

SILANE SAFETY SEMINAR 2006 TAIWAN

A One-Day Programme on 18th September, 2006
at the ITRI Auditorium, Hsinchu Park, Taiwan

- 1st seminar on Silane safety in Asia
- By leading experts in the industry

Who should attend ?

- All users of silane
- Production and maintenance personnel
- Operational & safety personnel
- Regulatory and emergency response personnel

Photo: L. Gerver, Air Products

Jointly organised by:



Asia Industrial Gases
Association



Council of Labor Affairs
Executive Yuan

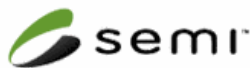


Industry Development
Board, Taiwan



Taiwan High Pressure
Gas Industrial Association

In cooperation with:



For registration, contact: ITRI E-mail: tinyichi@itri.org.tw Or use registration form provided

Taiwan Silane Safety Seminar Introduction

Silane, an electronic specialty gas has been used in commercial quantities since the mid 1960's when the first Integrated Circuit (IC) manufacturers began operation. In those early days there was significant debate on how to handle silane safely. The manufacturers made it in small batch reactors and only filled a 49-litre cylinder to 1 kg. The fill weights are now approaching 18 kg. Knowledge of silane's physical and chemical properties was vague. There was significant debate as to its stability in a cylinder. Over the last 40 years considerable study has been conducted to better understand silane's properties and its behaviour when it is released during an incident.

To better control the hazards, standards have been developed based on these studies. These include CGA G-13 - 2006 *Storage and Handling of Silane and Silane Mixtures* , FM Global 7-7 – 2004 *Semiconductor Fabrication Facilities* and NFPA 318 – 2006 *Standard for the Protection of Semiconductor Fabrication Facilities*. To help educate the gas supplier, users and the regulatory community on the studies and standards, a number of silane technical symposiums were conducted in the United States and Europe from the mid 1980's to the late 1990's.

As the IC and LCD manufacturers in Asia start to use increasing quantities of silane, it is becoming more important for a similar education to take place in Asia. The AIGA Electronic Specialty Gases Working Group recognize this key safety issue and has championed the effort to develop a comprehensive programme. This will be the first in the series of silane technical symposiums sponsored by the Asia Industrial Gas Association. This first is a joint effort with the Taiwan High Pressure Gas Industry Association, the host country association. To support this safety effort funding has been provided by the Taiwan Council of Labor Affairs Executive Yuan and the Taiwan Industry Development Board to offset the costs.

Programme and Presentations' highlights

8:00 – 8:30	Registration	
8:30 – 8:40	Welcome	AIGA,CLA,IDB,THPGIA
8:40 – 8:50	Introduction	Eugene Ngai, Seminar chairman
8.50 – 9:40	Silane release testing studies	Dr. Franco Tamanin
9:40 – 10:10	CGA Silane bulk release testing	Roger A. Smith
10:10 – 10:30	Tea Break	
10:30 – 11:00	Silane cylinder valves	Jerrold Sameth
11:00 – 11:30	Poly & Epi reactor silicon byproduct incidents	John O'Hehir
11:30 – 12:00	Cleanroom fire protection and NFPA-318	Al Brown
12:00 – 12:15	Morning session Q & A	Chairman: Eugene Ngai
12:15 – 13:30	Lunch	
13:30 – 14:00	Unique silane emergency response issues	Eugene Ngai/Kelvin Huang
14:00 – 14:30	Gas cabinet/VMB design	Jean-Paul Barbier
14:30 – 15:00	Silane cylinder storage and management	Kazuya Inoue
15:00 – 15:15	Tea Break	
15:15 – 15:45	Design of bulk containers	Fred Woods
15:45 – 16:15	CGA G-13 Silane	Dave Tolejko
16:15 – 16:45	Quantified risk assessments of silane systems	James VanOmmeren
16:45 – 17:00	Afternoon session Q & A	Chairman: Eugene Ngai

Presentation abstracts

Silane release testing studies (45 minutes)

Dr. Franco Tamanini, Consulting Research Scientist, FM Global

Numerous Silane release studies have been conducted since the mid 1970's, FM Global was contracted by Sematech Inc to review these studies and to conduct additional studies to better understand Silane release behavior in a gas cabinet. Dr. Tamanini was the project manager for these efforts and is one of the world known technical experts in this area

CGA silane bulk release testing (30 minutes)

Roger A. Smith, Technical Director, CGA

As the Industry started to increase their consumption of Silane, there was significant concern by the Fire Service and customers in the US as to the safe design of a bulk use facility. A number of Compressed Gas Association companies funded a study costing over \$1,000,000 to release Silane from a jumbo ISO tube (350 kg) and from cylinders (15 kg). The data allowed the development of safe setback distances in CGA Pamphlet G-13 -- 2006, *Storage and Handling of Silane and Silane Mixtures* to protect people and structures from over-pressurization or thermal exposures due to a sudden release from the PRD.

