

Harri K. Kytömaa, Ph.D., P.E., CFEI, CFI
Corporate Vice President**Professional Profile**

Dr. Harri Kytömaa is a Corporate Vice President and Director of the Thermal Sciences practice, specializing in mechanical engineering and the analysis of thermal and flow processes.

Dr. Kytömaa applies his expertise to the investigation and prevention of failures in mechanical systems, including combustion equipment. He also investigates fires and explosions, and the determination of their cause and origin. Dr. Kytömaa investigates such failures in aircraft, motor vehicles, marine facilities, industrial and manufacturing complexes, and office and residential occupancies. He has also provided consultation to the power generation, oil and gas, chemical, pulp and paper, and metal smelting industries. Dr. Kytömaa's project experience includes turbines, compressors, boilers, smelters, pneumatic and hydraulic systems, instrumentation, nuclear waste management, heat transfer systems, flammable vapors, flammable liquids, CO formation and migration and cryogenic liquids including LNG and its associated equipment.

Dr. Kytömaa has decades of experience in the area of dynamics and analysis of piping systems containing both liquids and gases. He has developed modeling tools to describe the response of liquid and gas piping systems to artificially induced sources of flow pulsation, as well as to natural sources such as those associated with reciprocating and rotating equipment, and piping components. He has applied these tools to modeling the dynamics and acoustics of drilling fluid filled piping systems for acoustic telemetry and Measurement-While-Drilling systems (MWD), which was one of the enabling technologies for directional drilling. Dr. Kytömaa has also applied his flow and acoustic expertise to gas piping and rotating equipment including gas turbines and compressors. This experience includes the characterization of rapidly varying pressures and forces caused by the interruption of rotating equipment or the sudden closing of valves and their effects.

Dr. Kytömaa has held several academic, research, and consulting positions, including that of Associate Professor of Mechanical Engineering at the Massachusetts Institute of Technology where he was head of the Fluid Mechanics Laboratory. He has also held positions as Visiting Professor at the Helsinki University of Technology and at the DOE Pacific Northwest Laboratory in Washington, and most recently, served as Lecturer in the Department of Mechanical Engineering at the Massachusetts Institute of Technology.

Academic Credentials and Professional Honors

Ph.D., Mechanical Engineering, California Institute of Technology, 1986

M.S., Mechanical Engineering, California Institute of Technology, 1981

B.Sc., Engineering Science, Durham University, England (with Honors), 1979

Sigma Xi; Lewis F. Moody Award for best paper on a subject useful in engineering practice presented to American Society of Mechanical Engineers (ASME), 1993; Henry L. Doherty Professor in Ocean Utilization, 1991–1993; Chairman, Organizing Committee, Engineering Foundation Workshop, Davos, Switzerland, 1993; National Science Foundation Review Panelist, Washington, DC, 1990; National Science Foundation Group Leader, Acoustic Methods Workshop on Visualization of Particulate Two-Phase Flows, Washington, DC, 1990; Diver in the Finnish Navy, rank Able Seaman, Distinguished Service, 1980; Institute of Mechanical Engineers Prize for Outstanding Project Work (United Kingdom), 1979

Licenses and Registrations

Registered Professional Mechanical Engineer, California, #34290; Louisiana, #PE.0035054; Massachusetts, #48202; Maine, #12370; Michigan, #6201057546; Washington, #47486; New York, #089361

Certified Fire and Explosion Investigator (CFEI) in accordance with the National Association of Fire Investigators (NAFI) National Certification Board per NFPA 921 Section 11.6.4; Certified Fire Investigator (CFI) in accordance with the International Association of Arson Investigators; National Waste Operations and Emergency Response Training, 29 CFR 1910.120; Fire Investigation 1A Certification accredited by the California State Fire Marshal

Languages

French, Finnish

Publications and Published Abstracts

Myers TJ, Long RT, Gavelli F, Kytömaa HK. The use of smoke detector sequence of activation in determining the area of origin of a fire: investigation of the FedEx DC-10 fire. Proceedings, International Symposium on Fire Investigation Science and Technology, Cincinnati, OH, 2008.

Myers TJ, Hinze PC, Kytömaa HK. Fire and explosion in an explosives conditioning bunker. Proceedings, 42nd Annual Loss Prevention Symposium, American Institute of Chemical Engineers Spring National Meeting, New Orleans, LA, 2008.

Myers TJ, Kytömaa HK, Smith TR. Environmental stress-corrosion cracking of fiberglass: Lessons learned from failures in the chemical industry. *J Hazard Mater* 2007; 142(3):695–704.

