Department of Chemical Engineering
University of Utah
2021

NAME	Geoffrey D. Silcox
ADDRESS	University of Utah Department of Chemical Engineering 50 S Central Campus Drive RM 3290 MEB Salt Lake City, UT 84112-9203
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Web page	http://scholar.google.com/citations?user=B7-xJ_gAAAAJ&hl=en

TITLE	Professor (Lecturing) and Associate Chair
EDUCATION	B.S. Chemistry, University of Utah 1977 Ph.D. Chemical Engineering, University of Utah 1985
RESEARCH INTERESTS	Controlling and characterizing the emissions of pollutants from the combustion of low quality fuels. Air pollution. Air quality. Process modeling.
HONORS AND AWARDS	Civically Engaged Scholar Award, Bennion Center, University of Utah, 2012. Placed among top engineering instructors based on course evaluations for CH EN 5305-001, Air Pollution Control Engineering, Fall 2006, Spring 2009, 2011, 2013, 2018. Placed among top engineering instructors based on course evaluations for CH EN 2300-001, Thermodynamics I, Fall 2005. Recognized by Latter-day Saint Student Association for Excellence in Education, Spring 2013 Distinguished Paper Award, 31st Combustion Symposium, 2007.
MEMBERSHIPS	ACS, AIChE

EXPERIENCE

2003 – present	Professor (Lecturer), Department of Chemical Engineering, University of Utah
2001 – 2003	Associate Professor (Lecturer), Department of Chemical and Fuels Engineering, University of Utah

2000 – present	Associate Chair, Department of Chemical Engineering, University of Utah
1997 – 2001	Associate Professor (Clinical), Department of Chemical and Fuels Engineering, University of Utah
1993 – 1997	Research Associate Professor, Department of Chemical and Fuels Engineering, University of Utah
1987 – 1993	Research Assistant Professor, Department of Chemical and Fuels Engineering, University of Utah
1984 – 1986	Group Leader and Research Engineer, Energy and Environmental Research Corporation, Irvine, California. Responsible for fundamental experimental and analytical investigations of the chemistry and physics of SO_2-sorbent reactions. Designed experimental combustion facilities ranging in size from 30 kW to 3 MW for $S0_2$ and $N0_x$ emissions control studies
1979 – 1981	Chemist, Occupational Safety and Health Administration, Salt Lake City, Utah.
1977 - 1978	NMR Technician, Department of Chemistry, University of Utah

TEACHING

1705, Design and Innovation in Chemical Engineering, Spring Semester 2018.

2300, Thermodynamics I, engineering thermodynamics. Taught Fall or Spring Semester 1999 - 2016. Online section introduced Fall 2001 and taught Fall 2002, Spring 2003 and Fall 2003 - 2005. Online section reintroduced Fall 2014.

2550, Statistics for Chemical Engineers, Fall Semester 2020.

2800, Fundamentals of Process Engineering, introduction to energy and material balances involving ideal gases, pure substances, mixtures, reactions, and recycle. Taught Summer Semester 2007.

364, Heat Transfer, an introductory class covering conduction, convection, and radiation. Taught Winter Quarter 1988, 1989, 1990, 1991.

3453, Heat Transfer, an introductory class covering conduction, convection, and radiation. Taught Fall and Spring Semesters 1998, 1999, Fall 2007, and Fall 2015.

374, Projects Laboratory, solution of realistic problems using theory and experiments on pilot- and bench-scale equipment. Taught Winter Quarter 1994, 1995, 1996, 1997, 1998.

3702, Projects Laboratory II, Spring Semester 2021.

3853, Chemical Engineering Thermodynamics, physical and chemical equilibrium in mixtures. Taught Fall Semester 2008 – 2013, 2016.

4903, Project Laboratory I, solution of realistic problems using theory and experiments on pilot- and bench-scale equipment. Taught Fall Semester 1998, 1999.

