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化學品反應不相容性評估

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化學不相容性表格(定性)

	非氧化無機胺類1	硫酸2	硝酸3	有機酸類4	腐蝕劑5	氨6	脂肪族胺類7	羥基胺類8	芳香族胺類9	醯胺類10	酸酐類11	異氫酸類12	乙酸乙烯酯類13	丙烯酸酯類14	丙烯類15	環氧類16	氯甲基一氯三園17
1.非氧化無機酸類		×			×	×	×	×	×	×	×	×	×			×	×
2.硫酸	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
3.硝酸		×			×	×	×	×	×	×	×	×	×	×	×	×	×
4.有機酸類		×			×	×	×	×				×				×	×
5.腐蝕劑	×	×	×	×							×	×				×	×
6.氨	×	×	×	×						×	×	×	×			×	×
7.脂肪族胺類	×	×	×	×							×	×	×	×	×	×	×
8.羥基胺類	×	×	×								×	×	×	×	×	×	×
9.芳香族胺類	×	×	×								×	×					
10.醯胺類	×	×	×			×						×					
11.酸酐類	×	×	×		×	×	×	×	×								
12.異氫酸類	×	×	×	×	×	×	×	×	×	×							
13.乙酸乙烯酯類	×	×	×			×	×	×									
14.丙烯酸酯類		×	×				×	×									
15.丙烯類		×	×				×	×									
16.環氧類	×	×	×	×	×	×	×	×									
17.氯甲基-氯三氨	×	×	×	×	×	×	×	×									

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實驗廢液相容表

編號	廢液主要成分	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	礦物性酸(非氧化性)	1																		
2	礦物性酸(氧化性)		2																	
3	有機酸			3																
4	醇類,二元醇類和酸類				4															
5	農藥,石綿等有毒物質					5														
6	醯胺類						6													
7	胺,脂肪族							7												
8	偶氮及重氮化合物,聯胺								8											
9	水									9										
10	鹼										10									
11	氰化物,硫化物及氰化物											11								
12	二磺氨基碳酸鹽												12							
13	酯類,醚類及酮類													13						
14	易爆物(註一)														14					
15	強氧化劑(註二)															15				
16	芳香族,不飽和烴類																16			
17	鹵化有機物																	17		
18	一般金屬																		18	
19	鋁,鉀,鋰,鎂,鈣,鈉等易燃金屬																			19

廢液之儲存除應考慮容器與廢液之相容性外,更應注意廢液間之相容問題,不具相容性之廢液應分別儲存.

顏色說明

代表顏色	混合後結果
	產生熱
	起火
	產生無毒和不易燃氣體
	產生有毒氣體
	產生易燃氣體
	爆炸
	劇烈聚合作用
	或許有危害性但不確定

範　例

	產生熱起火和毒性氣體

註一: 易爆物包括溶劑,廢棄爆炸物,石油廢棄物等.

註二: 強氧化劑包括鉻酸,氯酸,雙氧水,硝酸,高錳酸等.

US Chemical Hazards Response Information System (CHRIS)

- 美國46 CFR Part 150.120 。
  - Definition of incompatible cargoes
- 主要依物質的反應性為基礎進行分類。
- 共分有36類。
- 以X來表示該兩類物質的具不相容性。