Gavelli F, Chernovsky M, Kytömaa H. Modelling pool hazards from large-scale liquefied natural gas spills. *Exploration Production: Oil Gas Rev* 2008; 6(2):76–82.

Gavelli F, Bullister E, Kytömaa H. Applications of CFD (fluent) to LNG spills into geometrically complex environments. Proceedings, 2006 Mary Kay O'Connor Process Safety Center International Symposium, pp. 468–485, 2006.

Grossman HL, Ray RM, Zhao K, Kytömaa H. Analysis of garage fires. Paper 06B-360, Session B-9 Fire Safety, SAE World Congress, Detroit, MI, April 3–6, 2006.

Davis SG, Chavez D, Kytömaa H. Hot surface ignition of flammable and combustible liquids. SAE Paper 2006-01-1014. SAE Trans—J Fuels Lubricants 2006.

Myers TJ, Kytömaa HK, Smith TR. Environmental stress-corrosion cracking of fiberglass: Lessons learned from failures at small chemical facilities. Proceedings, Mary Kay O'Connor Process Safety Center Symposium, College Station, TX, 2005.

Gavelli F, Kytömaa H. Liquefied natural gas transportation. Coast Guard J Safety at Sea 2005; 62(3):33–36.

Boehm P, Kytömaa H, Moncarz P. LNG projects: Myths and realities of environmental and safety risks. ABA Energy Committees Newsletter 2005; 3(1):7–10.

Kytömaa H, Gavelli F. Studies of LNG spills over water point up need for improvement. Oil Gas J 2005; May 9.

Martin RJ, Myers T, Hinze P, Kytömaa H. Test your incinerator knowledge. Chem Engin Progr 2003; 99:36–39.

Martin RJ, Hinze P, Myers T, Kytömaa H. Thermal oxidizing systems—Test your knowledge to improve your refinery's safety and reliability. Hydrocarbon Processing 2002; 79–80, November.

Mottahed B, Kytömaa H. Cooldown simulation for the compact ignition Tokamak (CIT), poloidal field (PF) coils. Proceedings, IMECE '02, New Orleans, LA, November 17–22, 2002.

Shekarriz A, Brenden BB, Kytömaa H. Planar ultrasonic technique for real-time visualization and concentration measurement in dense solid-liquid slurries. Proceedings, FEDSM'98 ASME Fluids Engineering Division Summer Meeting, Washington, DC, June 1998.

Bamberger J, Kytömaa H, Greenwood MS. Slurry ultrasonic particle size and concentration characterization. In: Science and Technology for Disposal of Radioactive Tank Wastes. Schulz WW, Lombardo NJ (eds), Plenum Press, New York, NY, 1998.

Kytömaa H, Kataja M, Timonen. On the effect of pore pressure on the isotropic behavior of saturated porous media. J Appl Phys 1997; 81(11).

Kytömaa H. Avoiding duct explosions, system changes can lead to disaster. Chem Process 1996; July.

Prasad D, Kytömaa H. Particle stress and viscous compaction during shear of dense suspensions. Int J Multiphase Flow 1995; 21(5):775–785.

Kytömaa H. Theory of sound propagation in suspensions: A guide to particle size and concentration characterization. *Powder Technol* 1995; 82:115–121.

Schmid PJ, Kytömaa H. Receptivity of unbounded granular shear flow to periodic external forces. *Proceedings, Engineering Mechanics Conference, Stein Sture, Boulder, CO, 1995.*

Prasad D, Kytömaa H. Particle stress and viscous compaction. *Liquid-Solid Flows* 1994; 189:137–144.

Derksen JS, Kytömaa H. Acoustic properties of solid-liquid mixtures in the inertial regime: Determination of the added mass coefficient. *Liquid-Solid Flows* 1994; 189:75–81.

Schiaffino S, Kytömaa H. Impulsive fluidization: A mechanism for particle segregation in dense suspensions. *Indust Environ Applic Fluid Mechanics* 1994; 186:155–163.

Schmid PJ, Kytömaa H. Stability analysis of unbounded uniform granular shear flow. *J Fluid Mech* 1994; 264:255–275.

Kytömaa H, Corrington SW. Ultrasonic imaging velocimetry of transient liquefaction of cohesionless particulate media. *Int J Multiphase Flow* 1994; 20(5):915–926.

Solomon SD, Kytömaa H, Celi AC, Maas LC, Chou J, Hopkins E, Caguioa E, Lee RT. Myocardial tissue characterization by autocorrelation of two-dimensional ultrasonic backscatter. *J Am Soc Echocardio* 1994; 7(6):631–640.

Kytömaa H, Weselake K. Current distribution and finite element mesh selection for electrical impedance tomography. *Comp Mech: Int J* 1994; 15(2):161–172.

