KIMBLE J. CLARK, Ph.D.
Mechanical Engineer – Thermosciences
and
Vice President

Dr. Kimble Clark has over 35 years of experience in solving equipment and system problems in mechanical engineering and the thermosciences using engineering analysis and testing. His technical specialties include heat transfer, fluid mechanics, thermodynamics and combustion. He has conducted many investigations into the origin and cause of complex fires and explosions in chemical process plants, industrial facilities and commercial and residential buildings. Dr. Clark is also experienced in providing testimony for deposition, mediation, arbitration and trial.

SPECIALIZED PROFESSIONAL COMPETENCE

- Thermodynamics
- Fuel science
- Failure analysis and prevention
- Heat transfer
- Fluid mechanics
- Combustion
- Thermalhydraulics
- Process engineering
- Design defect analysis
- Fire origin and cause investigation
- Explosion origin and cause investigation
- Incident investigation
- Accident reconstruction
- Forensic photography
- Laboratory testing
- Full-scale field testing
- Patent evaluation
- Consulting and expert witness

EQUIPMENT

- Utility boilers
- Industrial boilers
- Pressure vessels
- Heat exchangers
- Industrial furnaces
- Residential gas furnaces
- Gas water heaters
- Industrial chillers
- Steam tubing
- Steam turbines
- Combustion turbines
- Pumps
- Fans
- Valves and piping
- Engines
- Structures

INDUSTRIES

- Power generation
- Petrochemical
- Manufacturing
- Transportation
- Agriculture
- Steel
- Metals processing
- Commercial gas appliance
- Residential gas appliance
- Aerospace

RECENT WORK

Fires and Explosions — Investigation of origin and cause of numerous fires and explosions in chemical plants, refineries, steel and metal heat treating plants, warehouses, commercial and residential buildings involving a wide range of fuels and explosives including wood,

natural gas, propane, hydrogen, coke oven gas, gasoline, fuel oil, epoxy, hydraulic fluid, ammonium perchlorate, ammonium nitrate, sodium hydrosulfite, sodium nitrate, and potassium nitrate.

Boilers, Heaters, and Furnaces — Investigation of equipment design defects and improper operation which cause waterwall and steam tube failures, burner and structural failures, fires and explosions, and carbon monoxide poisoning. Development of methods to prevent these failures; equipment includes utility boilers, heat recovery boilers, industrial furnaces and boilers, and commercial and residential water heaters and furnaces; fuels include coal, oil, gas, municipal waste, agricultural and wood waste, and mixtures thereof.

Engines and Turbines — Investigation of stationary and truck diesel engine failures, and marine and cogeneration steam and combustion turbine failures; determination of equipment impact due to use of off-specification fuels.

Petrochemical and Process — Investigation of ethylene plant heat exchanger shell catastrophic failure, geothermal steam well casing failure, urea reactor vessel failure, oil well fires and explosions; natural gas pipeline regulator failure; analysis of precision metering pump patent dispute; process analysis and testing of synthetic and biomass fuels in engines, turbines, and boilers.

Agricultural — Industrial refrigeration performance testing and system failure investigation; assessment of thermal insulation in growing room.

EARLIER WORK

Research and development in the aerospace industry. Specific examples include aircraft fuel crash fire modeling; testing of fire-resistant fabrics; testing and analysis of intumescent paint heating response; electric arc plasma analysis and design; testing of transpiration cooling for heated metal surfaces; development of models for the properties of high-pressure, high-temperature reacting gas mixtures; thermochemical ablation of spacecraft and missile reentry heat shields and rocket engine nozzles; and development of advanced temperature and heat flux instrumentation.

EDUCATION AND PROFESSIONAL BACKGROUND

- B.S. (Mechanical Engineering), Stanford University (1964)
- M.S. (Mechanical Engineering), Stanford University (1965)
- Ph.D. (Mechanical Engineering), Purdue University (1971)
- Research Assistant, Thermosciences Division, Department of Mechanical Engineering, Stanford University
- Research Assistant, Thermodynamics Instructor, and Post-Doctoral Researcher; High Temperature Gas Dynamics Laboratory, School of Mechanical Engineering, Purdue University
- Member:
  - American Society of Mechanical Engineers

- American Institute of Aeronautics and Astronautics
- National Fire Protection Association
- National Association of Fire Investigators
- Pi Tau Sigma (Mechanical Engineering Honorary Society)

- Vice President and Engineering Director, Aptech Engineering Services, Inc. (1984 to Present)
- Business Development Manager and Energy Systems Department Manager, Energy and Environmental Division, Acurex Corporation (1976 to1983)
- Staff Engineer, Project Engineer, Manager, Physical Gas Dynamics Section, Acurex Corporation (1965 to1975)
- U.S. Patent: Method of Extending the Useful Life of Boiler Tubes
- U.S. Patent: Method for Reduction of Sulfur Oxides and Particulates in Coal Combustion Exhaust Gases

SELECTED REPORTS, PUBLICATIONS, AND INVITED LECTURES

Expert Report on the Explosion at Napp Technologies Involving Technic, Inc. 9031 Gold Precipitating Agent, Limited Distribution Report (April 2000).

