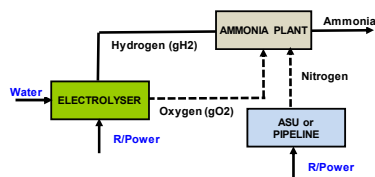
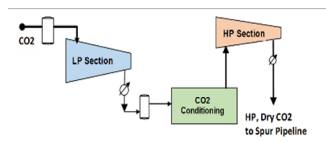


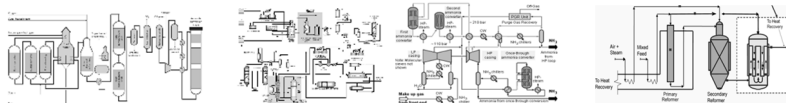
INTEGRATION STUDIES GREEN H2 & O2 ENRICHMENT



CO2 COMPRESSION & DEHYDRATION



TECHNOLOGY EVALUATION FOR CO2 REDUCTION & USE



OWNER'S ENGINEERS FOR EVALUATING & EXECUTING DECARBONIZATION SOLUTIONS

Decarbonization Consulting Advisory & Engg. Studies

Project Definition & Planning
Project Configurations
Technology Assessment
Project Risks & mitigation
Project Pre-feasibility
Project Cost Estimates
Design & Engg. Management
Critical Technical Reviews

SINCE 2005

Consulting to Decarbonize

by KPI Consulting, Houston

KPI has provided project development management and consulting services for over a dozen projects. KPI led the successful development of Four large projects as "Owner's Engineers" including a major Propylene derivatives complex in Saudi & ongoing CCS project at USGC. Our breadth of technology expertise coupled with our experience with various Decarbonization options provide the value addition for new projects and upgrading the existing facilities.

Expertise

- Ammonia Tech & Economics
- Methanol Tech & Economics
- H2 Production Tech & Economics
- OTF H2 Cost & Economic Analysis
- Ethylene & PDH Technologies
- SMR & ATR Syngas Technologies
- CO2 Capture Technologies (Pre & Post)
- CO2 Compression & Dehydration
- gH2/bH2 Integration Studies
- O2 Enrichment studies
- Green-Blue H2 & O2 Evaluation
- Strategic Project Planning
- Project definition & management
- Project Configuration Evaluations
- Technology & Risk Evaluation
- Due diligence- overall project
- Project Cost Estimates & Economics
- Project Pre-Feasibility
- Licensing/BEP Agreements reviews
- Project Execution support
- Critical Technical Reviews
- Simulation modeling

Resources

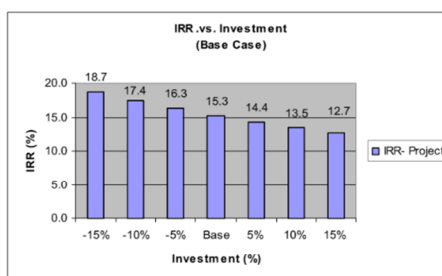
- Team of SME's- Houston office
- Working relations with Licensors
- Proven modeling & sizing tools
- Cost data base (*updated regularly*)

Projects/Studies Handled

- Green-Blue H2/NH3/MeOH Studies
- O2 Enrichment Studies
- g/bH2-NH3 Integration Studies
- Electric Pre-reformer
- CO2 Capture Feasibility Study
- CO2 Compression & Dehydration
- New Decarb Techn options studies
- Ammonia plant studies
- Methanol & value chain Studies
- Pet coke to Chemicals Studies
- Propane Dehydro (PDH) project
- Ethylene & value chain study
- Propylene value chain Project
- Oxo-Alcohol & derivatives project
- Acrylic Acid & derivatives project

References

SABIC, Advance Petrochemicals, Saudi Chevron, Tasnee, Chemanol, Methanol Holdings, Modi Group, D7 Petrochem, YCI, CFI, Nutrien, Yara, OCI, Dyno Nobel, CSBP Chemanol, Statoil, PPGPL, USGC



