

# Gas-Phase Phosgenation of TDA to Produce TDI

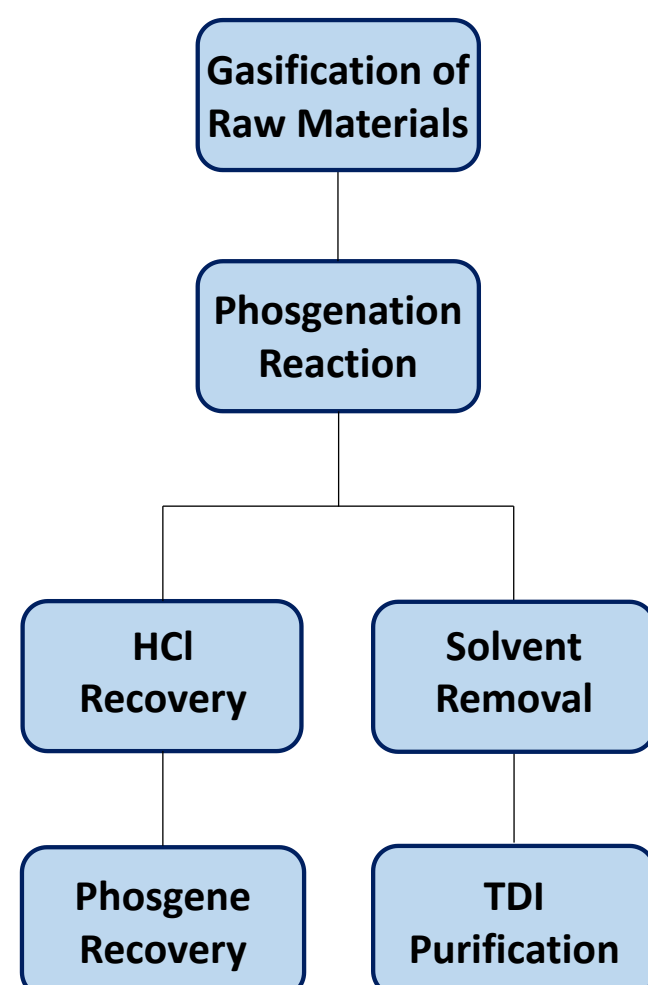
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## Abstract

This design is for a plant that produces toluene-diisocyanate (TDI), an important raw material for the production of flexible polyurethane foams. This industry is a growing global market. The novelty of this process is the phosgenation of toluenediamine (TDA) in the gas phase rather than the traditional liquid phase.