Coast Guard, DOT

CARGO COMPATIBILITY

CARGO GROUPS / REACTIVE GROUPS	1. NON-OXIDIZING MINERAL ACIDS	2. SULFURIC ACID	3. NITRIC ACID	4. ORGANIC ACIDS	5. CAUSTICS	6. AMMONIA	7. ALIPHATIC AMINES	8. ALKANOLAMINES	9. AROMATIC AMINES	10. AMIDES	11. ORGANIC ANHYDRIDES	12. ISOCYANATES	13. VINYL ACETATE	14. ACRYLATES	15. SUBSTITUTED ALLYLS	16. ALKYLENE OXIDES	17. EPICHLOROHYDRINS	18. KETONES	19. ALDEHYDES	20. ALCOHOLS, GLYCOLS	21. PHENOLS, CRESOLS	22. CAPROLACTAM SOLUTION
1. NON-OXIDIZING MINERAL ACIDS		X			X	X	X	X	X	X	X	X	X			X	X					
2. SULFURIC ACID	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3. NITRIC ACID		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
4. ORGANIC ACIDS		X			X	X	X	X				X				X	X					
5. CAUSTICS	X	X	X	X							X	X				X	X		X	X	X	X
6. AMMONIA	X	X	X	X						X	X	X	X			X	X		X			
7. ALIPHATIC AMINES	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X
8. ALKANOLAMINES	X	X	X	X							X	X	X	X	X	X	X		X			
9. AROMATIC AMINES	X	X	X								X	X							X			
10. AMIDES	X	X	X			X						X									X	
11. ORGANIC ANHYDRIDES	X	X	X		X	X	X	X	X													
12. ISOCYANATES	X	X	X	X	X	X	X	X	X	X										X		X
13. VINYL ACETATE	X	X	X			X	X	X														
14. ACRYLATES		X	X				X	X														
15. SUBSTITUTED ALLYLS		X	X				X	X														
16. ALKYLENE OXIDES	X	X	X	X	X	X	X	X														
17. EPICHLOROHYDRIN	X	X	X	X	X	X	X	X														
18. KETONES		X	X				X															
19. ALDEHYDES		X	X		X	X	X	X	X													
20. ALCOHOLS, GLYCOLS		X	X		X		X					X										
21. PHENOLS, CRESOLS		X	X		X		X			X												
22. CAPROLACTAM SOLUTION		X			X		X					X										
30. OLEFINS		X	X																			
31. PARAFFINS																						
32. AROMATIC HYDROCARBONS			X																			
33. MISCELLANEOUS HYDROCARBON MIXTURES			X																			
34. ESTERS		X	X																			
35. VINYL HALIDES			X																			X
36. HALOGENATED HYDROCARBONS																						
37. NITRILES		X																				
38. CARBON DISULFIDE							X	X														
39. SULFOLANE																						
40. GLYCOL ETHERS		X										X										
41. ETHERS		X	X																			
42. NITROCOMPOUNDS					X	X	X	X	X													
43. MISCELLANEOUS WATER SOLUTIONS		X										X										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

