AMCOL’s Business

- US-listed (NYSE:ACO); Incorporated in 1927.
  - Global leader in bentonite performance application products and services
    - Industrial and consumer end markets
    - Innovation and market driven development pipeline; Over 100 patents in force.
  - Global bentonite mining operations.
- Responsible corporate citizen (we understand our role in the community)
AMCOL’S Business Segments

- Metalcasting
- Minerals
- Specialty Minerals
- Coatings
- Cosmetics
- Nanocomposites
- Wine & Juice Clarification
- Speciality Minerals
- Laundry Detergent
- Oil & Gas Drilling
- Green Sand
AMCOL Trading Companies

28 Operating Companies

AMCOL Minerals Europe Ltd
AMCOL Specialty Minerals
AMCOL Detergent Specialties
Health & Beauty Solutions
AMERICAN COLLOID COMPANY
Nanocor
Amerifo Carriers
CETCO OILFIELD SERVICES COMPANY
GREEN SAND
AMCOL’S Global Locations

Globally Local
AMCOL’S Metal Casting Products Group

- MPG’s Mission -:
  - Technology with Experience
  - Provide the best product on time every time
  - Provide the best on site technical support
  - Provide the most cost effect performance rate
  - Help you produce the best casting results in your plant
**MPG’s Products**

- **Volclay** - Where high thermal performance counts
- **Maxibond** - Tailored bentonite blends for your castings
- **Econobond** - Perfect for less demanding applications
- **Maxicarb** - Bentonite and carbon raisers do it safely
Some MPG Customers

Ford, GM, Toyota, Daimler, Chrysler, Honda, John Deere, Tyco, Aisin, Nws Brakes, Thysen Krupp, Waupaca, I+F Teksid, Cherry, Hyundai
Bentonite

WHAT HAPPENS TO IT?

HOW MUCH IS USED?

WHY?
What Happens to the Sand

Schematic of Disamatic Moulding Line

0.5cm Exceeds 800°C (923cm³ of sand)

1.5cm exceeds 650°C (3086cm³ of sand)

2.5cm (250°C & 650°C) (5705cm³ of sand)

Untouched Moulding Sand – 25°C

Condensate Layer
Heat Abstraction into Moulding Sand

Fig. 10. Thermal curves for test mold 10, gray iron.

SAND MIXTURE

Percent by weight
94.0 SILICA SAND, AFS GFN 62
6.0 200 MESH WESTERN BENTONITE
2.70 MOISTURE

Green Compression Strength: 9.8 psi (0.689 kg/cm²)
Dry Compression Strength: 128.0 psi (9.1 kg/cm²)
Green Permeability: 112
Mold Hardness: 80-85

CASTING DATA

Metal: Gray Iron
Furnace Temperature: 2850°F (1566°C)
Pouring Temperature: 2750°F (1510°C)
Casting: 6.65" (16.9 cm) Diameter Sphere
Weight: 40 Pounds (18.1 kg)

Oven dried at 250°F - 300°F (121°C - 149°C) for 8 hours.
Heat Abstraction into Moulding Sand

Test Mold 18

SAND MIXTURE
Percent by weight:
- 94.0 SILICA SAND, AFS GFN 62
- 6.0 200 MESH WESTERN BENTONITE
- 3.0 MOISTURE

CASTING DATA
Metal: Steel (1020)
Furnace Temperature: 3100°F (1704°C)
Pouring Temperature: 3000°F (1649°C)
Casting: 6.65" (16.9 cm) Diameter Sphere
Weight: 42.5 Pounds (19.3 kg)

Green Compression Strength: 9.2 psi (.647 kg/cm²)
Green Permeability: 109
Mold Hardness: 80-85
Natural Sodium Bentonite has a higher fusion point at 600-700 C
Indian Bentonite has lower fusion point at 400-500 C
What we know then, is that there is a danger that the bentonite collapses, at the moment of maximum mould stress, as the sand expands.
Bentonites

- We can also conclude that due to the cooling effect of evaporation the mould face temperature will not exceed 1200°C, therefore a solid skin should form.

- If therefore we can instantly create a solidified skin which is not washed away as we fill the mould, within a time frame that avoids the onset of instability of the mould face, through expansion and degradation.

- Then defects should reduce as mould face stability improves.

- LESS of High Quality Materials is better than more of poor quality materials if we can keep them cool.
There are many papers about wet tensile, but what is very clear is that contaminants in the sand and over activation can have a devastating effect on wet tensile.
• These contaminants reduce the gel strength by introducing anions into the dipoids disrupting the attraction between platelets.

• They also reduce the surface tension as does soda ash and as heat dries the clay, it allows premature rupture of the gel skin and speeds moisture loss.

• This can lead to premature overheating and degradation of the clay.
What happens to the Sand

Schematic of Disamatic Moulding Line

0.5 cm Exceeds 800°C (923 cm³ of sand)

2.5 cm (250°C & 650°C) (5705 cm³ of sand)

1.5 cm Exceeds 650°C (3086 cm³ of sand)

Untouched Moulding Sand – 25°C

Condensate Layer

GREEN SAND Technology with experience
Degradation of additives

See Disa schematic drawing of a flywheel. The flywheel is Ø30cm x 3.5cm thick. The flywheel weighs approx 20kg. The mould weighs approx 54kg (46cm x 42cm x 20cm). This is a demonstration based on experimental results.

- The casting is shown in yellow.
- The red and orange zones indicate areas in which additions will definitely have their properties destroyed and hence will need to be replaced. (No matter what type of addition are used.)
- The green zone may need to be replaced depending on the quality of the additions, and operating variables.
- The blue zone is a condensate layer.
- The black zone is mould that will not experience any heating effects to affect properties.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Volume (cm³)</th>
<th>Wt of additions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mould (excl casting cavity) 46 x 42 x 20</td>
<td>36,166</td>
<td>5,425g</td>
</tr>
<tr>
<td>Yellow Zone (casting)</td>
<td>2,474</td>
<td>N/A</td>
</tr>
<tr>
<td>Red Zone</td>
<td>923</td>
<td>138g</td>
</tr>
<tr>
<td>Orange Zone</td>
<td>3,086</td>
<td>463g</td>
</tr>
<tr>
<td>Green Zone</td>
<td>5,785</td>
<td>868g</td>
</tr>
</tbody>
</table>
Bentonite Burn-out Volume against Temperature and Distance From Casting

27% Increase in usage

Which means if you are using a bentonite with Fusion point 550°C then with Blended Bentonite of 625°C fusion point your usage will reduce by 27%
Which means if you are using a bentonite with Fusion point 475°C then with Blended Bentonite of 610°C fusion point your usage will reduce by 52%.
What can we Conclude

• Because of Silica sand’s expansion characteristics.

• Time, Temperature, Turbulence, and Bentonite quality, can lead to mould face instability.

• Therefore everything which reduces the amount of non refractory materials in the sand and keeps the mould cooler during filling is desirable.
What can we Conclude

• The use of bentonite with better hydration and water retention properties slows evaporation extending the cooling period during mould filling.

• The use of bentonite which can hold its crystal water above the silica phase change temperature and is not fluxed at mould face temperatures, should improve mould face stability.

• Using less material means there is less to burn out

LESS IS BEST
What can we Conclude

• By blending bentonites you can also enhance their green properties and the bond development rate, without increasing dry strength or having a detrimental effect on the handling characteristics.

• Using less material means there is less to burn out.

LESS IS BEST
Thank you