Fine Coal Cleaning by Froth Flotation

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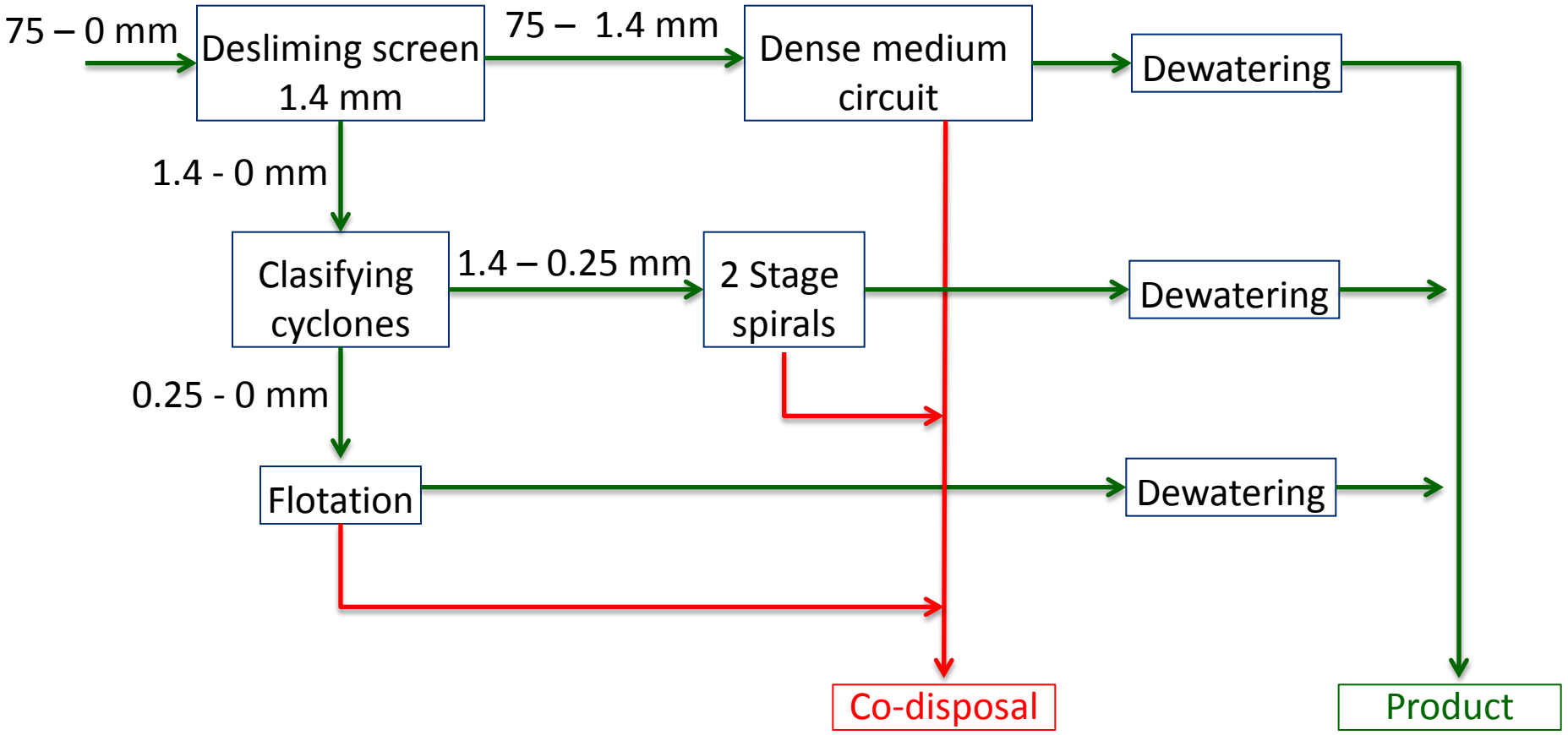
Outline

- Coal Preparation
- Froth Flotation
- Flotation Machine
- Bubble Size
- Froth Phase
- Jameson Cell

Coal Preparation

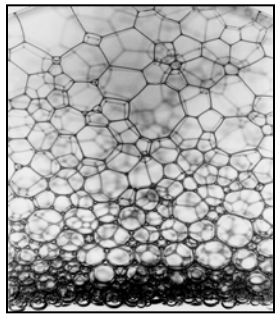
General

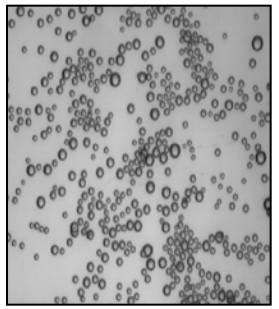


Froth Flotation

General

- Surface chemistry based separation technique.
  - Pulp consists of hydrophobic and hydrophilic species
  - Air bubbles are introduced into an agitated pulp
  - Hydrophobic particles attach to air bubbles and are carried to the surface
  - Laden bubbles overflow the flotation cell into the collecting launder
  - Hydrophilic particles remain in continuous phase

