoing*
  - *Novel Dewatering Technology*
    - *Can produce <5% moisture*

Bubble Generation in Microcel

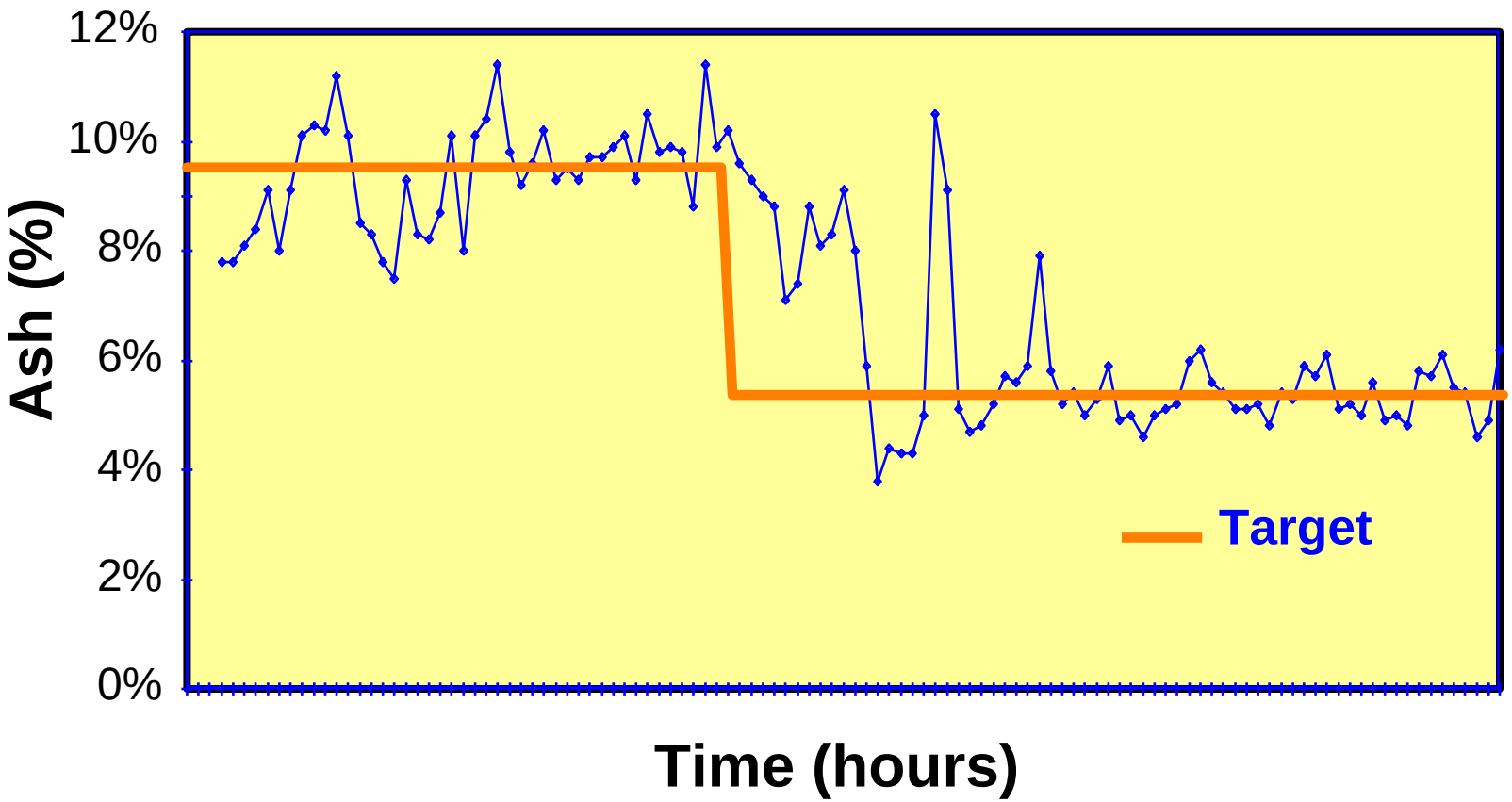


Microcel at Peak Downs



Benefits of Using Microcel at Peak Downs

Before and After Installation



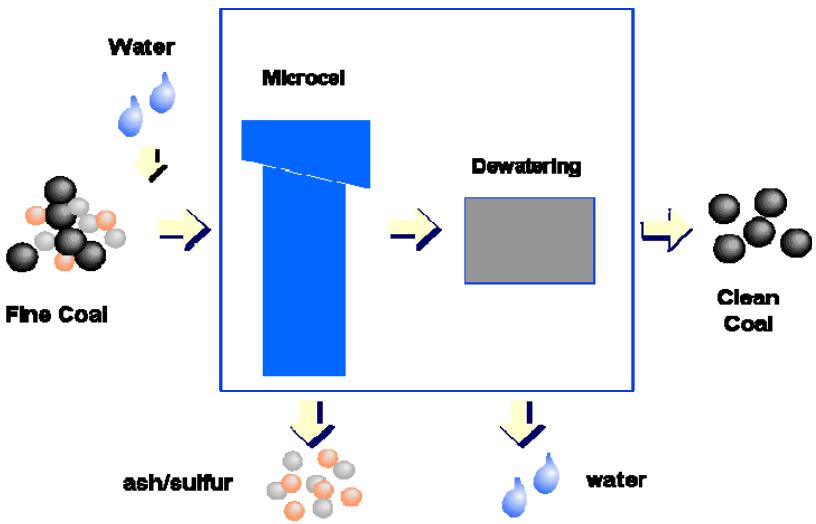
Ongoing Microcel Projects in Australia

Summary of Microcel Projects		
Site	No. of Cells	Customer
Collinsville	1	Xstrata
Millennium	4	Excel
Gregory	5	BMA
Dawson	6	Anglo Coal
Blackwater	6	BMA
Lake Lindsay	2	Anglo Coal
Sonoma	1	BMA

From Eriez Manufacturing

Advanced Coal Processing (2)