Kytömaa H. *Poudres & Grains, A.E.M.M.G. Association pour l'Etude de la Micromécanique des Milieux Granulaires, N° 5 – Mars-Avril, 1994.*

Kytömaa H, Prasad D. The transition from frictional domination to the viscous flow regime. pp. 281–287. In: *Powders and Grains, Volume 93. Thornton C (ed), Balkema, Rotterdam, 1993.*

Kytömaa H, McClintock F, Peterson C, Chiaffino S. Comminution of energy materials. *Proceedings, Argonne National Laboratory 11th Symposium on Energy Engineering Sciences, Argonne, IL, May 1993.*

Schiaffino S, Kytömaa H. Steady fluidization of fine particles in a fixed bed of coarse particles. *Powder Technol* 1993; 77:291–299.

Atkinson CM, Kytömaa H. Acoustic properties of solid-liquid mixtures and the limits of ultrasound diagnostics—I: Experiments. *Journal of Fluids Engineering* 1993; 115:665–675.

Kytömaa H, Peterson C, McClintock F, Schiaffino S. Fluidization and segregation in bi-disperse solid-liquid particulate systems. Proceedings, 11th Symposium on Energy Engineering Sciences, pp. 48–55, May 3–5, 1993.

Kytömaa H, Abnet C. Harmonic excitation of an unconstrained saturated particle bed. Proceedings, 9th Engineering Mechanics Conference, ASCE, College Station, TX, 1993.

Kytömaa H, Atkinson CM. Sound propagation in suspensions and acoustic imaging of their microstructure. *Mech Mater* 1993; 16:189–197.

Kytömaa H, Abnet CA. Measurement of velocity distribution in concentrated oscillating bed of sediments. Proceedings, American Society of Civil Engineers Ninth Engineering Mechanics Conference, College Station, TX, May 1992.

Atkinson CM, Kytömaa H. Acoustic wave speed and attenuation in suspensions. *Int J Multiphase Flows* 1992; 18(4):577–592.

Kytömaa H, Roco M (eds). Liquefaction and solidification. Chapter 24. pp. 861–883. *Particulate Two-Phase Flows*. Butterworth-Heinemann, Stoneham, MA, 1992.

Kytömaa H, Brennen CE. Small amplitude kinematic wave propagation in two-component media. *Int J Multiphase Flows* 1992; 17(1):13–26.

Kytömaa H, Schmid PJ. On the collision of rigid spheres in a weakly compressible fluid. *Phys Fluids* 1992; A (12):2683–2689.

Kandlikar SG, Pisera J, Kytömaa H, Thome RJ. Heat transfer and pressure drop characteristics of magnet winding during cooldown with flow boiling of LN₂. *Experimental Heat Transfer, Fluid Mechanics and Thermodynamics*, 1991.

Kytömaa H. Viscous particle interactions and their effect on kinematic wave propagation. *Chem Engin Commun* 1991; 105:27–41.

Kytömaa H. Effects of internal reordering on sedimentation waves in concentrated incompressible suspensions. *Fluid/Particle Separation J* 1991; (4)1:37–46.

Geschwindt JR, Kytömaa H. Design of the cooling system for the compact ignited Tokamak central solenoid. *Adv Cryogen Engin* 1990; 35B:957.

Kytömaa H. Propagation and structure of solidification waves in concentrated suspensions. *Mech Mater* 1990; 9:205–215.

Kytömaa H, Brennen CE. Some observations of flow patterns and statistical properties of three component flows. *Trans ASME* 1988; 110:76–84.

Kytömaa H, Brennen CE. Measurement of friction pressure drops in vertical slurry and bubbly flows. Proceedings, Cavitation and Multiphase Flow Forum, AIAA/ASME 4th Fluids Mechanics Plasma Dynamics and Lasers Conference, Atlanta, GA, May 1986.

Invited Lectures and Presentations

Kytömaa HK, Myers TJ, Ibaretta AF, Ponchaut NF. Anatomy of the failures that led to the Buncefield explosion and fire. Mary Kay O'Connor Process Safety Center Symposium, College Station, TX, 2009.

Kytömaa H. LNG pool spreading. LNG Safety Workshop, LNG Tech Global Summit 2007, Rotterdam, Netherlands, September 10, 2007.

Kytömaa H. LNG release from a vessel. Mary Kay O'Connor Process Safety Center: CLNG Workshop at the Hamilton Crowne Plaza, Washington, DC, June 12–13, 2007.