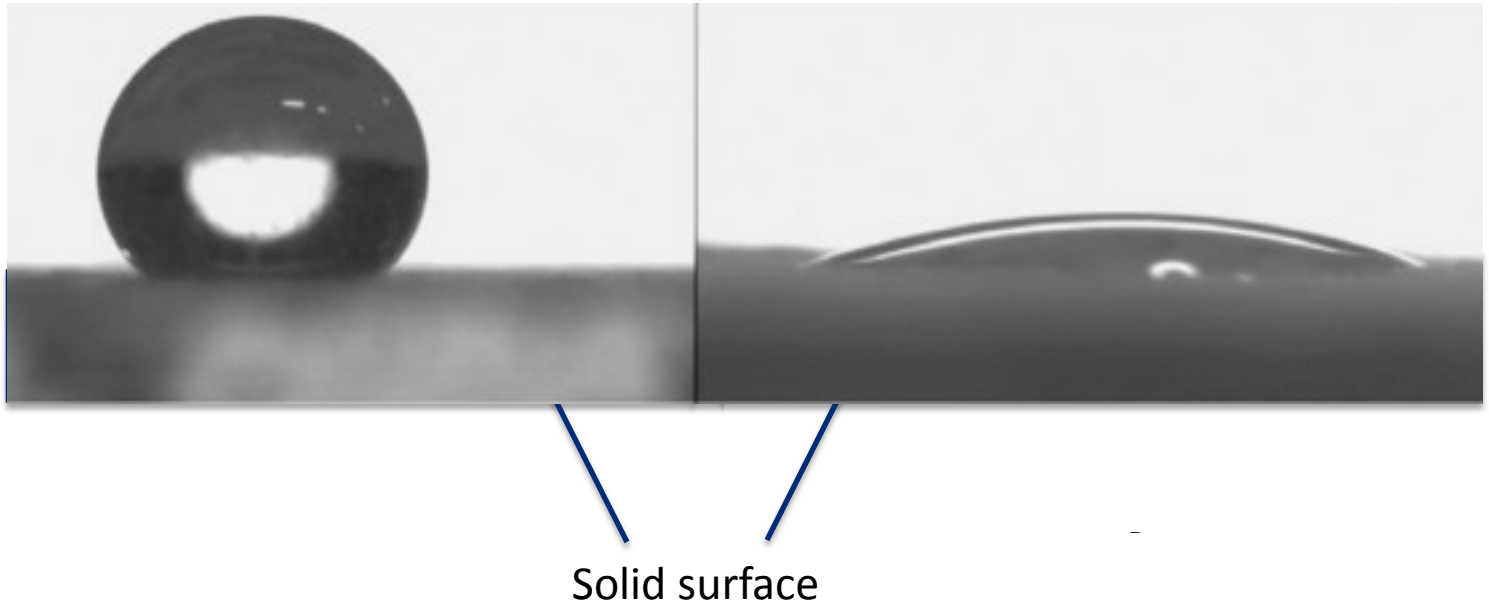




Froth Flotation

Hydrophobic and hydrophilic species

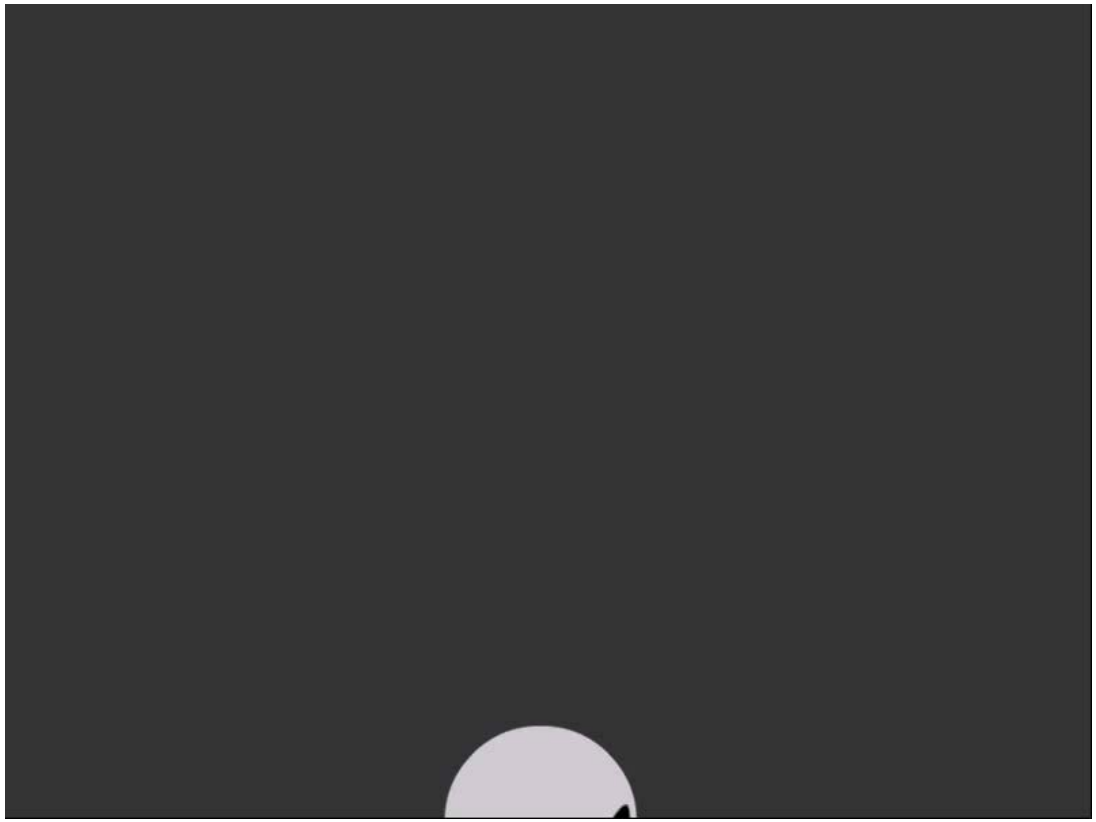
Coal is hydrophobic and ash is hydrophilic



Froth Flotation

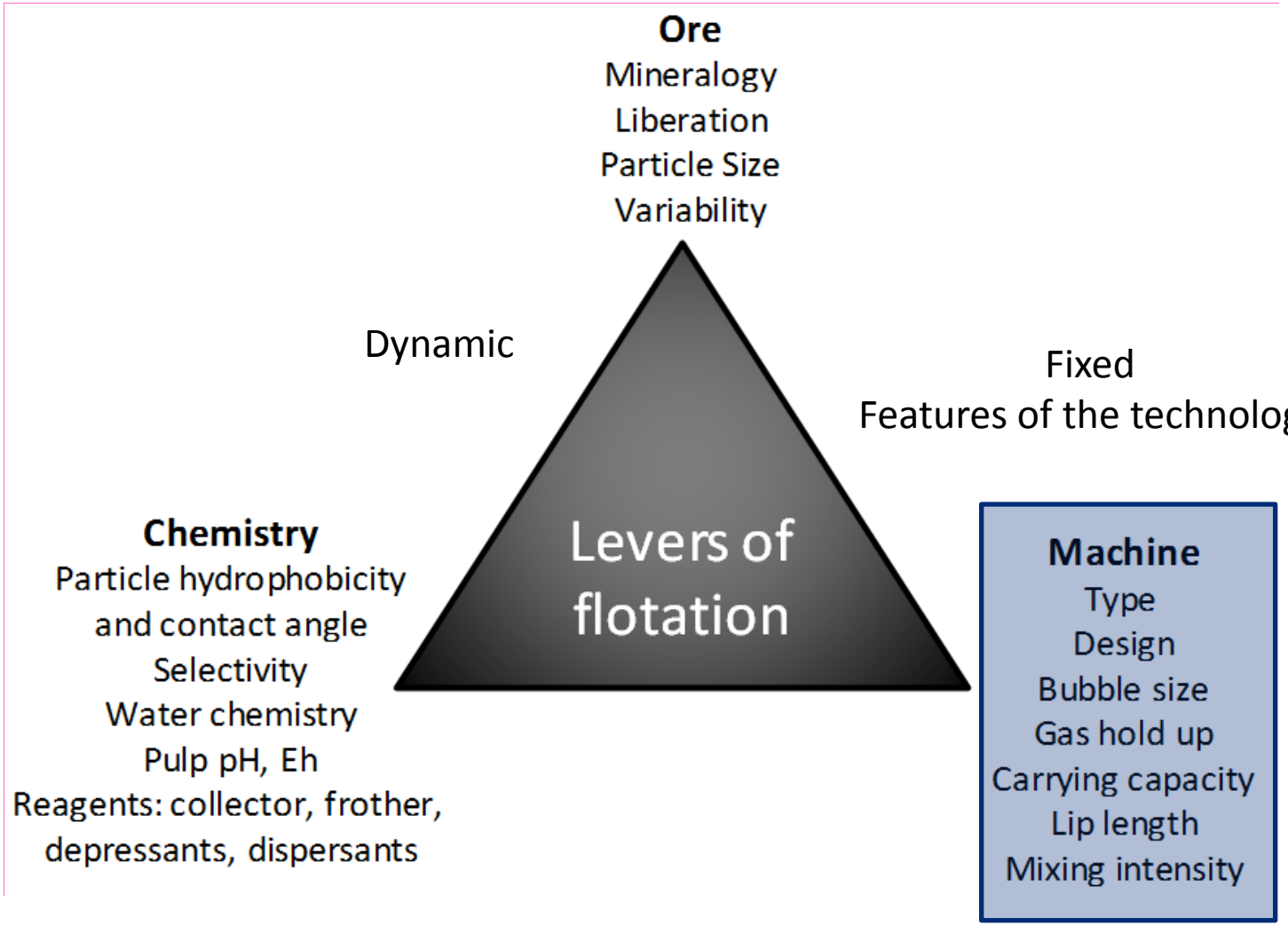
Hydrophobic and hydrophilic species

Coal particles attach to air bubbles



Froth Flotation

Background



Flotation Machine

Bubble generation

There exist many different techniques and devices to disperse air

- Shear action of a metallic surface moving at high speed in a relatively stationary liquid (rotor in mechanical cells)
- Jetting of air through small holes in a porous material (laboratory flotation columns)
- Jetting of air through a single hole (jetting spargers)
- Jetting of liquid into a liquid surface (Jameson cell)
- Shear action of a high velocity liquid striking a stationary metallic surface (in-line mixers and contact cells)