- Advanced Flotation
  - *Microcel Flotation*



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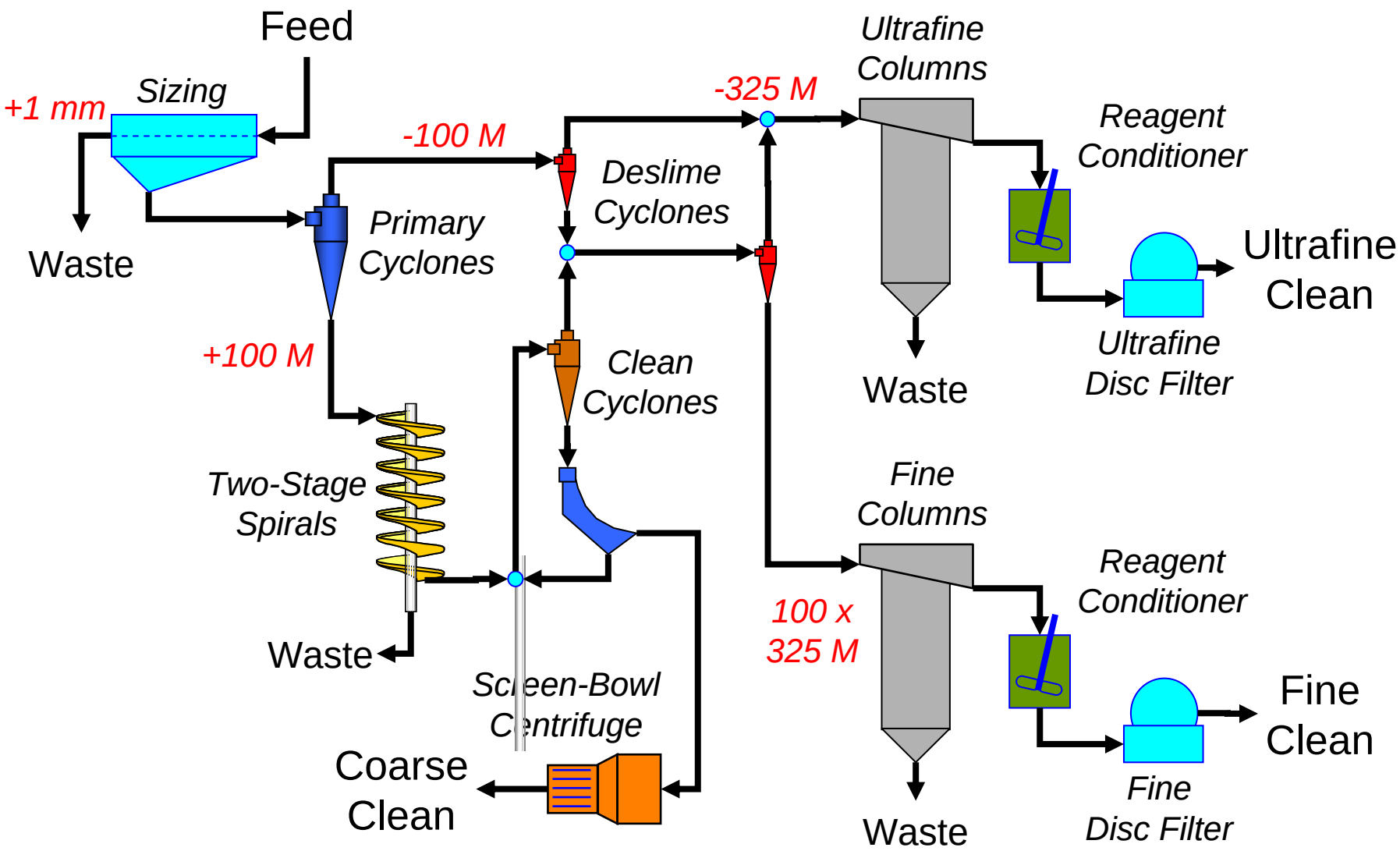
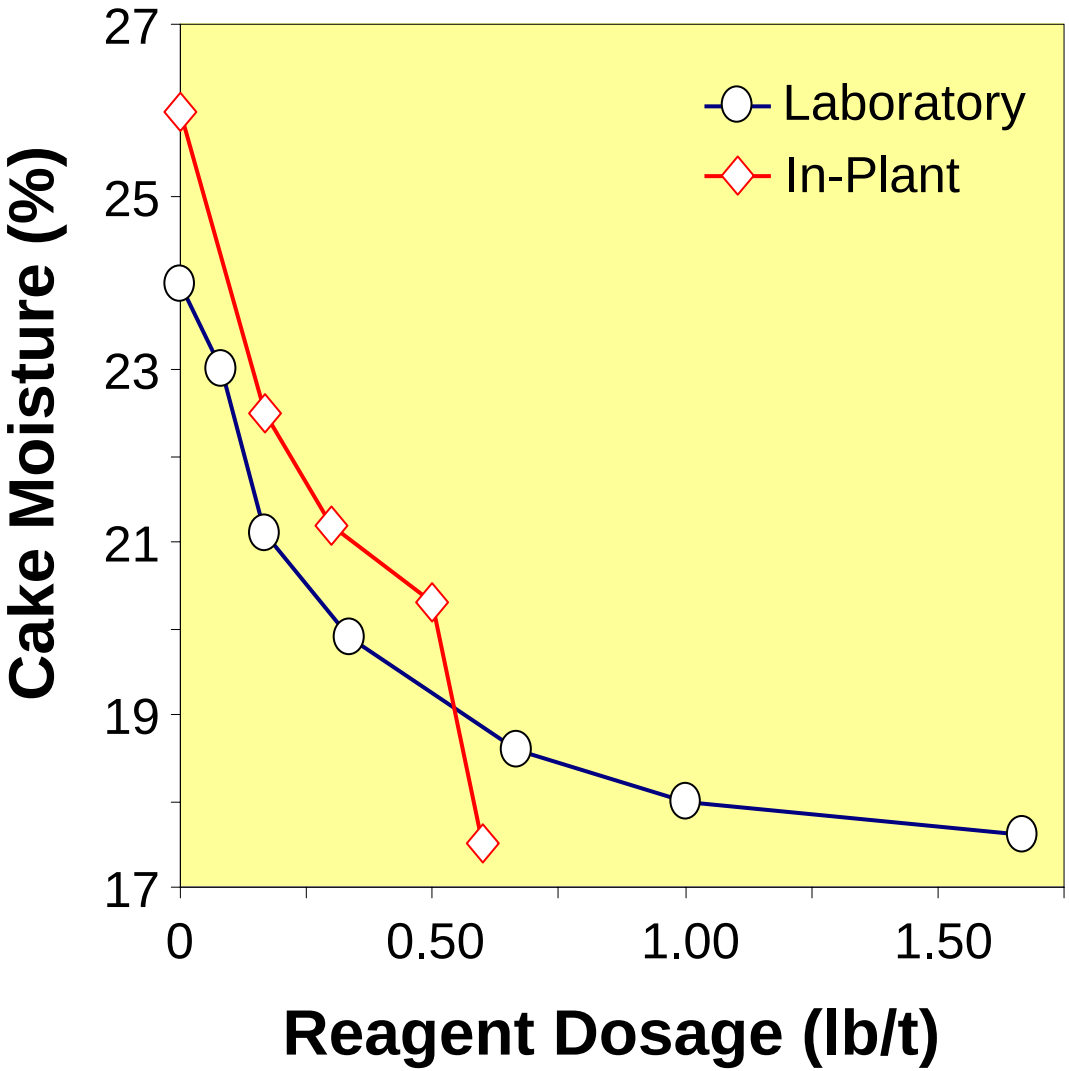
Novel Dewatering Aids

