IRAJ ISAAC RAHMIM
SENIOR INDUSTRY CONSULTANT

CAREER PROFILE

Iraj Isaac Rahmim is a specialist in oil and gas processing technology. He holds B.S. and M.S. degrees from the University of California and a Ph.D. from Columbia University, all in chemical engineering. Dr. Rahmim consults and lectures extensively in the Middle East and the Americas in areas related to refining and gas processing and treating.

Previously employed with Mobil and Coastal Corporations, Dr. Rahmim's early career in Mobil involved responsibilities for the development and commercialization of a variety of refinery process technologies related to light gas processing, heavy end upgrading, and clean fuels manufacture. Later with Coastal, a major natural gas company in North America, he was responsible for identifying, assessing, and championing novel technology opportunities and solutions for integration into the company's assets. His recent consulting and training clients have included major US and international firms such as El Paso, Canadian Natural Resources, Proctor & Gamble, Kuwait Petroleum Corporation, and Abu Dhabi Gas Industries as well as a number firms with technologies and solutions with applications in the oil, gas, and petrochemical industries

Dr. Rahmim is a Director of the American Institute of Chemical Engineers (AIChE) Fuels and Petrochemicals Division, the past president of the International Association for Energy Economics—Houston, and an associate member of the State Bar of Texas (Oil, Gas, and Energy Resources Law Section). Elected Full Member of Sigma Xi in 1987, he holds 20 US and international patents in gas and refining processes, has authored papers in a variety of technical areas, and has presented in and chaired sessions at national and international conferences. Quoted by industry standards such as the *International Energy Agency (IEA)* and *Chemical Market Reporter*, his latest article on novel GTL technology was published as a special cover article report in the Oil and Gas Journal.

PROFESSIONAL EXPERIENCE

FIT, Inc. – Industry Consulting Practice 2005 – Present
Senior Industry Consultant

Provides both consulting services and training to the refining industry.

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Energy Consulting Practice 1999-Present
President and Principal Consultant

- Developed conceptual design for the cryogenic recovery of propylene and pentenes as alkylation unit feedstocks for a 150 MBD refinery in order to meet Tier II product specifications. Included HYSYS process simulation and complete design book.

- Assisted Canadian client in design of upgrader distillation column for heavy oil sands project.

- Assisted client in evaluation of novel hydrocracking and hydrotreating (including diesel desulfurization) technology and developed plans for future actions.

- Revamped complex computer model of refinery operations and crude/products economics. Used to advise US and foreign clients on operations, transportation, and trading options.

- Technical advisor on refining for a large US litigation case. Provided full range of litigation support services related to refinery planning and LPs, operations, maintenance, and product transportation and pricing.

- Technical advisor on gasoline storage stability, additives, and transportation issues to member of State of California Attorney General's Task Force on Gasoline Pricing. Contributed to the AG's report.

- Provided consulting with a number of US venture capitalists as well as technology providers on the state of GTL/Fischer-Tropsch technologies. Work included design and economic studies, technology evaluation and valuation, and market analysis (including impact on gasoline, diesel, lubes, and waxes).

- Developed and taught workshops in North and South America and the Middle East on Refining Fundamentals, Refining Technology and Operations, Refining Planning and Scheduling, Refining Economics, Clean Fuels Manufacture, Light Gas Upgrading and Petrochemicals Manufacture, Natural Gas Production and Processing, Natural Gas Treating and Sulfur Recovery, Crude Oil Production and Transportation, and Chemical Engineering Fundamentals.

Coastal Corporation – Technology and Business Development Department 1995-99
Principal Engineer promoted to Consultant

- Prepared technical proposal and business case for Fluid Catalytic Cracker (FCC) hardware revamp and navigated $4 million project through Board approval. Key liaison during design, execution, and troubleshooting. Implemented successfully with short-time payout.

- Steered joint corporate/profit-center committee responsible for analyzing, recommending, and implementing FCC operating and capital options. Realized benefit in excess of $1 million.

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- Client representative for conceptual design of $500 million greenfield refinery in Venezuela which included, among others, crude units, delayed coking, gasoline hydrotreating/desulfurization, and sulfur recovery and handling. Developed process, utilities, and offsites designs, schedules, operating and capital economics. Closely integrated with transportation (pipelines, shipping) and upstream.

- Evaluated impact of Venezuelan heavy crude properties on US refinery metallurgy including the interacting effects of crude properties and process conditions (such as flow regimes).

- Performed strategic analysis of refinery light gas upgrading hardware options and presented at highest corporate levels. Team recommendations approved, $20 million construction completed and in operation.

- Performed economic and technical analyses for a variety of refining and petrochemical plants throughout the US and internationally. These include a Russian refinery, a US Gulf Coast ethylene glycol facility, and a western US Asphalt, Lube, Wax plant.

- Evaluated a variety of processes using computer models, small-scale testing, preliminary process design, and economic feasibility analysis. These processes include:

Crude Oil H2S removal	Asphalt manufacture
Crude unit (incl. desalter and heat balance)	Polymer and refinery grade propane production
Visbreaker	Gas recovery train (incl. deC4 and deC3)
Delayed coker	Amine recovery unit
Naphtha hydrotreater	Sour water stripping
Microwave-based desulfurization	Sulfur recovery/tail gas unit
Biodesulfurization (also de-N/V/Ni/arom)	Hydrogen unit
	Utilities and offsites
Solid catalyst alkylation	Storage and transportation strategy (incl. pipelines, port, shipping)
Free-radical-based alkylation replacement	Centrifugal separation of xylenes
Lube oil dewaxing	Cumene manufacture

Mobil Corporation – Process R&D Division 1990-95
Senior Staff Engineer promoted to Research Engineer

- Member of team which developed refinery FCC hardware retrofits for improved stripper operations and increased gasoline production. Successfully implemented at five locations (cost < $500K, payout approx. $1.8M/year) and offered for licensing.