(不)相容性定義

- 事業廢棄物貯存清除處理方法及設施標準第2條

  相容性：指事業廢棄物與容器、材料接觸，或二種以上之事業廢棄物混合，不發生下列效應者：

  1.產生熱。

  2.產生激烈反應、火災或爆炸。

  3.產生可燃性流體或有害流體。

  4.造成容器材料劣化，致降低污染防治之效果。

- 同法第12條

  不相容性之事業廢棄物不得混合清除

不相容性定義

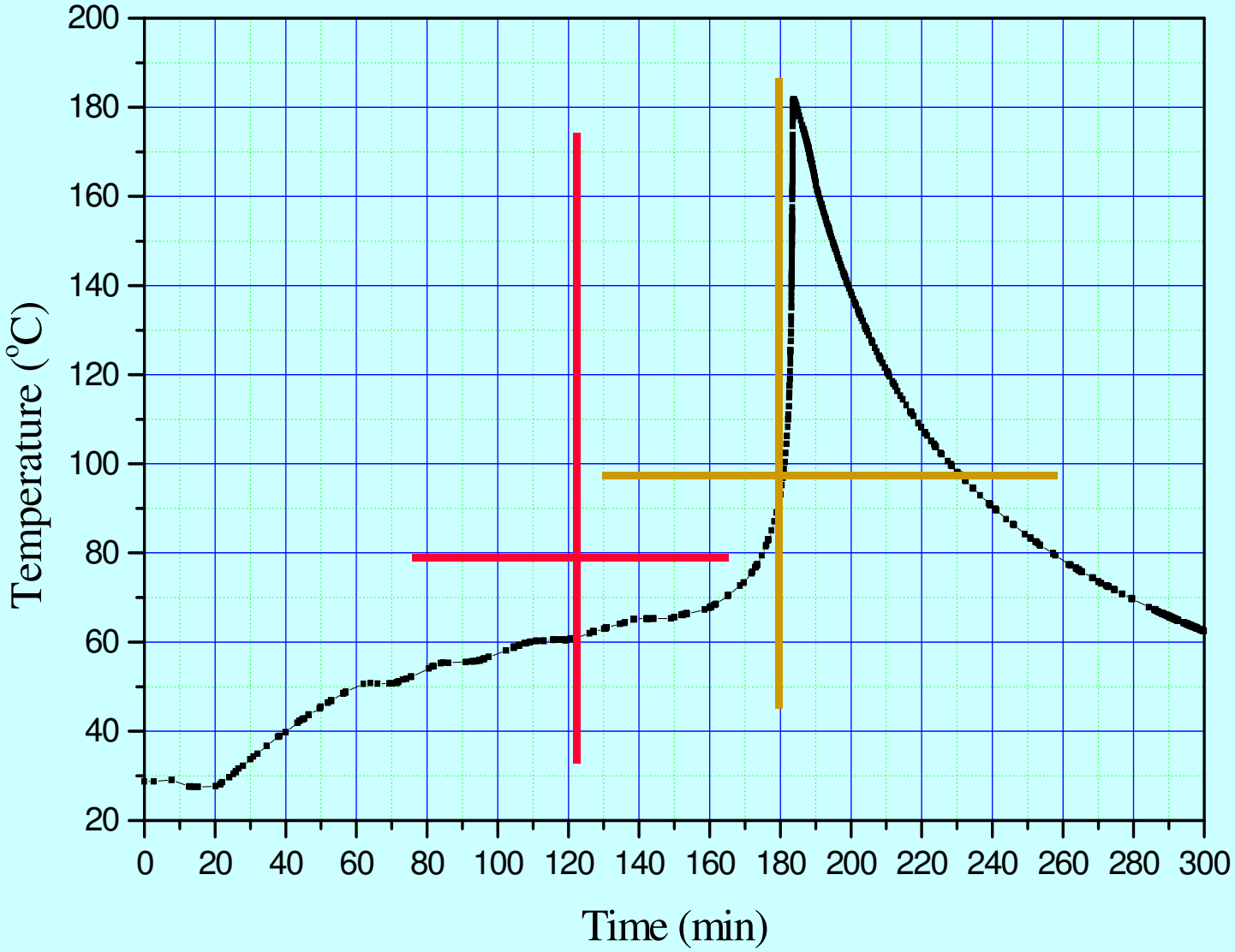
- PART 264_STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES [美國40 CFR 264.17(b)]

1. Generate extreme heat or pressure, fire or explosions, or violent reactions;
2. Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment;
3. Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions;
4. Damage the structural integrity of the device or facility;
5. Through other like means threaten human health or the environment.