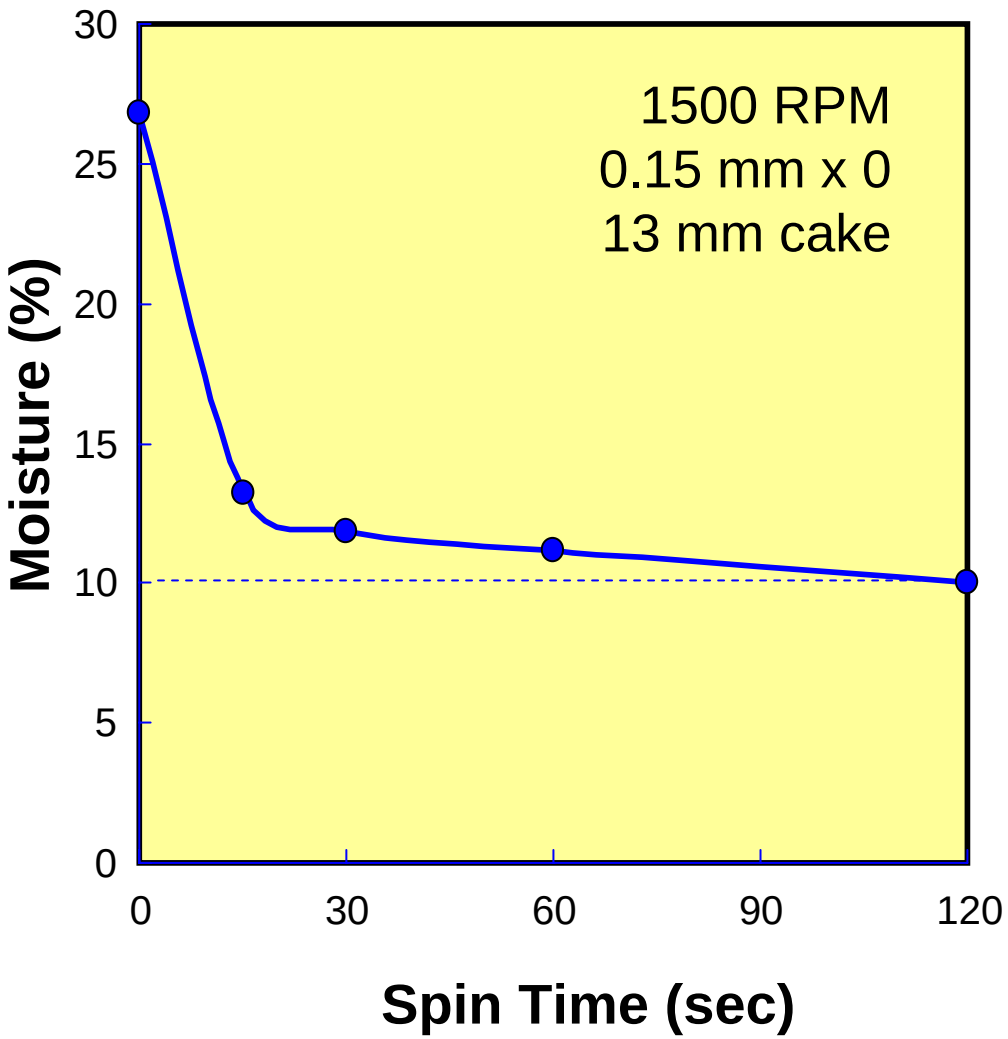
Dewatering Aides



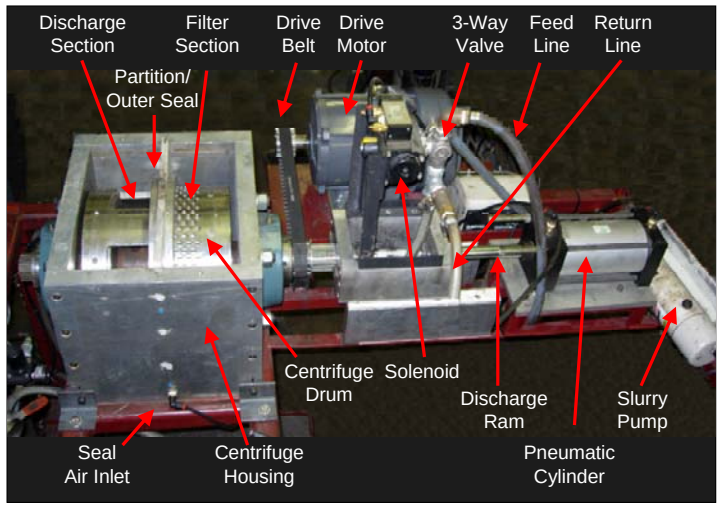
Dewatering Aids



Hyperbaric Filter Centrifuge

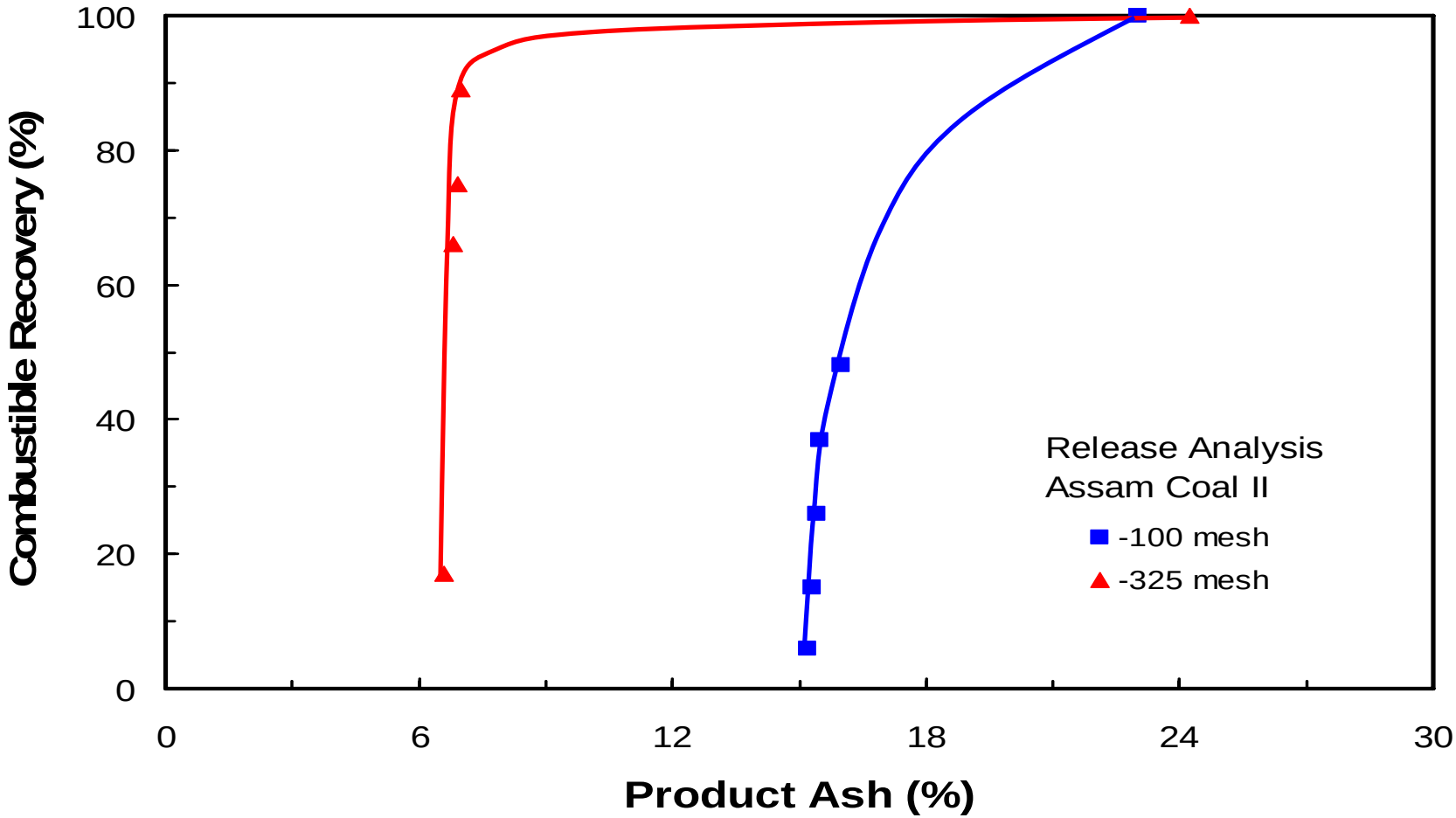


Pilot-Scale Prototype



