Comprehensive Re-utilization of Particle Pollutants from FCC Unit

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Content

1. Introduction of particle pollutants from FCC Unit

2. Forming reason of particle pollutants from FCC Unit

3. Classify of particle pollutants from FCC Unit

4. Different solid waste treatment technologies of particle pollutants from FCC Unit
The fluid catalytic cracking unit could use about **1.2 million tons** of catalytic cracking catalyst all over the world. In the process of production will produce more than **1 million tons** of spent catalyst. Most of the spent catalyst will be buried for no use value.
Hazard of particle pollution from FCC Unit

The particle in air can cause haze and other air pollution.  
The heavy metal cause serious pollution to the groundwater and soil.  

All this is a waste of natural resource.  
We need to make the fullest use of these resources.
2. Forming reason of particle pollutants from FCC Unit

1. High temperature or steam in high temperature

2. Coking

3. Metal poisoning

4. Mechanical friction
3. Classify of particle pollutants from FCC Unit

Application value

1. FCC catalyst has better performance
   \[ S_{\text{BET}} \geq 100 \text{m}^2/\text{g}, \quad \text{Activity} \geq 60\%, \quad \text{metal content} \leq 20000 \text{ppm} \]

2. The other useless pollutants
   \[ \text{Others except for above}, \quad \text{The flue gas desulfurization sludge} \]
3. Classify of particle pollutants from FCC Unit

How?

\[ S_{\text{BET}} \]

Activity

Analysis and determination platform
3. Classify of particle pollutants from FCC Unit

- Some metals (like Fe, Ni) has magnetism
- More metals, larger magnetism
- Particle pollutants with metal contents \( \geq 20000 \text{ppm} \) could be separated in some voltage

How? Magnetic separation

- More metal
- Less metal

Diagram:
- Entrance
- Magnetic disk
- Rubber wheel
- Exit
4. Different solid waste treatment technologies of particle pollutants from FCC Unit

1. FCC equilibrium catalyst rejuvenation technology  
   - FCC catalyst has better performance

2. Elements separation technology  
   - The other useless pollutants
Method: organic and inorganic coupling

Properties of product:
- Lower cost
- Specific selectivity
- High activity

Industrial application: 2009 in China
FCC equilibrium catalyst rejuvenation technology

Fresh catalyst → Deactivated catalyst → Regenerated catalyst → Rejuvenated catalyst
FCC equilibrium catalyst rejuvenation technology

Principle of rejuvenation

The raw material → Agent → The Rejuvenated Reaction → Filtering And Washing → Air drying → Rejuvenated catalyst
The comparison of catalyst properties before and after rejuvenation

<table>
<thead>
<tr>
<th>Item</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface area (m²/g)</td>
<td>92</td>
<td>173</td>
</tr>
<tr>
<td>Micro Activity % (m/m)</td>
<td>66</td>
<td>78</td>
</tr>
<tr>
<td>Pore size (ml/g)</td>
<td>0.14</td>
<td>0.23</td>
</tr>
<tr>
<td>Metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe (m%)</td>
<td>0.53</td>
<td>0.35</td>
</tr>
<tr>
<td>Ni (m%)</td>
<td>0.59</td>
<td>0.63</td>
</tr>
<tr>
<td>V (m%)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Na (m%)</td>
<td>0.30</td>
<td>0.21</td>
</tr>
<tr>
<td>Attrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-20 (µm)</td>
<td>1.32</td>
<td>0.61</td>
</tr>
<tr>
<td>20-40 (µm)</td>
<td>7.89</td>
<td>7.63</td>
</tr>
<tr>
<td>40-60 (µm)</td>
<td>24.87</td>
<td>24.11</td>
</tr>
<tr>
<td>60-80 (µm)</td>
<td>25.66</td>
<td>24.72</td>
</tr>
<tr>
<td>&gt;110 (µm)</td>
<td>15.36</td>
<td>18.69</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Catalyst</td>
<td>BASE</td>
<td>BASE 85%+ rejuvenated 15%</td>
</tr>
<tr>
<td>Processing capacity ton/day</td>
<td>4207</td>
<td>4196</td>
</tr>
<tr>
<td>Residue blending ratio %</td>
<td>57.86</td>
<td>58.01</td>
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<tr>
<td>Dry gas</td>
<td>4.16</td>
<td>4.07</td>
</tr>
<tr>
<td>LPG</td>
<td>17.41</td>
<td>16.69</td>
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<tr>
<td>Gasoline</td>
<td>35.51</td>
<td>36.09</td>
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<tr>
<td>Light diesel</td>
<td>24.19</td>
<td>24.42</td>
</tr>
<tr>
<td>Heavy diesel</td>
<td>4.82</td>
<td>4.77</td>
</tr>
<tr>
<td>Slurry</td>
<td>4.29</td>
<td>4.36</td>
</tr>
<tr>
<td>Coke</td>
<td>9.14</td>
<td>9.12</td>
</tr>
<tr>
<td>Loss</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>Gasoline + light diesel</td>
<td>59.7</td>
<td>60.51</td>
</tr>
<tr>
<td>LPG + gasoline + light diesel</td>
<td>77.11</td>
<td>77.2</td>
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</tbody>
</table>
Decomposition reaction

Chemical composition of pollutant

<table>
<thead>
<tr>
<th>Elements</th>
<th>Before treatment</th>
<th>After treatment</th>
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</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>42%</td>
<td>42%</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>48%</td>
<td>48%</td>
</tr>
<tr>
<td>RE₂O₃</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Fe、Ni、V、Ca、Na</td>
<td>(4%)</td>
<td></td>
</tr>
</tbody>
</table>

Elements separation

Page 15
Principle

Decomposition reaction

The other useless pollutants → Reacting agent → Reaction → Separation

- SiO₂ product
- Al product
- Rare earth product
- Ni product
- V and Ni product
Step 1  Separation of Si

Method  ➔ Acid-dissociation separation

Products  ➔ SiO$_2$

Quality  ➔ Purity $\geq$95%
Macroporous
Lightweight (0.4g/ml)

Application field  ➔ 1. Adsorbent
2. Support

Decomposition reaction
Step 2  Separation of Al

Method  Crystallization separation

Products  $\text{NH}_4\text{Al}(\text{SO}_4)\text{2} \cdot 12\text{H}_2\text{O}$

Quality  Industrial level of CNS

Application field
1、Purifying agent
2、Paper industry
3、Pharmaceutical industry
4、Light industry（tanning）
Step 3  Separation of RE

Method  ➔  Concentration separation

Products  ➔  RE-sodium sulfate double salt

Quality  ➔  Purity ≥95%

Application field  ➔  
1、Catalysis
2、Metallurgy
3、Ceramic
4、Textile

Decomposition reaction
Step 4  Separation of Ni

Method  ➔ Crystallization separation

Products  ➔ \((\text{NH}_4\text{)}_2\text{Ni(}\text{SO}_4\text{)}_2\cdot10\text{H}_2\text{O})\)

Quality  ➔ Purity ≥ 95%

Application field  ➔ Smelting of Ni
Step 5  Separation of other metals

Method  ➔  Alkali precipitation （still try our best for other method）

Products  ➔  Mixture of Fe、V、Ca and little Ni

Quality  ➔  Content of metals ≥50%

Application field  ➔  Steelmaking workshop and other familiar plant
Since 2006, our company invests a lot of research strength to solve the pollution problem of particle pollutants from FCC Unit. At present, we provides such services for more than a dozen units. With our help, they completely solve the pollution problem of particle pollutants from FCC Unit.
With our technology, you can completely solve the pollution problem of the particle pollutants from FCC Unit.

Q&A