

**REVISED:** December 2013**NAME:** Larry Eugene Erickson**YEAR BORN:** 1938**TITLE:** Professor of Chemical Engineering and Director, Center for Hazardous Substance Research**DEGREES:** B.S. Ch.E. Kansas State University, 1960  
Ph.D. Kansas State University, 1964**EXPERIENCE:**

Natural Gas Production Engineer, Mobil Oil Co., Summer 1959  
 Research Engineer (Polymer Chemistry), ESSO Research & Engineering Co., summer 1960  
 National Defense Education Act Fellow, 1960-63  
 Research Engineer (Process Control), Humble Oil & Refining Co., Summer 1961  
 Graduate Teaching Assistant, Kansas State University (2/5 time), 1962-63  
 National Science Foundation Fellow, 1963-64  
 Instructor, Kansas State University, 1964-65  
 Office of Saline Water Grant on Optimal Desalination Systems, 1965-1969  
 NSF Conference on Optimization Theory for Chemical Engineering Professors, lecturer and participant, summer 1965  
 Office of Saline Water Grant on Desalination by the Inversion in the Order of Melting by Applied Pressure, 1965 to 1967  
 Office of Water Resources Research Grant on Optimal Aeration Systems, 1965 to 1967  
 Assistant Professor, Kansas State University, 1965-67  
 Washington University Conference on Chemical Engineering Design Education, speaker and participant, summer 1966  
 Mid-America State Universities Association Conference on Modern Optimization Techniques and their Application in Engineering Design, lecturer and participant, December 1966  
 Dupont Summer Grant on the Optimal Design of Biochemical Processing Systems, summer 1967  
 Kansas Water Resources Research Institute Grant on Optimization of Step Aeration Waste Treatment Systems, 1967 to 1969  
 Water Pollution Control Administration Grant on the Optimal Design of Waste Treatment Systems, 1967 to 1972  
 Public Health Service Special Research Fellow at University of Pennsylvania, 1967-68  
 NASA Grant on Optimization of Life Support Systems and Their System Reliability, 1968 to 1971  
 Associate Professor, Kansas State University, 1968 to 1972  
 Office of Water Resources Research Grant on Modeling and Optimization of Water Resources Systems, 1968 to 1971  
 Office of Water Resources Research Matching Grant on Water Quality Modeling and Prediction, 1968 to 1973

continued

Kansas Water Resources Research Institute Grant on Experimental Optimization of Step  
 Aeration Waste Treatment Systems, 1969 to 1971  
 Public Health Service Research Career Development Award, 1970 to 1975  
 Professor, Kansas State University, 1972 to present  
 Kansas Water Resources Research Institute Grant on Design and Control of Transient  
 Waste Treatment Processes, 1971 to 1973  
 National Science Foundation Grant on Tower Systems for Microbial Growth 1972 to  
 1973  
 Consultant-Development Planning and Research Associates, 1972 to 1973  
 Consultant-Organization of American States, 1973  
 National Science Foundation Grant on Mass Transfer, Mixing and Growth in Tower  
 Fermentors with Motionless Mixers, 1974 to 1977  
 Visiting Scientist, Nutrition and Food Science, MIT, February 1975  
 Visiting Scientist in USSR, US-USSR Cooperative Research Program in Microbiology,  
 May-June 1975  
 Visiting Scientist in USSR, National Academy of Sciences Exchange Program,  
 September 1977-January 1978  
 National Science Foundation Grant on Synthesis of Optimal Tower Fermentation  
 Systems for Growth and Transport, 1977 to 1980  
 Department of Energy Grant on Development and Application of Material and Energy  
 Balance Regularities for Renewable Energy Resources, 1979-1981  
 National Science Foundation Grant on Applications of Mass and Energy Balance  
 Regularities in Biochemical Engineering, 1980-1984  
 National Science Foundation Grant on Synthesis of Optimal Tower Fermentors for  
 Viscous Fermentations, 1981-1986  
 U.S. Department of Agriculture Grant on Developing Scientific Expertise in  
 Characterizing and Processing Cereal and Animal Products, 1984-1988  
 National Science Foundation Grant on Development of Models and Continuous Culture  
 Theory for Photosynthetic Microbial Growth, 1984-1988  
 Visiting Professor, Chemical Engineering, University of California, Berkeley, Fall  
 Semester, 1985  
 Director, Office of Hazardous Waste Research, Kansas State University, 1985-1989  
 U.S.G.S. Cooperative Agreement for a Remedial Investigation and Feasibility Study of  
 Acid Sludge Waste at the Arkansas City Dump Site, Cowley County, Kansas,  
 1986-1988  
 NSF Grant on Transport Phenomena Associated with Gas-Liquid Dispersions in Tower  
 Fermentors for Plant and Animal Cell Culture Applications, 1987-1991  
 Environmental Protection Agency Grant for Hazardous Substance Research Center for  
 U.S. EPA Regions 7 and 8: Great Plains/Rocky Mountain Hazardous Substance  
 Research Center, 1989-present; Center Director, 1989-2003  
 National Science Foundation Grant on Environmental Air Quality, 2000-2004  
 U.S. Department of Defense Grant for Establishment of the NEER (Nonlethal  
 Environmental Evaluation and Remediation) Center, 2001-present; Center  
 Director, 2001-present  
 NSF Grant Combined Research - Curriculum Development (CRCD) in  
 Geoenvironmental Engineering, 2003-2007

continued

U.S. Department of Defense Subcontract through M2 Technologies for the Urban Operations Environmental Laboratory, 2002-2011.  
 Bioremediation of Chlorinated Dry Cleaning Solvents, Kansas Department of Health and Environment, 2004-2007.  
 National Science Foundation Grant, REU "Earth, Wind, and Fire: Sustainable Energy for the 21st Century," 2009-2015.  
 Westar and Burns and McDonnell, "Westar Wetlands Pilot Project," 2011-2012.  
 Certified Food Scientist by the International Food Science Certification Commission, Institute of Food Technologists, April 1, 2013 – present.