Effect of Particle Size on the Flotation of Indian Coal

Assam Coal 2



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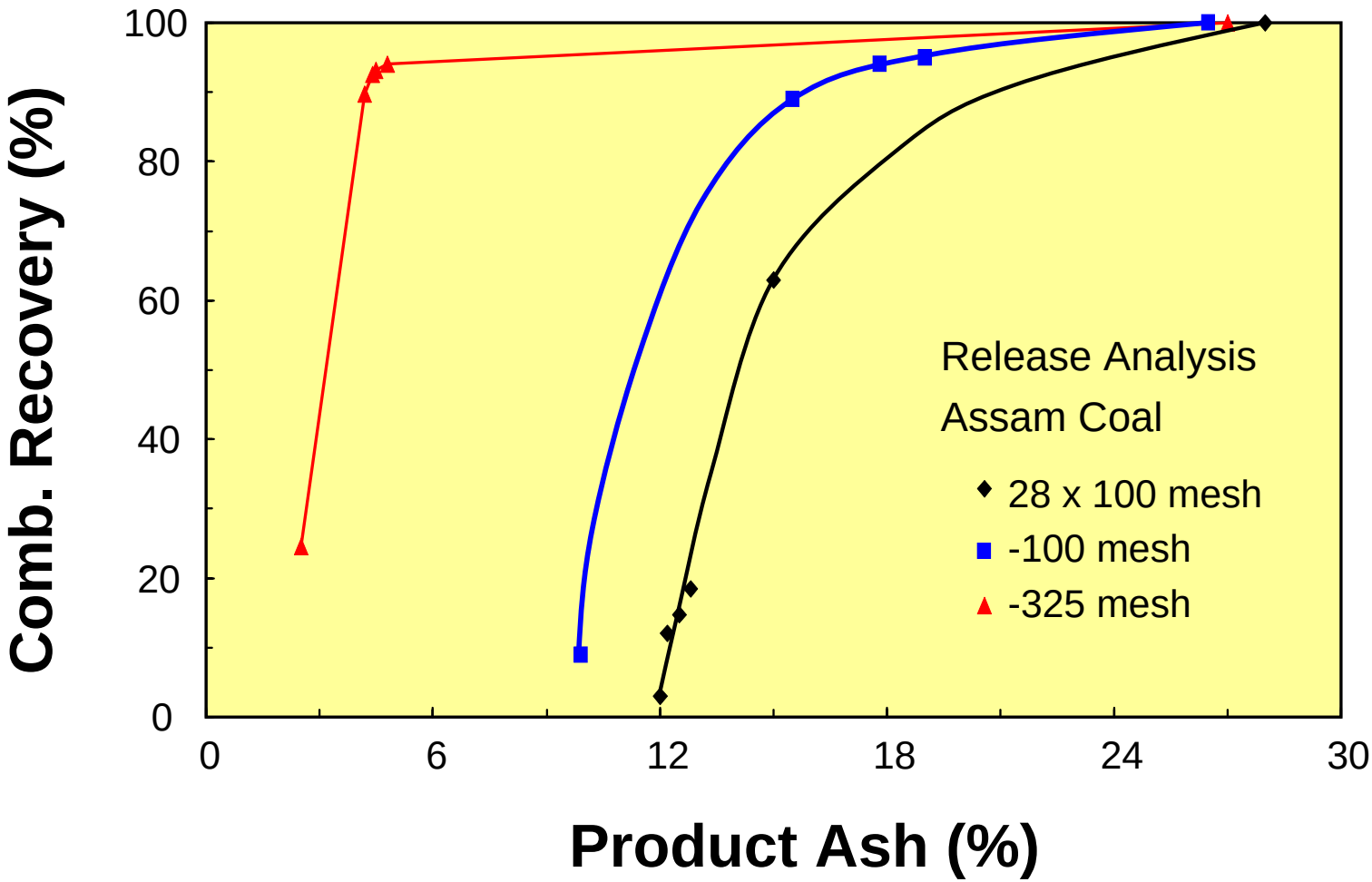
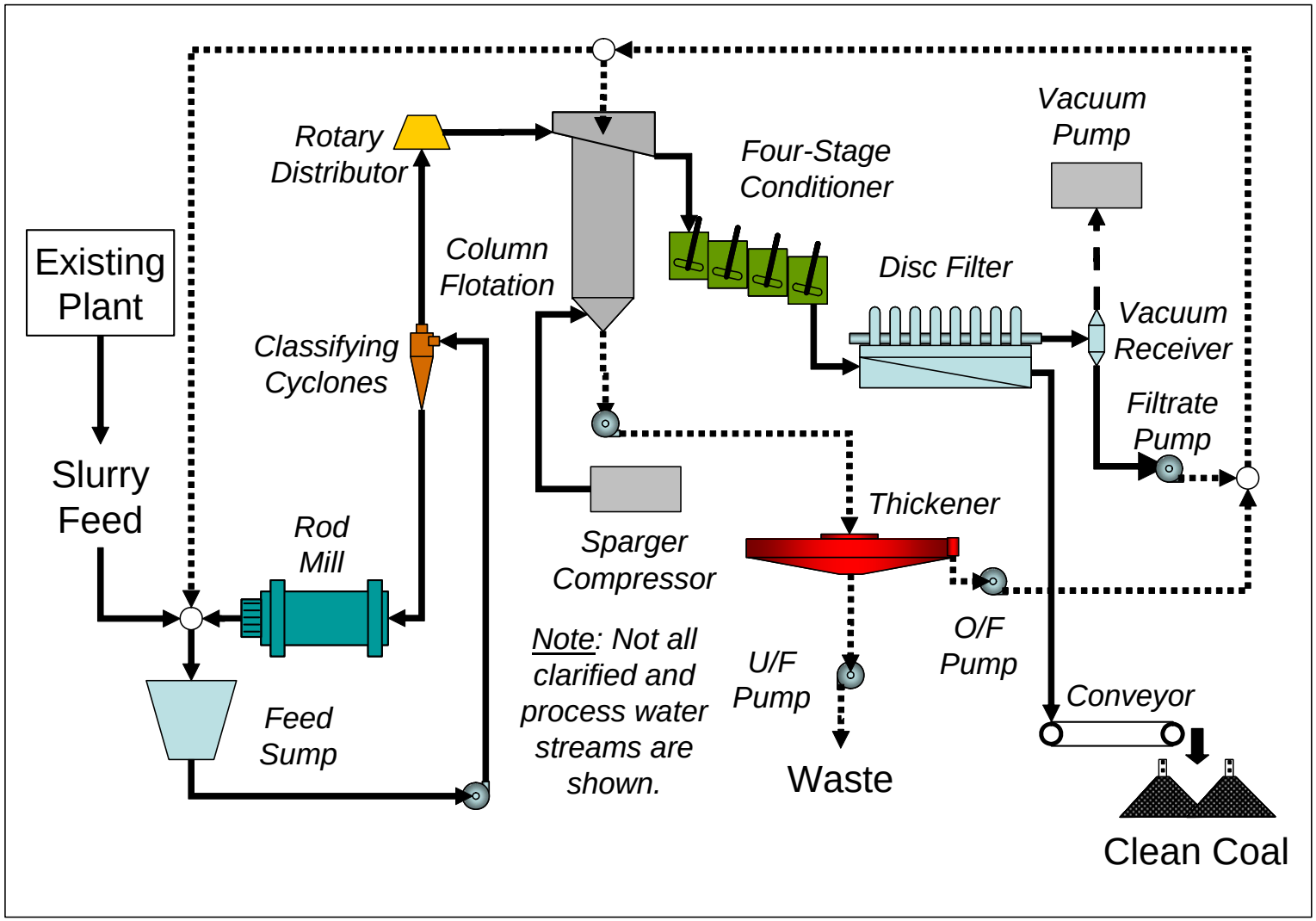
Assam Coal 1

