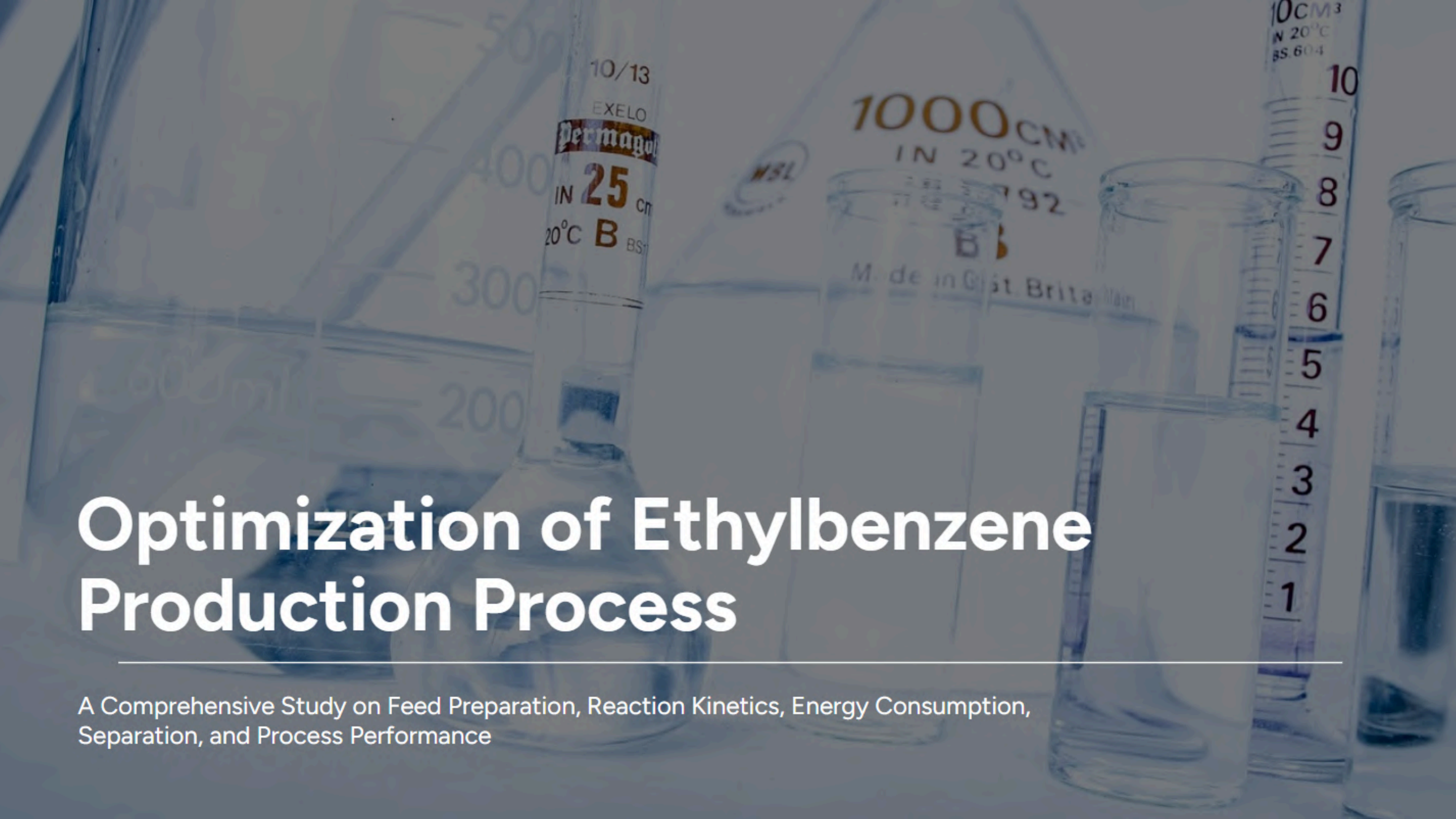


Optimization of Ethylbenzene Production Process

A Comprehensive Study on Feed Preparation, Reaction Kinetics, Energy Consumption, Separation, and Process Performance

TABLE OF CONTENTS

INTRODUCTION TO ETHYLBENZENE PRODUCTION

OBJECTIVES OF THE STUDY

MAXIMIZE ETHYLBENZENE YIELD

FOCUS ON INCREASING THE PRODUCTION OF ETHYLBENZENE IN THE PROCESS.