#### **HONORARY AND PROFESSIONAL SOCIETIES:**

Sigma Xi, Phi Kappa Phi, Phi Lambda Upsilon, Tau Beta Pi, Sigma Tau, American Institute of Chemical Engineers, Water Environment Federation, American Chemical Society, American Society for Microbiology, American Water Resources Association, The Society of Fermentation Technology (Japan), New York Academy of Sciences, American Society for Engineering Education, Kansas Academy of Sciences, Institute of Food Technologists, American Water Works Association, Society for Industrial Microbiology, Association of Ground Water Scientists and Engineers, Air and Waste Management Association

#### **HONORS:**

Halliburton Education Foundation Award of Excellence, 1985-1988  
 College of Engineering Advisor of the Year, 1987-1988  
 Sigma Xi Outstanding Scientist Award, Kansas State University, 1988  
 Beta Sigma Psi Lienemann Award, 1994  
 Phi Tau Sigma Outstanding Food Scientist Award, Kansas State University, 1995  
 Coauthor of outstanding poster at HSRC/WERC Joint Conference on the Environment, 1996  
 Kansas State University Professor of the Week, September, 2000  
 Irvin E. Youngberg Award, University of Kansas, 2001  
 Fellow of the American Institute of Chemical Engineers, 2001  
 Commerce Bank Distinguished Graduate Faculty Award, 2003  
 Engineering Research Excellence Award, 2003  
 Best Theoretical Paper Award, Practice Periodical of Hazardous Toxic and Radioactive Waste Management, 2004  
 Phi Kappa Phi Faculty Scholar Award, Kansas State University, 2006  
 AIChE Environmental Division, Lawrence K. Cecil Award, 2006  
 Making a Difference Award, Women in Engineering and Science Program, Kansas State University, 2007  
 Luther Achievement Award, Midland Lutheran College, 2007  
 KACEE Award for Excellence in Conservation and Environmental Education, 2008  
 International Phytotechnology Society Milton Gordon Award, 2010  
 Fellow of the Industrial and Engineering Chemistry Division of the American Chemical Society, 2013  
 Kansas State University Academy of Fellows, 2013

#### **FIELDS OF RESEARCH COMPETENCE:**

continued

Mathematical Optimization Techniques  
 Transport Phenomena  
 Process Design  
 Biochemical Engineering  
 Desalination  
 Biological Waste Treatment  
 Food Engineering  
 Environmental Engineering  
 Sustainability

## PROFESSIONAL PUBLICATIONS:

### A. Monographs and Books

1. Fan, L.T., in collaboration with T.C. Chen, S.J. Chen, Y.K. Ahn, C.L. Hwang, C.S. Wang, Y.C. Ko, L.E. Erickson, and L.S. Fan, *The Continuous Maximum Principle*, John Wiley & Sons, Inc., NY (1966).
2. P.S. Shah, L.T. Fan, I.C. Kao, and L.E. Erickson, "Modeling of Growth Processes with Two Liquid Phases: A Review of Drop Phenomena, Mixing and Growth" *Advances in Applied Microbiology*, Vol. 15, pp. 367-413 (1972).
3. Erickson, L.E. and G. Stephanopoulos, "Biological Reactors," *Chemical Reaction and Reactor Engineering*, J.J. Carberry and A. Varma (Eds.), pp. 779-838, Marcel Dekker, Inc., NY (1987).
4. Erickson, L.E., "Energy Requirements in Biological Systems" *Thermal and Energetic Studies of Cellular Biological Systems*, A.M. James, Ed., pp. 14-33, Wright, Bristol, England (1987).
5. Erickson, L.E. and D.Y.C. Fung, Editors, *Handbook on Anaerobic Fermentations*, Marcel Dekker, Inc., NY (1988).
6. Erickson, L.E., D.Y.C. Fung, and P. Tuitemwong, "Anaerobic Fermentations," *Biotechnology*, Vol. 3, *Bioprocessing*, G. Stephanopoulos, Vol. Ed., H.J. Rehm and G. Reed, Ed., 2nd Edition, pp. 295-318, VCH, New York (1993).
7. Erickson, L.E., R.J. Koodali, and R.M. Richards, Editors. 2010. *Nanoscale Materials in Chemistry: Environmental Applications*, ACS Symposium Series, Vol. 1045, American Chemical Society, Washington, D.C.

### B. Journal Articles and Reports

1. Erickson, L.E., C.S. Wang, C.L. Hwang, and L.T. Fan, "Heat Transfer to Magnetohydrodynamic Flow in a Flat Duct," *Journal of Applied Mathematics and Physics (ZAMP)*, Vol. 15, Fasc, 4, 408-418 (1964).

2. Erickson, L.E., L.T. Fan, and V.G. Fox, "Heat and Mass Transfer on a Moving Continuous Flat Plate with Suction or Injection," I.E.C. Fundamentals, 5, 19-25 (1966).
3. Erickson, L.E., L.C. Cha, and L.T. Fan, "The Cooling of a Moving Continuous Flat Sheet," Chemical Engineering Progress Symposium Series, Vol. 62, No. 64, 157-165 (1966).
4. Erickson, L.E. and L.T. Fan, "Tabular Solutions of the Blasius Equation for a Moving Continuous Flat Sheet for Various Amounts of Suction and Injection," Special Report No. 59, Kansas Engineering Experiment Station, Manhattan, KS (1966).
5. Fan, L.T., L.E. Erickson, R.W. Sucher, and G.S. Mathad, "Optimal Design of a Sequence of Continuous Flow Stirred-Tank Reactors with Product Recycle," I.E.C. Process Design and Development, 4, 431-434 (1965).
6. Ahn, Y.K., L.T. Fan, and L.E. Erickson, "Effects of Product Recycle and Temperature on Autocatalytic Reactions," A.I.Ch.E. Journal, 12, 534-540 (1966).
7. Chen, Y.C., C.Y. Cheng, L.E. Erickson, C.L. Hwang, and L.T. Fan, "Process Analysis and Design of a Reverse Osmosis Water Purification System," ACS Division of Water, Air, and Waste Chemistry, General Papers Vol. 6, No. 1, 29-35 (1966).
8. Fan, L.T., C.Y. Cheng, C.L. Hwang, L.E. Erickson, and K.D. Kiang, "Analysis and Optimization of a Multieffect, Multistage Flash Evaporation System," Special Report No. 74, Kansas Engineering Experiment Station, Manhattan, KS (1967).
9. Fan, L.T., E.S. Lee, and L.E. Erickson, "Unconstrained Optimization and the Differential Calculus," "Equality Constraints and Optimization," "Geometric Programming," "Dynamic Programming," and "Calculus of Variations," Proceedings of the MASUA Conference on Modern Optimization Techniques and their Application in Engineering Design, Part I, Manhattan, KS (1967).
10. Hwang, C.L., L.T. Fan, and L.E. Erickson, "Optimum Production Planning by the Maximum Principle," Management Science, 13, 751 (1967).
11. Fan, L.T., E.S. Lee, L.E. Erickson, and C.L. Hwang, "The Optimal Design of Desalination Systems," Second European Symposium on Fresh Water from the Sea, Athens, Greece, May 9-16, 1967; Preprint Paper No. 114, Vol. 4 of Symposium preprints; Desalination, 3, 225 (1967).
12. Fan, L.T., E.S. Lee, and L.E. Erickson, "Search Techniques" and "Linear Programming," Proceedings of the MASUA Conference on Modern Optimization Techniques and their Application in Engineering Design, Part II, Manhattan, KS (1967).