Flotation Machine

Ultimate goal

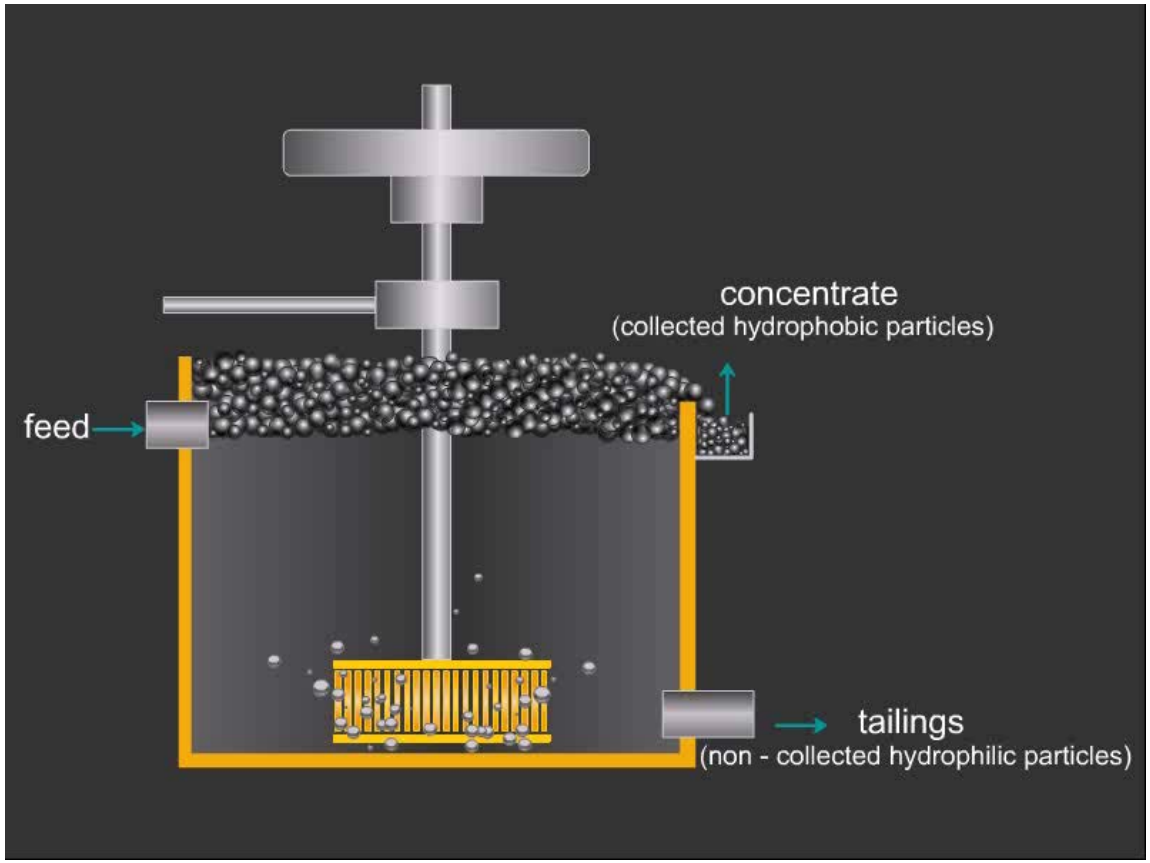
Froth flotation needs to be performed on machines that are designed for:

- Generation and distribution of bubbles
- Suspension and distribution of particles
- Generation of a “clean” froth phase