Gavelli F, Chernovsky MK, Bullister E, Kytömaa HK. Validation of a CFD model for vapor dispersion from LNG spills into an impoundment. American Institute of Chemical Engineers Spring National Meeting, Houston, TX, April 2007.

Kytömaa H. LNG hazards for offshore and onshore LNG receiving terminals. Invited speaker/faculty member, LNG Development in the Northeast, Boston MA, December 5, 2006.

Gavelli F, Bullister E, Kytömaa H. Application of the fluent model to LNG spills over water. The Status of CFD Models for LNG Exclusion Zones. Gas Technology Institute Seminar Houston, TX, September 13, 2006.

Kytömaa H. Modeling and simulation in the USA. Keynote address, MASI Conference on Modeling and Simulation, Jyväskylä, Finland, May 9, 2006.

Kytömaa H., Gavelli F, Rangwala A. Leakage of liquid from a cryogenic container. LNG: The Environmental and Safety Agenda Operations/Emergency Preparedness and Response AIChE Meeting, Vancouver, BC, September 13, 2005.

Kytömaa H. Risks and common misconceptions associated with LNG. Breakfast Seminar, the Downtown Club at Plaza, Houston, TX, May 25, 2005.

Gavelli F, Foulds J, Sire R, Kytömaa H. Root cause analysis of a gas turbine compressor stator blade failure. ASME Power Conference, Chicago, IL, 2005.

Myers T, Kytömaa H, Smith T. Environmental stress-corrosion cracking of fiberglass: Lessons learned from failures at small chemical facilities. Mary Kay O'Connor Process Safety Center Symposium, College Station, TX, 2005.

Kytömaa H. The Cleveland 1944 accident: History's worst liquefied natural gas (LNG) accident. Modern Marvels: Engineering Disasters 10, The History Channel, October 26, 2004.

Kytömaa H, Hinze P. Scientific fire investigation of automotive fires. Bowman and Brooke, LLP, Hot Topics Seminar Series, September 15, 2004.

Kytömaa H, Hinze P. Automobile fire investigations. Volvo Powertrain, Hagerstown, MD, September 1, 2004.

Kemal A, MacDonald M, Hebert J, Kytömaa H. Explosion hazards due to delayed ignition in gas turbines. Electric Power 2004, Baltimore, MD, 2004.

Kytömaa H. Garage and house fires. Bowman and Brooke, LLP, Hot Topics Seminar Series, Toyota USA, Los Angeles, CA, December 15, 2003.

Kytömaa H. Scientific investigation of fires and explosions. Georgia Defense Lawyer's Association, 36th Annual Meeting, Hilton Head, SC, July 2003.

Kytömaa H. Lessons learned in fire investigations. Trial Attorneys of America, Annual Meeting, Chicago, IL, June 2002.

Kytömaa H. Building air circulation and carbon monoxide poisoning. NFPA World Safety Conference, Minneapolis, MN, May 2002.

Kytömaa H. Fires and explosions in vapor control systems: A lessons learned anthology. AIChE Spring National Meeting, New Orleans, LA, March 2002.

Kytömaa H. Use of PowerPoint in the court room. International Association of Defense Counsel, Tucson, AZ, February 2002.

Kytömaa H. Explosions and fires accident reconstruction. Propane Gas Defense Association Meeting, Atlanta, GA, April 2001.

Kytömaa H. Investigation of a loading dock naphthalene fire. American Institute of Chemical Engineers Process Plant Safety Symposium, AIChE Spring National Meeting, Houston, TX, April 2001.

Kytömaa H. The use of technology in fire investigations. DRI Conference, Las Vegas, NV, February 2001.

Kytömaa H. Fire onboard DC-10 over New York City—A case study of the state of the art in aviation fire investigation. Thermal Sciences and Engineering, Exponent, Inc., March 1999.

Bamberger J, Greenwood MS, Kytömaa H. Ultrasonic characterization of slurry density and particle size. FEDSM98-5075. American Society of Mechanical Engineers, New York, NY, 1998.

Kytömaa H. Hazards associated with vapour abatement systems: Machinery failures and safety. Trends in Technology, Law and Insurance, Helsinki, Finland, September 1997.