KPI Consulting

16000 Park Ten Pl.,
Suite#903

Houston- 77084 (USA)

Phone: 281 773 1629

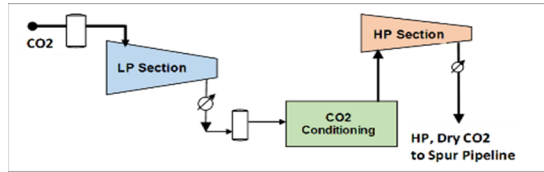
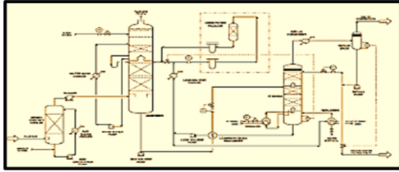
Fax: 832 565 9360

Email: info@kpieng.com

Web: kpieng.com, kpieng.net

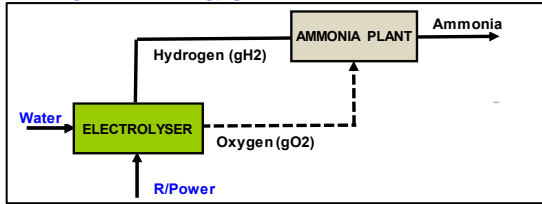


CO₂ CAPTURE, DEHYDRATION & COMPRESSION STUDIES

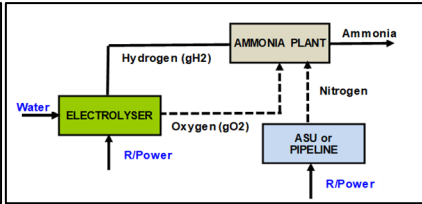


INTEGRATION STUDIES

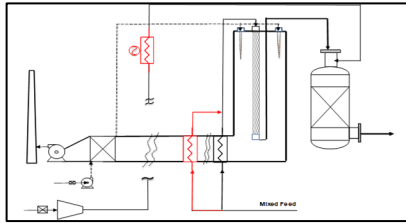
GREEN H₂ & O₂ ENRICHMENT



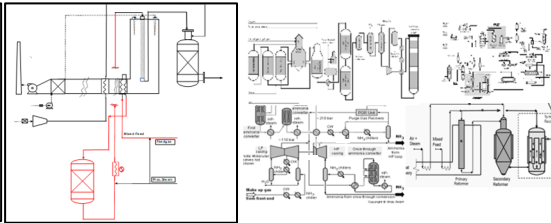
GREEN AMMONIA PLANT STUDIES



STUDY TO RECONFIGURE & ELECTRIFY FOR REDUCED FIRING



ATR & CO₂ REDUCTION TECHNOLOGY EVALUATION



COMPLETED SEVERAL DECARBONIZATION & CCS ENGINEERING STUDIES WITH COST ESTIMATES

Decarbonization Pathways & Solutions

by Kinetics Process Improvements, Houston

KPI-Houston is an Independent Process Technology & Consulting for Strategic analysis with in-depth Studies for CO₂ abatement pathways in Ammonia, Methanol & Petrochem plants. Also design and engg expertise in CO₂ capture, dehydration, Compression, Liquefaction including (g/b) H₂ integration, and O₂

Expertise & Services

- **Strategic Analysis & Studies**
 - ✓ CO₂ abatement Options
 - ✓ Green-Blue H₂/NH₃ options
 - ✓ Oxygen Enrichment
 - ✓ Ammonia Cracking
 - ✓ Plant Integration & Impact
 - ✓ New Technologies Evaluation
 - ✓ Project Risks
 - ✓ Costs & Economics
- **CO₂ Capture Technologies**
 - ✓ Pre-Combustion (syngas)
 - ✓ Post-Combustion (Flue gas)
- **CO₂ Dehydration & Clean-up**
 - ✓ Glycol units
 - ✓ Adsorbents/Molecular Sieves
- **CO₂ Transportation**
 - ✓ CO₂ Liquefaction
 - ✓ CO₂ Compression
- Supercritical CO₂ Equip. specs
- H₂ & O₂ Compression Specs
- Owner's Engineers