Flotation Machine

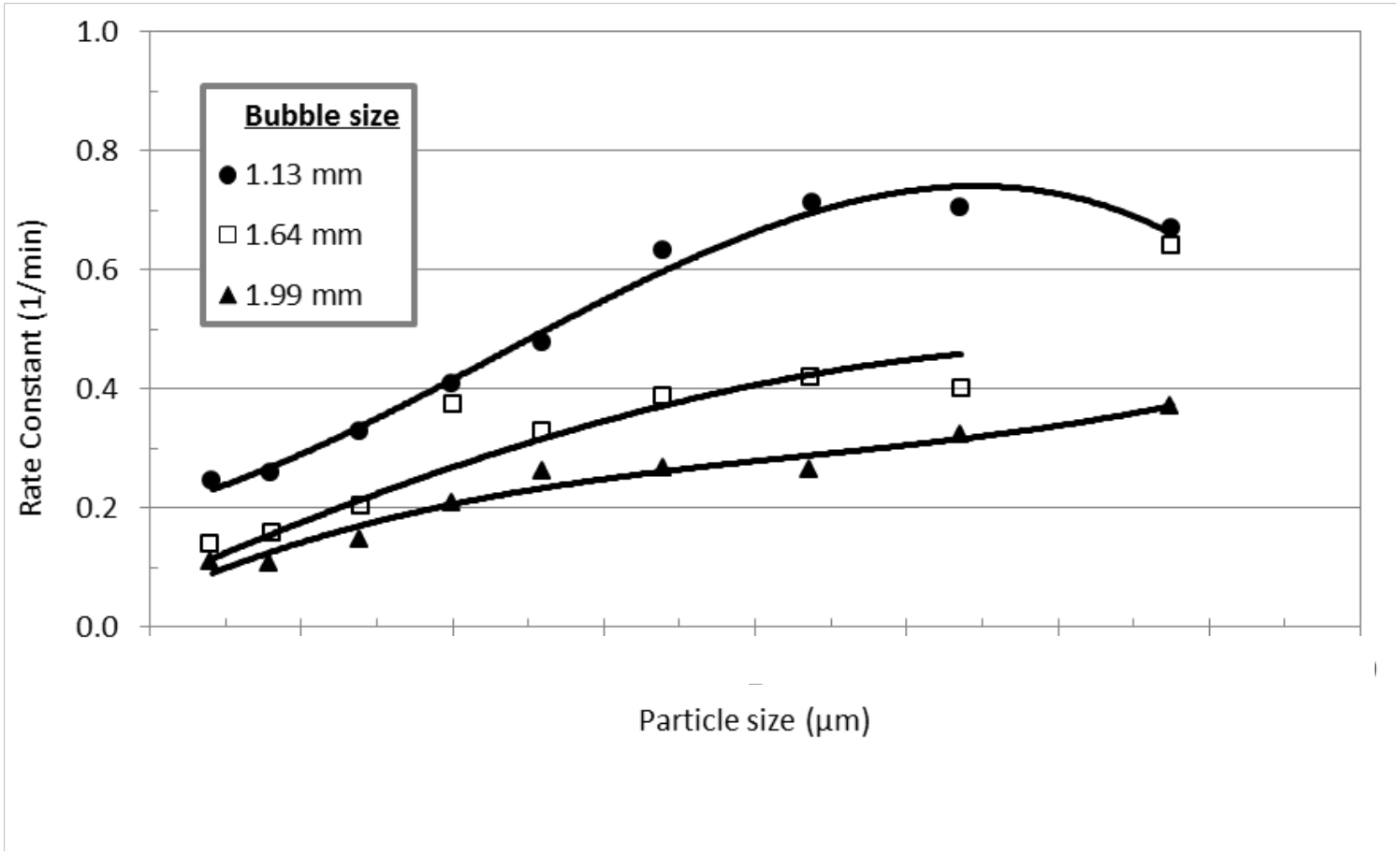
Ultimate goal

Coal is collected from the concentrate stream



Bubble Size

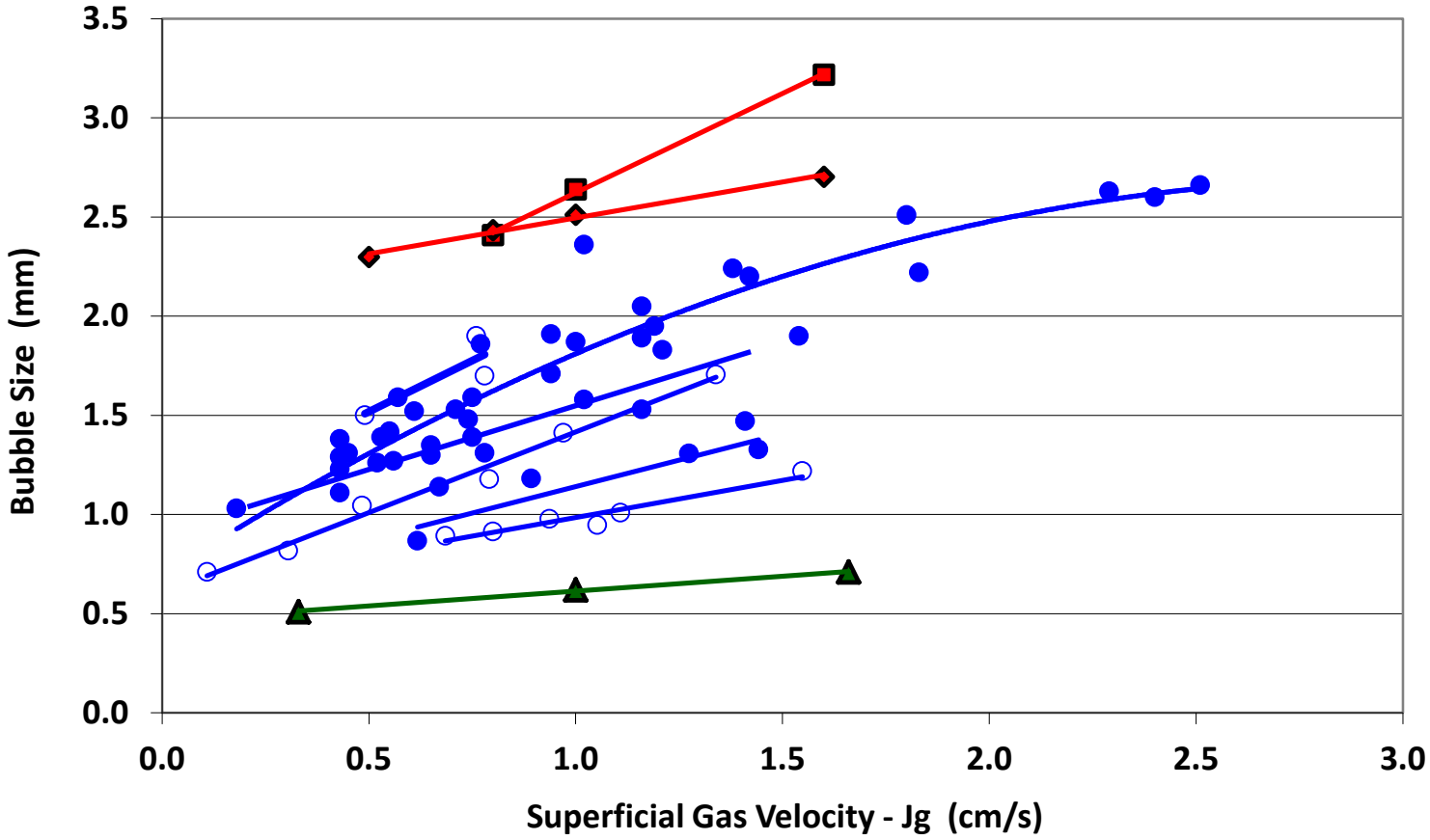
Fine bubbles are better for the whole size range



Bubble Size

Fine bubbles are better for the whole size range

Bubble size depends on the flotation technology



Bubble Size

Fine bubbles are better for the whole size range

Small bubbles means higher throughput

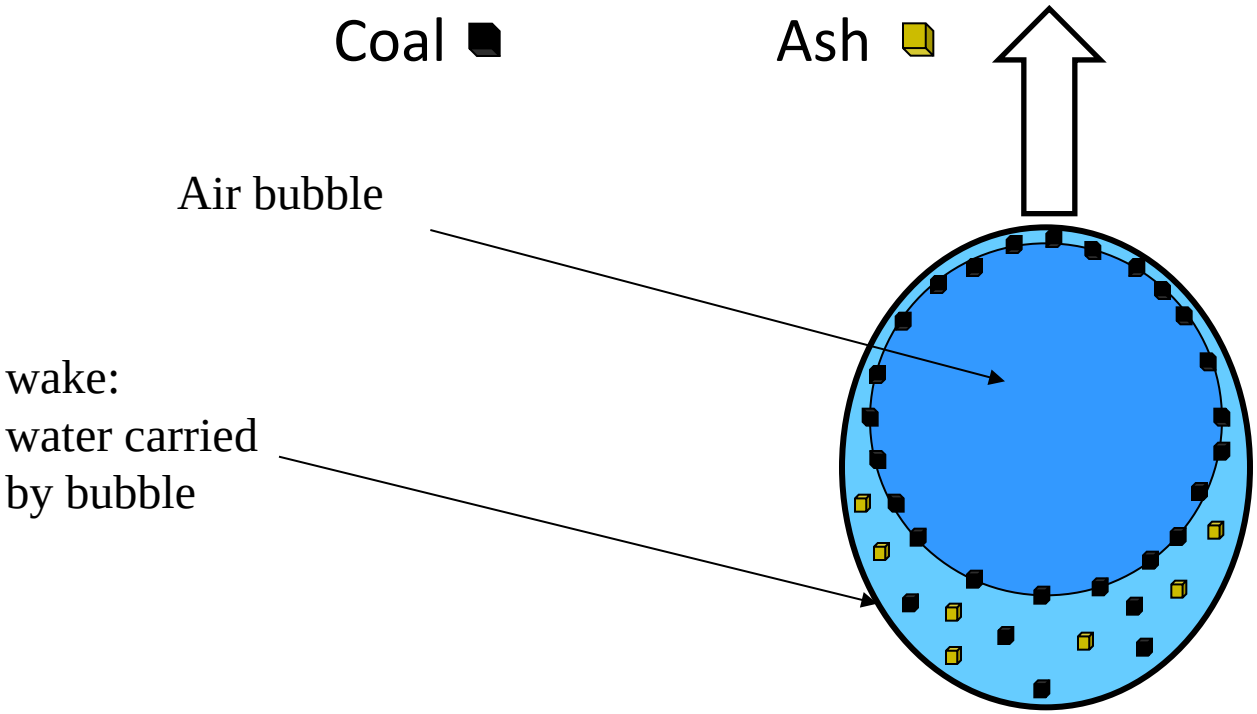
- Why do we need small bubbles?

Total Vol, mm^3	Bubble Diam, mm	No Bubbles	Bubble surface area mm^2	Particle Diam, mm	Particle surface area, mm^2	No particles
3	0.5	46	36	0.25	0.20	180
3	1.5	2	12	0.25	0.20	60

