

# An Advanced Process Analysis System for Improving Chemical and Refinery Processes

## Abstract

An advanced process analysis system has been developed to perform comprehensive evaluations on chemical plants and refineries for process improvements. The system integrates programs for on-line optimization, chemical reactor analysis, flowsheeting, pinch analysis and pollution indices. These programs are used interactively and share plant data through a database. Results from applying the system to a Monsanto/IMC Agrico contact process for sulfuric acid include an increased profit, reduced emissions and improvements in the chemical reactors and heat exchanger network which demonstrates the applicability of the system for pollution prevention.

**Keywords:** on-line optimization, chemical reactor analysis, pinch analysis, pollution index

## Introduction

An advanced process analysis system has been developed which is to be used by process and plant engineers to develop innovative and economically viable ways to optimize and modify processes significantly beyond their current capabilities. With this system, process engineers interactively and simultaneously use programs for on-line optimization, chemical reactor analysis, flowsheeting, pinch analysis and pollution indices. The results can be process modifications and controls that reduce wastes and energy consumption, in addition to increased profit and improved efficiency of operations.

An overview diagram of the advanced process analysis system is given in Fig. 1, and referring to this figure, the chemical reactor analysis program (Saleh, Hopper and Walker, 1995) evaluates modifications to have the best chemical reactor type and operating conditions. The flowsheeting program and the EPA pollution index methodology (Cabezas, et al, 1997) identifies pollutants and determines modifications to have the best configuration for separations equipment. The pinch analysis program, THEN, (Knopf, 1993) evaluates modifications to integrate the network of heat exchangers,

are shared by each program. The database structure is shown in Fig. 2.

The program has been developed with industrial and academic collaboration using the Monsanto designed, IMC-Agrico sulfuric acid contact plant. Support has been provided by EPA, and the program will be available through the EPA Technical Assistance Tools program. In the following paragraphs, a brief description will be given of the programs used in the system, and results of applying the program to the IMC Agrico plant will demonstrate the system's capabilities.

## Flowsheeting

Process flowsheet development is through an interactive Windows interface. A detailed description is provided in the users manual (Telang, 1998). As the process flow diagram is

# Chemical Process Analysis

**Rosina Ehmann**



## **Chemical Process Analysis:**

**Chemical Process Analysis** William L. Luyben, Leonard A. Wenzel, 1988 *Analysis and Synthesis of Chemical Process Systems* K. Hartmann, K. Kaplick, 2016-10-06 The methods used by chemists and chemical engineers for the conception design and operation of chemical process systems have undergone significant changes in the last 10 years The most important of modern computer aided techniques are process analysis and process system synthesis both of which are closely related The first part of the book presents the principles of model building simulation and model application On the basis of an appropriate set of hierarchical levels of chemical systems the general strategy of analysis by deterministic and statistical methods is treated The second part deals with process system synthesis beginning with reaction path analysis One of the major features of this part are new methods for the synthesis of reactor networks separation sequences heat exchanger systems and entire chemical process systems by a combined procedure of heuristic rules and fuzzy set algorithms This procedure which is known as knowledge engineering is an efficient combination of human creativity and theoretically based knowledge This book which is illustrated by examples should prove extremely useful as a text for a senior graduate course for students of chemistry and chemical engineering and will also be invaluable for chemists and chemical engineers in research and industry and specialists dealing with the analysis and synthesis of process systems

**Process Analysis and Simulation in Chemical Engineering** Iván Darío Gil Chaves, Javier Ricardo Guevara López, José Luis García Zapata, Alexander Leguizamón Robayo, Gerardo Rodríguez Niño, 2015-11-27 This book offers a comprehensive coverage of process simulation and flowsheeting useful for undergraduate students of Chemical Engineering and Process Engineering as theoretical and practical support in Process Design Process Simulation Process Engineering Plant Design and Process Control courses The main concepts related to process simulation and application tools are presented and discussed in the framework of typical problems found in engineering design The topics presented in the chapters are organized in an inductive way starting from the more simplistic simulations up to some complex problems

*Analysis, Synthesis and Design of Chemical Processes* Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, 2008-12-24 The Leading Integrated Chemical Process Design Guide Now with New Problems New Projects and More More than ever effective design is the focal point of sound chemical engineering Analysis Synthesis and Design of Chemical Processes Third Edition presents design as a creative process that integrates both the big picture and the small details and knows which to stress when and why Realistic from start to finish this book moves readers beyond classroom exercises into open ended real world process problem solving The authors introduce integrated techniques for every facet of the discipline from finance to operations new plant design to existing process optimization This fully updated Third Edition presents entirely new problems at the end of every chapter It also adds extensive coverage of batch process design including realistic examples of equipment sizing for batch sequencing batch scheduling for multi product plants improving production via intermediate storage and parallel

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**Process Analysis and Design for Chemical Engineers** William Resnick,1981      **Chemical Process Analysis and Design Using Computers** Working Party on the Use of Computers in Chemical Engineering. Symposium,1982

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**Process Analysis** David Mautner Himmelblau, Kenneth B. Bischoff, 1965 [Analysis, Synthesis, and Design of Chemical Processes, Fifth Edition](#) Richard Bailie C., Wallace Whiting B., Joseph Shaeiwitz A., Richard Turton. Debangsu Bhattacharyya, 2018

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**Guidelines for Chemical Process Quantitative Risk Analysis** CCPS (Center for Chemical Process Safety), 1999-10-15 Chemical process quantitative risk analysis (CPQRA) as applied to the CPI was first fully described in the first edition of this CCPS Guidelines book. This second edition is packed with information reflecting advances in this evolving methodology and includes worked examples on a CD-ROM. CPQRA is used to identify incident scenarios and evaluate their risk by defining the probability of failure, the various consequences, and the potential impact of those consequences. It is an invaluable methodology to evaluate these when qualitative analysis cannot provide adequate understanding and when more information is needed for risk management. This technique provides a means to evaluate acute hazards and alternative risk reduction strategies and identify areas for cost-effective risk reduction. There are no simple answers when complex issues are concerned, but CPQRA2 offers a cogent, well-illustrated guide to applying these risk analysis techniques, particularly to risk control studies. Special Details: Includes CD-ROM with example problems worked using Excel and Quattro Pro. For use with Windows 95, 98, and NT.

**Chemical Process Engineering Volume 1** Rahmat Sotudeh-Gharebagh, A. Kayode Coker, 2022-05-03 Written by two of the most prolific and respected chemical engineers in the world, this groundbreaking two-volume set is the new standard in the industry, offering engineers and students alike the most up-to-date, comprehensive, and state-of-the-art coverage of processes and best practices in the field today. This first new volume in a two-volume set explores and describes integrating new tools for engineering education and practice for better utilization of the existing knowledge on process design. Useful not only for students, professors, scientists, and practitioners, especially process, chemical, mechanical, and metallurgical engineers, it is also a valuable reference for other engineers, consultants, technicians, and scientists concerned about various aspects of industrial design. The text can be considered as a complementary text to process design for senior and graduate students as

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