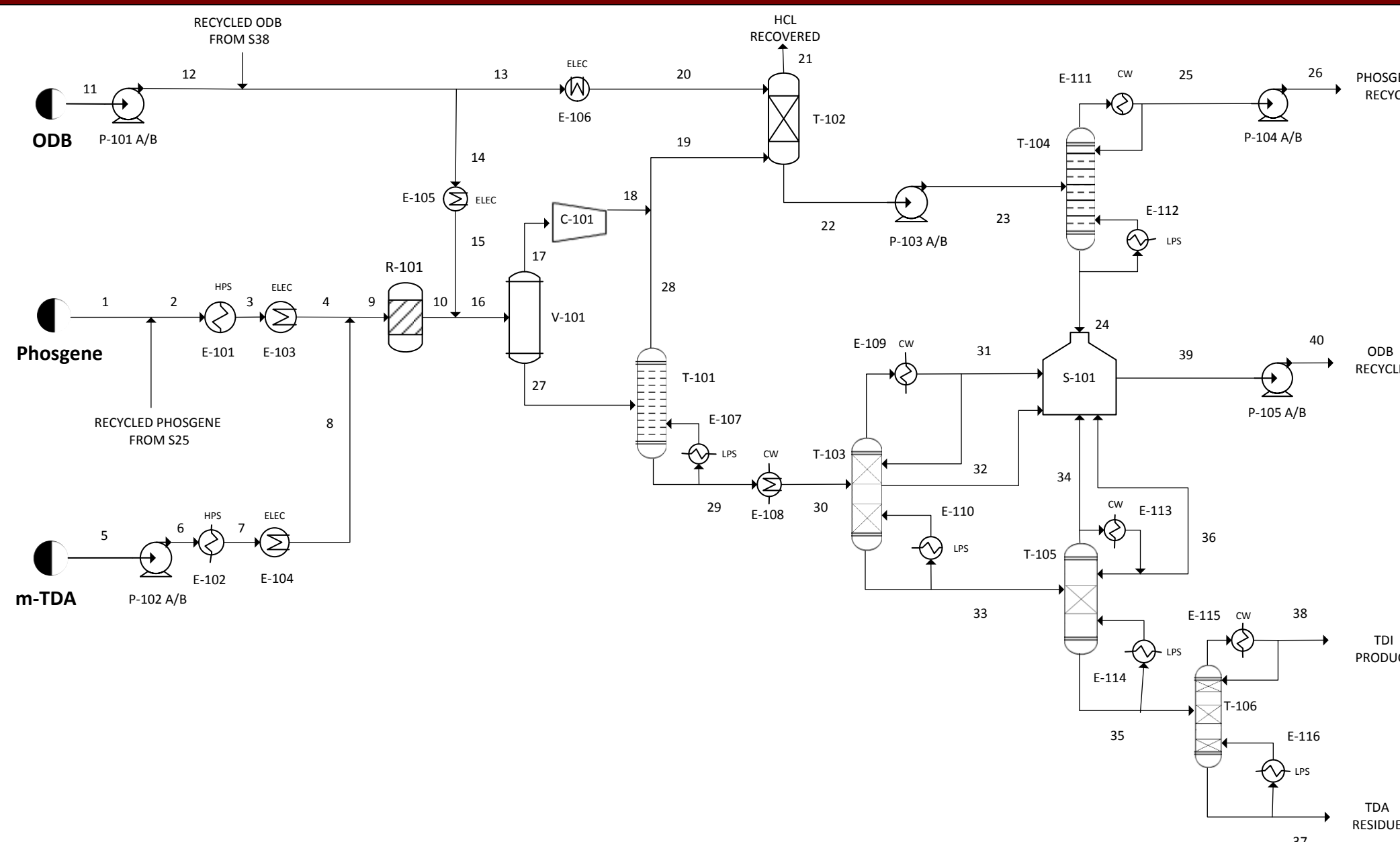
## Block Flow Diagram



## Key Points

- 17,600 kg/hr TDI produced – 150,000 tonnes/yr
- All recovered streams from separations are pure enough to be recycled back into the process or sold
- Recycle streams pumped into holding tanks

## Process Flow Diagram



## Product Purities

TDI	99.9%
Phosgene	94%
HCl	99.7%
ODB	99.8%

## Stream Specifics

Stream	Mass Flow (kg/hr)	Temp (°C)
9	55,881	349
16	117,881	150
38	17,630	175

## Equipment

ID	Equipment Name	ID	Equipment Name
C-101	Compressor	T-102	HCl Absorption Column
E-101-116	Exchangers	T-103	ODB Extraction Column #1
P-101-105 A/B	Pump	T-104	Phosgene Extraction Column
R-101	Phosgenation Reactor	T-105	ODB Extraction Column #2
S-101	Solvent Accumulation Tank	T-106	TDI Purification Column
T-101	Dephosgenation Column	V-101	Flash Separator

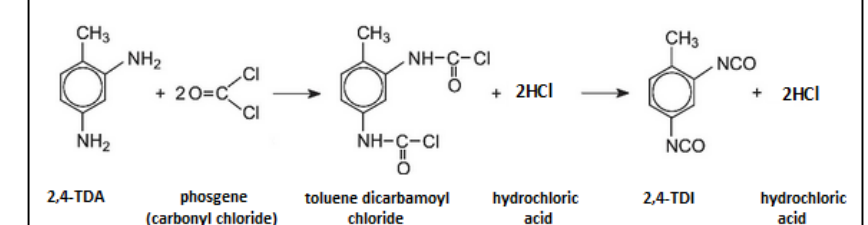
## Process Specifics

- Phosgene & TDA heated to 350 °C with HEX and electric heaters
- Reaction runs to 95% completion
- ODB solvent is used to quench reaction outlet and added in HCl extraction column
- All separations were optimized according to process equipment heuristics

## Why Gas-phase?

Performing the phosgenation reaction in the gas phase is more economical and environmentally friendly than in the liquid phase. Benefits include reducing solvent consumption by 80%, energy consumption by 60%, and reducing residence time from 50 minutes to 20 seconds.

## Reaction Occurring



Phosgenation Reaction

## Uses

Flexible foams can be found in car seats, upholstery, and mattresses. TDI can also be used to make rigid foam, coatings, adhesives and sealants, and elastomers.



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