Froth Phase

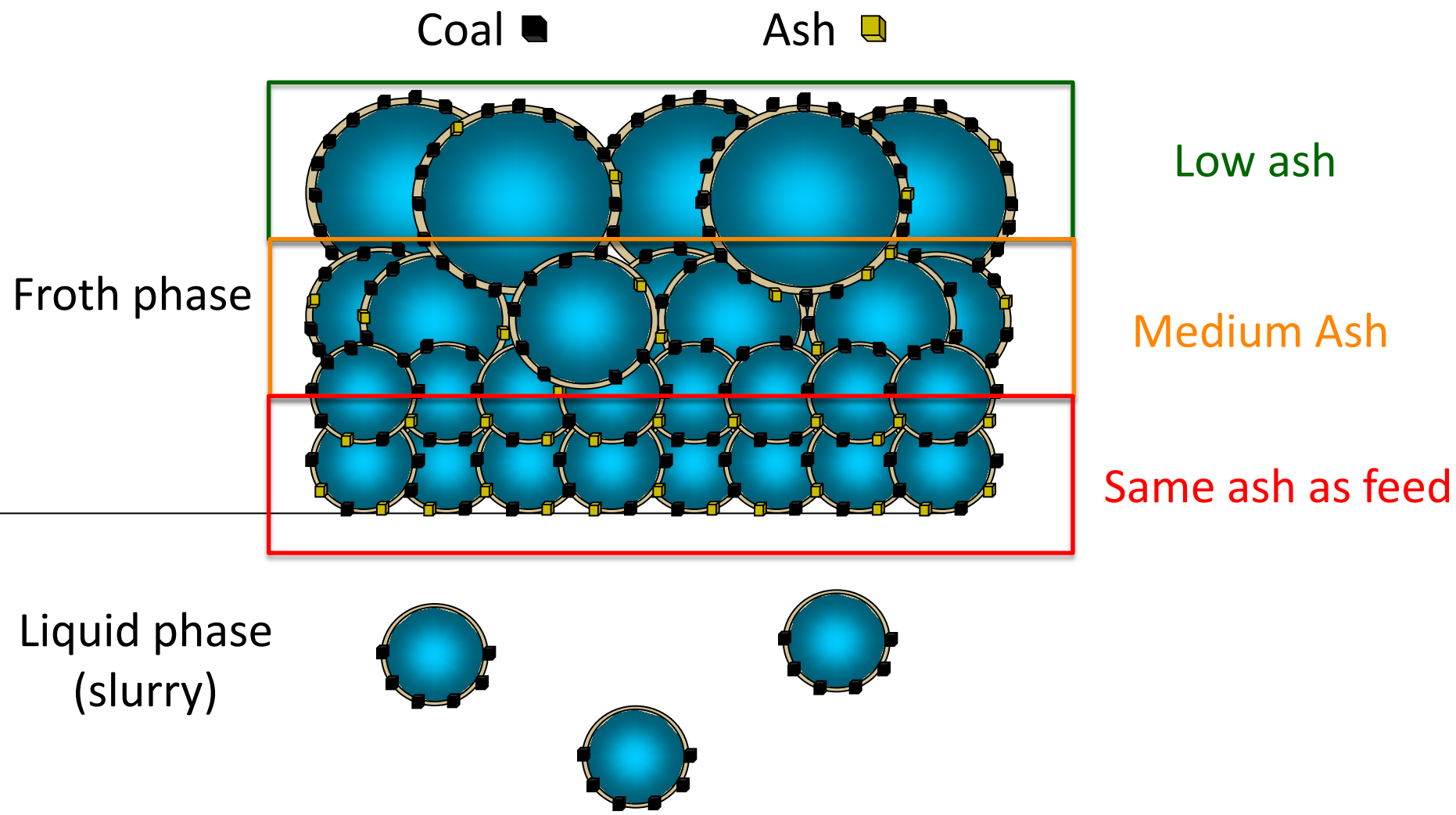
Water entrainment

Non-Selective recovery of coal and ash



Froth Phase

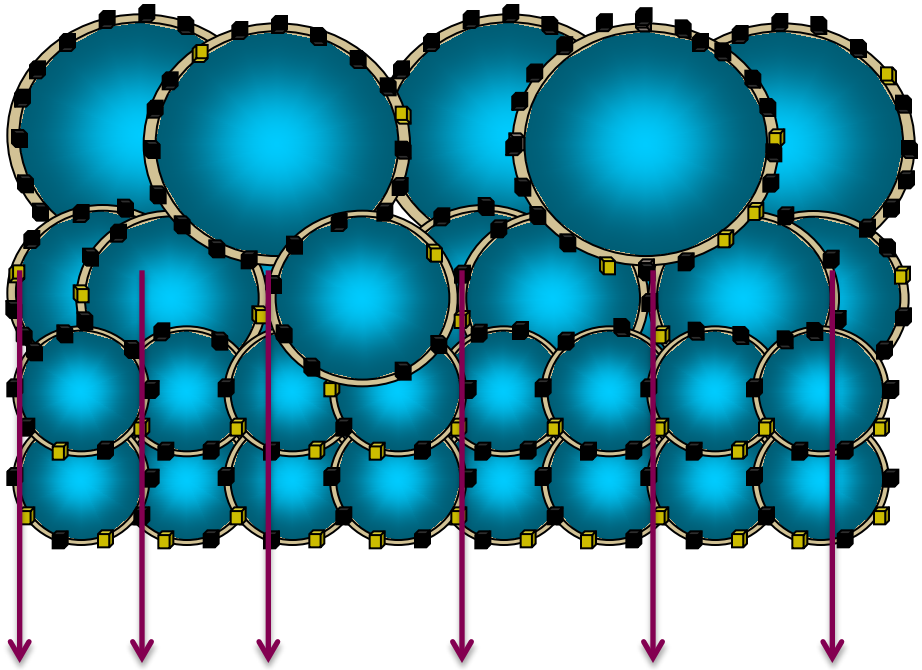
Water entrainment



Froth Phase

Water entrainment

Ash particles prefer to stay in water (hydrohilic)



