

## Silane and Chlorosilane Safety & ER PDC

A variety of Silanes and Chlorosilanes have been used for many years by the semiconductor IC industry. The most commonly used are silane, dichlorosilane and trichlorosilane. Despite this long history of use, these compounds have unique characteristics which must be considered for system design, operation, maintenance and effective incident mitigation. Despite 40 years of use, silane continues to cause serious incidents at user sites. The use of silane is expected to double or even triple as the Photovoltaic and LCD industries continue their dramatic growth. A number of companies are installing silane manufacturing facilities which use trichlorosilane as a raw material

In this PDC, Professor Jason Chen, Kaohsiung First University and Eugene Ngai, Chemically Speaking LLC will present results of their Silane release testing program. This program began in early 2006 immediately after the 2005 incident in Taiwan to better understand silane release behavior and why it doesn't always ignite immediately. To date hundreds of tests have been conducted under a variety of release conditions. While silane has been studied for almost 40 years by many researchers, the ignition behavior during a release remains a mystery. An extension of the testing program in 2008 was the spill testing of trichlorosilane and extinguishment of fires using a variety of foams. CGA G13 and ANSI standard is rapidly becoming a worldwide standard for silane systems. Since it was first published as CGA P32 in 1996 silane packaging, use and systems have changed. Setback distances which were based on the 1996 release studies may no longer be applicable. The issues with silanes and chlorosilanes extend to the exhaust of deposition equipment, namely explosions and chemical exposure potentials to personnel. Susan Creighton of S. Creighton Consulting will discuss reaction mechanisms and control measures for the exhaust of silane and chlorosilane processing equipment. Susan Creighton an industry EHS specialist will also present on silicon deposition issues and incidents

1. Silane Safety and ER (E. Ngai)
2. Silane Release Testing (Prof Chen)
3. CGA G13 Background and Basis for Setback Distances (E. Ngai)
4. Chlorosilane Safety and ER (E. Ngai)
5. Trichlorosilane Foam Testing (Prof Chen)
6. Silicon Deposition Incidents (S. Creighton)

This PDC is intended to give new and old users a detailed overview of silanes and chlorosilanes by industry experts.



## Speaker Biography

Jenq-Renn Chen

Professor and Director, EPA Southern ERT, NKFUST, Taiwan.

Jenq-Renn Chen is the Professor of the Department of Safety, Health and Environmental Engineering, National Kaohsiung First University of Science and Technology, Taiwan. He is also in charge of the Taiwan EPA Southern Emergency Response Team which provided emergency response service to southern Taiwan. He received MSc and PhD from Imperial College, London, UK, both in Chemical Engineering. He has authored more than 50 papers in international journals and conferences, all in the broad range of process safety. He also participated in more than 70 chemical emergency responses and incident investigation in Taiwan. His current research interests are gas explosion, bubble explosion, and fundamental aspects of chemical releases.

Sue Creighton

S. Creighton Consulting

Sue Creighton has been an EHS professional for 20 years with experience in biotech and semiconductor safety. Ms. Creighton has worked for Applied Biosystems, IBM, Applied Materials and EORM. She recently became an independent consultant providing Product and Occupational Consulting and training. Her expertise includes EHS Management, Product Compliance, Accident Investigation, Emergency Response and EHS Training. She has published on the subject of Silicon By-Product Reactions and has traveled to Europe and Asia conducting accident investigations with by-product reactions in semiconductor equipment. She has bachelors in Physics and is a Certified Safety Professional.

Eugene Ngai

Chemically Speaking LLC

Eugene has a BS in Chemical Engineering and an MS in Environmental Engineering, all from New Jersey Institute of Technology.

He has over 35 years of Specialty Gas Experience in Production, Laboratory, R&D, Engineering, Safety positions at Matheson, Exxon Research, Solkatrionic Chemicals and Scientific Gas Products. Had increasing management responsibilities during his career and held an Executive Management position as Vice President of Corporate Development and Technology for Solkatrionic Chemicals for 10 years prior to the Air Products acquisition in 1999. He had responsibility for EHS, Engineering, Information Technology, Research and Development, and Quality. At Air Products he was Director of Compound Semiconductor Technology in the Electronics Division and retired in 2009 as Director of ER and Disposal Technology in the Product Safety Group.

He is active in a number of industry associations, Compressed Gas Association (CGA), Asia Industrial Gas Association (AIGA), National Fire Protection Association (NFPA) and the Semiconductor Environmental Health and Safety Association (SESHA). He is a member of the UN TC58 SC2 WG7

He also developed and managed the Emergency Response Equipment and Training group from 1990-2008. He was the Course Director for a 3 day Specialty Gas Emergency Response course, which has trained over 4000 customers, government agencies and employees since 1990. He has trained over 750 Firefighters in Compressed Gas Safety and Emergency Response. He has taught at a number of Fire Academies worldwide, including New York and Singapore. He has made numerous presentations worldwide on Emergency Response, Product Safety, Gas Technology and Environment over the last 20 years. His most recent effort was on Silane Safety. He coordinated 1 day silane safety seminars, in Taiwan, Korea, Singapore, US and Europe.

He has 5 US patents for Gas Safety Devices and 1 pending for new gas purification technology