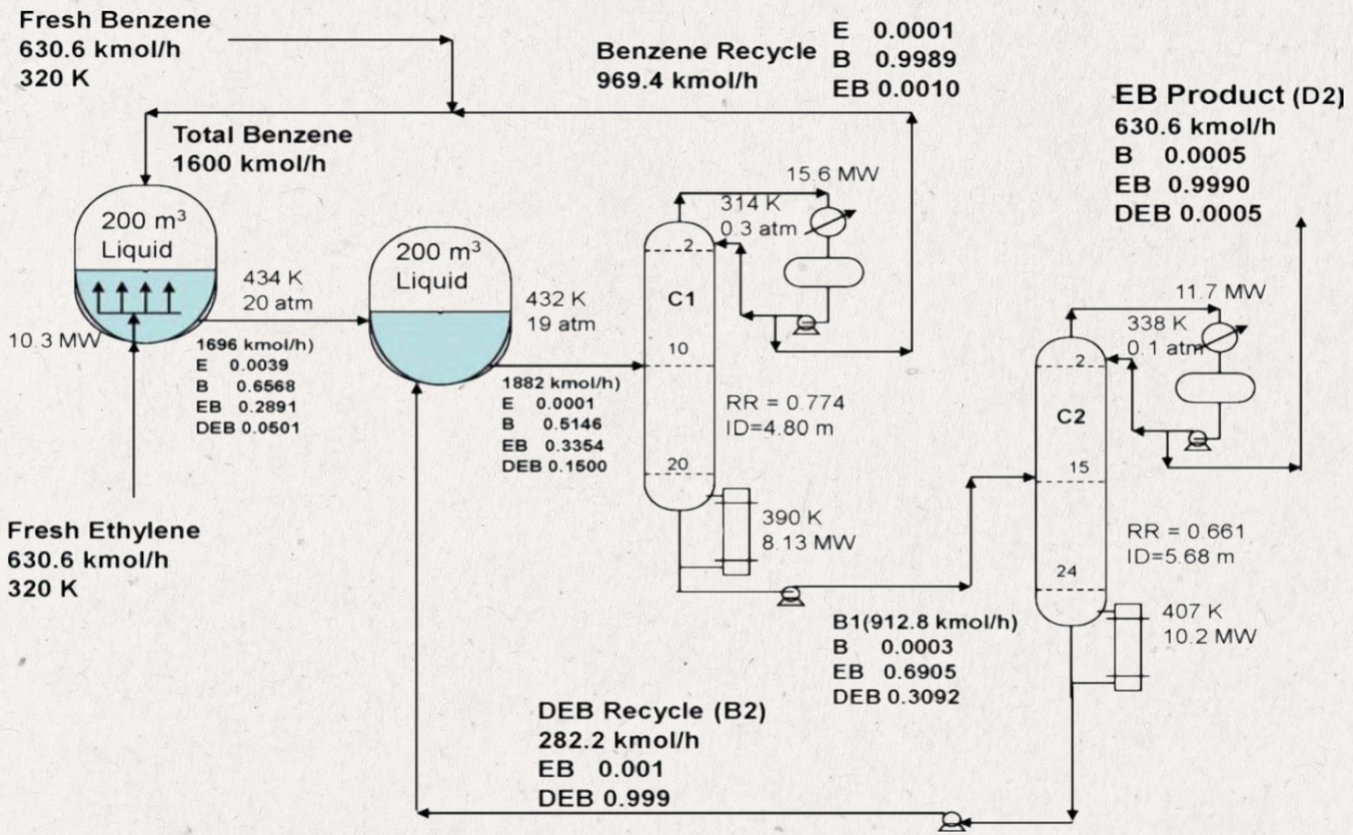
MINIMIZE BYPRODUCTS

REDUCE THE FORMATION AND ACCUMULATION OF BYPRODUCTS LIKE DI-ETHYLBENZENE.

ADJUST REACTOR PARAMETERS

ADJUST REACTOR PARAMETERS AND RECYCLE FLOWS FOR BETTER SYSTEM PERFORMANCE.

FLOW SHEET AND BLOCK DIAGRAM OVERVIEW



FEED PREPARATION PROCESS

Purification of Benzene and Ethylene

Remove impurities from benzene and ethylene.

Ensure high-quality feed for the reaction process.

Compression of Feed

Compress benzene and ethylene for optimal conditions.

Increase pressure to enhance reaction efficiency.

Heating for Reaction Conditions

Heat the compressed feed to the required temperature.

Achieve optimal conditions for the reactor operation.

Feed Preparation Conclusion

Critical step to ensure purity and efficiency.

Sets the foundation for successful ethylbenzene production.

REACTION KINETICS ANALYSIS

01

Define Reaction Kinetics

Reaction kinetics refers to the study of the rates at which chemical reactions occur and the factors that influence these rates.

02

Importance of Reaction Kinetics

Understanding reaction kinetics is crucial for optimizing chemical processes, such as ethylbenzene production, to enhance efficiency and yield.