- Provided first-line technical support (including on-site testing, computer modeling, vendor coordination) to refinery FCC units in the Middle East, Japan, Europe, Australia, and US resulting in operational improvements and catalyst cost savings.

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- Led a number of testruns and studies of operation of FCC regenerators, strippers, reactors, standpipes, and transfer line sections. Included commercial testruns, theoretical analyses, cold flow and radioactive tracer and scanning studies.

- Implemented desktop computer application module at refinery allowing low-risk FCC optimization tests. Trained personnel in use and troubleshooting.

- Developed and spearheaded implementation of first systematic performance metrics at site. Used as model for implementation by other departments.

- Co-invented step-out zeolitic technology for manufacture of isobutylene, a key petrochemical and MTBE feedstock. Studies included detailed experimental and theoretical analysis. Closely worked with catalyst design team to develop materials with improved surface and pore properties. Led R&D project, and participated in commercialization joint venture. Obtained substantial patent coverage, US and worldwide, to ensure licensing dominance.

EDUCATION

Ph. D., Chemical Engineering, Columbia University, New York	1990
M. S., Chemical Engineering, University of California, Santa Barbara	1985
B. S., Chemical Engineering, University of California, San Diego	1983

ADDITIONAL INFORMATION

US Citizen
Fuels and Petrochemicals Division of the American Institute of Chemical Engineers (Director)
State Bar of Texas – Oil, Gas and Mineral Law Section (associate member)
International Association for Energy Economics (Houston chapter past-president)
Sigma Xi (elected full member 1987)

SELECTED PUBLICATIONS AND PRESENTATIONS

S. A. Kalota and I. I. Rahmim. "Solve the Five Most Common FCC Problems." Sixth International Conference on Refinery Processing. American Institute of Chemical Engineers. New Orleans. March 2003.

I. I. Rahmim and L. L. Upson. Co-chairs. "Recent Advances in Resid Catalytic Cracking." International Conference on Refinery Processing (1998).

L. L. Upson and I. I. Rahmim. Co-chairs. "Short Residence Time Catalytic Cracking." International Conference on Refinery Processing (1998).

R. D. Hill, I. I. Rahmim, and R. G. Rinker. "Experimental Study of the Production of NO, N_2O, and O_3 in a Simulated Atmospheric Corona." *Industrial and Engineering Chemistry Research.* **27**, pp. 1264-1269 (1988).

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I. I. Rahmim, A. Huss, D. N. Lissy, and D. J. Klocke. "Paraemetric Study of Butene Skeletal Isomerization Using Mobil Proprietary ICAT-2." Annual meeting of American Institute of Chemical Engineers. St. Louis, November 1993.

A. Huss, Jr., D. J. Klocke, D. N. Lissy, I. I. Rahmim. "ISOFIN—A Highly Selective Process for Olefin Skeletal Isomerization." Meeting of American Institute of Chemical Engineers. 1996.

I. I. Rahmim. "Review of 'Refining Overview–Petroleum, Processes and Products'." *Chemical Engineering Progress*. March 2001. Pp. 65-66.

I. I. Rahmim. "Gas-to-Liquid Technologies: Advances, Economics, Prospects." 26th International Conference of the International Association for Energy Economics. Prague. June 2003.

I. I. Rahmim. "The Promises and Limitations of Gas-to-Liquid Technology." Global Forum on Natural Gas. Galveston. May 2004.

I. I. Rahmim. "Special Report: Stranded Gas, Diesel Needs Push GTL Work." Oil and Gas Journal. March 14, 2005.

I. I. Rahmim. "Potential Impact of GTL Commercialization on the Fuels and Specialty Product Markets." National Petrochemicals and Refiners Association Annual Meeting. Salt Lake City. March 2006. (Accepted for publication.)

SELECTED PATENTS

I. I. Rahmim, A. Huss, Jr., D. N. Lissy, D. J. Klocke, and I. D. Johnson. "Highly Selective n-Olefin Isomerization Process Using Microcrystalline ZSM-22." U.S. patent 5,157,194. Issue date October 20, 1992.

M. R. Apelian, I. I. Rahmim, A. S. Fung, and A. Huss, Jr. "n-Olefin Skeletal Isomerization Process using Dicarboxylic Acid Treated Zeolites." U. S. patent 5,321,194. Issue date June 14, 1994.

I. I. Rahmim, A. Huss, Jr., D. N. Lissy, D. J. Klocke, and W. O. Haag. "Highly Selective n-Butene Isomerization Process using ZSM-35." U. S. patent 5,449,851. Issue date September 12, 1995.

A. Husain, A. Huss, Jr., and I. I. Rahmim. "Process for the Production of Alkylate Gasoline from FCC Light Aliphatics." U. S. patent 5,475,175. Issue date December 22, 1995.

A. Huss, Jr., I. I. Rahmim, and P. Wood. "Highly Selective n-Olefin Isomerization Process using Multiple Parallel Reactors." U. S. patent 5,489,726. Issue date February 6, 1996.

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W. O. Haag, A. Huss, Jr., D. J. Klocke, D. N. Lissy, and I. I. Rahmim. "Highly Selective n-Olefin Isomerization Process using Small Crystal ZSM-35 Catalyst." U. S. patent 5,516,959. Issue date May 14, 1996.

I. I. Rahmim, D. N. Lissy, A. Huss, Jr., and D. J. Klocke. "Highly Selective n-Olefin Isomerization Process using Low Zeolite Content ZSM-35 Catalyst." U. S. patent 5,523,511. Issue date June 4, 1996.

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