"Two Patents pending- Reducing CO₂ footprint in Primary Reformers"

Methodology

- Integration with gH₂/bH₂
- Electrify & O₂ Enrichment
- Reconfigure to reduce Firing
- CO₂ Capture & Utilization

Tools

- Simulation modeling & sizing
- Extensive Cost database
- Rigorous Economic models

Studies/Projects References

- gH₂/NH₃ Engg Study- 400 tpd
- gH₂/NH₃ integration study
- CCS study (2 x3000 tpd CO₂)
- CO₂ Capt/ Comp/ Dehy study
- CO₂ Capture from Flue gas
- CCS study (3900 tpd CO₂)
- Electric Pre-reforming Study
- O₂ Enrichment Study

End Users Served

- CFI, Nutrien, Dyno Nobel, Yara, OCI
- Chemanol, CSBP, Statoil, USGC

Decarbonization Strategies & Solutions in Ammonia, Methanol & Petrochem Plants

Green-Blue H₂ Integration Studies
Oxygen Enrichment Studies
CO₂ Capture Feasibility Studies
CO₂ Compression & Dehydration
H₂ Compression & O₂ removal
Oxygen Compression
New Technology Evaluation
Plant Impact & Engg Studies
Risk Assessment
Cost Estimates

SINCE 2005



Kinetics Process Improvements

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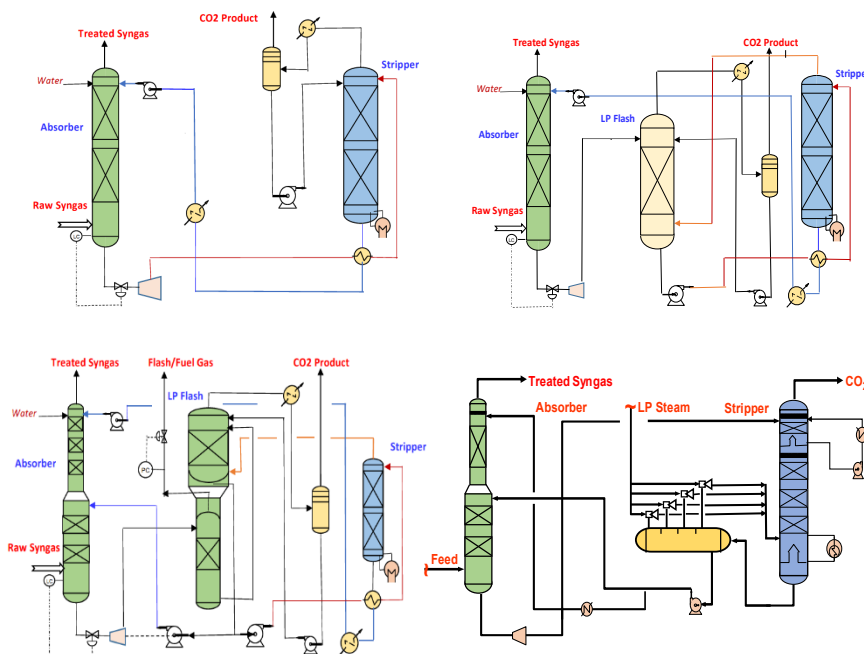
Fax: 832 565 9360

Email: process@kpieng.com

Web: kpieng.com, kpieng.net



"Completed over a dozen Engineering studies and six successful upgrades of pre-combustion CO₂ capture units"



