



## Crystallization

### Aromatics

#### Application

The Badger/Niro *Para*-xylene Crystallization process recovers high-purity *para*-xylene from aromatic streams. This technology is particularly attractive for feeds containing more than 70% *para*-xylene. A concentrated stream of this type can be produced using UOP's PX-Plus™ process, which selectively disproportionates toluene to *para*-xylene and benzene. Similarly concentrated *para*-xylene streams can be generated from the HySorb™ process, which involves adsorptive concentration of *para*-xylene. With such a feed, this *para*-xylene crystallization technology can achieve 99.9+% product purity, with high recovery and less energy consumption than competing processes.

Xylene streams produced in naphtha reformers, isomerization units, and other equilibrium-limited processes typically have *para*-xylene concentration of the C<sub>8</sub> aromatics near 22%. For grassroots facilities operating on these traditional feeds, adsorption by the Parex™ process is typically chosen over crystallization for recovering *para*-xylene because crystallization is limited to a recovery of about 60% for low purity feeds, while the Parex process can achieve 99.9% purity at 97% recovery per pass when processing the low purity feed.

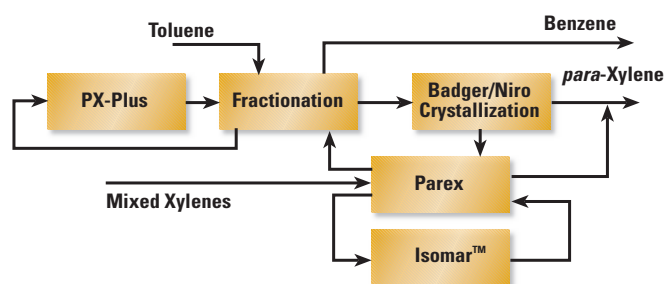
With feeds *para*-xylene concentrations of 70% or more, recoveries above 90% become possible with crystallization using a single refrigerant compressor system. This avoids the need for expensive cascaded-refrigerant systems using two compressors and two refrigerants, and thus improves the relative economics to favor crystallization for processing these feeds.

When the PX-Plus Process is used, Badger/Niro *Para*-xylene Crystallization is typically the most economical way to purify 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 flowschemes. One example is shown below.

Badger/Niro technology is based on continuous suspension crystallization, like all traditional *para*-xylene crystallization. As a result, it can be used to revamp an existing crystallizer for higher product purity and

increased throughput with conventional feedstocks. Revamp scenarios also include the possibility for very large increases in capacity with increased concentration *para*-xylene feedstock when an adsorption or PX-Plus unit is added to the processing scheme.

#### PX-Plus Process with Badger/Niro Crystallization

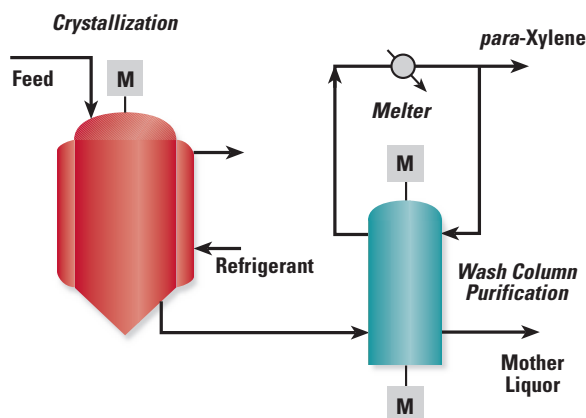


#### Process description

The process designs for Badger/Niro *Para*-xylene Crystallization units are based on the use of vertical vessel, scraped-surface crystallizers, and wash columns. Inside the wash column, the crystals are mechanically pushed upward, and the mother liquor is washed away counter currently 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 a portion of the melt 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, utility consumption is minimal because the *para*-xylene is crystallized only once. The process uses 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.

## Process Flow Scheme



## Features and benefits

**Single stage crystallization on concentrated feeds** - when feeds with better than 70% PX are further purified to 99.9 wt% PX, this crystallization scheme becomes economic.

**Integration of crystallization and wash columns** - the use of single stage crystallization with wash columns allows energy efficiency and recovery levels that were not achievable with traditional designs.

**Suitable for revamps of existing crystallizers** - existing crystallizers can be expanded by converting them to single stage design and adding wash columns to achieve purity.

## Economics

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*.

**Estimated Erected Cost US\$ MM 27**  
(2006 US Gulf coast basis, inside battery limits only)

## Utilities, per MT of PX

Electric, kWh	56
LP Steam, kg	77
Cooling water, m <sup>3</sup>	23

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

## Experience

Badger Technologies Center of Stone & Webster Inc. and Niro Process Technology combined their crystallization and wash column technologies in 1993 with the formation of an alliance. Since that time, three 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

Badger/Niro *Para-xylene* Crystallization technology services are available on request. For more information, contact your local UOP representative or our Des Plaines sales office:

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