BP Whiting Refinery Expansion:

Developing Wastewater Cleanup Options

Midterm Presentation
IPRO 346 Objectives

- To understand the regulatory, social, environmental, and technical aspects of the planned upgrade to BP’s Whiting refinery
- To find alternatives to the wastewater cleanup issue that has been the source of controversy
- To explore and evaluate (preferably using HYSYS or any other simulation software) technical options.
Flow Diagram of Typical Refinery

- Finished products are shown in blue.
- Many refineries also include vacuum residuum crackers.
- The "other gases" entering the gas processing unit includes all the gas streams from the various process units.
Water Quality Standards

- **Tier 1** maintains and protects existing uses and water quality conditions necessary to support such uses.

- **Tier 2** maintain and protect “high quality” waters -- water bodies where existing conditions are better than necessary to support CWA § 101(a)(2) "fishable/swimmable" uses.

- **Tier 3** maintain and protect water quality in Outstanding State Resource Waters (OSRW).

- BP Whiting Refinery Falls in **Tier 2** and **Tier 3**.
Mixing Zone

EPA has been pushing to eliminate mixing zones that include bioaccumulative chemicals, such as mercury. The BP permit does not allow a mixing zone for mercury. The mixing zone authorized in the BP permit applies to TTS and ammonia, and federal and state law authorizes mixing zones for these parameters.

Alternative Mixing Zone

IDEM is proposing to allow a discharge induced mixing zone through a diffuser in Lake Michigan which produces a mixing volume of lake water that is 37.1 times greater than the discharge volume of 21.4 million gallons per day from Outfall 001.

The alternate mixing zone will encompass a 182 feet radius from the diffuser.
Mercury Limitations

- BP is allowed to pour small amounts of toxic metal into Lake Michigan till 2012
- Federal records analyzed by the Tribune show BP puts 2 pounds of mercury into the lake every year from the Whiting Refinery
- Under standards adopted by EPA in 1995, BP’s annual discharge of the metal should be reduced to 8/100th of a pound
### Proposed BP Permit Limits Monthly Average

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Current (lbs/day)</th>
<th>Draft/Proposed (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>4,161</td>
<td>4,161</td>
</tr>
<tr>
<td>COD</td>
<td>30,323</td>
<td>30,323</td>
</tr>
<tr>
<td>O&amp;G</td>
<td>1,368</td>
<td>1,368</td>
</tr>
<tr>
<td>Phenolics</td>
<td>20.33</td>
<td>20.33</td>
</tr>
<tr>
<td>Sulfide</td>
<td>23.1</td>
<td>23.1</td>
</tr>
<tr>
<td>Total Chromium</td>
<td>23.9</td>
<td>23.9</td>
</tr>
<tr>
<td>Hex Chrom</td>
<td>2.01</td>
<td>2.01</td>
</tr>
<tr>
<td>TSS</td>
<td>3,646</td>
<td>4,925</td>
</tr>
<tr>
<td>Ammonia</td>
<td>1,030</td>
<td>1,584</td>
</tr>
</tbody>
</table>
# Emission Comparison

<table>
<thead>
<tr>
<th>Plant Location</th>
<th>Total Suspended Solids, pounds per day monthly average</th>
<th>Ammonia, pounds per day monthly average</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP Refinery - Whiting</td>
<td>4,925</td>
<td>1,584</td>
<td></td>
</tr>
<tr>
<td>Chicago - Stickney Plant*</td>
<td>144,115</td>
<td>60,048 summer 96,077 winter</td>
<td>* One of seven plants</td>
</tr>
<tr>
<td>Racine, WI</td>
<td>9,007</td>
<td>No Limit*</td>
<td>* Plant currently produces 1,501 lbs./day/avg.</td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td>59,047</td>
<td>13,187 – 32,870*</td>
<td>* South Shore plant only. Jones Island has no ammonia limit</td>
</tr>
<tr>
<td>Saginaw, MI*</td>
<td>8,006</td>
<td>1,334 – 1,975</td>
<td>* Discharges into Saginaw River which flows to Lake Huron</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>233,000</td>
<td>No Limit*</td>
<td>* Plant currently produces 88,877 lbs./day/avg. Discharges into Detroit River which flows into Lake Erie</td>
</tr>
</tbody>
</table>
What is Tar Sands?

- Deposits of bitumen, a heavy black viscous oil that must be rigorously treated to convert it into an upgraded crude oil before it can be used by refineries to produce gasoline and diesel fuels.

- Substantially heavier than other crude oils.

- Can be found in three places in Alberta - the Athabasca, Peace River and Cold Lake regions - and cover a total of nearly 140,200* square kilometers.
**Bitumen / Heavy Oil**

**Heavy crude oil**

- Any type of crude oil which does not flow easily. Properties include higher viscosity and specific gravity, as well as heavier molecular composition.
- Generally a diluent is added at regular distances in a pipeline carrying heavy crude to facilitate its flow.
- Some petroleum geologists categorize bitumen from tar sands as extra heavy oil although bitumen does not flow at ambient conditions.

**Bitumen**

- Mixture of organic liquids that are highly viscous, black, sticky, entirely soluble in carbon disulfide.
- Composed primarily of highly condensed polycyclic aromatic hydrocarbons.
- Most bitumens contain sulfur and several heavy metals such as nickel, vanadium, lead, chromium, mercury and also arsenic, selenium, and other toxic elements.
How We Make Oil at Syncrude

Wastewater Treatment Plant

BP Products, Whiting Refinery
Wastewater Treatment Plant

Refinery Wastewater → Bar Screen → Grit Chamber → API Separator (#7 SEP) → Surge Tank 5050 → EQL. Tank 5051 → EQL. Tank 5052 (Future) → Dissolved Air Flocculation Unit

Stage 1 Aeration Tank 5001 → Stage 2 Aeration Tank 5002 → Splitter Box 5003 → Clarifier 5005

Stage 1 Aeration Tank 5001 → Stage 2 Aeration Tank 5002 → Clarifier 5004 → Final Filters

Fire Water and Cooling Tower Make-Up Water → Effluent to the Lake
Future Work

Project Technical Requirements

• Thorough investigation and reporting of background materials related to:
  
  Planned refinery expansion
  Permitting aspects
  Environmental issues

• Technical understanding and communication of wastewater treatment facilities

• Exploration and analysis of technical alternatives on wastewater treatment for BP Whiting refinery
IPRO 346 Website

- http://www.iit.edu/~ipro346s08/index.html
Thank you!