



Production of Benzene via the Hydrodealkylation of Toluene

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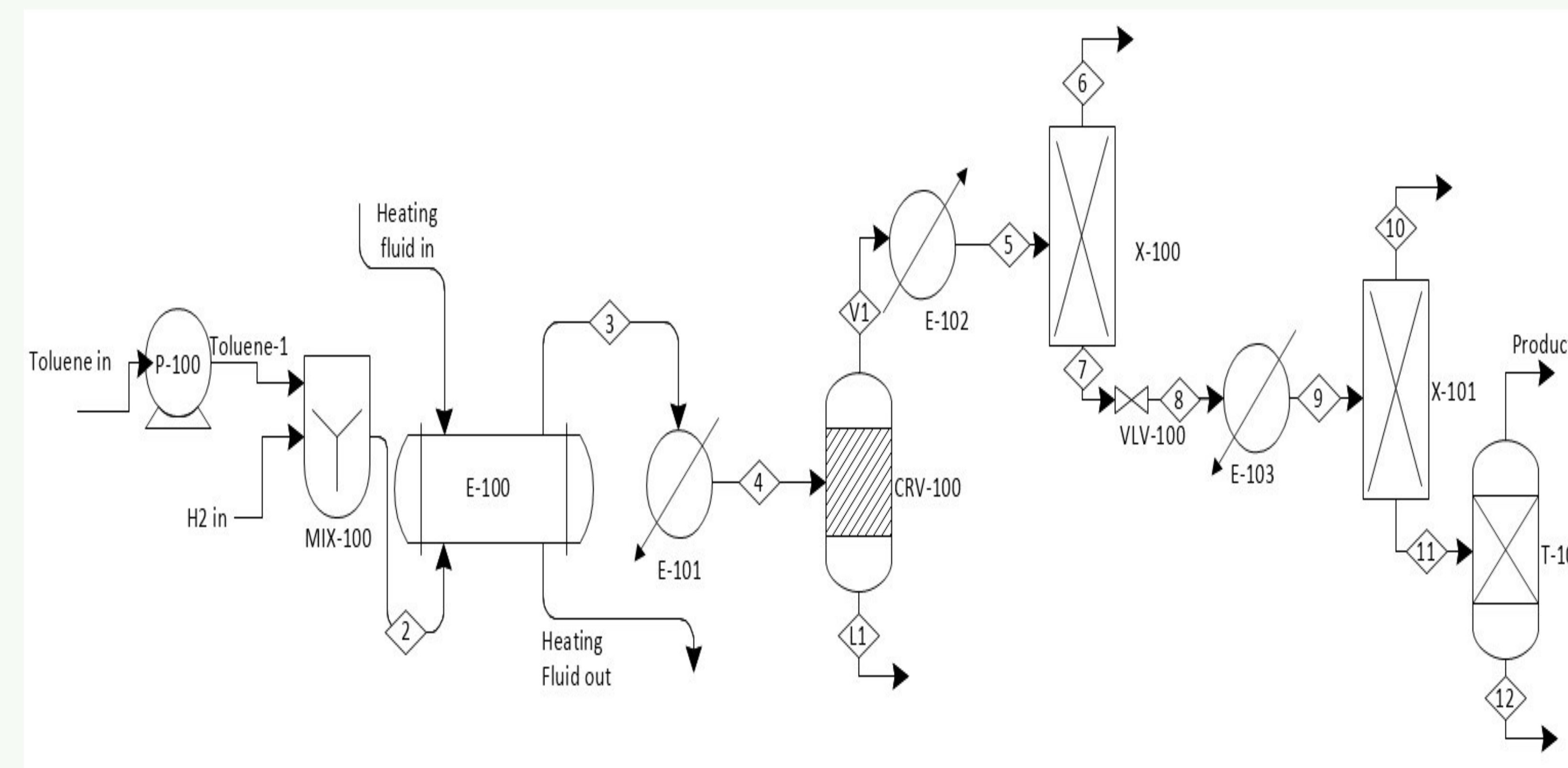


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Abstract:

- Design and simulation of an industrial benzene production process using Hydrodealkylation (HDA).
- Recycled toluene converted to benzene using hydrogen at high temperature and pressure.
- Process modeled and optimized using ASPEN HYSYS with accurate material and energy balances.
- Achieved ~99.95% benzene purity and ~75% toluene conversion.
- Annual production capacity of approximately 153,000 tons.
- Major equipment includes a fixed-bed reactor, heat exchangers, and a distillation column.
- Equipment designed according to ASME and TEMA standards.



Stream No.	Description	Main Components	Notes
1	Toluene Feed	Toluene	Fresh feed entering mixer
2	Hydrogen Feed	H ₂	Provides excess H ₂ to improve selectivity & prevent coke
3	Mixed Feed	Toluene + H ₂	Sent to heater before reactor
4	Reactor Inlet	Hot Toluene + H ₂	Heated mixture entering reactor
5	Reactor Outlet	Benzene + Methane + Unreacted Toluene + H ₂	Hot effluent after reaction
6	Cooled Stream	Same components as 5	After cooler, prepared for separation
7	Benzene Product	Benzene (99.9%)	Final product
8	Off-Gas / Purge	H ₂ + CH ₄ traces	Prevent hydrogen buildup
9/10	Column Feeds	Hydrocarbon mixture	Entering separation unit
11	Reflux / Overhead	Light gases or benzene-rich vapor	Depends on column design
12	Bottoms	Benzene or heavy components	Final purified product or recycle