Low liquid content

Medium liquid content

High liquid content

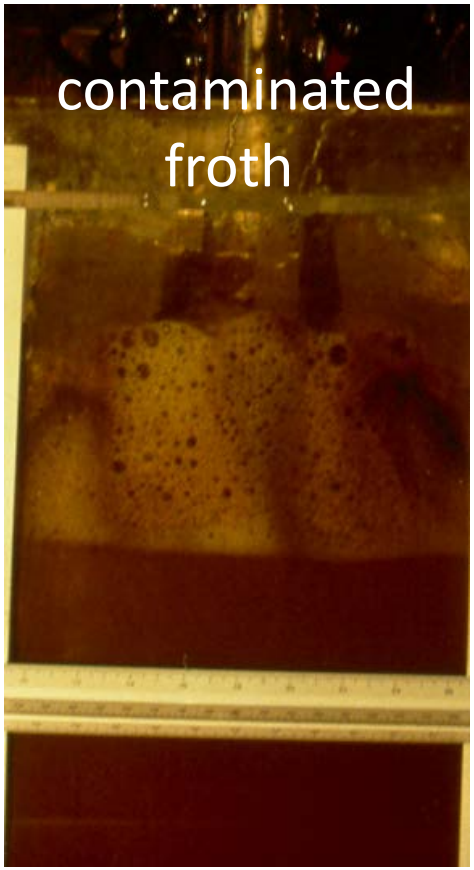
Drainage

Froth Phase

Removal of entrained ash by wash water

water sprayed in via this ring

start

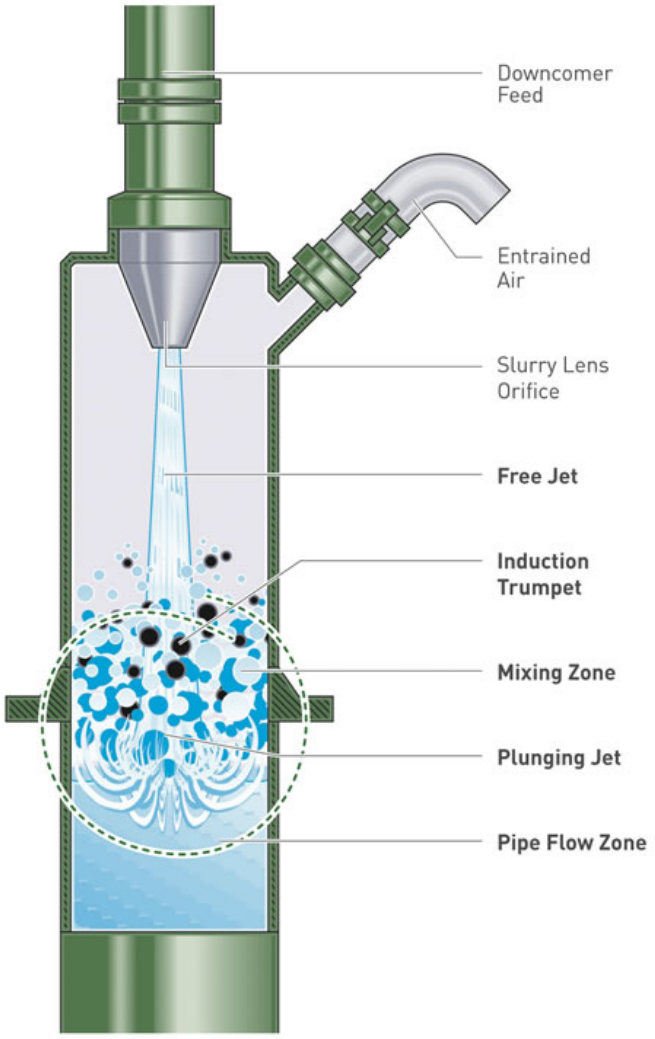


after a few minutes

with wash water on

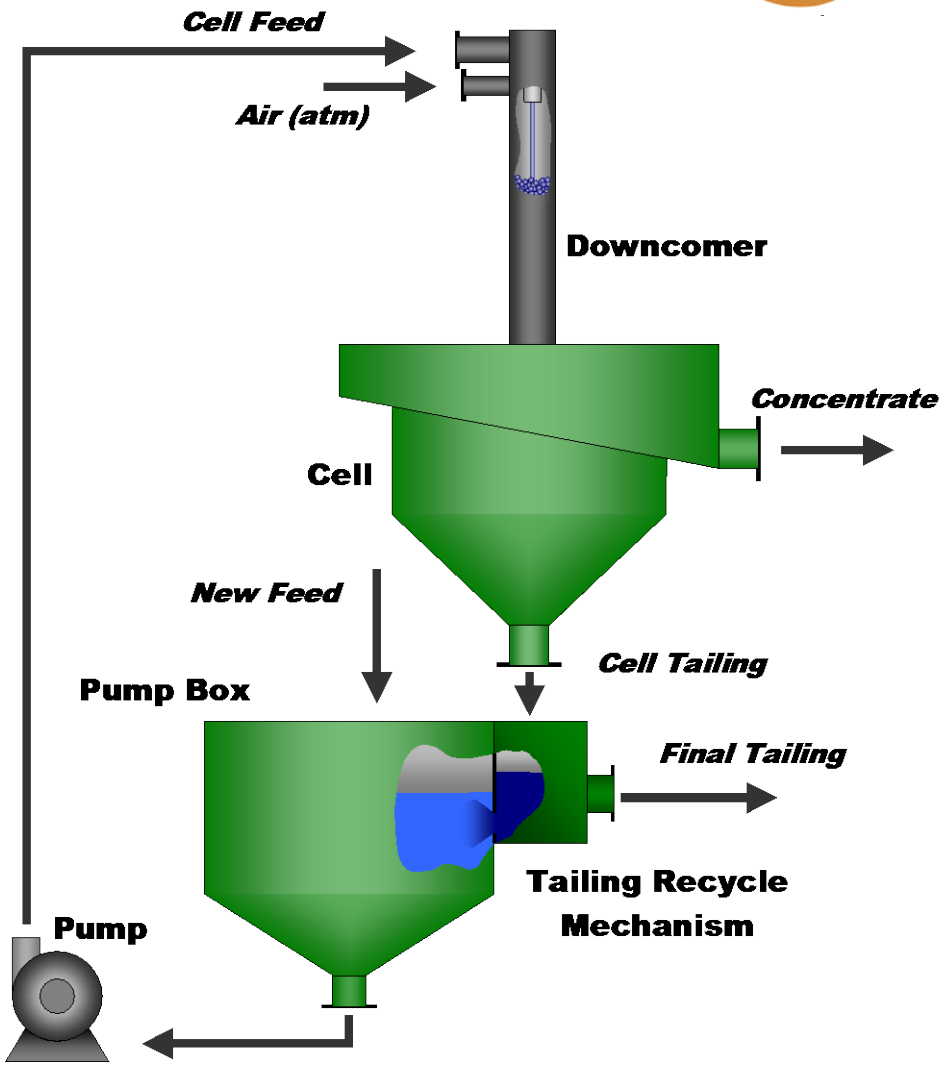
Jameson Cell

- Pressurized slurry enters downcomer through a nozzle at high velocity
- The jet entrains air from the atmosphere
- Jet plunges into slurry surface causing the air to shear into fine bubbles
- High intensity mixing leads to high probably of bubble-particle collision and contact
- Slurry and collected particles exit downcomer
- Particle laden bubbles are separated from the pulp

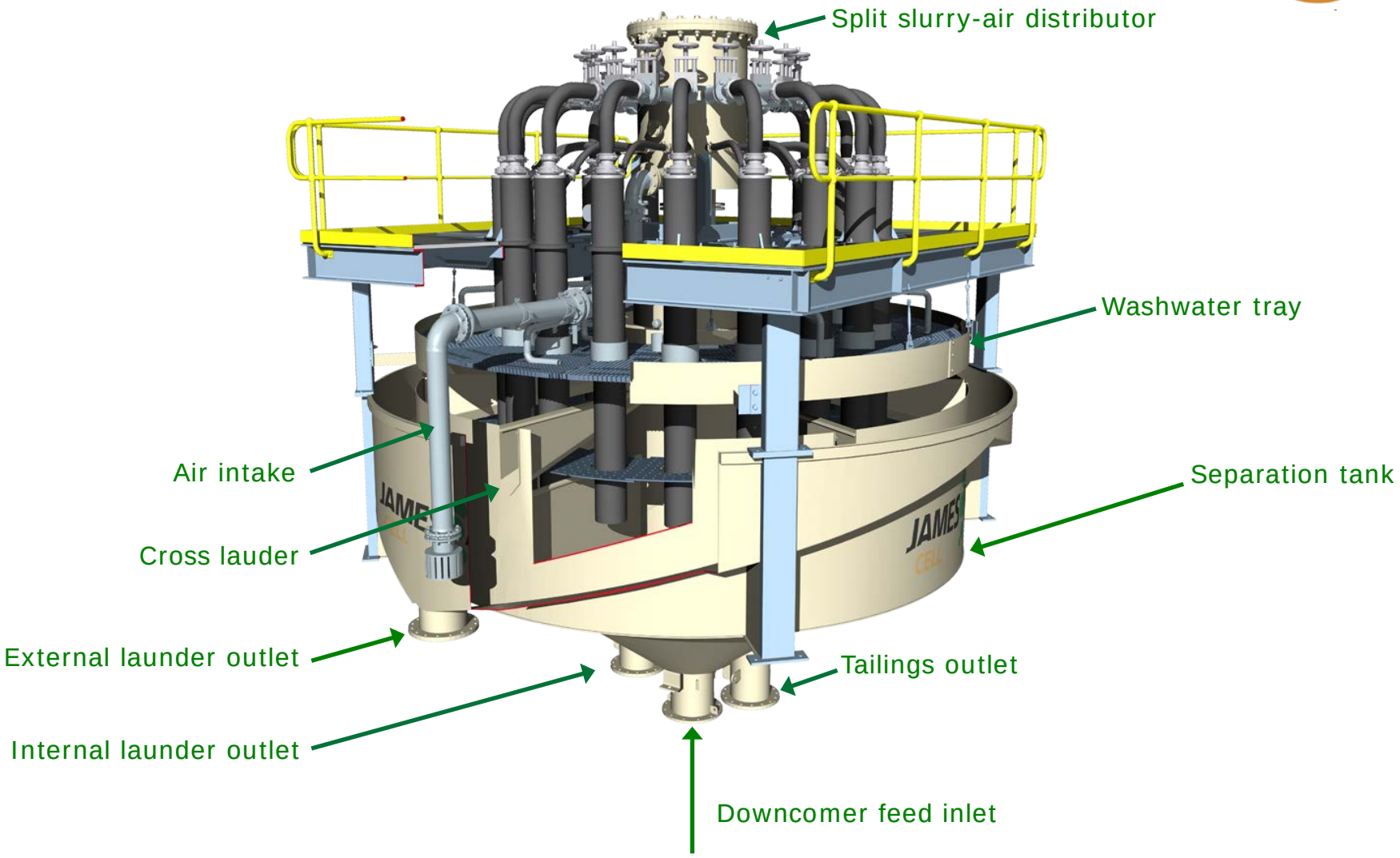


Jameson Cell

- To account for fresh feed flow fluctuations, a portion of tailings are re-circulated
- Downcomer always operates at constant feed pressure and flow rate which provides consistent:
  - Jet velocity
  - Air entrainment
  - Mixing intensity