- Kytömaa H. Hazards associated with fume collection and abatement systems: Process safety. AIChE Spring Meeting, Houston, TX, March 1997.
- Kytömaa H. Safe operation of VOC collection/destruction systems. New England Environmental Expo, Boston, MA, May 1996.
- Kytömaa H. Ultrasound in suspensions. Harvard University, Cambridge, MA, October 1994.
- Kytömaa H. Unsteady fluidization of BiDisperse particulate systems. AIChE Meeting November 1993.
- Kytömaa H. Shearing of dense suspensions. University of Surrey, Guildford, UK, July 1993.
- Kytömaa H. The modeling of the dynamics of long fluid filled transfer lines. IKU, Trondheim, Norway, October 1992.
- Kytömaa H. The propagation of ultrasound through dense suspensions. IKU, Trondheim, Norway, October 1992.
- Kytömaa H. Acoustic measurements in very concentrated solid-liquid mixtures and internal imaging of liquefaction events. California Institute of Technology, Pasadena, CA, March 1992.
- Kytömaa H. Ultrasonic measurements of liquefaction events. Mechanical Engineering Seminar Series, University of Michigan, Ann Arbor, MI, December 1991.
- Kandlikar, S.G., Pisera, J., Kytömaa, H., and Thome, R.J. Heat transfer and pressure drop characteristics of magnet winding during cooldown with flow boiling of LN₂. Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics, Dubrovnik, Yugoslavia, August 1991.
- Kytömaa H. Acoustic properties of solid-liquid mixtures. Sibley School of Mechanical and Aerospace Engineering Colloquium Series, Cornell University, Ithaca, NY, March 1991.
- Kytömaa H. Stability of multicomponent flows. Department of Mechanical Engineering, Johns Hopkins University, Baltimore, MD, November 1988.
- Kytömaa H. On enhanced separation processes in three-component mixtures. Society of Rheology Annual Meeting. Atlanta, GA, October 1987.
- Kytömaa H. Kinematic wave propagation in two-phase flows. Department of Mechanical Engineering Colloquium, University of California, Santa Barbara, CA, February 1986.

Reports

Kytömaa H, Rau C, Smith T, Huet R. Evaluation of the March 1995 failure of turbine generator #3 at Skeena Cellulose, Inc. Exponent Failure Analysis Associates, Menlo Park, CA, May 2003.

Kytömaa H. June 4, 2000, ABB auxiliary boiler explosion. Exponent Failure Analysis Associates, Menlo Park, CA, July 20, 2000.

Kytömaa H. Investigation of the explosion at the Nottingham filtration plant, Cleveland, Ohio. Exponent Failure Analysis Associates, Menlo Park, CA, November 5, 1999.

Kytömaa H. Thermostat tests. Exponent, Menlo Park, CA, March 3, 1999.

Kytömaa H. Water heater evaluation. Exponent, Menlo Park, CA, September 29, 1998.

Kytömaa H. Investigation in the matter of Fireman's Fund Insurance Company vs. Xerox Corporation. Exponent Failure Analysis Associates, Menlo Park, CA, March 20, 1998.

Kytömaa H. Fire damage to Chiron DNA synthesizer. Exponent Failure Analysis Associates, Menlo Park, CA, November 17, 1997.

Kytömaa H, Nunes S. Analysis of mist deflagrations and pool fires near the Schenck Dynamic Balancer. Exponent Failure Analysis Associates, Menlo Park, CA, August 26, 1997.

Kytömaa H. Passaic New Jersey fire. Exponent Failure Analysis Associates, Menlo Park, CA, August 4, 1997.

Kytömaa H. Federal Express DC-10 fire on September 5, 1996. Exponent Failure Analysis Associates, Menlo Park, CA, July 18, 1997.

Kytömaa H, Häkkinen RJ, Hirsch C, Krause E. Computational fluid dynamics (CFD) technology programme 1995–1999. Helsinki, Finland, June 1997.

Kytömaa H. Maruchan instant lunch product, Welbilt microwave oven. Exponent Failure Analysis Associates, Menlo Park, CA, March 28, 1996.

Kytömaa H, Smith T. Investigation of the December 29, 1995, fire at the DuPont May plant, Exponent Failure Analysis Associates, Menlo Park, CA, June 25, 1999.

Kytömaa H, Foulds J, Reza A, Hinman E, Correia P. Old Harbour power station, Boiler No. 4 explosion, June 3, 1994, Jamaica. Exponent Failure Analysis Associates, Menlo Park, CA, November 16, 1995.

Kytömaa H, Grosso D. Dynamic modeling of drilling fluid flow circuits for acoustic telemetry, 1993.

Kytömaa H. Interpretation of measured stand-pipe and annulus signals for the detection and quantification of down-hole gas. Report to Teleco Oilfield Services, Inc., October 1991.

Kytömaa H, Winckelmans G. A fully time dependent numerical model for the sudden influx and propagation of gas in wells. Report to Teleco Oilfield Services, Inc., January 1991.

Professional Affiliations

Member: American Society of Mechanical Engineers; American Institute of Chemical Engineers; Society of Fire Protection Engineering; Sigma Xi, The Scientific Research Honor Society; National Fire Protection Association