THE APPLICATION OF DRY SEPARATION TECHNOLOGY IN THE UNITED STATES

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What is Dry Coal Processing?
A Coal Preparation Process that uses air instead of water to remove unwanted material from coal!
Coal Deshaling Concept

Coal Operation -> ROM Coal -> Dry Coal Cleaner -> Processing Plant -> Haulage

High-Density Rock
Applications

- Removing excess ash from ROM coal.
- Pit cleaning/rib coal recovery.
- Gob pile processing.
- Deshaling of metallurgical coal.
- Pyrite removal from high sulfur coal.
- On site processing of High Wall Miner coal.
- Coal prep in regions with water scarcity.
- Processing of low-rank coal, e.g. lignite.
- Destoning of coal in utilities and cement plants.
Who is FGX SepTech LLC?

- Lexington, KY based subsidiary of TSM MFG
- The United States sales and service arm of the world's leader in dry coal processing with over 2,000 units sold.
Results of Expanded FGX-1 Cleaning Performance Evaluation: Performed by Southern Illinois University in conjunction with Illinois Clean Coal Institute.

<table>
<thead>
<tr>
<th>Ash %</th>
<th>Total Sulfur %</th>
<th>Yield %</th>
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</thead>
<tbody>
<tr>
<td>Feed</td>
<td>Product</td>
<td>Middlings</td>
</tr>
<tr>
<td>29.05</td>
<td>16.91</td>
<td>56.03</td>
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<tr>
<td>42.88</td>
<td>17.65</td>
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<td>40.06</td>
<td>15.24</td>
<td>51.88</td>
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<td>42.36</td>
<td>16.33</td>
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<tr>
<td>30.84</td>
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<td>28.23</td>
<td>15.49</td>
<td>47.61</td>
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<td>34.45</td>
<td>13.48</td>
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<td>36.79</td>
<td>27.12</td>
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<td>33.16</td>
<td>21.56</td>
<td>81.14</td>
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<tbody>
<tr>
<td>Feed</td>
<td>Product</td>
<td>Middlings</td>
</tr>
<tr>
<td>25.94</td>
<td>19.37</td>
<td>27.91</td>
</tr>
<tr>
<td>36.48</td>
<td>12.95</td>
<td>16.15</td>
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</table>
A preliminary economic analysis based on the technical data generated during this study and the installation and operating experience of a newly installed full-scale FGX Dry Separator in the US estimates total capital, installation, and operating costs for cleaning Illinois coal using the FGX Dry Separator to be $0.91/ton of raw coal and $1.56/ton of clean coal.

The operating cost alone is estimated to be $0.69/ton of raw coal and $1.19/ton of clean coal.
CASE STUDY
EAGLE RIVER COAL
HARRISBURG, ILLINOIS, UNITED STATES
“The FGX plant has worked great for us for the past 4 years. The plant does an excellent job removing ash and sulfur from our raw feed. We see 15% - 18% ash reduced to 8% - 9% ash on our clean product, with sulfur reduction around 1.5%. We are extremely pleased with the performance of our FGX 24A plant and the support we get from the FGX crew.”

-Joey Pilcher, Eagle River Coal Co.
CASE STUDY
EAGLE RIVER COAL
HARRISBURG, ILLINOIS, UNITED STATES

1. **Type of Coal:** Bituminous
2. **Application:** Thermal & Industrial
3. **Tons Per Annum Processed:** 900,000
4. **FGX Plant:** FGX-24A, 240 Tons Per Hour
5. **Date Commissioned:** August 2011
CASE STUDY (CONT’D)
EAGLE RIVER COAL
HARRISBURG, ILLINOIS, UNITED STATES

Typical Analysis Run of Mine
- Ash 16%
- Sulfur 6%
- BTU 11,300

Post Processed Analysis (Average)
- Ash 8%
- Sulfur 4%
- BTU 12,500

50% Reduction
33% Reduction
10%+ INCREASE
EAGLE RIVER COAL
HARRISBURG, ILLINOIS, UNITED STATES

**Economic Benefit Per Ton**

*Ash: $0.10 per every 1% of reduction = $0.80 p/ton*

*Sulfur: $0.10 per every .1% of reduction = $2.00 p/ton*

*BTU’s: $0.25 per every 100 BTU increase = $3.00 p/ton*

**Sales Price Beneficiation:**

900,000 Tons per Annum

\[ \times 5.80 \text{ per Ton} \]

\[ \$5,220,000 \text{ per Annum} \]

*premium/penalty based on average US Thermal coal contract*
CASE STUDY (CONT’D)
EAGLE RIVER COAL
HARRISBURG, ILLINOIS, UNITED STATES

Net Economic Benefit

Additional Revenue from Beneficiation per Annum  $5,220,000
Operating and Maintenance Cost per Annum      -  $900,000
NET GAIN                                         $4,320,000
CASE STUDY
SUN ENERGY GROUP
HOLLAND, INDIANA, UNITED STATES
CASE STUDY:
Sun Energy Group
HOLLAND, IN

“This plant has allowed us to sell more coal by the 15th of our first operating month than we have in previous complete months.”
- Bobby Childress, Sun Energy Group
CASE STUDY
SUN ENERGY GROUP
HOLLAND, INDIANA, UNITED STATES

- **Type of Coal:** Bituminous
- **Application:** Thermal
- **Tons Per Annum Processed:** 300,000
- **FGX Plant:** FGX-12, 120 Tons Per Hour
- **Date Commissioned:** June 2015
CASE STUDY (CONT’D)
SUN ENERGY GROUP
HOLLAND, INDIANA, UNITED STATES