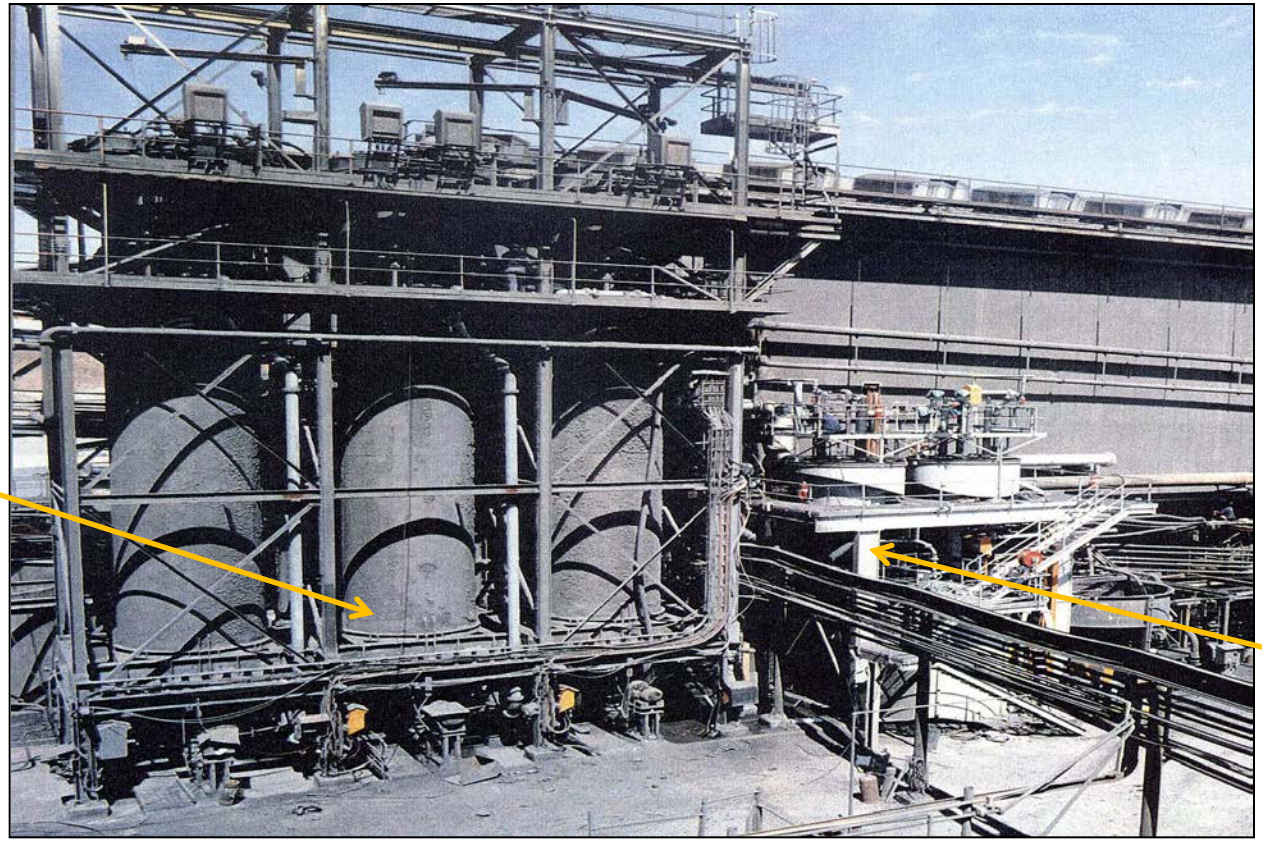


Jameson Cell



Jameson Cell Operation

Jameson Cell



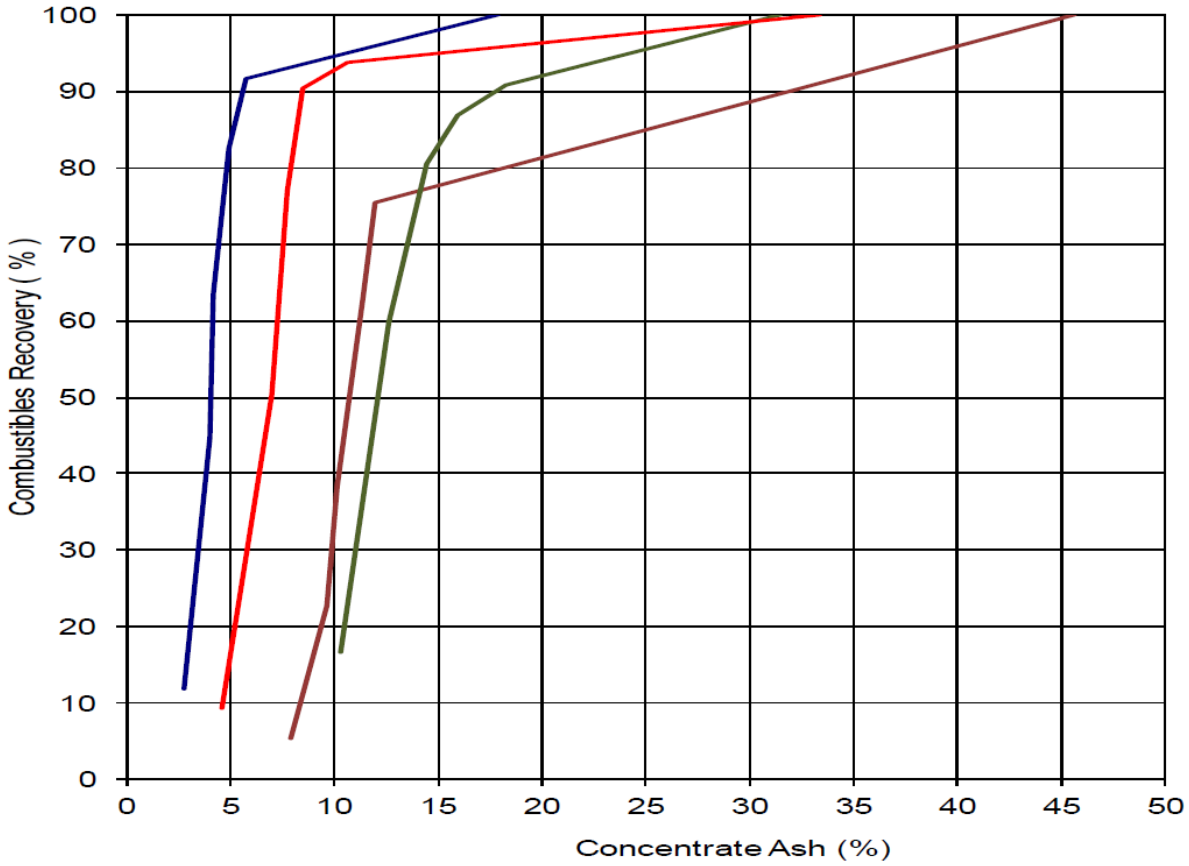
Three 2.5 m x
16 m columns

Two 1.9 m
Jameson Cells

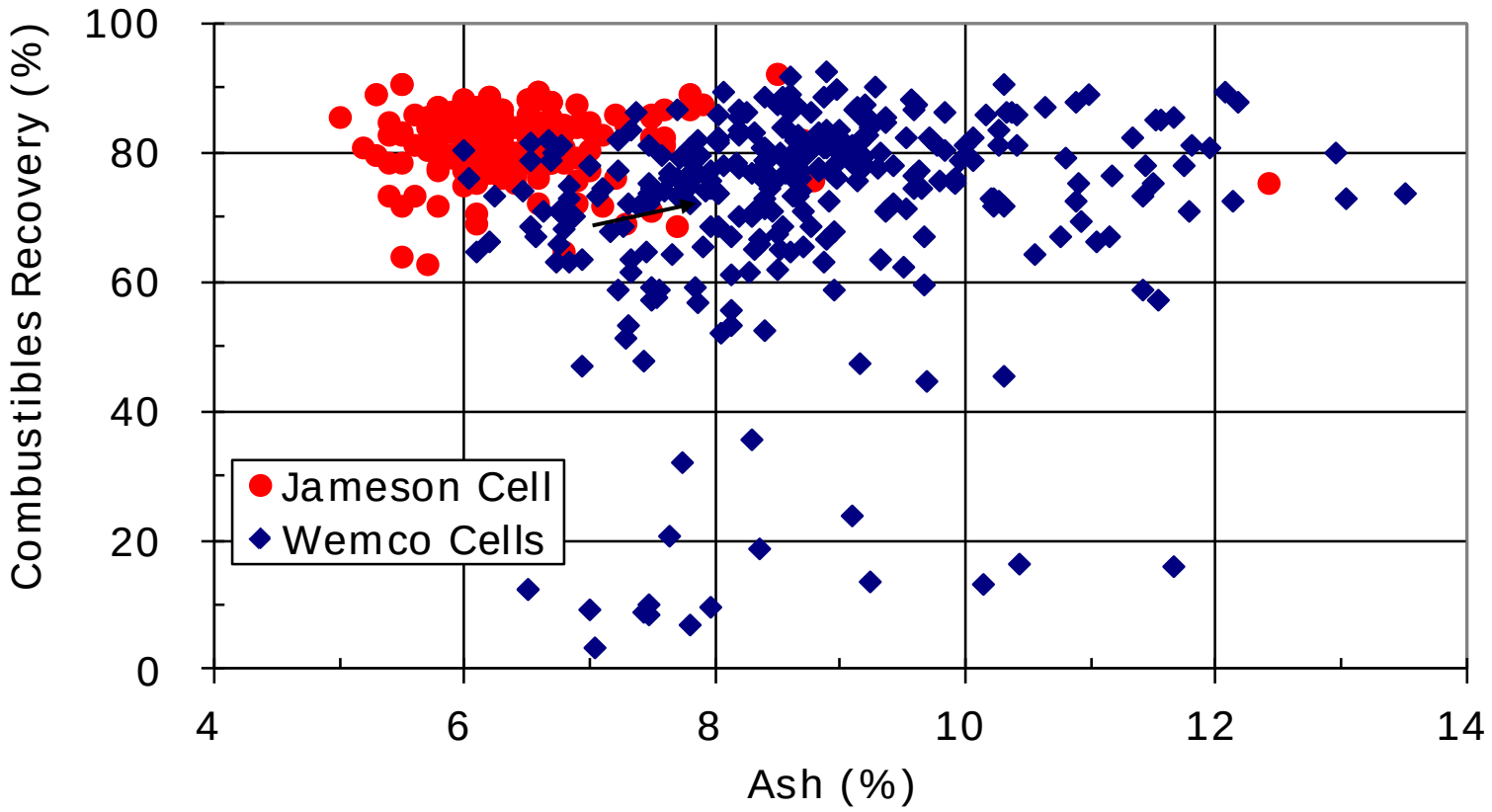
Each Jameson Cell
has the same capacity
as one column