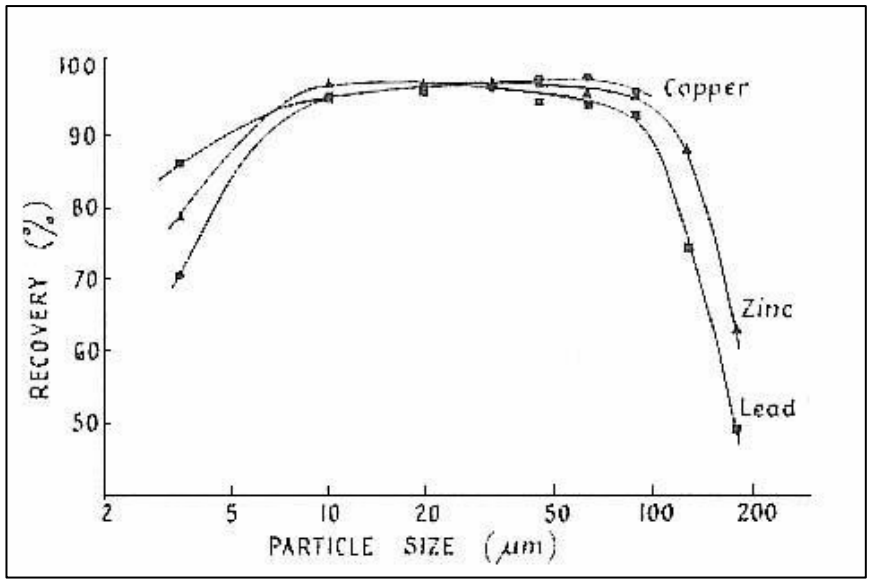


Advanced Fine Coal Beneficiation (4)

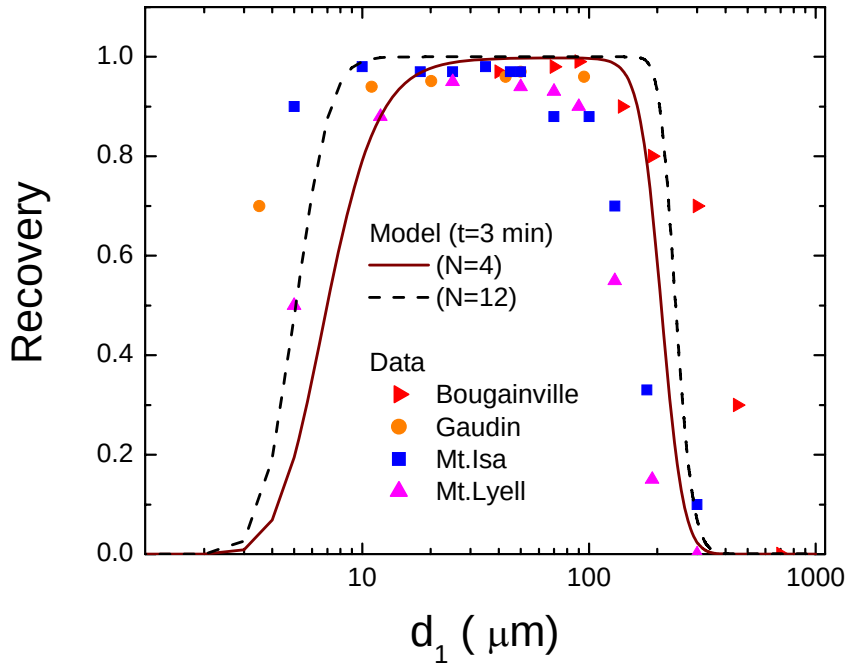
for Indian Metallurgical Coal



Effect of Particle Size on Flotation



(Gaudin, 1931)



(Sherrell, Do and Yoon, 2005)

Coarse Coal Flotation (1)

Ofori, Brien, Firth, Jenkins (2005)