13. Fan, L.T., C.Y. Cheng, L.Y.S. Ho, C.L. Hwang, and L.E. Erickson, "Analysis and Optimization of a Reverse Osmosis Water Purification System," Special Report No. 73, Kansas Engineering Experiment Station, Manhattan, KS (1967).
14. Erickson, L.E. and L.T. Fan, "Optimization of the Hydraulic Regime of Activated Sludge Systems," Water Pollution Control Federation Journal, 40, 345 (1968).
15. Erickson, L.E., Y.S. Ho, and L.T. Fan, "Modeling and Optimization of Step Aeration Waste Treatment Systems," Water Pollution Control Federation Journal, 40, 717 (1968).
16. Miner, J.R., R.I. Lipper and L.E. Erickson, "Modeling Feedlot Runoff Pollution," Trans. ASAE, 10, 497 (1967).
17. Fan, L.T., C.Y. Cheng, C.L. Hwang, L.E. Erickson and K.D. Kiang, "Analysis and Optimization of a Multieffect Multistage Flash Distillation System - Part I. Process Analysis," Desalination, 4, 336-360 (1968).
18. Fan, L.T., C.Y. Cheng, C.L. Hwang, L.E. Erickson and K.D. Kiang, "Analysis and Optimization of a Multieffect Multistage Flash Distillation System - Part II Optimization," Desalination, 4, 361-388 (1968).
19. Fox, V.G., L.E. Erickson, and L.T. Fan, "Methods for Solving the Boundary Layer Equations for Moving Continuous Flat Surfaces with Suction and Injection," A.I.Ch.E. Journal, 14, 726-736 (1968).
20. Erickson, L.E., G.K.C. Chen, and L.T. Fan, "Modeling and Optimization of Biological Waste Treatment Systems," Chem. Engg. Progr. Symp. Series, 64, No. 90, 97 (1968).
21. Fan, L.T., C.Y. Cheng, L.Y.S. Ho, C.L. Hwang, and L.E. Erickson, "Analysis and Optimization of a Reverse Osmosis Water Purification System - Part I. Process Analysis and Simulation," Desalination, 5, 237-265 (1968).
22. Fan, L.T., L.E. Erickson, J.T. Tseng, C.L. Hwang, and C.Y. Cheng, "Analysis of a Reverse Osmosis Water Purification System and its Optimization Based on the Plug Flow Model for the Bulk Flow in the Membrane Unit," Report No. 13, Institute for Systems Design and Optimization, Kansas State University, 1969.
23. Fox, V.G., L.E. Erickson, and L.T. Fan, "The Laminar Boundary Layer on a Moving Continuous Flat Sheet Immersed in a Non-Newtonian Fluid," AIChE Journal, 15, 327 (1969).
24. Fan, L.T., P.S. Shah, and L.E. Erickson, "Simulation of Reacting Systems Using S/360 CSMP" Proceedings of the Conference on Applications of Continuous System Simulation Languages, 63, San Francisco, CA (June 1969).

25. Tsai, B.I., L.E. Erickson, and L.T. Fan, "The Effect of Micromixing on Growth Processes," *Biotechnology and Bioengineering*, XI, 181 (1969).
26. Erickson, L.E., A.E. Humphrey, and A. Prokop, "Growth Models of Cultures with Two Liquid Phases I. Substrate Dissolved in Dispersed Phase," *Biotechnology and Bioengineering* XI, 449 (1969).
27. Erickson, L.E. and A.E. Humphrey, "Growth Models of Cultures with Two Liquid Phases II. Pure Substrate in Dispersed Phase," *Biotechnology and Bioengineering* XI, 467 (1969).
28. Erickson, L.E. and A.E. Humphrey, "Growth Models of Cultures with Two Liquid Phases III. Continuous Cultures," *Biotechnology and Bioengineering* XI, 489 (1969).
29. Fan, L.T., C.Y. Cheng, L.Y.S. Ho, C.L. Hwang and L.E. Erickson, "Analysis and Optimization of a Reverse Osmosis Water Purification System - Part II Optimization," *Desalination*, 6, 131 (1969).
30. Fan, L.T., C.L. Hwang, N.C. Pereira, L.E. Erickson, and C.Y. Cheng, "Systems Analysis and Optimization of Dual Purpose Nuclear Power and Desalting Plants," Report No. 16, Institute for Systems Design and Optimization, Kansas State University (1969).
31. Erickson, L.E., L.T. Fan, E.S. Lee, and D.L. Meyer, "A Nonlinear Model of a Water Reservoir System with Multiple Uses and Its Optimization by Combined Use of Dynamic Programming and Pattern Search Techniques," *Water Resources Bulletin*, 5, No. 3, 18 (1969).
32. Prokop, A., L.E. Erickson, J. Fernandez, and A.E. Humphrey, "Design and Physical Characteristics of a Multistage Continuous Tower Fermentor," *Biotechnology and Bioengineering*, XI, 945 (1969).
33. Shastry, J.S., L.T. Fan and L.E. Erickson, Discussion of "Reaeration Prediction in Natural Streams," by E.L. Thackston and P.A. Krenkel, *Journal of the Sanitary Engineering Division, ASCE*, 95, SA6, 1186 (1969).
34. McDermott, C., E.S. Lee, and L.E. Erickson, "Iterative Techniques in Optimization: II. The Linearity Difficulty in Dynamic Programming and Quasilinearization," *A.I.Ch.E. Journal*, 16, 639 (1970).
35. Shastry, J.S., L.T. Fan, and L.E. Erickson, "Collection and Analysis of Water Quality Data," Special Report No. 19, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1970).