4905, Project Laboratory II, solution of realistic problems using theory and experiments on pilot- and bench-scale equipment. Taught Spring Semester 2000, 2020.

5207, Statistics for Chemical Engineers, Fall Semester 2017 - 2019.

5305/6305, Air Pollution Control Engineering. Taught Spring or Fall Semester 2006 - 2021.

570, Process Dynamics I, introduction to process dynamics and control. Taught Spring Quarter 1996 - 1998.

6158, Energy and Society. New course developed with Kerry Kelly and taught for the first time Summer 2014.

664, Advanced Heat Transfer I, a graduate level class covering conduction and radiation. Taught Fall Quarter 1987 - 1997.

6453, Heat Transfer, a graduate level class covering conduction, convection, and radiation. Taught Spring Semester 1998 - 2005.

666, Advanced Interphase Transfer Processes I, a graduate level class covering diffusion and differential processes. Taught Winter Quarter 1992, 1993.

CONSULTING

1990 – 2019 Reaction Engineering International, Salt Lake City, Utah. General combustion modeling, analysis, and furnace design: heat transfer, mass transfer, energy and material balances, pollutant formation and control. Research and design pertaining to the mineral processing industry.

SERVICE

2000 – present Associate Chair, Chemical Engineering

2000 – present Undergraduate Advisor, Chemical Engineering

2003 – present Chair, Undergraduate Committee, Chemical Engineering

2005 – present	Director, U of Utah, Great Salt Lake Section of AIChE
2006 – present	Member and Chair, Chemical Engineering ABET Committee.
2006 – present	Member, College of Engineering ABET Committee.
2011 – 2017	Chair, College of Engineering Mathematics Committee.
2015 – present	College of Engineering Curriculum Committee
2015 – present	College of Engineering Scholarship Committee
2015 – present	Chemical Engineering Scholarship Committee
2013 – 2016	General Education Curriculum Council
2011 – 2013	American Institutions Committee, Undergraduate Studies
2009 – 2012	Undergraduate Council Representative for Engineering
2009 – 2012	Member, Chemical Engineering Graduate Committee
2008 – 2009	Member, U of U Community Engagement Co-Requisite Committee
2006 – 2009	Member, College Council (Engineering).
2006 – 2008	Member, U of U Social Science Area Committee.
2006 – 2008	Member of Faculty Advisor Committee for Higher Education Teaching Specialist (HETS) designation
2003 – 2004	Member of Engineering Dean Search Committee.
2002 – 2004	Chair, Great Salt Lake Section of AIChE
2001 – 2002	Vice Chair, Great Salt Lake Section of AIChE
1999 – 2000	Freshman Advisor, Chemical Eng.
1997 – 2006	Member of the Chemical Demilitarization Citizens Advisory Commission for the State of Utah.
1997 – 1999	Graduate Student Advisor.
1994 – 1999	Chair of Graduate Program Committee, Chemical Eng.

1991 - 1993	Representative for Chemical Eng. on the College Council & Chairman of the Council's Curriculum Committee.
RESEARCH GRANTS	"Sorbent Injection Testing for General Electric," General Electric. Award No. A02-J01659000, 10/19/88-2/28/89, $32,004.00.
	"Entrained Flow Reactor Studies of the SO2-Lime Reaction," General Electric. Award No. A02-A05772000, 6/15/90-12/31/90, $32,410.00.
	"Low Temperature Absorption Tests," Energy and Environmental Research Corporation. Award No. 38772, 9/1/89-9/30/90, $44,015.00.
	"Rotary Kiln Model and Program," Morrison Knudsen Engineering, Inc. Award No. WP 15964, 8/16/89-8/15/90, $36,500.00.
	"Air Impacts of Incineration of Unconventional Fuels," (with J. S. Lighty) Weyerhaeuser Company - $30,000 - October 1989-September 1990
	"LIMB Process Model Development and Jet Mixing," U. S. EPA (with D. W. Pershing), Award No. CR-815810-01-1, 6/89-6/91, $100,000.
	"Hazardous Waste Incineration," NSF Advanced Combustion Engineering Research Center (with D. W. Pershing and J. S. Lighty), 5/93-5/94, $120,000.
	"Incineration of Unconventional Fuels," NSF Advanced Combustion Engineering Research Center, 4/90-4/92, $70,000.
	"The Development and Evaluation of Natural Gas-Fired Solid Waste Incineration Devices," Gas Research Institute (with D. W. Pershing and J. S. Lighty), 11/90-4/94, $520,000.
	"Incineration of Unconventional Fuels," Weyerhaeuser Corp., 12/95-12/96, $15,000.
	"Knowledge-Based Expert Systems for Cement Kilns," Centers of Excellence, State of Utah, 7/93-6/94, $29,320.
	"Advanced Combustion Engineering Research Center Rotary Kiln Consortium," NSF, 5/94-4/97, $66,000.

