BADGER/NIRO *PARA*-XYLENE CRYSTALLIZATION PROCESS

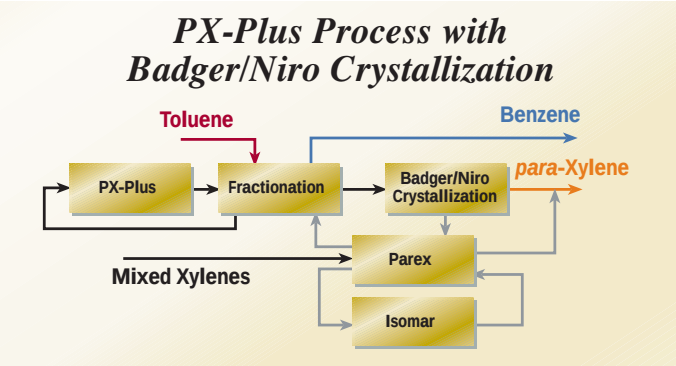
APPLICATION

The Badger/Niro *Para*-xylene Crystallization process recovers high-purity *para*-xylene from aromatics streams. This technology is particularly attractive when the feed has over 70% *para*-xylene. Such concentrated streams are available from UOP's PX-Plus™ process, which selectively disproportionates toluene to *para*-xylene and benzene. Similar concentrated *para*-xylene streams can be generated from the HySorb™ process, which involves adsorptive concentration of *para*-xylene. With such feeds, this *para*-xylene crystallization technology achieves 99.9+% product purity, with high recovery and lower consumption of utilities than any competing process.

In xylenes streams from naphtha reformers, isomerization units, and other equilibrium-limited processes, the *para*-xylene content of the C_8 aromatics is typically near 22%. In a new grassroots facility operating on these traditional feeds, adsorption by UOP's Parex™ process is typically chosen over crystallization for recovering *para*-xylene because, for this low-purity feed, crystallization is limited to a recovery of about 60%, while the Parex process can achieve 99.9% purity at 97% recovery per pass.

With feed *para*-xylene concentrations of 70% or more, recoveries above 95% become possible with crystallization. With these higher concentration *para*-xylene feeds, high recoveries can be achieved using a single refrigerant compressor system, thus avoiding the need for expensive cascaded-refrigerant systems using two compressors and two refrigerants.

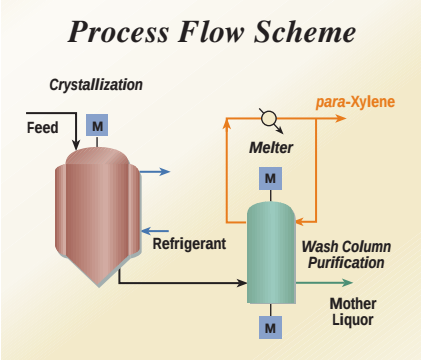
When PX-Plus processing is used, Badger/Niro crystallization is typically the most economical way to make the final purification of the *para*-xylene. The integrated design of these UOP and Badger/Niro technologies is currently available for license as the PX-Plus XP™ process. The Badger/Niro *Para*-xylene Crystallization and PX-Plus processes can also be integrated into an existing aromatics complex using a number of different flow schemes. One example is shown above.



Because the Badger/Niro technology is based on continuous suspension crystallizers, like all traditional *para*-xylene crystallization installations, it can be used to revamp traditional units. The unit can be revamped for higher product purity and increased throughput with conventional feedstock purity, or for very large increases in capacity with the higher concentration *para*-xylene feedstocks available when combined with an adsorption or PX-Plus unit. Another revamp scenario involves lowering an existing Parex unit's product purity in conjunction with increasing throughput, and routing this lower purity product to a new Badger/Niro crystallization unit. The best alternative is determined by the specific project objectives and the limitations involved with the existing installation.

PROCESS DESCRIPTION

The process designs for Badger/Niro *Para*-xylene Crystallization units are based on the use of vertical-vessel, scraped-surface crystallizers, and wash columns. The simplest form of this technology is shown in the flow scheme on the following page. The crystallizers create a slurry of high-purity *para*-xylene crystals in a mother liquor. This slurry is fed to Niro wash columns where the crystals are separated from the mother liquor, and melted for the final product.

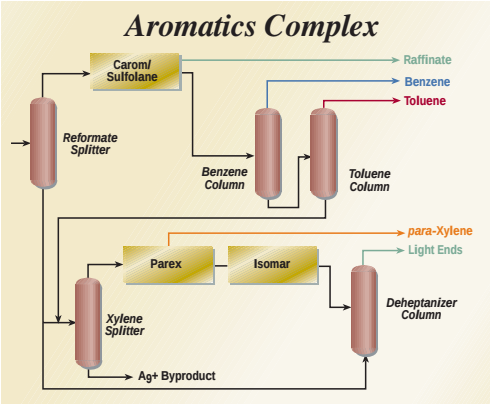


Inside the wash column, the crystals are mechanically pushed upward, and the mother liquor is washed away countercurrently from the crystals with product-purity *para*-xylene flowing downward. This wash *para*-xylene is recovered because it freezes as it heats the crystals up to the melting point of pure *para*-xylene. The crystals enter the top head and are fluidized by circulating product-purity *para*-xylene liquid. The resulting slurry leaves the wash column and enters a heat exchanger where the crystals are melted. The net product *para*-xylene is split off, and the rest of the melt is recirculated back to the top head of the wash column for the fluidization of more crystals. Because the crystal washing is countercurrent, the washing is very complete, and thus, the product purity is very high. With the wash recovered internally, there are no processing costs for wash recovery as there are with either centrifuges or filters.

In all forms of this technology, the consumption of utilities is minimal because the *para*-xylene is crystallized only once, there is effective heat integration, and wash recovery is done without additional refrigeration or other utilities. The optimal implementation of this technology depends on the feed purity, *para*-xylene recovery, and throughput objectives of the project.

Economics

An existing Parex-based aromatics complex was evaluated with the objective of increasing the *para*-xylene production by 65% while maintaining overall *para*-xylene product purity at 99.8%. The increased production was achieved with the addition of a PX-Plus XP process scheme and replacement of the existing benzene and toluene columns. The simple return on investment for the expansion was calculated to be an attractive 63%.



A summary of the investment cost and utility requirements for a typical Badger/Niro *Para*-Xylene Crystallization unit is given below. The basis for this design is 400,000 MTA of *para*-xylene product from a 90% *para*-xylene feed at 93.5% recovery. The product purity is 99.9+%, and the purity of the mother liquor stream is 37% *para*-xylene. The estimated inside battery limits erected cost for the unit assumes construction on a US Gulf Coast site in the fourth quarter 2000.

EEC, ISBL (including refrigerant inventory)	**US$ MM**	20.4
Utilities, per MT PX product		
Electric, kWh		49
LP Steam, kg		75

The steam can be at any pressure above atmospheric, so it can often be supplied by low-level waste heat.

Experience

The Badger Technology Center of Washington Group International and Niro Process Technology combined their crystallization and wash column technologies in 1993 with the formation of an alliance. Since that time, five design packages have been sold for *para*-xylene purification. The first commercial unit started up in mid-1999.

UOP now offers the Badger/Niro technology for installation in series with PX-Plus or HySorb processes, as well as for crystallization or Parex-unit-based aromatics complex revamps.

For More Information

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