36. Fan, L.T., P.S. Shah, and L.E. Erickson, "Simulation of Biological Processes by Analog and Digital Computers," Special Report No. 20, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1970).
37. Osakada, K., N.C. Pereira, L.T. Fan, C.L. Hwang, and L.E. Erickson, "Systems Analysis and Optimization of an Electrodialysis Desalination Process," Special Report No. 21, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1970).
38. Fan, L.T., G.K.C. Chen, L.E. Erickson, and M. Naito, "Effects of Axial Dispersion on the Optimal Design of the Activated Sludge Process," *Water Research*, 4, 271 (1970).
39. Fan, L.T., J.T. Tseng, C.L. Hwang, L.E. Erickson, "System Analysis and Economic Optimization of Reverse Osmosis Desalination Processes," *Proceedings 3rd International Symposium on Fresh Water from the sea*, Vol. 2, 371-384 (1970).
40. Fan, L.T., C.L. Hwang, N.C. Pereira, L.E. Erickson, and C.Y. Cheng, "Systems Analysis and Economic Optimization of Dual Purpose Power and Desalting Systems," *Proceedings 3rd International Symposium on Fresh Water from the Sea*, Vol. 3, 231-251 (1970).
41. Chen, M.S.K., L.E. Erickson, and L.T. Fan, "Consideration of Sensitivity and Parameter Uncertainty in Optimal Process Design," *I.E.C. Process Design and Development*, 9, 514 (1970).
42. Fan, L.T., B.I. Tsai, and L.E. Erickson, "Simultaneous Effect of Macromixing and Micromixing on Growth Processes," *A.I.Ch.E. Journal*, 17, 689 (1971).
43. Fan, L.T., L.E. Erickson, P.S. Shah and B.I. Tsai, "Effect of Mixing on the Washout and Steady State Performance of Continuous Cultures," *Biotechnology and Bioengineering*, 12, 1019 (1970).
44. Fan, L.T., J.S. Shastry, and L.E. Erickson, "On the Analysis and Use of Water Quality Data," *Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management*, Water Resources Center, University of Wisconsin, Madison, WI (1970).
45. Erickson, L.E., L.T. Fan, P.S. Shah and M.S.K. Chen, "Growth Models of Cultures with Two Liquid Phases: IV. Cell Adsorption, Drop Size Distribution, and Batch Growth," *Biotechnology and Bioengineering*, 12, 712 (1970).
46. Prokop, A., L.E. Erickson, and O. Paredes-Lopez, "Growth Models of Cultures with Two Liquid Phases V. Substrate Dissolved in Dispersed Phase - Experimental Observations," *Biotechnology and Bioengineering*, 13, 859 (1970).

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47. Kang, S.F., L.T. Fan, E.S. Lee, and L.E. Erickson, "Modeling Feedlot Runoff Pollution: I. Analog Simulation," Transactions of ASAE, 13, 864 (1970).
48. Kang, S.F., L.T. Fan, E.S. Lee, and L.E. Erickson, "Modeling Feedlot Runoff Pollution: II. Quasilinearization," Transactions of ASAE, 13, 864 (1970).
49. Shastry, J.S., L.T. Fan, and L.E. Erickson, "Use of Spectral Analysis in Analyzing Water Quality Data," Report No. 25, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1971).
50. Fan, L.T., G.K.C. Chen, and L.E. Erickson, "Efficiency and Utility of Collocation Methods in Solving the Performance Equations of Flow Chemical Reactors with Axial Dispersion" Chem. Engg. Sci., 26, 379 (1971).
51. Lee, S.S., L.E. Erickson, and L.T. Fan, "Modeling and Optimization of a Tower-Type Activated Sludge System" Biotechnology and Bioengineering Symp. No. 2, 141 (1971).
52. Tsai, B.I., L.T. Fan, L.E. Erickson, and M.S.K. Chen, "The Reversed Two-environment Model of Micromixing and Growth Processes" Journal of Applied Chemistry and Biotechnology, 21, 307 (1971).
53. Fan, L.T., R.S. Nadkarni, and L.E. Erickson, "Management of Optimum Water Quality in a Stream," Water Research, 5, 1005 (1971).
54. Choi, S.K., L.T. Fan, L.E. Erickson, and R.I. Lipper, "Transport Rate of COD through a Wet Porous Stratum - Measurement of Diffusivity of Cattle Manure Solution" Transactions American Society of Agricultural Engineers, 14, 720 (1971).
55. Fan, L.T., R.S. Nadkarni, and L.E. Erickson, "Dispersion Model for a Stream with Several Waste Inputs and Water Intakes" Water Resources Bulletin, 7, 1210 (1971).
56. Choi, S.K., L.T. Fan, and L.E. Erickson, "Simultaneous Dispersion and Decay of Radioactive Wastes" Health Physics, 22, 177 (1972).
57. Humphrey, A.E. and L.E. Erickson, "Kinetics of Growth on Aqueous - Oil and Aqueous - Solid Dispersed Systems," Journal of Applied Chemistry and Biotechnology, 22, 125 (1972).
58. Erickson, L.E., S.S. Lee, and L.T. Fan, "Modeling and Analysis of Tower Fermentation Processes I. Steady State Performance" Journal of Applied Chemistry and Biotechnology, 22, 199 (1972).
59. Chiu, S.Y., L.T. Fan, I.C. Kao, and L.E. Erickson, "Kinetic Behavior of Mixed Populations of Activated Sludge," Biotech. and Bioeng., 14, 179 (1972).

