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PETROLEUM REFINING INDUSTRY

POLLUTION PREVENTION

OPPORTUNITIES

CHECKLIST

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Pollution Prevention Opportunities for Petroleum Refining Industry

The keys to pollution prevention for the petroleum refining industry are, for the short term, waste segregation, good operating practices and oil recovery. For the medium term, the driving force is probably product reformulation, which has resulted in production changes in meeting limitations for air toxic compounds and vapor pressure in fuel products. For the longer term, the keys may be more targetted hydrocarbon rebuilding and reforming to produce the desirable fuel components, while avoiding the undesirable toxic ones. More specifically, catalytic conversions and expanded use of hydrogenation may hold the most promise.

Y/N

Opportunities

Comments

(The following checklist presents a compilation of pollution prevention opportunities. However, since every refinery is unique, some of the opportunities may be more applicable to one refinery than to another. Please use the checklist with caution.)

I. Good Operating Practices

Material Input, Storage and Handling

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| — Specify lower bottom sludge and water content for crude oil supply | To reduce wastes in storage tank and desalter through improved separation of water and bottom sludge at extraction |
| — Use recycled water as make-up water for crude desalter | Recycled water quality is sufficient for desalting |
| — Reroute desalter water with emulsifiers to intermediate tankage | To minimize emulsifier carryover to API separator |
| — Segregate and dispose of ballast water to salt water channel, if available | To minimize brine contamination of treated water for reuse |
| — Replace desalting with an aggressive chemical treatment system for applicable situation, through crude oil dehydration in tankage with emulsion breaker, chloride reduction with caustic injection, ammonia replacement with neutralizing amine, film inhibitor feed rate optimization and anti-foulant injection to debutanizer heat exchanger (<u>Oil & Gas Journal</u> , 3/20/1989, pg. 60) | To eliminate desalter water blowdown, which could be high in benzene and emulsifiers, while maintaining corrosion protection |
| — Segregate and discharge blowdown and water treatment regenerant to salt water channel or truck to ocean outlet, if available | To minimize brine contamination of treated water for reuse |

- ___ Use corrosion resistant liners in storage and slop oil tanks To minimize sludge formation and need for tank cleaning
- ___ Install agitator in crude oil storage tanks To minimize sludge accumulation
- ___ Avoid high shear pumping of oily wastes; use Archimedean screw pumps as appropriate To minimize emulsion formation
- ___ Install tank cover and seal To minimize emission loss and moisture entry
- ___ Install improved non-leaking seals To eliminate leak losses
- ___ Install sealless pump To eliminate leaks and fugitive emissions
- ___ Maintain seals regularly To prevent leaks
- ___ Recycle seal flushes and purges To minimize wastes for treatment
- ___ Pave process area To minimize dirt entry to sewer
- ___ Install cover for sewer drain To minimize dirt entry to sewer
- ___ Collect catalytic fines during loading and unloading To prevent fines from becoming wastes
- ___ Recover coke fines for sale with coke To prevent solids entry to sewer
- ___ Reuse recycled water for washdown if quality is desirable To minimize need for discharge
- ___ Integrate process units to pass processing streams from one unit to the next, if appropriate To avoid intermediate tankage but may lose operational flexibility
- ___ Blend fuels in-line To avoid blending tankage
- ___ Install closed looped sampling system To flush materials back to the tank or pipeline and minimize volatile compound emissions
- ___ Use computer software to track all hazardous materials and wastes To better manage virgin materials and waste streams
- ___ Return oily wastewater and sludge from distribution and sales terminals to refinery as permitted by federal and state recycling regulations To afford proper handling of oily wastes
- ___ Segregate scrap metals for sale To reclaim metals for reuse

- ___ Recondition valve and vessel for reuse To further reduce scrap metal wastes
- ___ Recover and reuse sandblasting grit as blasting media or as a light aggregate in concrete product To minimize need for grit disposal, but beware of lead and heavy metal contaminations

Stormwater Management

- ___ Selectively cover loading rack and process areas to divert rainwater To preclude rainwater contamination
- ___ Segregate storm water collection system from process drainage To prevent cross contamination of storm water
- ___ Impound rainwater in collection basin or tank as appropriate To hold water pending determination of treatment need
- ___ Sweep streets and redesign catch basins to exclude dirt To prevent dirt entry to storm drain
- ___ Keep tank farm and process area clean, including secondary containment areas To avoid contaminating rainwater
- ___ Reuse rainwater after gravity recovery of oil and solids To minimize need for discharge
- ___ Discharge rainwater to public storm drain system under NPDES permit To avoid using sewer capacity
- ___ Dike process area that drains to storm water collection system as appropriate To prevent contamination of storm water
- ___ Regularly clean out drainage system to remove accumulated dirt To minimize contamination of storm water

Firefighting Water and Spillage Management

- ___ Install tank overflow prevention system To prevent spills
- ___ Pave areas under pipe rack To facilitate leak detection
- ___ Contain spillage with diking and absorbent materials To minimize spreading of spillage
- ___ Recover and reuse spillage To minimize need for disposal
- ___ Impound fire fighting water in rainwater basins or storage tanks as appropriate To hold and test before discharge or reuse
- ___ Prevent automatic crossover of storm drain to wastewater collection system To prevent spills and fire fighting water that entered the storm drain system from overwhelming the wastewater treatment system