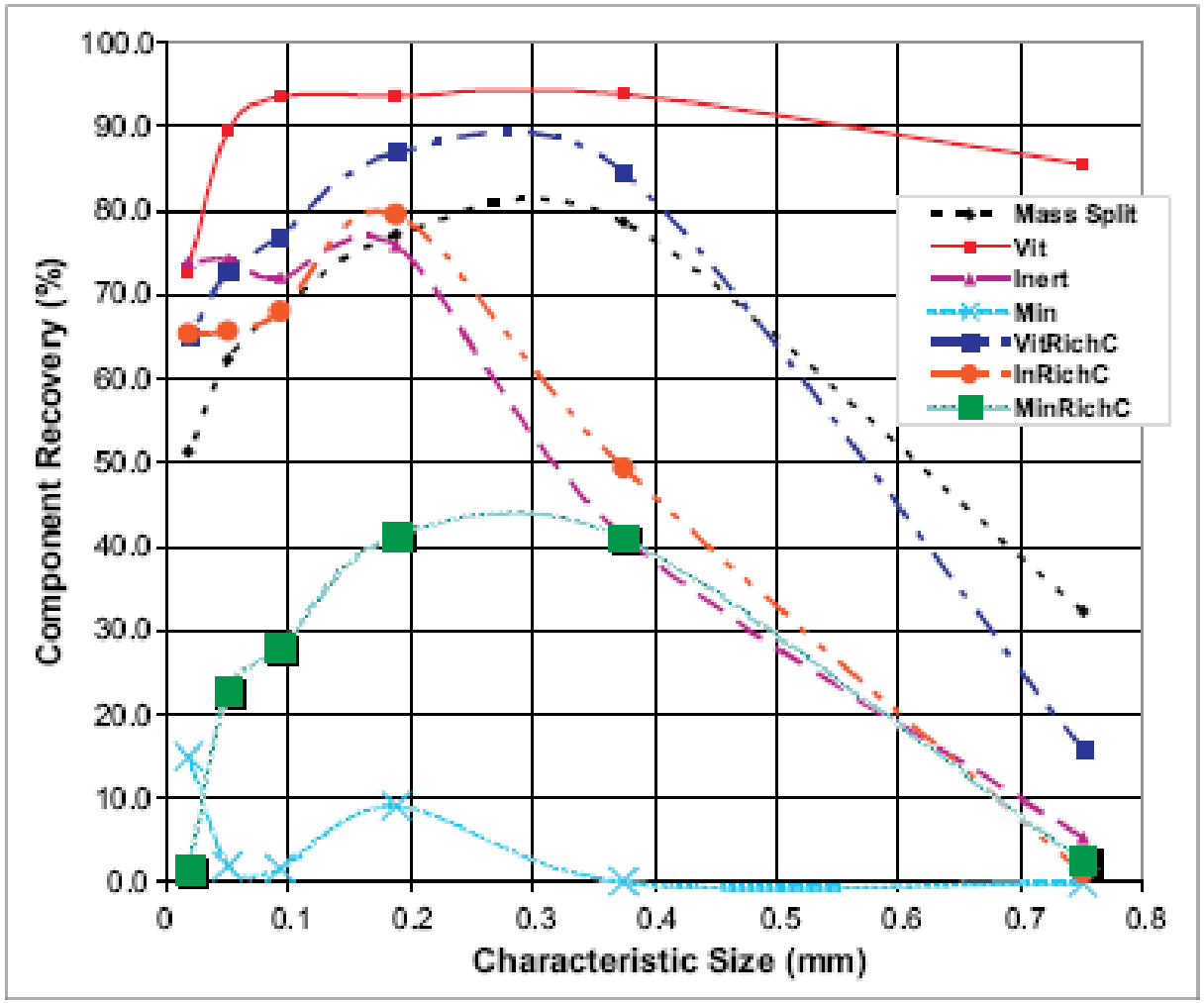
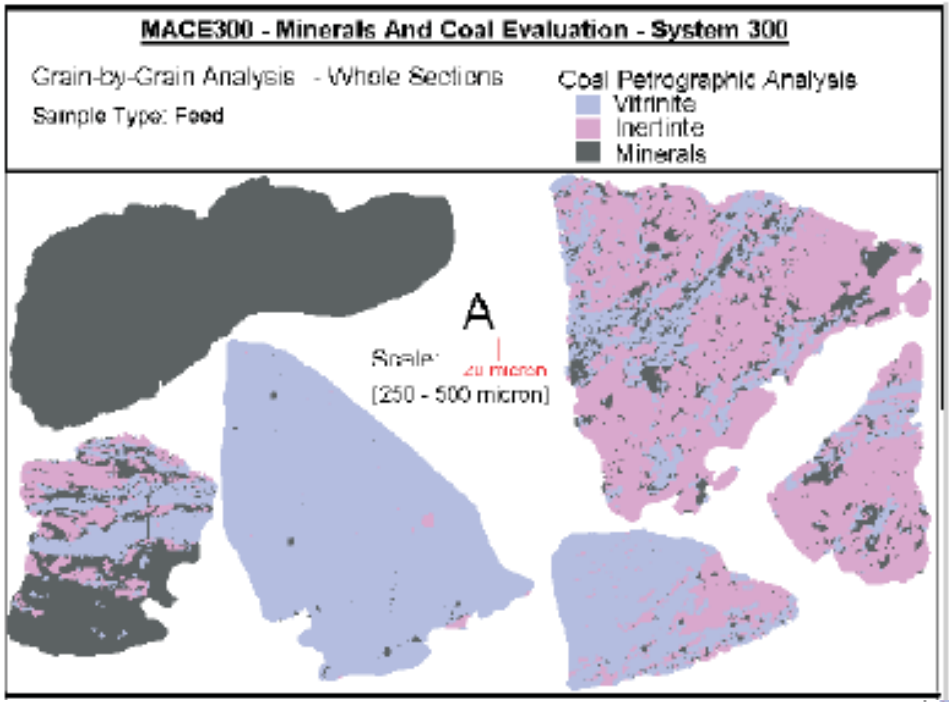
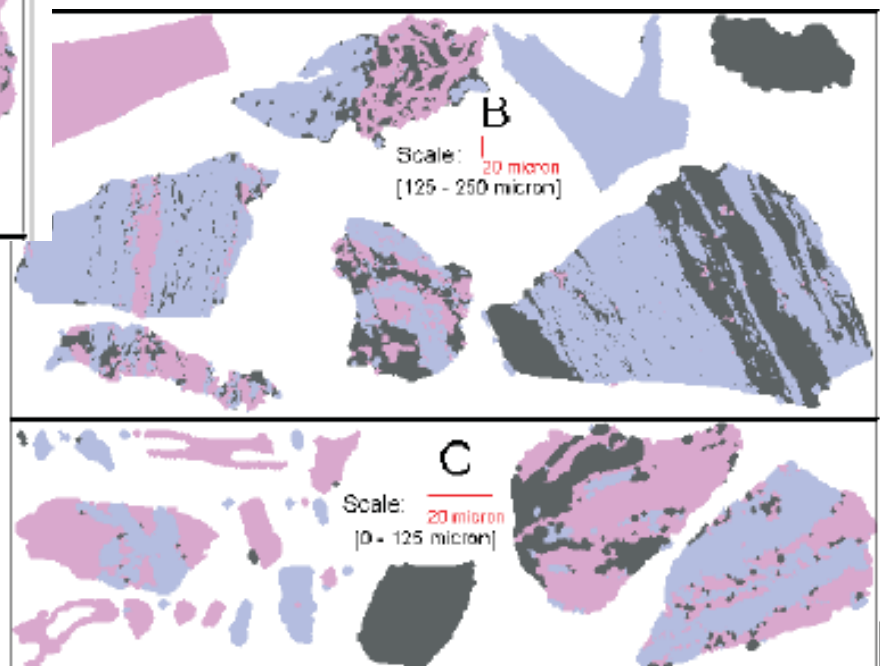


FIG 3 - Component recovery as a function of particle size.