CO2 Removal Systems Revamping & Upgrading

aMDEA & Benfield Systems for Higher Capacity Reduced CO2 Slip

IMPLEMENTED MANY SUCCESSFUL REVAMPS OF AMDEA & BENFIELD CO2 REMOVAL SYSTEMS

Revamping CO2 Removal Systems

By Kinetics Process Improvements, Houston

KPI-Houston is an Independent Process Technology, Design & Engg Consulting group specializing in Ammonia & Methanol Plants Revamps to improve the Capacity, Efficiency, and Reliability & CO2 footprint. Over 100 Revamp Studies completed

Revamp Experience

- **aMDEA Systems**
 - ✓ Single & Two Stages
 - ✓ Single-stage with LP flash
 - ✓ HP flash CO₂ recovery
 - ✓ Vac. Flash with LP Flash
 - ✓ Conversion of MEA to aMDEA
- **Benfield Systems**
 - ✓ With all Activators in use
 - ✓ All Process Configurations
 - ✓ Conversion to aMDEA study

Expertise & Services

- **Proven Simulation modeling**
 - ✓ aMDEA Systems
 - ✓ Benfield Systems
- Holistic approach
- Evaluation of Column internals
- Evaluation & sizing Flash Drum
- Evaluation & Sizing Ejectors
- Evaluation & Sizing Reboilers
- Equipment evaluation & sizing
- Revamp Cost Estimates
- Basic Process Design Package

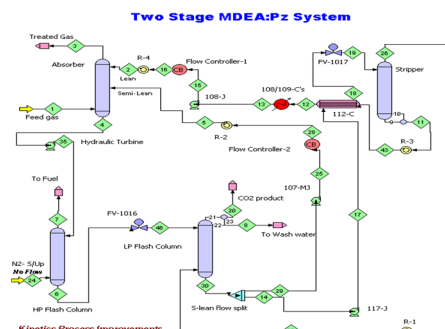
References

- **Revamp Engineering Studies:**
 - ✓ aMDEA- 1200 tpd Ammonia *
 - ✓ aMDEA- 3000 tpd Ammonia
 - ✓ aMDEA- 2520 tpd Ammonia *
 - ✓ aMDEA- 1950 tpd Ammonia *
 - ✓ Benfield-2200 tpd Ammonia *
 - ✓ Benfield-2200 tpd Ammonia *
 - ✓ Benfield-2250 tpd Ammonia *
 - ***Successfully Implemented**
- **Revamp approach/scope:**
 - ✓ Simulation modeling
 - ✓ Engineering Study
 - ✓ Equipment Evaluation & sizing
 - ✓ Budgetary Cost Estimation
- **Revamp objectives included:**
 - ✓ Reducing CO₂ Slippage
 - ✓ Higher Capacity
 - ✓ Equipment adequacy & sizing

End Users

Nutrien, CNC, N2000, LSB
CFI & YARA (for various site locations)

SINCE 2006



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Kinetics Process Improvements, Inc.

Independent Consultants & Engineers

Serving to Improve, Decarbonize & De-bottleneck

- **Ammonia Plants** (Integration with gH2L'' fCl m[Yb'9 bf]W a YbL
- **Methanol Plants** (Electrification)
- **Ethylene Plants** (New Tech evaluations)
- **PDH Plants**
- **Decarbonization Solutions**

- Technology Evaluation
- Project Cost Estimate
- Risk Assessment
- Due Dilligence
- Economic Evaluation

PROJECT FEASIBILITIES

REVAMP STUDIES

- Capacity/Efficiency Improvements
- Plant Energy Audits
- Reformer Re-ratings
- MIC™ Revamp without major compressor upgrades
- Synloop Optimizer

- Process & Technology
- Equipment:
Monitoring Techniques
Reliability Reviews
- Plant Modeling

CUSTOM PROCESS TRAINING

PROCESS DESIGN & ENGINEERING

- Basic Engineering Pkg
- Pilot Scale Up
- Process Simulations
- Converter Modeling



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