Other Gases			
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REVIEW OF HYDROGEN INCIDENTS 1994 - 1998

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Summary

This note presents the results of a review of hydrogen incidents reported to HSE over the period 1994 -1998. It also provides details of the main sources of guidance on the storage, handling and use of hydrogen.

Hydrogen is used in the production of a wide range of chemicals and foodstuffs. It is used in metallurgical processes such as heat treatment, metal production, welding, cutting and thermal spraying. It is also used in semiconductor manufacture and in the electrical power industry.

Hydrogen can also be an unwanted by-product of chemical processes such as dissolution of metals, electrochlorination and electrolytic plating. Most commonly, it is generated during the charging of lead-acid batteries.

Hydrogen is flammable in the range 4 -75% (by volume in air) and has a very low ignition energy.

Sources of Information

The information for the review was extracted from the FIREX database and from the FOCUS investigation database. All the incidents have been reported to HSE under RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations).

199 incidents were identified involving hydrogen gas. The majority (141) are associated with battery explosions. Such explosions often result in reportable injuries to the face and hands particularly if protective equipment is not being worn.

The remaining 58 incidents have been divided into ten categories according to the use or process involved. (See table below.) It was difficult to identify any particular trends or any common failure modes. Most incidents involving a hydrogen supply system were due to some form of leak. The cause of the leak (where specified) was either physical damage - for example during loading/unloading operations - or plant deterioration/poor maintenance. In most cases the hydrogen leak either ignited immediately or dispersed very quickly, without build up of gas, and so reduced the possibility of serious damage and injury. Unfortunately, this was not the case in the two thermal spraying incidents where the leaking hydrogen accumulated in cabinets. When the gas eventually ignited, the result was serious injury and a fatality.

Incidents involving by-product hydrogen gas usually resulted from a failure to disperse the gas quickly enough. For example, in the dissolution of metals, the rate of hydrogen production depends on many factors. Deviations from normal conditions can result in more rapid

hydrogen generation which can then be ignited by static or a similarly low energy ignition source.

The miscellaneous incidents usually resulted from the inadvertent generation of hydrogen caused by accidental or deliberate metal/acid or metal/water contact during cleaning or disposal operations.

From the information provided on the incident reports, only one involved liquid hydrogen facilities.

Summary of hydrogen incidents 1994 - 1998

	YEAR	1994	1995	1996	1997	1998		TOTAL
ACTIVITY								
Batteries		28	28	29	25	31		141
Chemical process		4	5	3	1	2		15.
Furnaces		3	1	1	4	2		11
Laboratory		1	1	2	2	1		7
Metal dissolution		1		2	1			4
Transport				3	1			4
Turbine		1		1		2		4
Electrochlorination		1		2	1			4
Electroplating			1	1				2
Thermal spraying					1	1		2
Miscellaneous		2				3		5
TOTAL		41	36	44	36	42		199

Guidance

British Compressed Gases Association

GN2 Guidance for the storage of transportable gas cylinders for industrial use Rev 2 1997

CP8 The safe storage of gaseous hydrogen in seamless cylinders and similar containers 1986

CP18 The safe storage, handling and use of special gases in the microelectronics industry 1995

CP25 Revalidation of bulk liquid, nitrogen, argon and hydrogen storage tanks Rev 1 1998

European Industrial Gases Association

IGC 15/80 Gaseous hydrogen stations

IGC 06/93/E Safety in storage, handling and distribution of liquid hydrogen

National Fire Protection Association

NFPA 50A Standard for gaseous hydrogen systems at consumer sites 1999 edition

NFPA 50B Standard for liquefied hydrogen systems at consumer sites 1999 edition

Health and Safety Executive

IND(G)139L Electric storage batteries, Safe charging and use

Internal

FIC 278 33 (Originally FIC 294 37) 1985

Catalytic hydrogen generators, fire and explosion risks

FIC 655 3 1974 Explosions in barrel plating machines

Thermal Spraying and Surface Engineering Association

Code of Practice for the Safe Operation of Thermal Spraying Equipment (in preparation)