BIOREMEDIATION OF SOLID WASTE

Distribution of Solid Waste in the United States

TCP Feedstocks

- **Agricultural**
  Plant or animal waste including cellulosic material; poultry, hog or cattle offal; bones; litter, grease and manure.

- **Industry**
  Tires, plastics, PCB’s, incinerator ash, paper (black liquor), metals, chemicals and petroleum products (heavy crude oil, coal, shale and tar sands, coal tars, and asphaltine residues).

- **Municipal**
  Food waste, paper, plastics and others.

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TCP End Products

Hydrocarbon Oils
High value crude oil, including light oil (naphtha) and fuel oil (#2-4), which can be sold to refineries, fuel blenders or power utilities.

Natural Gas
Fuel gas comprised of methane, propane and butane, containing sufficient BTUs to fire turbines or boilers to generate electricity or thermal energy.

Fatty Acid Oils
Carboxylic acids including palmitic, stearic and oleic, used in manufacturing of detergents and soaps, cleaners, stabilizers, lubricants, pharmaceuticals, personal care products, and rubber products among others.

Carbon
For use as a filter (wastewater cleanup), fuel source (substitute coal) or high-value organic fertilizer.

Minerals
For use as a high-value fertilizer to rebalance macronutrients and replace depleted micronutrients in the soil.

<table>
<thead>
<tr>
<th>Oil By-Product</th>
<th>End Product</th>
<th>Uses</th>
<th>Typical Output - Crude Oil (approx. % per barrel)</th>
<th>Typical Output - TCP (approx. % per barrel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquefied Petroleum Gas (LPG)</td>
<td>Ethane Propane Butane</td>
<td>Heating, cooking Chemical feedstocks Motor gasoline Blending</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Light Ends Naphthas Gasolines</td>
<td></td>
<td>Petrochemical feedstocks Reforming into gasoline Automotive oil</td>
<td>35%</td>
<td>60%</td>
</tr>
<tr>
<td>Middle Distillates Jet Kerosene Diesel Heating/Gasoil Vacuum/Gasoil</td>
<td></td>
<td>Aviation fuel Automotive fuel Domestic heating fuel Distilled to lighter product</td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>Residual Fuel Oil Cracked Fuel Oil Straight-Run Fuel Oil Asphalt Bitumens Coke Sulfur</td>
<td></td>
<td>Power generation Ship fuel Fuel oil Road surfacing Roofing Manufacturing of steel Chemical industry</td>
<td>20%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Other applications under testing
- Coal
- Decanted oil slurry
- Sewage sludge
- Coal fines
- Vacuum residuals
- Tires
- Drilling muds
- Infectious medical waste
- Plastics

Potential Annual Fuel Oil Output
- Agriculture 4 billion barrels of oil
- Industry 1.3 billion barrels of oil
- Municipal 569 million barrels of oil

World Fatty Acid Demand
Approximately 2.75 million tons/year
Rate of Growth 2.2% - 2.5% per year