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60. Chiu, S.Y., L.E. Erickson, L.T. Fan, and I.C. Kao, "Kinetic Model Identification in Mixed Populations Using Continuous Culture Data" *Biotechn. and Bioeng.*, 14, 207 (1972).
61. Shah, P.S., L.T. Fan, J.C. Baltes, and L.E. Erickson, "Washout and Steady State Analysis of a Two Stage Continuous Anaerobic Digester System" Report 35, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1972).
62. Walawender, W.P., L.T. Fan, and L.E. Erickson, "Feedlot Manure and Other Agricultural Wastes as Future Material and Energy Resources: I. Introduction and Literature Review" Report 36, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1972).
63. Chen, G.K.C., L.T. Fan, and L.E. Erickson, "On the Merits of Partial Fluid Mixing in the Biochemical Reactor System" *Can. J. of Chem. Engg.*, 50, 157 (1972).
64. Chen, G.K.C., L.T. Fan and L.E. Erickson, "Computer Software for Wastewater Treatment Plant Design" *Journal Water Pollution Control Federation*, 44, 746 (1972).
65. Kao, I.C., D.E. Robker, L.T. Fan, A. Snyder, and L.E. Erickson, "Analysis and Properties of a Quaternary Ammonium Triiodide Ion Exchange Sterilization Process," *Journal of Fermentation Technology*, 50, 438 (1972).
66. Shah, P.S., L.E. Erickson, L.T. Fan and A. Prokop, "Growth Models of Cultures with Two Liquid Phases. VI. Parameter Estimation and Statistical Analysis," *Biotechnology and Bioengineering*, 14, 533 (1972).
67. Prokop, A. and L.E. Erickson, "Growth Models of Cultures with Two Liquid Phases. VII. Substrate Dissolved in Dispersed Phase; Effect of Dispersed Phase Volume and Temperature," *Biotechnology and Bioengineering*, 14, 571 (1972).
68. Prokop, A., M. Ludvik, and L.E. Erickson, "Growth Models of Cultures with Two Liquid Phases, VIII. Experimental Observations on Droplet Size and Interfacial Area," *Biotechnology and Bioengineering*, 14, 587 (1972).
69. Shastry, J.S., L.T. Fan and L.E. Erickson, "Analysis of Water Quality Using Spectral Analysis," *Water, Air and Soil Pollution*, 1, 233 (1972).
70. Fan, L.T., C.L. Hwang, N.C. Pereira, L.E. Erickson, and C.Y. Cheng, "Systems Analysis of Dual-Purpose Nuclear Power and Desalting Plants, Part I. Optimization," *Desalination*, 11, 217 (1972).
71. Shah, P.S., L.T. Fan, and L.E. Erickson, "Modeling of Fermentations with Two Liquid Phases: Effects of Segregation on Continuous Fermentations," *Proceedings First Pacific Chemical Engineering Congress, Kyoto, Japan, Session 6*, p. 91 (1972).

72. Choi, S.K., L.T. Fan, L.E. Erickson, and R.I. Lipper, "Diffusion of Cattle Manure Solution through a Wet Porous Stratum with Reaction," *Water, Air, and Soil Pollution*, 1, 390 (1972).
73. Kao, I.C., L.E. Erickson, W.E. Craig, and L.T. Fan, "Effects of Temperature and Resin Particle Size on the Performance of a Triiodide Disinfection Column," *J. of Fermentation Technology*, 51, 159 (1973).
74. Fan, L.T., L.E. Erickson, J.C. Baltes, and P.S. Shah, "Analysis and Optimization of Two-Stage Digestion," *Water Pollution Control Federation Journal*, 45, 591 (1973).
75. Fan, L.T., P.S. Shah, and L.E. Erickson, "Synthesis of Optimal Feedback Control Systems for Fermentations and Biological Waste Treatment Processes," in *Fermentation Technology Today*, edited by G. Terui, Society of Fermentation Technology, Japan, p. 167 (1973).
76. Fan, L.T., P.N. Mishra, G.K.C. Chen, and L.E. Erickson, "Application of Systems Analysis Techniques in Biological Waste Treatment," in *Fermentation Technology Today*, edited by G. Terui, Society of Fermentation, Japan, p. 555 (1973).
77. Walawender, W.P., L.T. Fan, C.R. Engler, and L.E. Erickson, "Feedlot Manure and Other Agricultural Wastes as Future Material and Energy Resources: II Process Descriptions" Report No. 45, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1973).
78. Kao, I.C., S.Y. Chiu, L.T. Fan, and L.E. Erickson, "ATP Pools in Pure and Mixed Cultures" *Journal Water Pollution Control Federation*, 45, 926 (1973).
79. Walawender, W.P., L.T. Fan, C.R. Engler, and L.E. Erickson, "Feedlot Manure and Other Agricultural Wastes as Future Material and Energy Resources: III Economic Evaluations," Report No. 46, Institute for Systems Design and Optimization, Kansas State University, Manhattan, KS (1973).
80. Shastry, J.S., L.T. Fan, and L.E. Erickson, "Analysis of Tanks-in-Series Model with Backflow for Free-Radical Polymerization," *J. of Applied Polymer Science*, 17, 1339 (1973).
81. Radha Krishna, K.P., L.T. Fan, and L.E. Erickson, "Supplementation of Missing Values in Water Quality Data," *Water Resources Bulletin*, 9, 455 (1973).
82. Shastry, J.S., L.T. Fan and L.E. Erickson, "Nonlinear Parameter Estimation in Water Quality Modeling" *Journal of Env. Eng. Div. ASCE*, 99, No. EE3, 315 (1973).