"Selection and Analysis of the Use of Waste Fuels in Brick Manufacturing," Southwest Center for Environmental Research and Policy, EPA, 1/95-9/97, $95,000.

"Rotary Kiln Model for Phosphate Ore Calcination," Monsanto Company, 6/95-12/97, $40,000.

"Energy Recovery From Propellant Binder Residue: Pilot-Scale Testing of Cement Kiln Applications," Thiokol Corp., 11/95-3/96, $40,000.

"Agricultural Risk Assessment," Dames & Moore, Inc., 9/95-3/97, $50,000.

"Coupling of One-D and Three-D Rotary Kiln Models," Monsanto Company, 1/97-4/97, $5000.

"Energy Recovery from Scrap Tires," Southwest Center for Environmental Research and Policy, US EPA, 6/97-5/99, $95,000.

"Rotary Kiln Model for Phosphate Ore Calcination," Monsanto Company, 3/98-3/00, $100,000.

"Treatment of Waste Sludge from PC-Board Fabrication," Reaction Engineering International, 7/01-12/01, $7,871.

"Regeneration of Catalytic Exhaust Mufflers," Utah Transit Authority, 7/2000-7/2005, time and materials basis.

"Applied Environmental Research for the US-Mexico Border," Southwest Center for Environmental Research and Policy, US EPA, 6/04-8/06, $74,962.

"Analysis of Bromine-Mercury Reactions in Flue Gas," DOE National Energy Technology Lab, 1/06-1/10, $200,000.

“Coal and Oil Shale Retort,” Millennium Synfuels, 4/07-12/07, $255,000 with Kevin Whitty, Eric Eddings, and JoAnn Lighty.

“Analysis of Reactions between Chlorine, Bromine, and Mercury in Flue Gas,” Electric Power Research Institute, 9/09-3/10, $40,000.

“Oxy-coal Combustion: Deposit Probe Development and Hg Speciation Studies,” DOE and State of Wyoming, 01/11-06/13, $540,691 with Jost Wendt.

"CASE-Coal 7.0: Mercury Control," DOE. 07/01/2008 - 08/31/2013, $20,496.00.

"$C0_2$ Predictivity-$C0_2$ Lifecycle," NNSA, 07/01/2010 - 09/30/2013, $115,060.00.

"In-Situ Oil Shale Heater," American Shale Oil, 05/01/2012 - 04/30/2014, $415,782 with Eric Eddings.

"Development of a Sub-Surface Bruner Technology for In-Situ Heating," American Shale Oil, 05/01/2014 – 04/30/2016, $175,000 with Eric Eddings.

"CO Generation from Diesel Fuel," Snow, Christensen, and Martineau, 12/22/2017 – 05/08/2018, $4,759.

EDUCATIONAL GRANTS

"Engineering Thermodynamics - An Online Course," Teaching Assisted Curriculum Center, College of Engineering, Department of Chemical and Fuels Engineering, University of Utah, 2000-2001, $15,000.