03

Factors Affecting Reaction Rates

Temperature, pressure, concentration of reactants, and catalysts play significant roles in determining the speed and efficiency of chemical reactions.

04

Key Reactions in Ethylbenzene Production

Primary reactions involve the conversion of ethylene and benzene to ethylbenzene, with side reactions leading to the formation of di-ethylbenzene and regeneration processes.

05

Reaction Rate Constants and Activation Energies

Reaction rate constants and activation energies are essential parameters that dictate the speed and selectivity of reactions in the ethylbenzene production system.

ENERGY CONSUMPTION BREAKDOWN

10 kWh

Compression

Compression of feed mixture.

8 kWh

Heating

Heating to reaction temperature.

15 kWh

Distillation

Separation of products and unreacted feed.

12 kWh

Reactor Operation

Operation of CSTR.

SEPARATION AND RECYCLE PROCESSES

ASPEN SIMULATION SETUP

Define Thermodynamic Properties

Utilize the Peng-Robinson equation of state for property calculations.

Implement Reactor Modeling

Employ a convergent reactor system to ensure precise control over temperature and pressure during the reaction process.

Utilize Distillation Modeling

Apply a rigorous stage-by-stage method in distillation columns for efficient separation of components.

Analyze Process Performance

Study the impact of operating conditions like temperature, pressure, and feed composition on conversion, selectivity, and yield.

Evaluate Energy Consumption

Summarize energy consumption for major unit operations including compression, heating, reactor operation, and distillation.

RESULTS: PROCESS PERFORMANCE ANALYSIS

85%

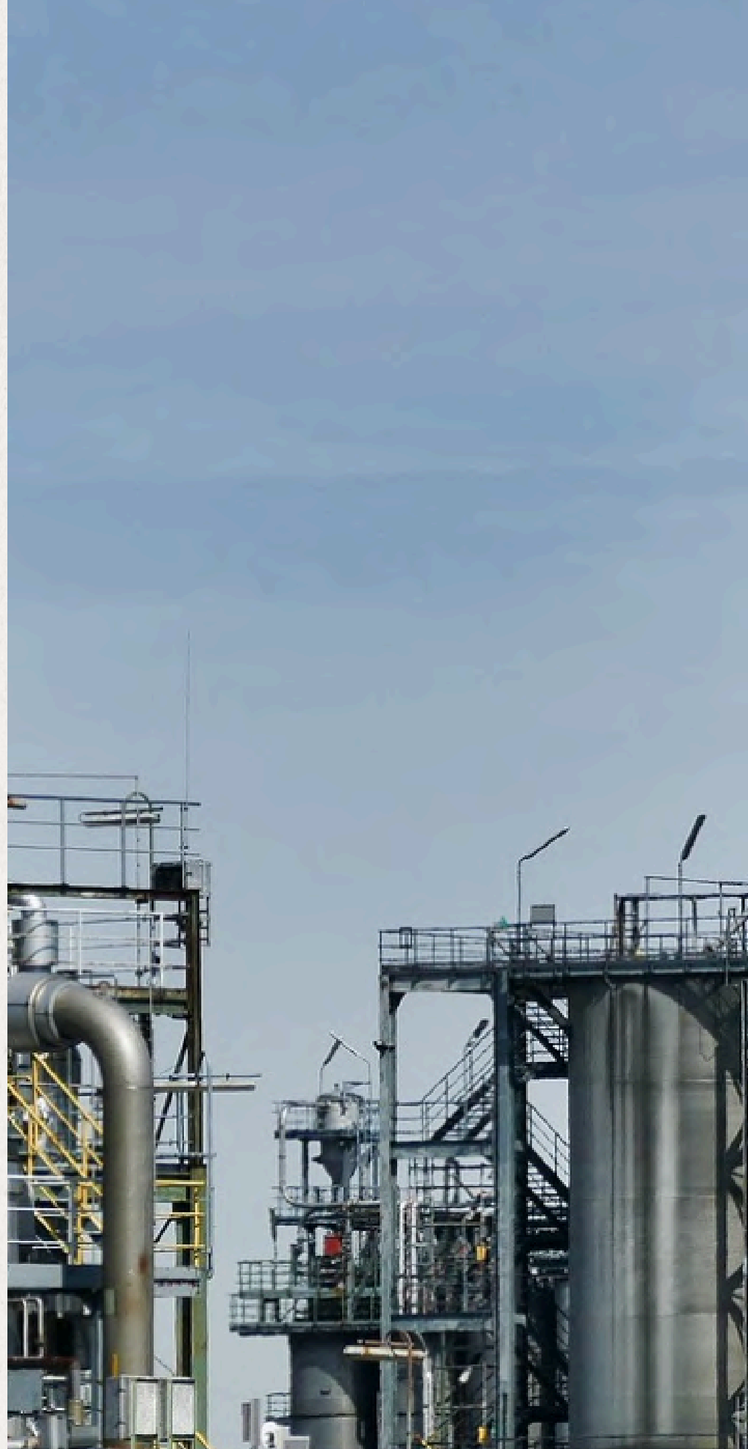
Ethylbenzene Selectivity

Process Performance Analysis

100%

Di-ethylbenzene Recycle

Process Performance Analysis



CONCLUSION AND KEY FINDINGS

45 kWh

Total Energy Consumption

The total energy consumed during the process.