Coarse Coal Flotation (2)

Ofori, Brien, Firth, Jenkins (2005)

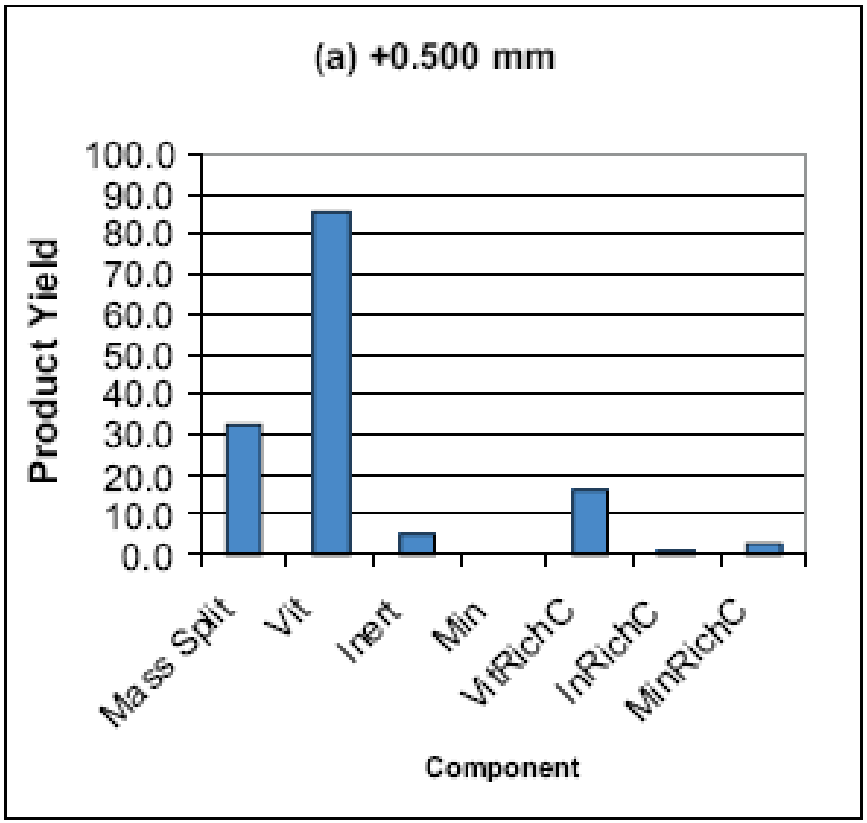


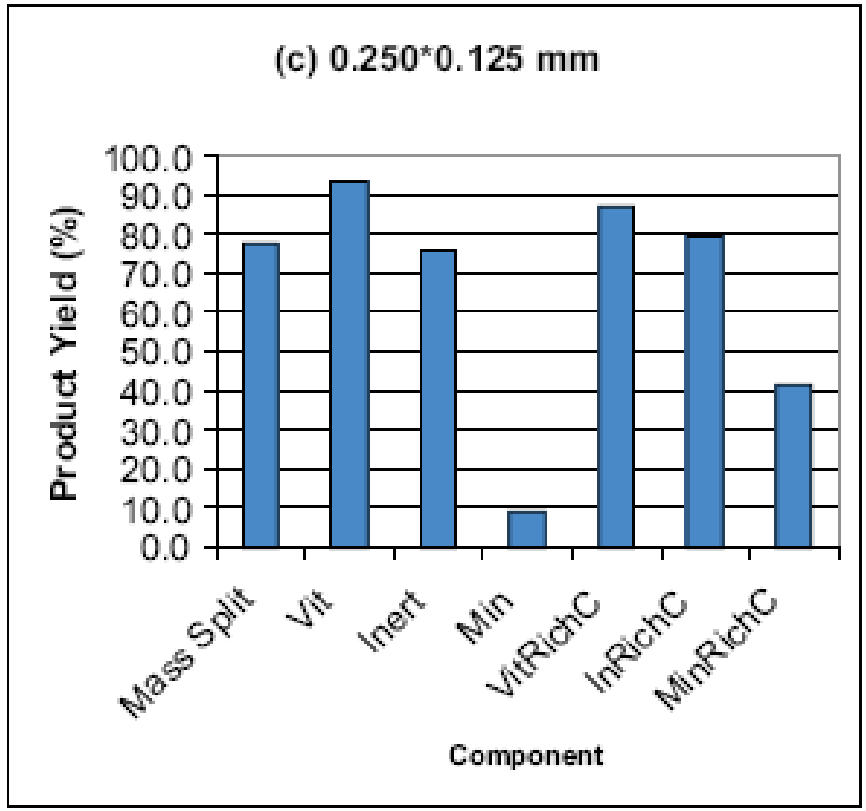


MACE™ 300 images on Bowen bsain coal

Coarse Coal Flotation (3)

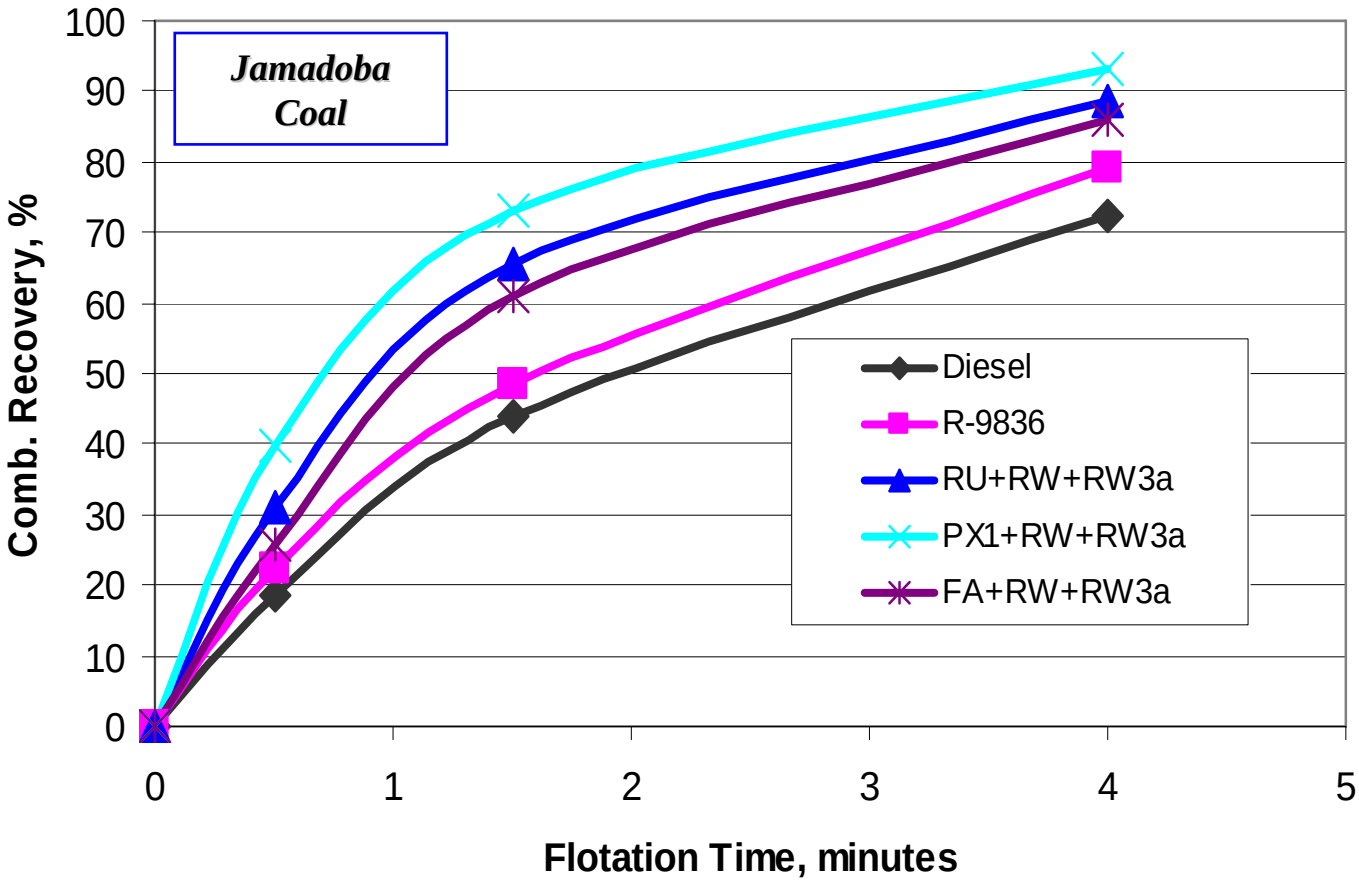
Less hydrophobic coals drop off.