83. Chiu, S.Y., I.C. Kao, L.E. Erickson, and L.T. Fan, "ATP Pools in Activated Sludge," *Water Pollution Control Federation Journal*, 45, 1746 (1973).
84. Fan, L.T., P.N. Mishra, J.S. Shastry, K. Osakada and L.E. Erickson, "Synthesis of Bioengineering Systems," *AIChE Symposium Series*, 69, No. 132, 123 (1973).
85. Shastry, J.S., L.T. Fan, and L.E. Erickson, "Determination of Optimal Reactor System Configuration for Polymerization Reactions. I. Free-Radial Polymerization at Constant Temperature," *Journal of Applied Polymer Science*, 17, 3101 (1973).
86. Shastry, J.S., L.T. Fan, and L.E. Erickson, "Determination of Optimal Reactor System Configuration for Polymerization Reactions. II. Effect of Chain Transfer, Autoacceleration, and Temperature Profile," *Journal of Applied Polymer Science*, 17, 3127 (1973).
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## C. Presentations of Papers

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2. "Optimal Design of a Sequence of Continuous Flow Stirred-Tank Reactors with Product Recycle," 149th National American Chemical Society Meeting, Detroit, MI, April (1965).
3. "The Cooling of a Moving Continuous Flat Sheet," Eighth National Heat Transfer Conference, Los Angeles, CA, August (1965).
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30. Shah, P.S., L.T. Fan, and L.E. Erickson, "Modeling of Fermentations with Two Liquid Phases: Effects of Segregation on Continuous Fermentations," First Pacific Chemical Engineering Congress, Kyoto, Japan, October (1972).
31. Fan, L.T., P.N. Mishra, J.S. Shastry, K. Osakada, and L.E. Erickson, "Synthesis of Bioengineering Systems," 75th National AIChE Meeting, Detroit, MI, June 1973.
32. Mishra, P.N., L.T. Fan, and L.E. Erickson, "Application of Mathematical Optimization Techniques in Computer Aided Design of Wastewater Treatment Systems," Fourth Joint Chemical Engineering Conference, Vancouver, Canada, September 1973.
33. Fan, L.T., P.N. Mishra, and L.E. Erickson, "Optimal Synthesis in the Design of Water Pollution Control Systems," Fourth Joint Chemical Engineering Conference, Vancouver, Canada, September 1973.
34. Erickson, L.E., T. Nakahara, J.R. Gutierrez, G.T. MacLean, and L.T. Fan, "Modeling Hydrocarbon Fermentations," US-USSR Conference on Data Acquisition and Processing for Laboratory and Industrial Measurements in Fermentation Processes, Philadelphia, August 1975.

35. Heydweiller, J.C., L.E. Erickson, and L.T. Fan, "Consideration of Suspended Solids Transport in Activated Sludge Systems Synthesis," Presented at National AIChE Meeting, Kansas City, (April, 1976).
36. Erickson, L.E., G.T. Maclean, M.E. Orazem, and L.T. Fan, "Oxygen Transfer in Cultures with Two Liquid Phases," Fifth International Fermentation Symposium, Berlin (July, 1976).
37. Erickson, L.E., J.R. Gutierrez, and T. Nakahara, "Growth of Cultures with Two Liquid Phases in Tower Systems," Fifth International Fermentation Symposium, Berlin (July, 1976).
38. Erickson, L.E., J.R. Gutierrez, and C.S. Ho, "Modeling Hydrocarbon Fermentations in Airlift Systems," Joint US/USSR Conference, Moscow State Univ., Moscow, USSR (June 6 - 8, 1977).
39. Erickson, L.E., C.S. Ho, and M.E. Orazem, "Mass Transfer in Single and Multistage Airleft Fermentors," Engg. Foundation Conference, Henniker, N.H. (July, 1977).
40. Erickson, L.E., I.G. Minkevich, and V.K. Eroshin, "Utilization of Mass-Energy Balance Regularities in the Analysis of Continuous Culture Data," 7th International Symposium on the Continuous Cultivation of Microorganisms, Prague, July 10-14, 1978.
41. Erickson, L.E. "Applications of Mass and Energy Balance Regularities in Hydrocarbon Fermentations," Engineering Foundation Conference on Biochemical Engineering, Henniker, N.H., August 20-25, 1978.
42. Erickson, L.E., "Applications of Mass-Energy Balances in On-Line Data Analysis," 2nd International Conference on Computer Applications in Fermentation Technology, Philadelphia, PA, August 28-30, 1978.
43. Ferrer, A. and L.E. Erickson, "Data Consistency, Yield, Maintenance, and Hysteresis in Batch Cultures of *Candida lipolytica* Cultured on n-Hexadecane," American Chemical Society National Meeting, Washington, D.C., (Sept. 1979).
44. Solomon, B.O. and L.E. Erickson, "Microbial Conversion of Grain Dust to Useful Products," Symposium on Grain Dust, Manhattan, KS (Oct. (1979)).
45. Erickson, L.E. and B.O. Solomon, "Modeling and Analysis of Microbial Energetics," US/USSR Conference on Fundamentals of Microbial Processes, M.I.T., Cambridge, MA (Oct. 1979).