**Typical Analysis Run of Mine**
- Ash 19%
- Sulfur 7%
- Mercury 3 ppm
- BTU 11,100

**Post Processed Analysis (Average)**
- Ash 10%  **50% Reduction**
- Sulfur 4%  **33% Reduction**
- Mercury <1 ppm  **67% Reduction**
- BTU 11,800  **6%+ INCREASE**
CASE STUDY (CONT’D)

SUN ENERGY GROUP
HOLLAND, INDIANA, UNITED STATES

**Economic Benefit Per Ton**

*Ash: $0.10 per every 1% of reduction = $0.90 p/ton
*Sulfur: $0.10 per every .1% of reduction = $3.00 p/ton
*Mercury: Priceless!
*BTU’s: $0.25 per every 100 BTU increase = $1.75 p/ton

**Sales Price Beneficiation:**

300,000 Tons per Annum

\[
x \times 5.65 = 1,695,000 \text{ per Annum}
\]

*premium/penalty based on average US Thermal coal contract*
CASE STUDY (CONT’D)
SUN ENERGY GROUP
HOLLAND, INDIANA, UNITED STATES

**Net Economic Benefit**

Additional Revenue from Beneficiation per Annum $1,695,000

Operating and Maintenance Cost per Annum - $300,000

NET GAIN $1,395,000

*This coal would be unmarketable at a 19% ash and 3 ppm mercury to most customers in the US thermal coal market!*
CASE STUDY
SHANDUKA COAL
MIDDELKRAAL COLLIERY
MPUMALANGA COALFIELD, SOUTH AFRICA

• “The technology provides a cost-effective solution for upgrading low ranking coal through deshaling. No water is used in the process and subsequently no slurry or polluted water is produced.”
  – Johan Cowan, Processing Manager for Genet Mineral Processing, who developed and commissioned the plant at Middelkraal.

“Dry Coal Processing Reaping the Rewards,” Mining Mirror Magazine, 1/2/2013
“In May 2012, the air plant achieved a remarkable production target of 400,000 tonnes”

– Zirk van der Bank, Chief Operating Officer, Shanduka Coal

“Dry Coal Processing Reaping the Rewards,” Mining Mirror Magazine, 1/2/2013
CASE STUDY (CONT’D)

SHANDUKA COAL
MIDDELKRAAL COLLIERY
MPUMALANGA COALFIELD, SOUTH AFRICA

- **Type of Coal:** Bituminous
- **Application:** Thermal
- **Tons Per Annum Processed:** 4,500,000
- **FGX Plant:** FGX-48A, 480 Tons Per Hour
- **Date Commissioned:** 2010
CASE STUDY (CONT’D)
SHANDUKA COAL
MIDDELKRAAL COLLIERY
MPUMALANGA COALFIELD, SOUTH AFRICA

Typical Analysis Run of Mine
Ash 60%+

Post Processed Analysis (Average)
Ash 35%

50% Reduction
or
168,000 Tons per Month of Reject Material
CASE STUDY (CONT’D)
SHANDUKA COAL
MIDDELKRAAL COLLIERY
MPUMALANGA COALFIELD, SOUTH AFRICA

**Economic Benefit**

**FGX vs DMS (Conventional)**

<table>
<thead>
<tr>
<th>Description</th>
<th>FGX SepTech, LLC</th>
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<tbody>
<tr>
<td>Tons Processed per Annum:</td>
<td>4,800,000 Tons</td>
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<tr>
<td>FGX Processing Costs (per manager):</td>
<td>x $0.70</td>
</tr>
<tr>
<td>Total Operating and Maintenance</td>
<td>$3,360,000</td>
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<tr>
<td>Tons Processed per Annum:</td>
<td>4,800,000 Tons</td>
</tr>
<tr>
<td>DMS Processing (Assumes $4 per Ton):</td>
<td>x $4</td>
</tr>
<tr>
<td></td>
<td>$19,200,000</td>
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</table>
CASE STUDY (CONT’D)

SHANDUKA COAL
MIDDELKRAAL COLLIER
MPUMALANGA COALFIELD, SOUTH AFRICA

FGX SepTech vs Dense Media Separation

Net Savings

Dense Media Processing Cost $19,200,000
FGX Dry Coal Separating Cost - $3,360,000

NET SAVINGS $15,840,000 per annum (est)
Cowan states that the FGX-48A operated on a 7 day per week, 22 hour per day basis with the operator performing an 8 hour preventative maintenance shift every Wednesday. He states that the plant achieved an availability of **97%**!
“Cowan believes that dry processing technology such as air separation will become a viable processing technology for the Waterberg coalfield in the future, because of its water scarcity.”

“Dry Coal Processing Reaping the Rewards,” Mining Mirror Magazine, 1/2/2013

“...It is a low-cost dry process with easy operation and low maintenance. It is environmentally friendly and able to remove pyretic sulphur in high-sulphur coal,” he concludes.
DEVELOPMENT OF AN ADVANCED DESHALING TECHNOLOGY TO IMPROVE THE ENERGY EFFICIENCY OF COAL HANDLING, PROCESSING, AND UTILIZATION OPERATIONS

U. S. Department of Energy
Industrial Technologies Program, Mining of the Future ID Number: DE-FC26-05NT42501

Applicant: University of Kentucky Research Foundation Principal Investigator: Rick Q. Honaker
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Phone: (859) 257-1108; Fax: (859) 323-1962; e-mail: rhonaker@engr.uky.edu

Co-Principal Investigator: Gerald H. Luttrell Department of Mining & Minerals Engineering, Virginia Tech
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Project Team

University of Kentucky Virginia Tech
THANK YOU

www.fgxseptech.com