Coal Flotation

- Need to characterize the flotation response of each coal seam: Standard tree test, release analysis or another procedure

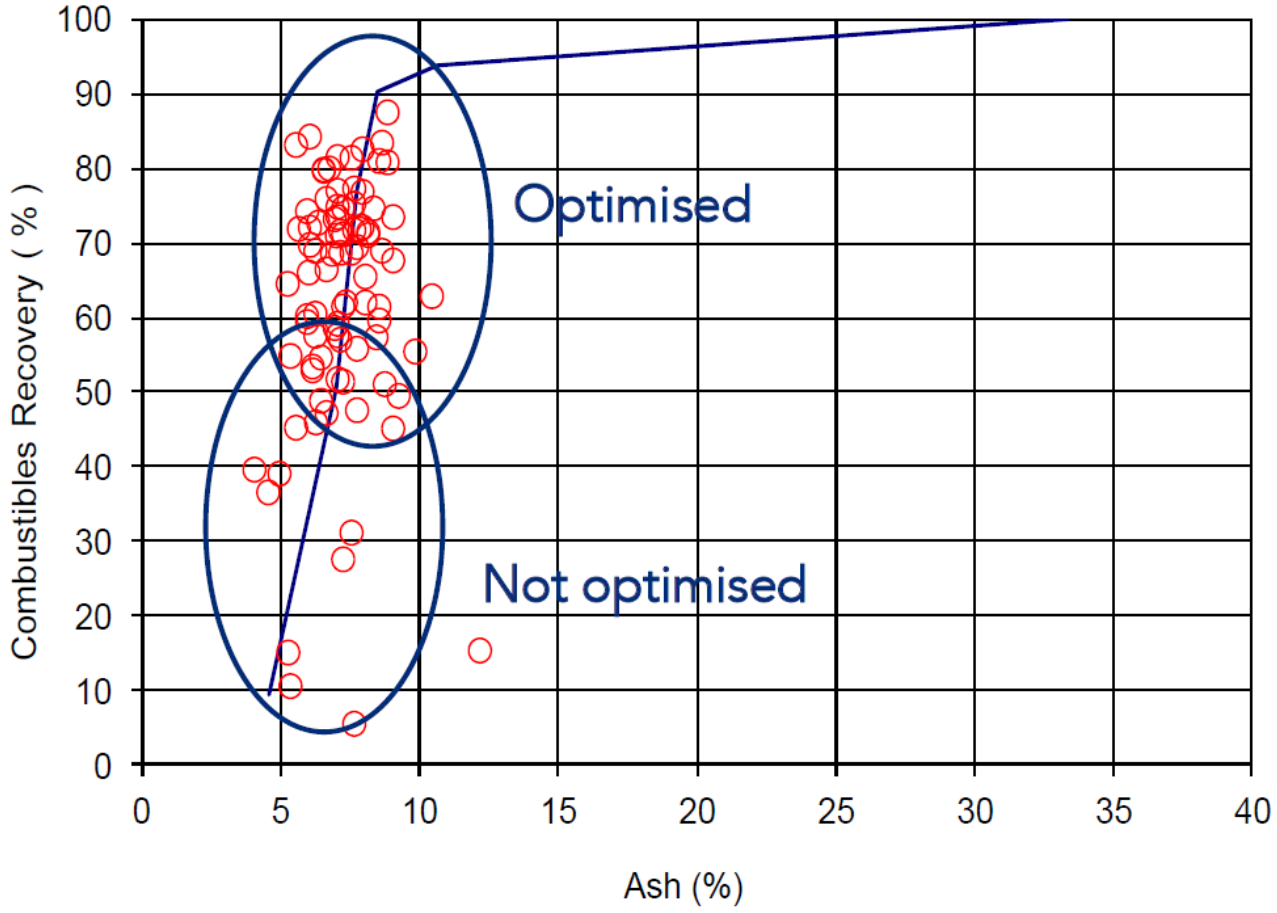


Plant Performance



Plant Performance

- Performance depend on the selected operating variables



Questions?