46. Orazem, M.E., L.T. Fan, and L.E. Erickson, "Characterization of Two-Directional Dispersed Phase Flow Through Time Series Analysis," AIChE San Francisco Meeting, November, 1979.
47. Erickson, L.E., "Energetic Yields in Fermentation Processes," Engineering Foundation Conference on Biochemical Engineering, July 13-18, 1980.
48. Erickson, L.E. and V. Deshpande, "Gas-Liquid Dispersion Characteristics in Airlift Fermentors," Sixth International Fermentation Symposium, London, Ontario, Canada, July 20-25, 1980.
49. Erickson, L.E., "Energetic Yield Associated with Hydrocarbon Fermentations," Sixth International Fermentation Symposium, London, Ontario, Canada, July 20-25, 1980.
50. J.L. Hess, D.P. Hasza, and L.E. Erickson, "Estimating Yield and Maintenance Parameters Associated with Microbial Growth," Annual Meeting of American Statistical Association, Houston, TX (Aug. 1980).
51. Erickson, L.E. and S. Patel, "Applications of Available Electron Concepts and Regularities in Biological Heat Transfer and Thermodynamics," Presented at 1981 AIChE Annual Meeting, New Orleans, LA (Nov. 1981).
52. Patel, S. and L.E. Erickson, "Bioenergetics and Efficiencies in Living Systems," Kansas Academy of Sciences Annual Meeting (April 1982).
53. Solomon, B.O., M.D. Oner, and L.E. Erickson, "Analysis of Microbial Growth and Product Yields," Kansas Academy of Sciences Annual Meeting (April, 1982).
54. Solomon, B.O., L.E. Erickson, and S.S. Yang, "Utilization of Statistics and Experimental Design in Data Collection and Analysis," American Chemical Society National Meeting, Kansas City (Sept., 1982).
55. Erickson, L.E. and M.D. Oner, "Available Electron and Energetic Yields in Fermentation Processes," Engineering Foundation Conference on Biochemical Engineering, Santa Barbara, CA (Sept., 1982).
56. Solomon, B.O., M.D. Oner, L.E. Erickson, and S.S. Yang, "Estimation of Parameters where Dependent Observations are Related by Equality Constraints," AIChE Annual Meeting, Los Angeles, CA (Nov., 1982).
57. Patel, S.A., L.A. Glasgow, C.H. Lee, and L.E. Erickson, "Effect of Viscosity on Mass Transfer in Airlift Fermentors," AIChE Annual Meeting, Los Angeles, CA (Nov., 1982).

58. Glasgow, L.A., L.E. Erickson, C.H. Lee, and S.A. Patel, "New Techniques to Investigate Transport Phenomena in an Airlift Fermentor," Paper 77a, AIChE National Meeting, Denver, CO (Aug., 1983).
59. Erickson, L.E., B.O. Solomon, M.D. Oner, and S.S. Yang, "Estimation of Yields Associated with the Conversion of Cereal Carbohydrates to Fermentation Products," AACC Annual Meeting, Kansas City (Oct., 1983).
60. Erickson, L.E. and H.Y. Lee, "Process Analysis and Design of Algal Growth Systems," Algal Biomass Workshop, University of Colorado, Boulder (April 1984).
61. Yang, S.S., B.O. Solomon, M.D. Oner, and L.E. Erickson, "Estimation of Parameters for Some Multiresponse Models where the Responses are Related by Constraints," Joint Statistical Meetings, Philadelphia, PA (August, 1984).
62. Oner, M.D., L.E. Erickson, and S.S. Yang, "Yield Maintenance and Product Formation in Anaerobic Fermentations," AIChE Annual Meeting, San Francisco (November, 1984).
63. Oner, M.D., L.E. Erickson, and S.S. Yang, "Kinetics and Bioenergetics of Pure and Mixed Cultures of Lactic Acid Bacteria," paper 41, American Chemical Society Meeting, Chicago, IL (Sept., 1985).
64. Patel, S.A., L.A. Glasgow, L.E. Erickson, and C.H. Lee, "Liquid-Phase Measurements in an Airlift Column," Paper 27d, AIChE Meeting, Chicago, IL (Nov., 1985).
65. Davis, L.C., L.E. Erickson, and G.T. Jones, "Determining Gas Diffusivities in Nodules from Lag Phases in Acetylene Reduction," Sixth International Symposium on Nitrogen Fixation, Oregon State University, Corvallis (Aug., 1985).
66. Oner, M.D., L.E. Erickson, and S.S. Yang, "Mathematical Modeling and Analysis of Yoghurt Fermentations," Fourth International Congress on Engineering and Food, Edmonton, Alberta, Canada (July, 1985).
67. Chung, D.S., B. Kanujoso, L.E. Erickson, and C.H. Lee, "Grain Aeration and In-Store Drying in USA," International Seminar on Preserving Grain Quality by Aeration and In-Store-Drying, Kuala Lumpur, Malaysia (October, 1985).
68. Lee, H.Y. and L.E. Erickson, "Kinetic and Bioenergetic Studies of *Spirulina platensis* in Chemostat and Turbidostat Cultures," Eighth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN (May, 1986).

69. Erickson, L.E., C.E. Curless, and H.Y. Lee, "Modeling and Simulation of Photosynthetic Microbial Growth," Engineering Foundation Conf., Biochemical Engineering (July, 1986).
70. Lee, H.Y. and L.E. Erickson, "Bioenergetics of Photosynthetic Microbial Growth," AIChE Annual Meeting, Miami Beach, FL (Nov., 1986).
71. Lee, C.H., L.A. Glasgow, L.E. Erickson, and S.A. Patel, "Liquid Circulation in Airlift Fermentors," AIChE Annual Meeting, Miami Beach, FL (Nov. 1986).
72. Erickson, L.E., "Current Research in Biological Treatment of Hazardous Wastes," AIChE, Kansas City Section (Nov., 1986).
73. Jones, G.T., L.A. Glasgow, L.E. Erickson, "Local Liquid Velocity Measurements in a Split Cylinder Airlift Column," 194th American Chemical Society National Meeting, New Orleans (Sept., 1987).
74. Lee, C.H., L.E. Erickson, and L.A. Glasgow, "A Model for Bubble Breakage Frequency in Turbulent Gas-Liquid Dispersions," AIChE Annual Meeting, New York (Nov., 1987).
75. Erickson, L.E., "Applications of Mass Spectrometers in Monitoring and Control," Sensors and Control Systems in the Baking Industry, American Institute of Baking, Manhattan, KS (Dec., 1987).
76. Muralidharan, N., L. Davis, and L.E. Erickson, "Monitoring the Fate of Toluene and Phenol in the Rhizosphere," 23rd Annual Biochemical Engineering Symposium, Norman, Oklahoma, April 17, 1993.
77. Yang, X., L.E. Erickson, and L.T. Fan, "Mass Transfer in the Bioremediation of Soils Contaminated with Trapped Non-aqueous Phase Liquids," 23rd Annual Biochemical Engineering Symposium, Norman, Oklahoma, April 17, 1993.
78. Yiin, T., L.A. Glasgow, and L.E. Erickson, "Hydrodynamic Motions Associated with Bubble Coalescence and Breakup," 23rd Annual Biochemical Engineering Symposium, Norman, Oklahoma, April 17, 1993.
79. Davis, L.C., C. Chaffin, M. Nayaranan, W.G. Fately, L.E. Erickson, "Monitoring the Beneficial Effects of Plants in Bioremediation of Volatile Organic Compounds," Hazardous Waste Research Conference, Manhattan, Kansas, May 25-26, 1993.
80. McDonald, J.P., C.A. Baldwin, L.E. Erickson, and L.T. Fan, "Modeling Bioremediation of Soil Aggregates with Residual NAPL Saturation," Hazardous Waste Research Conference, Manhattan, Kansas, May 25-26, 1993.

