Petroleum Refining Processing Crude Separation Processes and Catalytic Cracking-
Generic Scenario for Estimating Occupational Exposure and Environmental Releases
-Draft-

U.S. Environmental Protection Agency
Office of Pollution Prevention and Toxics
Chemical Engineering Branch
1200 Pennsylvania Avenue
Washington, D.C. 20460

1991

General Information:

Fluid Catalytic Cracking (FCC)

Introduction. FCC is used to convert crude oil (generally atmospheric and/or vacuum distilled) into lighter products such as gasoline and diesel fuel. They are increasingly being used for olefin production to feed octane additive production (MTBE, ETBE, TAME) as well as recovery of sulfur present in crude. FCC units (FCCU) can vary in throughput from a few thousand barrels of oil per day (BPD) to over 100,000 BPD. There are 42 gallons/barrel.

Processing/Use. A typical FCCU oil feed rate is 40,000 BPD. A fine, fluidized catalyst (particle size distribution 10-130 microns) is circulated through the unit and continuously regenerated. The lighter products formed by "cracking" the feed are separated from the gaseous product stream by selective condensation. The products are either blended into final products or further processed at the refinery.

Crude Separation Processes

Introduction. Crude separation processes are the most basic part of petroleum refining and consist of distillation either at ambient pressure or under vacuum. Refineries vary in size from 20,000 BPD to over 400,000 BPD.

Processing/Use. A typical refinery processes about 100,000 BPD. Crude is received at the refinery and then distilled into "cuts" at different boiling point ranges. A small portion (about 10%) of the distilled crude is directly made into products with the rest being further processed in the FCCU or other refinery process units.

Generic Exposure Assessments for Petroleum Refining Processing
Crude Separation Processes and Catalytic Cracking

No. Sites:

Assume:
200 refineries in U.S.[1]
One FCC and one crude separation unit per refinery
Typical refinery processes 100,000 barrels/day crude[2]
Typical FCC unit processes 40,000 barrels/day feed[2]
Days/year: Assume 350 days/year[2]

No. Workers/Site: For entire refinery, assume 50 workers/shift, 24 hrs/day, 7 days/week, 4 shifts.[3] For each FCC or crude unit, assume 5 workers/shift, 24 hrs/day, 7 days/week, 4 shifts.

Days/year, assume 250 days/year

Inhalation Exposure: For FCC and crude separation units, assume highest exposure is in inhalation of distillates or VOC's from leaking manifolds and pumps.[4] Also, assume OSHA nuisance PEL for catalyst particulate inhalation. Nickel+Vanadium metal loadings on equilibrium FCC catalysts average 1,000 ppm.[5] This corresponds to about 500 mg/day using the OSHA PEL of 0.05 mg/m^3 for both.

Dermal Exposure: Usually negligible as FCC and crude units are closed processes. Can have incidental exposure during repairs of FCC and crude units.[4]

Environmental Releases:

For crude unit only:
Total releases = 0.07% of refinery throughput[1]
Water releases = 0.004% of refinery throughput[1]
Landfill = negligible
Incineration = 0.046% of refinery throughput[1]
Air releases = 0.02 % of refinery throughput[1]

For FCC unit only:

Catalyst usage is typically 0.3 lbs/barrel/day feedstock. For sulphur dioxide abatement catalyst, usage rate is much lower, about 0.01 lbs/barrel/day. The reason for this lower usage rate is that these catalysts are not for catalytic cracking, but rather for absorption of sulphur oxides. Incineration and water releases are negligible. Assume 100% of catalyst is landfilled.

References

1. Information is from Joint Amoco-EPA project, using Amoco's Yorktown refinery actual operating data.

2. Petroleum Refining; Gary, James, Handwerk, Glenn, 1984.

3. Telephone communication with personnel from Katalistiks International, a division of UOP Inc. 1991

4. Professional Engineering Judgment of the author, Daniel Fort

5. Threshold Limit Values and Biological Exposure Indices for 1989-1990, American Conference of Governmental Industrial Hygienists.