GRADUATE THESIS STUDENTS SUPERVISED

F. Babazadeh	Ph.D. – ChE, 2018, with Eric Eddings
P. Buitrago	Ph. D. – ChE, 2011
B. Cauch	M. S. – ChE, 2009
D. C. Gao	M. S. – ME, 1991
D. C. Gao	Ph. D. – ME, 1995
B. Keyes	Ph. D. – ChE, 1992
F. S. Larsen	Ph. D. – ChE, 1993
V. Mehrotra	Ph. D. – ChE, 2000
S. D. Serre	Ph. D. – ChE, 1999
E. Stewart	M. S. – ChE, 1997

UNDERGRADUATE THESIS STUDENTS SUPERVISED

D. C. Gao, 1989
F. S. Larsen, 1989
D. Matthews, 1992
D. A. Wagner, 1999
K. Wendel, 2006

PEER REVIEWED JOURNAL PUBLICATIONS

Buitrago, P.A., B. Van Otten, C.L. Senior, and G.D. Silcox, "Impinger-Based Mercury Speciation Methods and Gas-Phase Mercury Oxidation by Bromine in Combustion Systems," *Energy and Fuels*, **27**, 6255-6261, 2013.

Cauch, B., G. D. Silcox, J. S. Lighty, J. O. L. Wendt, A. Fry, and C. L. Senior, "Confounding Effects of Aqueous-Phase Impinger

Chemistry on Apparent Oxidation of Mercury in Flue Gases," *Environ. Sci. Technol.*, **42**, 2594–2599, 2008.

Cundy, V. A., T. W. Lester, C. Leger, G. Miller, A.N. Montestruc, S. Achara, A. M. Sterling, D. W. Pershing, J. S. Lighty, G. D. Silcox, and W. D. Owens, "Rotary-Kiln Incineration: Combustion Chamber Dynamics," *Journal of Hazardous Materials* , **22**, 195-219, 1989.

Fry, A., B. Cauch, G. D. Silcox, J. S. Lighty, C. L. Senior, "Experimental Evaluation of the Effects of Quench Rate and Quartz Surface Area on Homogeneous Mercury Oxidation," *Proceedings of the Combustion Institute,* **31**, 2855–2861, 2007.

Gao, D. and G. D. Silcox, "The Effect of Treatment Temperature on Metal Recovery from a Porous Silica Sorbent by EPA Method 3050 and by an HF-Based Method," *Journal of the Air & Waste Management Association*, **43**, 1004, 1993.

Kelly, K. E., R. Kotchenruther, R. Kuprov, G. D. Silcox, "Receptor model source attributions for Utah's Salt Lake City airshed and the impacts of wintertime secondary ammonium nitrate and ammonium chloride aerosol," *Journal of the Air & Waste Management Association*, **63** (5) 575-590, 2013.

Kelly, K. E., G. D. Silcox, A. F. Sarofim, D. W. Pershing, "An evaluation of ex situ, industrial-scale, aqueous CO_2 mineralization," *International Journal of Greenhouse Gas Control*, **5**, 1587–1595, 2011.

Kelly, K. E., D. Wang, M. Hradisky, G. D. Silcox, P. J. Smith, E. G. Eddings, D. W. Pershing, "Underground coal thermal treatment as a potential low-carbon energy source," *Fuel Processing Technology*, **144**, 8 – 19, 2016.

Keyes, B. R. and G. D. Silcox, "A Fundamental Study of the Thermal Desorption of Toluene From Montmorillonite Clay Particles," *Environmental Science and Technology*, **28**, 840-849, 1994.

Larsen, F. S., W. H. McClennen, X. Deng, G. D. Silcox, and K. Allison, "Hydrocarbon and Formaldehyde Emissions from the Combustion of Pulverized Wood Waste," *Combustion Science and Technology*, **85**, 259, 1992.

Larsen, F. S., Silcox, G. D., Keyes, B. R., "The Development of a Thermal Treatment Assessment Procedure for Soils Contaminated

with Hydrocarbons," *Combustion Science and Technology*, **101**, 443-459, 1994.

