



Carom Process™

Aromatics

Application

The Carom process allows Udex™ and Tetra™ process unit operators to economically revamp their unit to increase capacity or reduce utilities and production costs.

The Carom process recovers petrochemical-grade BTX aromatics (benzene, toluene, and xylenes) using a combination of liquid-liquid extraction and extractive distillation. The Carom process can be used to recover aromatics from a wide variety of feedstocks, including reformate, pyrolysis gasoline byproducts from ethylene crackers (pygas), and coal liquid byproducts from coke ovens (coke oven light oil or COLO). Benzene is often recovered by extraction or extractive distillation in order to meet purity specifications for petrochemical applications. Toluene must be extracted for direct use in petrochemical applications and is usually extracted before being fed to a dealkylation or disproportionation unit for production of additional benzene and xylenes.

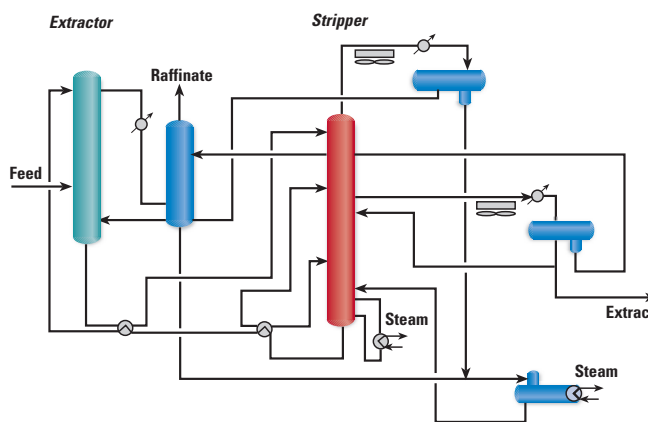
Modern CCR Platforming™ units operate at such high severity that the C₈⁺ fraction of the reformate does not contain significant amounts of nonaromatic impurities. As a result, this fraction can be sent directly to the xylenes recovery section of an aromatics complex without extraction. Pygas and COLO feedstocks must be thoroughly hydrotreated prior to extraction to saturate dienes and remove sulfur and nitrogen. The C₈⁺ fraction of pygas and COLO streams contain significant amounts of nonaromatic impurities and therefore is typically extracted before being recovered as marketable mixed xylenes or sent to xylenes recovery.

Process description

The Carom process consists of moderate temperature liquid-liquid extraction of the aromatics followed by hot stripping from the solvent at atmospheric pressure. The Carom process uses a unique two-component solvent system which can be tailored for a wide range of feedstock compositions. It is similar to the well-known Udex process in that it consists of only two main columns, an extractor and a stripper. The process consists of three internal circulation loops: solvent, water, and hydrocarbon recycle. The feed enters the extractor somewhere between the middle and bottom tray depending on whether the emphasis is on higher recovery or higher

product purity. The lean solvent, essentially free of hydrocarbon components, enters the extractor column at the top. The denser solvent phase travels down the column from tray to tray as the hydrocarbon phase travels upward. On each tray, both the solvent and hydrocarbon phases are intimately contacted and re-separated. The solvent leaves the bottom of the extractor rich in aromatics while substantially all the nonaromatic hydrocarbons leave the top of extractor as raffinate.

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A recycle stream from the stripper overhead is introduced at the bottom of the extractor in order to back-extract the heavy nonaromatics from the solvent as it leaves the bottom of the extractor.

The rich solvent is sent to the top of the stripper. After the initial flash, the rich solvent is subjected to a combination of extractive distillation and steam stripping in the upper section of the stripper column. The nonaromatics are removed as stripper overhead vapors, along with a small amount of aromatics. The stripper overhead vapors and the vapor from the flash are combined in the overhead condenser. The hydrocarbon and water phases are separated in the stripper overhead receiver, and the hydrocarbon phase is recycled back to the bottom of the extractor. The water phase joins the spent wash water from the raffinate wash column to become the stripping water.

By the time the rich solvent reaches the extract side-draw on its way down the stripper column, only aromatic hydrocarbons remain in solution. In the section

below the sidedraw, the solvent is stripped of aromatic by the combined action of stripper reboiler and stripping steam injected near the bottom of the column. The extract vapors leaving through the sidedraw are essentially pure aromatic hydrocarbons. The extract is directed to the fractionation section where petrochemical grade benzene, toluene and C₈ aromatics are recovered. At the bottom of the stripper column, hydrocarbon-free lean solvent is cooled to extraction temperature before it enters the top of the extractor column.

Product quality and yields

Aromatics recovery and product purity are largely a function of feedstock composition and solvent circulation rate. In general, higher purity and recovery performance require more energy input. However, the inherent selectivity and capacity of the solvent system determine the maximum level of that can be achieved and define the relative economics between process designs. Individual Carom units can be designed for higher or lower levels of performance, depending on processing objectives and economics.

Features and benefits

Economic revamps of existing Udex or Tetra units -
Since Carom units have the same flowscheme as Udex or Tetra units, existing units can easily be converted to Carom operation.

Low cost expansions and efficiency improvements -
Due to the improved selectivity and capacity of the Carom solvent, operating costs can be reduced or capacities can be increased.

Case study

Basis: 10,000 BPD reformate feed, BT cut,
60 wt-% aromatics

Performance:

Product Purity, wt-%	
Benzene	99.98
Toluene	99.9
Nonaromatic Impurities, wt-ppm	
Benzene	< 200
Toluene	< 600
Product Recovery, wt-%	
Benzene	99.9+
Toluene	99.8+

Estimated Erected Cost, US\$ (millions)

(Inside battery limits only)

Carom Unit	13.6
BT Fractionation	3.9
Solvent Inventory	0.3

Operating Requirements

Energy Consumption, Btu/lb extract	700
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Revamp opportunities

Because its flowscheme is similar, the Carom process is ideal for upgrading older Udex and Tetra units and other extraction units designed for glycol solvents. Converting an existing BTX extraction unit to the Carom process can result in a 50-100% increase in feed capacity, higher product purity, better aromatics recovery, and improved energy efficiency of up to 30% per unit of product. The scope of each revamp depends upon the processing objectives and the constraints of the existing equipment. The basic conversion to the Carom process involves replacing the solvent inventory with a nominal mixture of 80% tetra-ethylene glycol and 20% Carom concentrate, and installing a small product wash column for the extract. Much of the work necessary for the revamp can be scheduled to minimize the shutdown time required. Significant additional throughput can usually be achieved by installing UOP's multiple upcomer trays in the extractor and multiple downcomer trays in the stripper.

Commercial experience

The Carom process was introduced in 1986 and a total of seven Carom units have been licensed. Six of these units are revamps of older Udex and Tetra units, and one is a new unit that started up in 1997.

For more information

Carom technology services are available upon request. For more information, contact your local UOP representative or our Des Plaines sales office:

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