Silane cylinder valves (30 minutes)

Jerrold Sameth, Chief Technologist – Director of Gas Packaging, Matheson Tri-Gas Inc.

A review of the history and lessons learned with Cylinder Valves. This will include outlet connections, Pressure Relief Devices. Seat Materials. A review of the Matheson Tri Gas Silane Fire - 1997 - Newark, CA which ties together fill density, pressure, compressibility, burst disc rating and extrusion of the fuse metal will also be included in the presentation.

Poly & Epi reactor silicon byproduct incidents (30 minutes)

John O'Hehir, Product Safety Engineer, Applied Materials Inc

During the Poly and Epi deposition process, numerous Silicon compounds are formed which tend to accumulate as liquids or solids throughout the process piping after the reactor. Some of these are air reactive and have caused a number of incidents during routine processing or maintenance activities.

Cleanroom fire protection and NFPA-318 (30 minutes)

Al Brown, Managing Director, Rushbrook Consultants

The risk from fire in semiconductor and TFT-LCD cleanrooms can be reduced to an acceptable level through the application of fire protection standards such as NFPA 318, a standard used in the US and internationally to design and operate cleanrooms. Al Brown, a professional fire safety engineer, is a member of the NFPA318 committee and co-chair of the SEMI Fire Protection Task Force. Al will explore how fire & explosion safety can be achieved in a modern wafer fab, drawing on his experience of fire and explosive atmosphere assessments in Europe and his involvement in recent 300mm wafer fab and Gen 6 & 7 TFT-LCD projects in Asia.

Unique silane emergency response issues (30 minutes)

Eugene Ngai, Air Products & Chemicals Inc & Kelvin Huang, Air Products San Fu Gas Company

The unpredictable behavior of silane and the possibility of a severe consequence require a knowledgeable and coordinated response by the ER team. This will review some important issues and considerations that an ER team must consider during an incident. It will also review some ER techniques that have been used

Gas cabinet/VMB design (30 minutes)

Jean-Paul Barbier, Specialty Gas Director, Air Liquide

Since silane is a pyrophoric gas, special care must be taken for the use of cylinders containing compressed silane. Silane cylinders may be used in non confined environment in order to minimize the consequences of an explosion in case of a leak which does not ignite immediately. But silane cylinders can also be used safely in gas cabinets providing appropriate gas cabinet design and silane handling procedures. This presentation focuses on safety aspects of the design and operation of silane gas cabinets. It includes descriptions of fire resistant gas cabinet materials, appropriate gas cabinet ventilation and silane abatement systems, silane handling manifold purge design and procedures, silane detection systems connected to automatic warning or emergency actions, flow restrictor orifices inside cylinder valves to limit the maximum flow of silane in case of leak, etc.

Design of bulk containers (30 minutes)

Megan Kujawa, Materials Engineer, REC Silicon

The standard for silane delivery in current and future semiconductor, flat panel display, and photovoltaic fabs is bulk delivery in ISO modules. ISO modules are also used for trans-filling silane into smaller cylinders. REC Silicon/ASiMI will present a discussion on silane safety as it relates to the design, fabrication, usage and transportation of bulk silane in ISO modules.

CGA G-13 -- 2006 Storage and Handling of Silane and Silane Mixtures (formerly P-32) (30 minutes)

Dave Tolejko, Process Safety Engineer, Praxair

CGA G-13 (second edition of P-32) is becoming the standard in the U.S. for Silane storage and use. This presentation will review the background of how G-13 was developed, and adoption of the standard as an American National Standard.. Under the international harmonization effort this will be reviewed for adoption by AIGA, EIGA and JIGA. It will highlight key requirements of the standard.

Quantified risk assessments of silane systems (30 minutes)

James VanOmmeren, Process Safety Engineering Associate, Air Products and Chemicals, Inc.

Many release tests have been conducted from silane cylinders in the last 30 years. However, only one release study involving bulk containers of silane has been conducted to date (sponsored by CGA). A safety review of bulk silane delivery systems will be presented based on the bulk testing results. Current consequence modeling of bulk silane system gas dispersion, jet flame, and vapor cloud explosion hazards will be compared versus the bulk testing results.

