

The Percy Nicholls Award
For Notable Scientific or Industrial Achievement
In the Field of Solid Fuels
In recognition of the Outstanding Achievement of

Hishashi Kobayashi

In the field of solid fuels, the Fuels and Combustion Technologies Division of the American Society of Mechanical Engineers, and the Coal Division of the American Institute of Mining, Metallurgical and Petroleum Engineers jointly confer upon him the

Percy Nicholls Award for 2004

Dr. Hishashi (Sho) Kobayashi has made outstanding contributions to the applications of oxygen in combustion that have led to reductions in emissions, improvement in product quality, and increases in efficiency of fuels. His major achievements include:

- Development of the two competing reaction model of coal devolatilization that is widely used to model rates of volatile evolution and total volatile yields in pulverized coal fired systems.
- Reduction of NO_x by judicious injection of oxygen in a. burners now utilized in coal-fired electrical power generating stations, b. incineration of hazardous wastes, with simultaneous increases in capacity.
- Replacement of oxygen in commercial glass furnaces with reductions in emissions of NO_x, particulate matter, accompanied by increases in fuel efficiency.
- Distributed combustion of oxygen and fuel in high temperature furnaces leading to uniform heat flux distribution and low NO_x emissions.
- Stratification of atmospheres in direct-fired aluminum melting furnaces to provide a protective layer of nitrogen to reduce product loss, increase fuel efficiency, and reduce emissions.

His ability to draw on his fundamental understanding of processes and the engineering principles on which they are based, his use of that understanding to conceive and test new processes and carry them through to commercialization, and his numerous patents and publications constitute a worthy legacy to the benefit of all who rely on the clean and efficient utilization of fuels.



Dr. Hisashi ("Sho") Kobayashi

Dr. Hisashi ("Sho") Kobayashi is Corporate Fellow at Praxair, Inc. (Formerly Union Carbide Corporation). Most of his 29 year career has been dedicated to developing unique combustion applications focused on reducing pollutant emissions and increasing fuel efficiency in industrial furnaces, incinerators and coal fired boilers. His efforts have resulted in over 50 US patents, most of which have been practiced in various industries to improve energy efficiency and reduce emissions. He has also published over 50 technical papers and is a leading expert on oxygen combustion.

After completing his doctoral work at M.I.T. on high temperature devolatilization of coal particles, Dr. Kobayashi joined UCC in 1976 and worked on exploratory oxygen applications for pyrolysis and partial oxidation of municipal solid waste and other biomass, desulfurization and coal gasification processes, and particulates removal technologies. In 1985 he proposed and began the development of a process for utilizing oxygen in the incineration of hazardous wastes. This process not only enabled a two-fold increase in incineration capacity, but simultaneously resulted in a reduction of NO_x and other pollutant emissions. This technology was commercialized and ultimately led to an increase in the rate at which Superfund sites were remediated. This process earned the prestigious Kirkpatrick Chemical Engineering Achievement Award in 1989. In 1990 he proposed the "Dilute Oxygen Combustion" concept, in which fuel is reacted with high temperature, very diluted oxygen stream (less than 10% O₂) for ultra low NO_x combustion. This work, together with other development activities in Europe and Japan, stimulated applications of combustion with high temperature diluted oxidants and set a new direction of industrial combustion R&D. The process was successfully developed and commercialized in steel reheat furnaces in 1998.

He also pioneered the development of oxygen glass melting under a cooperative program with the U.S. Department of Energy. He led the development team that ultimately converted the first large commercial glass furnace to pure oxy-fuel combustion in 1991. The results from this commercial demonstration catalyzed the worldwide conversion of air-fuel fired furnaces to oxy-fuel fired furnaces. As a result of this effort, over 25% of the U.S. commercial glass furnaces have adopted oxy-fuel combustion and realized 80-90% emissions reductions of NO_x, 20-50% reductions in particulate emissions and improvements in fuel efficiencies of 15-50%. This technology earned a number of awards including the Technology Commercialization Award from the DOE in 1995, the National Energy Award from the DOE in 1996 and the Eighth Annual National Award for Environmental Sustainability from Renew America in 1998. In 1994 he proposed the concept of Stratified Atmosphere Combustion in which a protective layer of nitrogen is formed within a directly fired furnace thereby protecting the reactive surface from the products of combustion. This process, known as High Yield Melting, was demonstrated in a commercial furnace in partnership with Alcoa and demonstrated 80% dross reduction, 45% fuel savings and 50% emissions reductions. The process received the Indiana Governor's Award for Pollution Prevention in 2001.

In 1999 he proposed the concept of oxygen addition to coal fired boilers as a mechanism to enhance staged combustion to mitigate NO_x production in power plants. The process was developed under a cooperative program with the National Energy Technology Laboratories, U.S. Department of Energy, tested over a variety of scales, and culminated in the first commercial installation in 2003. NO_x emissions below 0.15 lb NO_x/MMBtu was achieved on a 100 MW wall fired boiler burning a Class C bituminous coal without a post combustion de-NO_x system.

Dr. Kobayashi holds a bachelor's degree in Aeronautical Engineering from the University of Tokyo and a M.S. and a Ph.D. in Mechanical Engineering from Massachusetts Institute of Technology