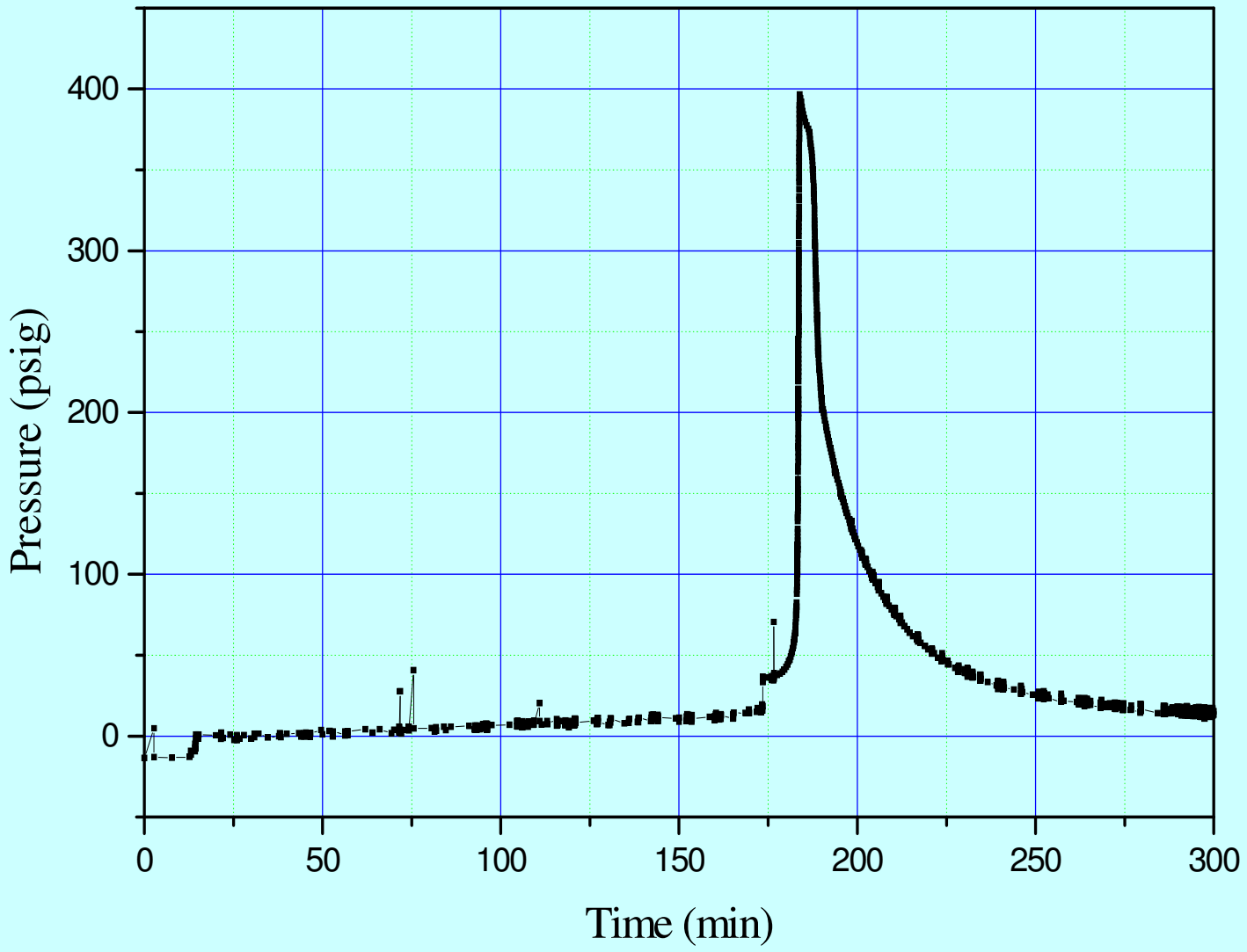
So,

- Exterme heat
- Violent reaction
- Pressure
- Fire
- Explosion
- Flammable and/or toxic gas, fume, mist, dust