Silane cylinder storage and management (30 minutes)

Kazuya Inoue, Asia Operations Manager, Electronics Materials, BOC-Edwards

This paper will cover cylinder inspection, proper storage and protection of cylinders under different environment conditions, separation distances, inventory control and cylinder management as well as the installations of gas detection and monitoring systems.

Biographies



Jean-Paul Barbier
Specialty Gas Director, Air Liquide

Jean-Paul Barbier has a Master Degree in Chemical Engineering and a PhD in Organo-metallic chemistry. He has worked for the last 28 years at Air Liquide and has held a variety of scientific and technical positions both in France and in the US, primarily in Electronic Specialty Gases. He is now the Air Liquid Group Technical Senior Expert and in the field of Specialty Gases for both semiconductor and laboratory and analysis markets. He represents Air Liquide at the European Industrial Gas Association (EIGA) as Chairman of Working Groups for the writing of Codes of Practice for "Compressed oxidant-fuel gas mixtures manufacturing" and on "Fluorine



Al Brown
Managing Director,
Rushbrook
Consultants.

Al Brown is a leading specialist in fire and risk engineering and assessment, with particular expertise in the semiconductor and TFT-LCD industries, including assessment of manufacturing equipment and processes as well as semiconductor gas and chemical facilities. Before founding Rushbrook Consultants in 1999 he spent 14 years with FM Global where he was the Staff Engineering Semiconductor Industry Specialist and contributor to the development of FM 7-7 including the section on protection of Bulk Silane systems. He is regularly involved the development of risk mitigation strategies, as well as the design of fire protection systems for semiconductor wafer and LCD fabs in Europe and SE Asia. Al is a registered professional engineer in the UK, and member of the Institution of Fire Engineers, Society of Fire Protection Engineers and Institution of Mechanical Engineers. He is a member of the NFPA 318 Technical Committee, Co-chair of SEMI Europe EHS Committee and co-leader of the Fire Protection and Risk Assessment Task Forces



Kelvin Huang
Senior Manager, Air Products San Fu Gas Company

Kelvin Huang is a Senior Manager at Air Products San Fu Gas Company and is now directing the Electronic Gas SAP implementation effort in Asia for Air Products. He has over 12 years of experience in a variety of positions, Quality Assurance, Project Engineering, Process Development, Megasys Operations and plant manager of the Shanhua II ESG facility. He also has been an Air Products certified ER trainer and has conducted training courses in China and Taiwan. He has a Masters in Organic Chemistry



Kazuya Inoue
Asia Operations Manager, Electronics Materials, BOC Edwards

Kazuya Inoue is currently based in Japan as Asia Operations Manager, Electronics Materials, BOC Edwards. Kazuya has worked extensively in the electronics specialty gases field in the areas of production, engineering, project management, commissioning, quality and safety management in the U.S, Europe and Asia. He graduated in Electronics Property from the Osaka Electronics Communication University in 1984 and joined Osaka Sanso Kogyo Ltd. (OSK). In 1993, he was involved in the design and construction of the Ina plant in Japan and managed the plant from 1994 -1999. In 2003 he transferred to BOC Edwards Japan from OSK.



Megan Kujawa is a Materials Engineer for REC Silicon (formerly ASiMI), in Butte, MT. In this role, she has been instrumental in the design and fabrication of packages for silicon gasses filling, transportation, and discharge. She holds bachelor's degrees in Metallurgical Engineering and Welding Engineering from Montana Tech of the University of Montana. Megan is a Certified Welding Inspector (CWI) and serves as an adjunct welding and metallurgy professor for the University.

Megan Kujawa
Materials Engineer, REC Silicon



He has 35 years of Specialty Gas Experience in Production, Laboratory, R&D, Engineering, Safety positions. Was the Vice President of Technology for Solkatronic Chemicals for 10 years prior to the Air Products acquisition in 1999 with responsibility for EHS, Engineering, Information Technology, Research and Development, and Quality. Most recently he was Director of CS Technology in the Electronics Division and is now Director of ER and Disposal Technology in the Product Safety Group. He started the Emergency Response Equipment and Training group in 1990. He is the Course Director for a 3 day Specialty Gas Emergency Response course, which has trained over 4000 customers, government agencies and employees and over 750 Firefighters in Compressed Gas Safety and Emergency Response. He has 4 US patents for Gas Safety Devices and 2 pending for new Purification Technology

Eugene Y. Ngai
Director of ER and Disposal Technology,
Air Products and Chemicals, Inc.