Preliminary Investigation of Apartment Door Lock Failures, Limited Distribution Report (with E. Sullivan) (July 2000).

Investigation into the Origin of the Explosion at the Terra Fertilizer Plant, Port Neal, Iowa, Limited Distribution Report (with Q.A. Baker, et.al.) (April 2000).

Expert Report on the June 7, 1999 Explosion in the FV-102 Fractionator at Caribbean Petroleum Refinery, Limited Distribution Report (October 2000).

Review of Eight Stainless Steel Fragments From ICI Canada, Inc., Limited Distribution Report (with P. B. Lindsay, et al.) (April 2000).

Engineering Investigation and Analysis of the Explosion in the Humberto Vidal Building, San Juan, Puerto Rico, Limited Distribution Report (with R. J. Schreiber, et al.) (March 1999).

Preliminary Analysis of Propane Gas Leak, Migration, Accumulation and Explosion in Humberto Vidal Building, San Juan, Puerto Rico, Limited Distribution Report (May 1998).

Analysis of Epoxy Exothermic Reaction, Limited Distribution Report (June 1996).

Evaluation of Utah Power and Light Company's Hunter 3 Boiler Waterwall Circulation and its Role in 1986 Corrosion Incident, Limited Distribution Report (with T.S. Torbov, et al.) (December 1993).

Quantum Chemical Corporation, Morris, Illinois Ethylene Plant Vessel Fragmentation, September 12, 1989, Failure Analysis Report, Limited Distribution Report (with M.T. Cronin, et al.) (July 1993).

Field Evaluation of Cofiring Gas with Coal for Quantifying Operational Benefits and Emissions Trim in a Utility Boiler, Two Volumes, GRI-92/0456, Gas Research Institute (with T.S. Torbov, et al.) (February 1993).

Improved Superheater Component Longevity by Steam Flow Redistribution, EPRI TR-101697, Electric Power Research Institute (with K.G. Hara, et al.) (December 1992).

Investigation of Chemical Reaction Between Sodium Hydrosulfite and Air and Water, Limited Distribution Report (with S.M. Kohan) (February 1992).

SO_2 and Particulate Emissions Reduction in a Pulverized Coal Utility Boiler Through Natural Gas Cofiring, 1991 SO_2 Control Symposium, Washington, D.C. (with T.S. Torbov, et al.) (December 1991).

Summary of Industrial Refrigeration Evaporator Performance Tests, Limited Distribution Report (with C.Q. Lee and R.J. Schreiber) (March 1991).

Cofiring with Natural Gas: Case History, CIBO Technical Conference, Current Developments in Control Systems for SO_2 Emissions, Washington, D.C. (with S.A. Lefton, et al.) (July 1990).

Redistribute Steam to Extend Boiler-Tube Life, Power (with C.Q. Lee, et al.) (April 1990).

Field Evaluation of Cofiring Gas with Coal for Quantifying Operational Benefits and Emissions Trim in a Utility Boiler, GEN-UPGRADE '90, International Symposium on Performance Improvement, Retrofitting, and Repowering of Fossil Fuel Power Plants, Washington, D.C. (with R.J. Impey, et al.) (March 1990).

Assuring Increased Reliability of Superheater and Reheater Tubing and Headers by Optimization of Steam Side and Gas Side Temperatures, GEN-UPGRADE '90, International Symposium on Performance Improvement, Retrofitting, and Repowering of Fossil Fuel Power Plants, Washington, D.C. (with S.A. Lefton, et al.) (March 1990).

Improved Superheater Component Longevity by Steam Flow Redistribution, Electric Power Research Institute Conference on Plant Maintenance Technology, Houston, Texas (with K.G. Hara, et al.) (November 1989).

Remaining Life Assessment of Superheater and Reheater Tubes, EPRI CS-5564, Electric Power Research Institute (with S.R. Paterson, et al.) (May 1988).

Stress Intensity Factors for Cracked Metallic Structures Under Rapid Thermal Loading, Report for Wright-Patterson Air Force Base, Ohio (with R.C. Cipolla) (October 1987).

Methodology for Assessing the Remaining Useful Life of Critical Power Plant Components, Electric Power Research Institute Conference on Life Extension and Assessment of Fossil Plants, Washington, D.C. (with S.A. Lefton, et al.) (June 2-4, 1986).

Creep Damage and Remaining Life Assessment of Superheater and Reheater Tubes, Electric Power Research Institute Conference on Life Extension and Assessment of Fossil Plants, Washington, D.C. (with S.R. Paterson and T.W. Rettig) (June 2-4, 1986).

Boundary-Layer Aspects of High-Temperature Flows in Concrete Ducts-Equilibrium Chemistry Model, DNA 4832F, Defense Nuclear Agency, Washington, D.C. (with C.J. Wolf, et al.) (December 1978).