Conversion and Upgrading Processes

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| <p>— Improve conversion in reactors through various means including the followings:</p> <ul style="list-style-type: none">. Distribute feeds better at inlets and outlets,. Upgrade catalysts continuously,. Provide separate reactor for recycled streams for more ideal reactor conditions,. Better heating and cooling to avoid hot spots,. Improve control to maintain optimum conditions in reactor,. Use inhibitors to minimize unwanted side reactions. | <p>To improve yield and conversion, and minimize the formation of undesirable compounds from side reactions</p> |
| <p>— Filter catalyst fines from decanter oil from the Fluid Catalytic Cracking unit</p> | <p>To recover and reuse catalyst</p> |
| <p>— Reclaim hydroprocessing catalysts for metals and alumina</p> | <p>To recover the metals on the catalysts like cobalt and molybdenum, as well as those removed from oil like nickel and vanadium; the alumina carrier is also recovered</p> |
| <p>— Recycle catalyst for bauxite in cement manufacturing</p> | <p>To minimize need for disposal</p> |
| <p>— Recover fluoride from spent caustics from a HF alkylation process by calcium precipitation</p> | <p>To produce calcium fluoride solids for use in cement industry or as fluxing agent in glass and steel industries</p> |
| <p>— Reuse spent fluidized catalytic cracking unit (FCCU) catalysts in residue FCCU</p> | <p>To reuse catalysts in another FCCU where higher metal content on the catalysts can be tolerated</p> |
| <p>— Reactivate catalysts for reuse</p> | <p>To reuse catalysts after the nickel and vanadium deposits are removed</p> |
| <p>— Regenerate spent sulfuric acid by commercial reclaimer using incineration</p> | <p>To regenerate the acid and avoid neutralization</p> |
| <p>— Reclaim extraction solvents like sulfolane and sulfinol</p> | <p>To recover solvents for reuse, with the residuals going for feed to a sulfuric acid plant because of their high BTU and sulfur contents</p> |

Product Treatment

- ___ Minimize the amount of caustic and rinse water used for product treatment through better contacting and recycling To minimize need for treatment of wastewater
- ___ Consider hydrotreating for pollutant removal To eliminate the use of caustic and water in product treatment
- ___ Send spent caustics to reclaimer To reclaim cresylic and naphthenic compounds for sale
- ___ Reuse spent sulfuric caustics for paper manufacturing To reuse the caustics if the strength is high enough
- ___ Regenerate clay from jet fuel filtration by washing with naphtha and drying by steam heating and feeding to furnace To recycle filter clay

Equipment Cleaning - Heat Exchangers

- ___ Use lower pressure steam To reduce tube-wall temperature and sludge formation
- ___ Desuperheat steam To reduce tube-wall temperature and increase the effective surface area of the exchanger because the heat transfer coefficient of condensing steam is ten times greater than that of superheated steam
- ___ Install a thermocompressor To reduce tube-wall temperature by combining high and low pressure steam
- ___ Use staged heating To minimize degradation, staged heating can be accomplished first using waste heat, then low pressure steam and finally, desuperheated high pressure steam
- ___ Use on-line cleaning techniques for exchangers Recirculating sponge balls and reversing brushes can be used to reduce exchanger maintenance and also to keep the tube surface clean so that lower temperature heat sources can be used
- ___ Use non-corroding tube Corroded tube surfaces foul more quickly than non-corroded ones

Waste Gas Treatment

- Regenerate di-ethanol-amine (DEA) using slip stream filtration in addition to carbon filtration To remove degradation products and prolong DEA life
- Substitute Sulften Sulfur Recovery Process for Beavon Process To avoid generation of spent Stretford Solution which contains vanadium
- Regenerate activated carbon from gas scrubbing To avoid need for disposal

Wastewater and Sludge Treatment

- Add forebay skimming for API separator To recover more hydrocarbons for recycle
- Use floating roof on treatment tanks and drains To minimize air emissions
- Use pressurized air in flotation To minimize air emissions
- Pretreat desalter water blowdown before co-mingling with other oily wastes, using absorption with light oil, or stripping with steam, nitrogen, methane or vacuum To pretreat the high concentration of benzene and possibly, emulsifiers in the desalter water blowdown
- Thicken sludge in sludge tank and decant supernatant To aid in sludge dewatering
- Treat sludge with heat and chemicals to release more oil and water To further reduce hydrocarbon content in sludge
- Dewater sludge to cake form To minimize water content and remove some oil
- Reclaim hydrocarbons in sludge by feeding it to a delayed coker which produces fuel grade coke To dispose of solids and to reclaim hydrocarbon value
- Use solvent extraction to remove hydrocarbons from sludge To treat sludge for disposal and recover hydrocarbons
- Use high temperature sludge drying to desorb hydrocarbons To treat sludge for disposal and recover hydrocarbons
- Feed sludge cake to cement kiln for energy recovery To recycle sludge for its energy value
- Evaluate gasification of oily wastes To convert waste to usable methane

Utility Production - Steam, Hydrogen

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| ___ Use closed-loop cooling water system | To minimize water loss |
| ___ Demineralize cooling tower feed water | To reduce cleaning and waste generation |
| ___ Use polymers for boiler feed water treatment | To reduce boiler cleaning |
| ___ Collect condensate for reuse | To avoid sewer discharge |
| ___ Use non-chromate corrosion inhibitor | To minimize chromate emissions and also chromate treatment in blowdown |
| ___ Reclaim hydrogen plant catalysts | To recover materials in catalysts |

III. Product Reformulation and Material Substitution

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| ___ Reformulate leaded gasoline to non-leaded alternative with MTBE | To eliminate lead from gasoline and product storage tanks |
| ___ Reduce benzene and other volatile hydrocarbons in gasoline through re-blending with oxygenates like MTBE | To decrease emissions of air toxics and smog-forming volatile organics |