99%

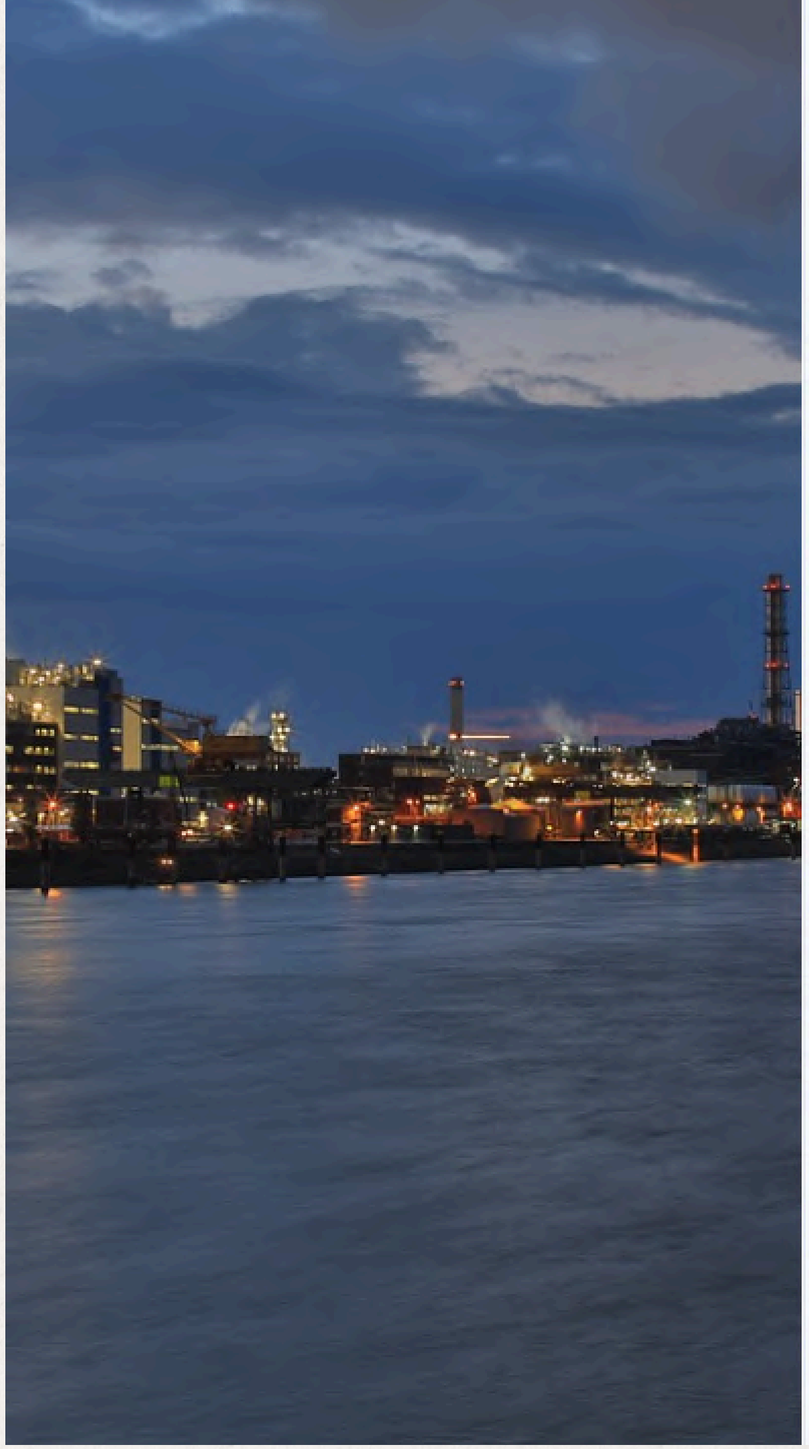
Maximum Ethylbenzene Yield

The highest yield of ethylbenzene achieved.

Achieved

By-Product Minimization

Successful minimization of by-products in the process.



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Thank you!

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