PNEUMATIC JIGGING OF FERRO ALLOYS - like the barbers cat?

PD Scott - Mintek 75
PHYSICAL SEPARATION – PRINCIPLES

PROPERTIES OF MATERIAL

- PARTICLES NOT MINERALS
- LIBERATION
- PARAMETER
  - Density
  - Size
Density curve showing the effect of incomplete liberation.

- \( \rho_l \) = Density of light mineral
- \( \rho_h \) = Density of heavy mineral
CHARACTERISTICS OF SEPARATOR

- TURBULENT REMIXING
- RESIDENCE TIME
- ENTRAINMENT
Partition curve for a mineral separation

Partition number
(fraction of particles with property value of \( X \) that reports to the concentrate)

Tromp area

Ideal separation

Typical partition curve for a mineral separation

Property \( X \)
GRADE VS RECOVERY

Typical grade–recovery curve
Forces acting on a particle as it settles through a fluid

\begin{align*}
F_b & = \text{Gravitational force} \\
& = Mg = Vg \rho_g \\
F_b & = \text{Buoyancy force} \\
& = V \rho_f g \\
F_d & = \text{Hydrodynamic drag force on the particle as it moves through the fluid.} \\
\text{If the particle is spherical,} \\
(a) \quad & \text{under conditions of laminar flow,} \\
F_d & = \frac{1}{2} C_d \pi d^2 v^2 \\
(b) \quad & \text{under conditions of fully developed turbulent flow,} \\
F_d & = \frac{1}{8} C_d \pi d^2 v^2 \\
\end{align*}

where \( M, V, \rho_p, d \) are respectively the mass, volume, density, and size (diameter) of the particle, \\
\( \rho_f, \eta \) are respectively the density and viscosity of the fluid, \\
\( f_0 \) is the experimentally determined drag coefficient, and \\
g is the gravitational constant.
### Capacities of gravity concentrators

<table>
<thead>
<tr>
<th>Type of concentrator</th>
<th>Typical maximum capacity, t/h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dense-medium separator</strong></td>
<td></td>
</tr>
<tr>
<td>Tank or drum vessel</td>
<td>500*</td>
</tr>
<tr>
<td>Dyna Whirlpool</td>
<td>100</td>
</tr>
<tr>
<td><strong>Stratification separator</strong></td>
<td></td>
</tr>
<tr>
<td>Jig</td>
<td>200*</td>
</tr>
<tr>
<td>Pinched sluice</td>
<td>4</td>
</tr>
<tr>
<td>Reichert cone</td>
<td>90</td>
</tr>
<tr>
<td>Spiral</td>
<td>5</td>
</tr>
<tr>
<td><strong>Thin-film concentrator</strong></td>
<td></td>
</tr>
<tr>
<td>Shaking table</td>
<td>2.5</td>
</tr>
<tr>
<td>Bartles–Mozley table</td>
<td>2.5</td>
</tr>
</tbody>
</table>

* The capacities of these devices are highly variable and depend very strongly on the size and nature of the material treated, and on the geometry and operating conditions of the separator.
SETTLING RATES

- LARGE > SMALL PARTICLES
- DENSITY –
- SHAPE
- SOLIDS CONCENTRATION/MEDIA DENSITY
- HETEROGENEITY – DIFFERENT CUT SIZE

\[ v_\infty = k_2 \left[ d \left( \rho_s - \rho_f \right) \right]^{0.5} \]
JIG SCHEMATIC

• Float
• Gate
• Air Intake
• Water level
• Media Density
MINERAL JIGS
MINERAL JIGS

a) End view

- Water level
- Perforated bed support
- Mechanical plunger or pulsating air supply causes water level to rise and fall

b) Side view of the bed

- Splitting gate
- Light particles
- Heavy particles
- Small heavy particles forming the 'hutch' product

The mineral jig
JIG SIZE

- CAPACITY – WIDTH 60t/h = 1m
- LENGTH – RESIDENCE TIME
VALVE ANIMATION
BATCH JIG
JIGSCAN

- WATER LEVEL
- PULSE VELOCITY
- BED DENSITY – NUCLEONIC
- MODEL BASED GATE CONTROL
BLOCK FLOW DIAGRAM

Dump reclamation & hauling <400mm
Primary crushing <100mm
Primary screening 25 x 80mm
Secondary crushing <25mm
Wet screening
Coarse jig 6 x 25mm
Fines jig 0.15 x 6mm
Water treatment
1. S/Mn metal products
2. Slag tailings (Aggregates)
3. 0.15 x 6mm
4. 9 x 0.15mm
5. 6 x 25mm
PLANT ANIMATION
PLANT ANIMATION
Partition Curve - Destoning

Partition Factor

Density (kg/l)

Ep = 0.0275
# COAL PERFORMANCE

**Table 1: Coarse coal measured performance**

<table>
<thead>
<tr>
<th>COARSE</th>
<th>FEED</th>
<th>CLEAN COAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t/h/m</td>
<td>Ash%</td>
</tr>
<tr>
<td><strong>FCB Washery:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-75mm Aus. (TC)</td>
<td>40-48</td>
<td>130</td>
</tr>
<tr>
<td>0,5-75mm</td>
<td></td>
<td>110</td>
</tr>
<tr>
<td><strong>APIC Pilot:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-40mm India (27%CA)</td>
<td>47.1</td>
<td>20</td>
</tr>
<tr>
<td>6-40mm RSA (Am on A1)</td>
<td>38.5</td>
<td>20</td>
</tr>
<tr>
<td>6-40mm RSA (Am on A1)</td>
<td>38.8</td>
<td>16.7</td>
</tr>
<tr>
<td>1-40mm RSA (SA on A8)</td>
<td>29.1</td>
<td>27</td>
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</tbody>
</table>

**Table 2: Fine coal measured performance**

<table>
<thead>
<tr>
<th>FINES</th>
<th>FEED</th>
<th>CLEAN COAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t/h/m</td>
<td>Ash%</td>
</tr>
<tr>
<td><strong>FCB Washeries:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-13mm Aus (TC)</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>0.5-2mm</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>0.3-8mm USA (CI)</td>
<td>(13)</td>
<td>75</td>
</tr>
<tr>
<td>0.5-16mm Ger. (SBW)</td>
<td>30.6</td>
<td>63</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

- The APIC Jig and JIGSCAN Controller take the guesswork out of Jigging, Grant Loveday, Andrew Jonkers
- Atoll, Private Communications