A Study of the Feasibility of Investigating Radiation/Turbulent-Mixing-Layer Interactions in a Constricted Arc, Aerotherm Final Report 75-167, NASA Langley Research Center, Hampton, Virginia, Contract NA51-13666 (with E.V. Nelson, et al.) (October 1975).

Correlation for the Viscosity of Air Including Effects of Dissociation, AIAA Journal, Vol. 13, No. 10, pp. 1406-1407 (with A.D. Anderson) (October 1975).

Analytic and Experimental Evaluations of Flowing Air Test Conditions for Selected Metallics in a Shuttle TPS Application, NASA Contractor Report CR-2531, Langley Research Center, Washington, D.C. (with J.W. Schaefer, et al.) (August 1975).

Analytical and Design Study for a High-Pressure, High-Enthalpy, Constricted Arc Heater, AEDC-TR-75-47, Arnold Engineering Development Center (DY), Air Force Systems Command, Arnold Air Force Station, Tennessee (with W.E. Nicolet, et al.) (July 1975).

Methods for the Analysis of High-Pressure, High-Enthalpy, Constricted Arc Heaters, AIAA Tenth Thermophysics Conference, Denver, Colorado, AIAA Paper 75-704 (with W.E. Nicolet, et al.) (May 27-29, 1975).

Intumescent Coating Modeling, Journal of Fire and Flammability, Vol. 6, pp. 205-221 (with D.E. Cagliostro, et al.) (April 1975).

Exploratory Development of Heat Resistant and Nonflammable Fibrous Materials, Technical Report AFML-TR-74-233, Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio (with B. Laub and E. Chu) (February 1975).

Cooling by Discrete and Porous Injection Into a Turbulent, Supersonic Boundary Layer, AIAA 12th Aerospace Sciences Meeting, Washington, D.C., Paper 74-98 (January 30 - February 1, 1974)

AIAA Journal, Vol. 12, No. 12, pp. 1679-1686 (with C.T. Nardo, et al.) (December 1974).

Analytical Modeling of Intumescent Coating Thermal Protection System in a JP-5 Fuel Fire Environment, Aerotherm Final Report 74-101, NASA Contract NA52-7709, NASA Ames Research Center, Moffett Field, California (with A.B. Shimizu, et al.) (June 1974).

Analysis of the Thermal Response of Parachute Fabrics in Crash-Fire Environments, Technical Report ASD-TR-74-25, Air Force Systems Command, Aeronautical Systems Division, Life Support Systems, Program Office, Wright-Patterson Air Force Base, Ohio (with B. Laub and K.A. Green) (February 1974

Procedure for Simultaneous Analysis of Multiproperty Data, ASME Sixth Symposium on Thermophysical Properties, Atlanta, Georgia (with W. Leidenfrost and P.E. Liley) (August 5-8, 1973).

Analysis of the Thermal-Response of Protective Fabrics, Technical Report AFML-TR-73-17, Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio (with H.L. Morse, et al.) (January 1973).

The Multipurpose Instrument Used for Computation of Thermophysical Properties and Production of Self-Consistent Tables and Mollies Charts, Physica, Vol. 66 (with W. Leidenfrost and P.E. Liley) (1973).

Thermochemical Nonequilibrium in an Argon Constricted Arc Plasma, AIAA Fourth Fluid and Plasma Dynamics Conference, Palo Alto, California (June 21-23, 1971)

AIAA Journal, Vol. 10, No.1, pp. 17-18 (with F.P. Incropera) (January 1972).

Electron-Ion Recombination - A Critical Review of Theories and Experimental Results for an Argon Plasma, ASME Fifth Symposium on Thermophysical Properties, Newton, Massachusetts (with F.P. Incropera) (September 30, 1970).

Thermochemical Ablation of Rocket Nozzle Insert Materials, NASA Contractor Report NASA CR-66632, NASA Langley Research Center, Washington, D.C. (with R.A. Rindal, et al.) (February 15, 1968).

Experimental and Theoretical Analysis of Ablative Material Response in a Liquid-Propellant Rocket Engine, NASA Contractor Report NASA CR-82301, NASA Lewis Research Center, Hampton, Virginia (with R.A. Rindal, et al.) (September 1, 1967).

Experimental and Analytical Evaluation of the Apollo Thermal Protection System Under Simulated Re-Entry Conditions, Aerotherm Final Report 67-16, NASA Manned Spacecraft Center, Houston, Texas (with J.W. Schaefer, et al.) (July 15, 1967).

Calorimetric Techniques of Plasma Jet Temperature Measurement, Technical Report SU247-10, Mechanical Engineering Department, Stanford University (with F.P. Incropera) (October 1965).

ADDITIONAL INFORMATION

For more information regarding APTECH's personnel and services, please contact our Corporate Headquarters in Sunnyvale, California (USA) at (408) 745-7000 or visit our website (http://www.aptecheng.com).