Lighty, J. S., G. D. Silcox, D. W. Pershing, V. A. Cundy, and D. G. Linz, "Fundamentals for the Thermal Remediation of Contaminated Soils: Particle and Bed Desorption Models," *Environ. Science and Tech.*, **24**, 750-757, 1990.

Milne, C. R., G. D. Silcox, D. W. Pershing, and D. A. Kirchgessner, "Calcination and Sintering Models for Application to High-Temperature, Short-Time Sulfation of Calcium-Based Sorbents," *I & EC Research,* **29,** 139-149, 1989.

Milne, C. R., G. D. Silcox, D. W. Pershing, and D. A. Kirchgessner, "High-Temperature, Short-Time Sulfation of Calcium-Based Sorbents: I. Theoretical Sulfation Model," *I & EC Research,* **29**, 2192-2201, 1991.

Milne, C. R., G. D. Silcox, D. W. Pershing, and D. A. Kirchgessner, "High-Temperature, Short-Time Sulfation of Calcium-Based Sorbents: II. Experimental Data and Theoretical Model Predictions," *I & EC Research,* **29**, 2202-2214, 1991.

Newton, G. H., D. J. Harrison, G. D. Silcox, and D. W. Pershing, "Control of S0x Emissions by In-Furnace Sorbent Injection: Carbonates vs Hydrates," *Environmental Progress*, **5**, 140, 1986.

Owens, W. D., G. D. Silcox, J. S. Lighty, X. Deng, and D. W. Pershing, "Thermal Analysis of Rotary Kiln Incineration: Comparison of Theory and Experiment,"*Combustion and Flame*, **86**, 101-114, 1991.

Owens, W. D., G. D. Silcox, J. S. Lighty, X. Deng, D. W. Pershing, V. A. Cundy, C. B. Leger, A. L. Jakway, "The Desorption of Toluene from a Montmorillonite Clay Adsorbent in a Rotary Kiln Environment," *J. Air Waste Manage. Assoc.*, **42**, 681-690, 1992.

Parry, G. E., A. L. Bunge, G. D. Silcox, L. K. Pershing, D. W. Pershing, "Percutaneous Absorption of Benzoic Acid Across Human Skin I: *In Vitro* Experiments and Mathematical Modeling," *Pharmaceutical Res.*, **7**, 230-236, 1990.

Pershing, D. W., J. S. Lighty, G. D. Silcox, M. P. Heap, and W. D. Owens, "Solid Waste Incineration in Rotary Kilns," *Combustion Science and Technology*, **93**, 245, 1993.

Preciado, I., T. Young, and G.D. Silcox, “Mercury Oxidation by Halogens under Air- and Oxygen-Fired Conditions,” *Energy and Fuels*, **28**, 1255-1261, 2014.

Rink, K. K., Larsen, F. S., Kozinski, J. A., Lighty, J. S., Silcox, G. D., and Pershing, D. W., "Thermal Treatment of Hazardous Wastes: A Comparison of Fluidized Bed and Rotary Kiln Incineration," *Energy and Fuels*, **7**, 803, 1993.

Serre, S. D., G. D. Silcox, "Adsorption of Elemental Mercury on the Residual Carbon in Coal Fly Ash," *Ind. Eng. Chem. Res.*, **39**, 1723, 2000.

Shareh, F. B., G. D. Silcox, E. G. Eddings “Calculated Impacts of Diluents on Flame Temperature, Ignition Delay, and Flame Speed of Methane-Oxygen Mixtures at High Pressure and Low to Moderate Temperatures,” *Energy and Fuels*, **32**, 3, 3891-3899, 2018.

Silcox, G.D., K.E. Kelly, E.T. Crosman, C.D. Whiteman, B.L. Allen, “Wintertime $PM_{2.5}$ Concentrations During Persistent, Multi-Day Cold-Air Pools in a Mountain Valley,” *Atmospheric Environment*, **46**, 17-24, 2012.