For the last two years Mr. John O'Hehir has worked for Applied Materials in Product Safety for the Front End Products Group (FEP) supporting the 200 and 300mm advanced epi deposition systems. Prior to this he worked for 9 years as a senior consultant to a Product Safety 3rd party providing SEMI S2 safety evaluations worldwide. In parallel he has been a voting member on various product safety standard writing committees including SEMI S2/S8 and soon to be released SEMI S6. Mr. O'Hehir holds a B.S. from Clarkson University in Industrial Hygiene and Environmental Toxicology

John O'Hehir
Product Safety, Applied Materials Inc.



Jerrold D. Sameth is the Chief Technologist and Director of Gas Packaging for Matheson Tri-Gas, a Taiyo Nippon Sanso Group Company. He joined the company in 1980 and is based in Parsippany, NJ. He is responsible for all facets of cylinder and valve engineering. He actively participates on CGA and ISO Cylinder and Valve Committees and has been a member of the AIGA Working Group on Electronic Specialty Gases since its inception in 2002. He is a 1971 Chemical Engineering Graduate of the City College of New York.

Jerrold Sameth
Chief Technologist – Director of Gas Packaging Matheson Tri-Gas Inc.



Roger Smith is the Technical Director for the Compressed Gas Association (CGA), which promotes the safe manufacture, transportation, storage, trans-filling, and disposal of industrial and medical gases and their containers, located in Chantilly, Virginia. Mr. Smith has 35 years experience in the industrial and medical gas industry with 25 years in operations. Industry experience includes the management of manufacturing facilities, both single and multiple site operations, and as Senior Vice President of Operations, directed of all activities related to manufacturing, engineering, regulatory affairs, quality assurance and research and development for 8 years at Matheson Gas Products

Roger A. Smith
Technical Director, Compressed Gas Association



After coordinating for several years FM Global's research activities in the area of explosions, Dr. Tamanini moved two years ago to the Consulting Research Scientist position. In his current role, he provides support to the Manager of Research, and to the entire scientific and engineering staff, on issues spanning all research topics of interest to FM Global. They include: fire testing; material flammability; CFD modeling of fires and explosions; impact of natural hazards (wind, flood, earthquake..) on property; risk assessment; equipment reliability; and material damage. In addition, Dr. Tamanini has contributed original work in several technical areas which include explosion and fire hazards

Dr. Francesco Taman
Consulting Research
Scientist,
FM Global,
Research Group

Dr. Tamanini started working at Factory Mutual Research in 1974 after receiving a Ph.D. in applied physics from Harvard University. He also holds MS degrees from the California Institute of Technology and the Politecnico of Torino in Italy. He has served as the Chairman of the Eastern States Section of the Combustion Institute, is the 1996 recipient of the Bill Doyle award of the AIChE, and has published numerous refereed papers and technical reports.



David C. Tolejko
Global Process Gases
Safety Engineer,
Praxair, Inc.

David Tolejko is the Process Safety Engineer for the Electronics Group of Praxair, Inc., and is responsible for the safe design and handling of high hazard materials for the electronics industry on a global basis. Since joining Praxair in 1974, Dave has held various positions including engineer and supervisor in Control Systems Engineering and Environmental Systems Field Project Manager. Since 1986, he has worked in the Safety Engineering group, performing some of the first process hazard analysis using hazops and FMEA. In 1994, Dave joined the Electronics group and worked with local building and fire code officials on projects around the world on design and installation of hazardous gas delivery systems at semiconductor fabs. He was also part of the Praxair team on the CGA Task Force to develop the Silane standard P-32/G-13. He presented a seminar on silane at the Taiwan Industrial Technology Research Institute in April 2005. As part of his ongoing safety commitment, Dave is the past fire Chief of the Grand Island Fire Co. and past commander and present Safety Officer for the Erie County Hazardous Material Response Team.



James VanOmmeren
Process Safety
Engineering Associate,
Air Products and
Chemicals, Inc.

James VanOmmeren joined Air Products and Chemicals, Inc. in 1981 and has held various technical assignments within the corporation, including Development and Process Engineering. In 1993, he joined Process Safety Engineering supporting high-purity hazardous materials and equipment for Electronics use. He recently was named an Engineering Associate and is the Global Process Safety Lead for Air Products' Electronics Division (\$1.3B annual sales). Jim is responsible for Process Safety involving Electronics equipment manufacturing, gases and chemicals manufacturing, transportable containers and operational services provided to customers. He specializes in various qualitative risk review and quantitative risk calculation methodologies, and provides safety training globally to employees, customers, local authorities and emergency responders. Jim received his BSChE from University of Delaware in 1981 and is currently a member of several CGA Subcommittees. He has authored several papers, given presentations at global symposiums and holds eight patents dealing with gas and cryogenic processing.