81. Yang, X., L.E. Erickson, and L.T. Fan, "Transport Properties of Toluene as a Non-aqueous Phase Liquid in Groundwater," Hazardous Waste Research Conference, Manhattan, Kansas, May 25-26,1993.



## LECTURES AND PRESENTATIONS

A. Invited Lectures

1. "The Maximum Principle," Northwestern University Chemical Engineering Department Colloquium, October 1964.
2. "The Discrete Maximum Principle" and "The Continuous Maximum Principle," NSF Summer Institute on Mathematical Methods in Engineering for College Teachers of Engineering, July 1965.
3. Several lectures on "The Maximum Principle and Its Application to Complex Processes," NSF Conference on Optimization Theory for Chemical Engineering Professors, August 1965.
4. "Optimization Procedures," A.I.Ch.E., Kansas City Section, All Day Meeting, March 18, 1966.
5. Several lectures on "Optimization and Its Use in Process Design," Virginia Polytechnic Institute Chemical Engineering Department, April 1966.
6. "The Use of Optimization Techniques in Senior Process Design Classes," Conference on Chemical Engineering Design Education, Washington University, September 1966.
7. Several lectures on "Optimization Techniques," Mid America State Universities Association Conference on Modern Optimization Techniques and Their Application in Engineering, Design, December 1966.
8. "The Use of Optimization in the Analysis and Design of Water Purification Systems," University of Nebraska, Chemical Engineering Department Seminar, March 6, 1967.
9. "Protein from Petroleum," Wichita Chemical Engineers Club, April, 1969.
10. "Two Lectures on Optimization Techniques and Their Use in Designing Desalination Systems," Office of Saline Water Conference on Optimization Methods - Application to Desalting, March, 1969.
11. "Modeling Microbial Growth in Petroprotein Processes," Drexel Institute of Technology Chemical Engineering Department Seminar, January 26, 1970.
12. "Analysis of Growth Processes in Tower Fermentation Systems," Institute of Microbiology, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, September 11, 1970.
13. "Modeling of Hydrocarbon Fermentation Processes," Institute of Microbiology, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, October 5, 1970.

14. "Optimization of Biological Waste Treatment Systems" and "The Role of the Chemical Engineer in Biochemical and Environmental Engineering," University of Kansas, Lawrence, April 6, 1971.
15. Dynamics, Control, and Stability in Biological Waste Treatment," Phillips Petroleum Co., May 15, 1972.
16. "Modeling Microbial Growth in Oil - Water Systems," Phillips Petroleum Co., May 16, 1972.
17. "Design and Optimization of Hydrocarbon Fermentation Processes," Institute of Microbiology, Prague, Czechoslovakia, August 23, 1972.
18. Biological Waste Treatment Short Course, Center for Advanced Studies, National Polytechnic Institute, Mexico City, Mexico, May 14-25, 1973.
19. "Design of Biological Waste Treatment Systems," Rice University, Oct. 8, 1973.
20. "Surface Considerations in Single Cell Protein Production from Hydrocarbons," Gordon Research Conference on Chemistry at Interfaces, July 22-26, 1974.
21. "Models and Systems Engineering Techniques in Biochemical Engineering" and "Modeling Cultures with Two Liquid Phases," MIT, February 1975.
22. "Growth Models of Cultures with Two Liquid Phases," Columbia University, March 14, 1975.
23. "Optimal Design of Hydrocarbon Fermentation Processes," Kazan Institute of Chemical Technology, Kazan USSR, May 23, 1975.
24. "Production of Single Cell Protein," Wichita Section of AIChE, September 16, 1975.
25. "Growth of Cultures with Two Liquid Phases in Tower Systems," Institute of Microbiology, Czechoslovak Academy of Sciences, Prague (July, 1976).
26. "Mass Transfer, Mixing, and Growth in Airlift Tower Fermentors," USDA Grain Marketing Research Laboratory (January, 1977).
27. "Mass-Energy Balance Method in Fermentation," Institute for Protein Synthesis, Moscow, USSR (Dec., 1977).
28. "Mass-Energy Balance Method in Fermentation," Institute of Microbiology, Moscow, USSR (Jan. 1978).

29. "Mass Transfer in Air Lift Fermentors," August Kirchenstein Institute for Microbiology, Riga, Latvia, USSR (Jan. 1978).
30. "Application of Chemical Engineering in Fermentation Technology," Regional Society of Chemical Engineers, Guayaquil, Ecuador (May 1979).
31. "Biochemical Engineering Short Course," University of Guayaquil, Guayaquil, Ecuador (May 1979).
32. "Recent Developments in Intermediate Moisture Foods," Symposium on Food Dehydration, Kansas State University, Manhattan, Kansas, September 26, 1980.
33. "Mass and Energy Balances in Bioconversion Processes," University of Minnesota, Oct. 10, 1980.
34. "Thermodynamic Efficiency of Microbial Growth and Product Formation," Washington University, St. Louis, March 16, 1983.
35. "Estimation of Yield and Maintenance Parameters Associated with Growth and Product Formation," University of Florida, March 18, 1983.
36. "Use of Mass Balances in Fermentation Process Analysis and Control," Eastman Kodak, Co., May 17, 1984.
37. "Kinetics and Bioenergetics of Photosynthetic Microbial Growth," Washington University, St. Louis, October 27, 1986.
38. "Research to Develop New Products from Grains," U.S. Grain Marketing Research Laboratory, April 1, 1987.