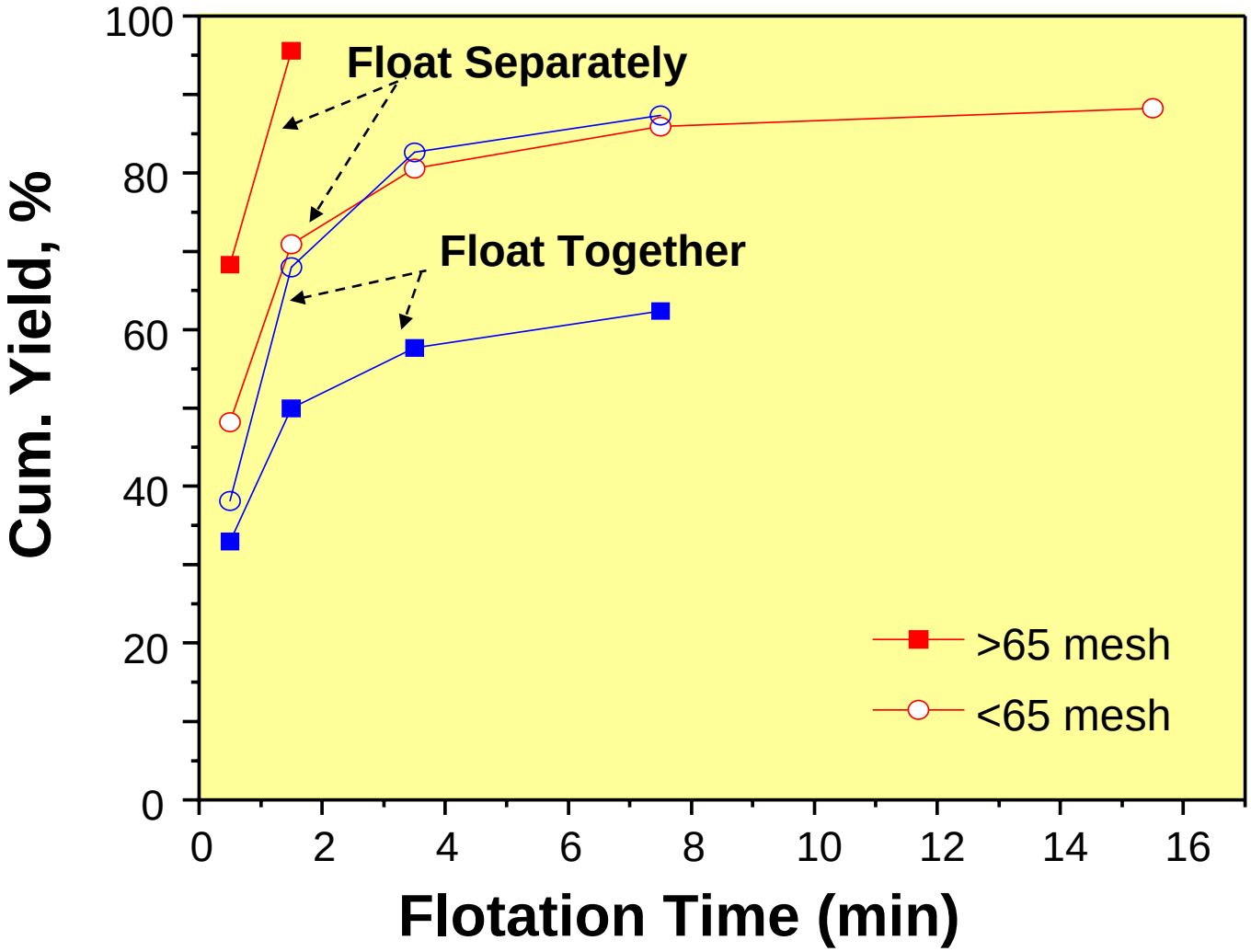
Coarse Coal Flotation (5)

Indian coal may need a more powerful collector.



Advanced Fine Coal Beneficiation (6)

Split Flotation helps Indian coal.



Coarse Particle Flotation (7)

How hard do we float?

	Individual		Cumulative		
Froth Product	Mass (%)	Ash (%)	Mass (%)	Ash (%)	Recovery (%)
C1	10.95	6.55	10.95	6.55	15.3
C2	15.26	6.88	26.21	6.74	36.5
C3	34.35	9.07	60.56	8.06	83.2
C4	10.76	17.32	71.32	9.46	96.4
T	28.68	91.70	100.00	33.05	100.0
Total	100.00	33.05	---	---	---

Conclusion: Incremental ash <20-25% in flotation, so always pull float cells "hard" (produce grey tails).

Maximizing Yield

Operation at Constant Incremental Ash

	Dense Medium Cyclone				Dense Medium Bath			
SG Value	Mass (%)	Ash (%)	Cum Mass (%)	Cum Ash (%)	Mass (%)	Ash (%)	Cum Mass (%)	Cum Ash (%)
1.30	31.12	4.44	31.12	4.44	5.32	4.51	5.32	4.51
1.35	28.27	7.65	59.39	5.97	11.32	7.50	16.64	6.55
1.40	13.41	13.74	72.80	7.40	16.32	13.52	32.96	10.00
1.45	1.71	19.40	74.51	7.67	4.32	19.54	37.28	11.11
1.50	0.90	24.67	75.41	7.88	2.35	25.11	39.63	11.94
1.55	0.64	29.60	76.05	8.06	1.23	30.14	40.86	12.48
1.60	0.87	34.22	76.92	8.36	1.03	34.14	41.89	13.02
1.65	1.03	38.55	77.95	8.76	1.24	39.01	43.13	13.76
1.70	1.26	42.63	79.22	9.30	1.92	41.95	45.05	14.97
1.80	1.45	48.30	80.67	10.00	2.21	47.69	47.26	16.50
2.00	2.95	58.30	83.62	11.70	3.28	59.23	50.54	19.27
Feed	16.38	87.22	100.00	24.07	49.46	86.54	100.00	52.54

Summary

- Advanced fine coal beneficiation technologies have been developed.
  - *Microcel flotation column*
    - *Eriez Manufacturing*
    - *Metso Minerals*
  - *Fine coal dewatering technologies*
    - *Nalco*
    - *Decanter*
  - *Coarse coal flotation collector*
    - *Nalco*
- For Indian coals
  - *Fine coal flotation can produce low-ash products.*
  - *Coarse coal flotation can help increase yield.*