Silcox, G. D., F. S. Larsen, W. D. Owens, and M. Choroszy-Marshall, "Kinetics of Hydrocarbon and Pesticide Removal from Clay Soils During Thermal Treatment in a Pilot-Scale Rotary Kiln." *Waste Management*, **15**, 339-349, 1995.

Silcox, G. D., and D. W. Pershing, “The Effects of Rotary Kiln Operating Conditions and Design on Burden Heating Rates as Determined by a Mathematical Model of Rotary Kiln Heat Transfer,” *J. Air Waste Manage. Assoc.*, **40**, 337-344, 1990.

Silcox, G. D., G. E. Parry, A. L. Bunge, L. K. Pershing, and D. W. Pershing, “Percutaneous Absorption of Benzoic Acid Across Human Skin II: Prediction of an *in Vivo*, Skin-Flap System Using *in Vitro* Parameters,” *Pharmaceutical Res.*, **4**, 352-358,1990.

Silcox, G. D., J. C. Kramlich, D. W. Pershing, "A Mathematical Model for the Flash Calcination of Dispersed $CaCO_3$ and $Ca(OH)_2$ Particles," *I & EC Research*, **28**, 155, 1989.

Silcox, G. D., D. M. Slaughter, and D. W. Pershing, “High Temperature Sulfation Studies in an Isothermal Rector: A Comparison of Theory and Experiment,” *Twentieth Symposium*

(International) on Combustion, The Combustion Institute, Ann Arbor, Michigan, 1984.

Van Otten, B., P.A. Buitrago, C.L. Senior, and G.D. Silcox, "Gas-Phase Oxidation of Mercury by Bromine and Chlorine in Flue Gas," *Energy and Fuels*, **25**, 3530–3536, 2011.

Veranth, J. M., D. Gao, and G. D. Silcox. "Field Investigation of the Temperature Distribution in a Commercial Hazardous Waste Slagging Rotary Kiln" *Environ. Sci. Technol.*, **30**, 3053, 1996.

Veranth, J. M., G. D. Silcox, and D. W. Pershing. "Numerical Modeling of the Temperature Distribution in a Commercial Hazardous Waste Slagging Rotary Kiln" *Environ. Sci. Technol.*, **31**, 2534, 1997.

PEER REVIEWED PRESENTATIONS

Silcox, G. D., "Comparison of Students' Performance in Online and Conventional Sections of Engineering Thermodynamics," "Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition", Salt Lake City Utah, June 19-23, 2004.

BOOKS

de Nevers, N., G. D. Silcox, *Fluid Mechanics for Chemical Engineers*, 4th ed., McGraw-Hill, New York, 2020.

PEER REVIEWED BOOK CHAPTERS

Silcox, G. D., J. S. Lighty, and M. E. Keener, "Hazardous Waste Incinerators," in *Kirk-Othmer Encyclopedia of Chemical Technology*, 5th Edition, John Wiley, NY, 2004.

Silcox, G. D., F. S. Larsen, and D. W. Pershing, "Mathematical and Physical Modeling of Rotary Kilns with Applications to Scaling and Design," in *Incineration of Hazardous Waste: Toxic Combustion By-Products*, p. 411-425, Gordon and Breach, NY, 1992.

BOOK CHAPTERS

Hoyt, H.C., J. J. Noble, A. F. Sarofim, G. D. Silcox, P. C. Wankat, K. S. Knaebel, "Heat and Mass Transfer," in *Perry's Chemical Engineers' Handbook*. D.W. Green and R.H. Perry, Editors, 8th ed., McGraw-Hill, New York, 2008.

Silcox, G. D., J. J. Noble, P. C. Wankat, K. S. Knaebel, "Heat and Mass Transfer," in *Perry's Chemical Engineers' Handbook*. D. W. Green and M. Z. Southard, Editors, 9th ed., McGraw-Hill, New York, 2019.