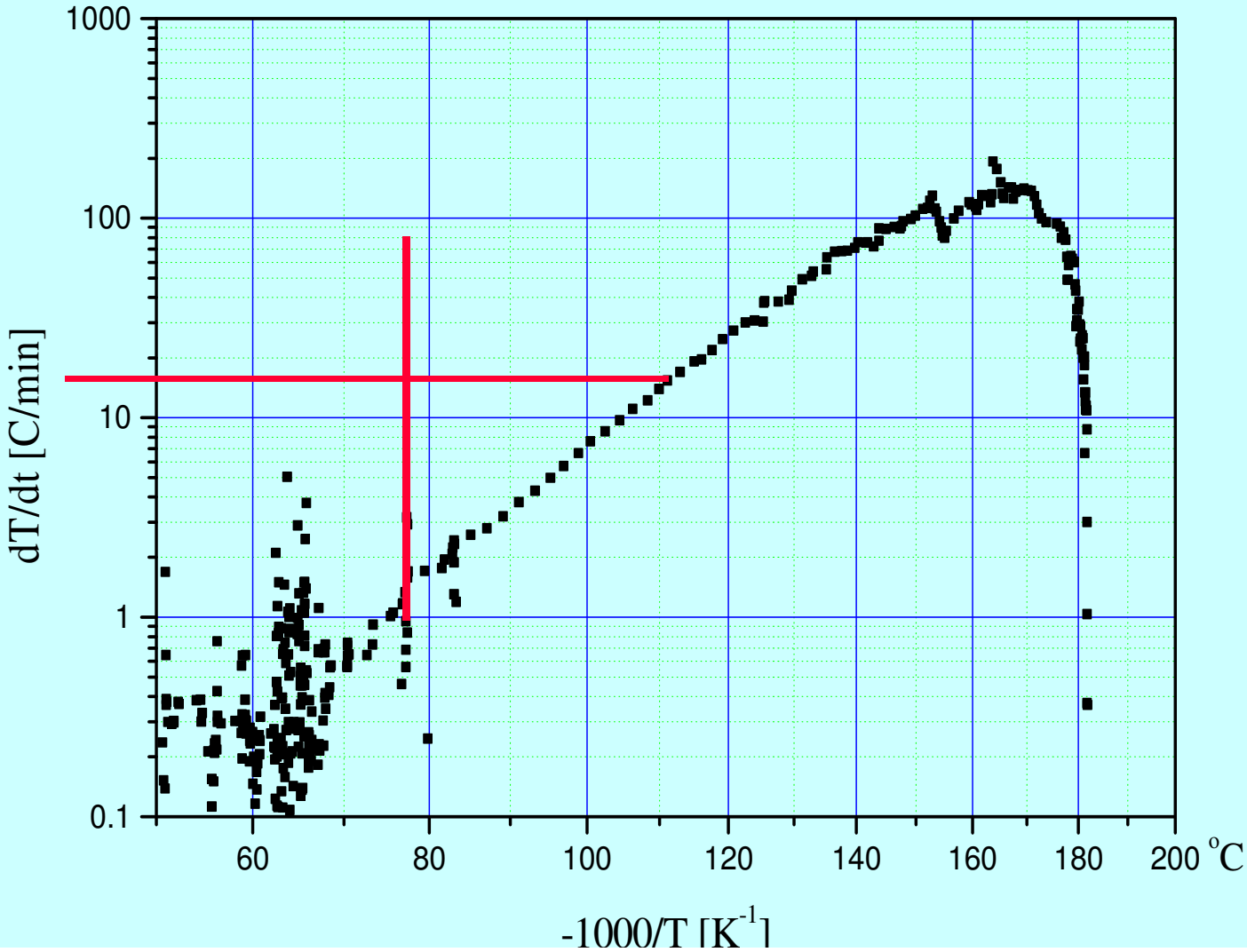
溫度上升情形


Temperature (°C)
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Time (min)

壓力上升情形


Pressure (psig)
400
300
200
100
0
0
50
100
150
200
250
300
Time (min)

升溫速率與溫度關係圖


1000
100
10
1
0.1
dT/dt [C/min]
60
80
100
120
140
160
180
200 °C
-1000/T [K-1]

SEMI S2

Some Definitions

- HPM (hazardous production material) - a solid, liquid, or gas that has a degree-of-hazard rating in health, flammability, or reactivity of class 3 or 4 as ranked by NFPA704
- Incompatible - chemicals that, when combined unintentionally, may react violently or in an uncontrolled manner, releasing energy that may create a hazardous condition

危害辨識-NFPA704危害標示

健康危害
0 一般物質
1 輕微危害性
2 具危害性
3 非常危險
4 致死

可燃性(閃火點)
0 不可燃
1 高於94℃
2 低於94 ℃
3 低於38 ℃
4 低於23 ℃

藍色:表示健康危害

紅色:表示火災危害(可燃性)

黃色:表示反應性(安定性)

白色:表示特殊危害

特殊危害
OX 氧化劑
ACID 強酸
ALK 強鹼
COR 腐蝕性
W 勿與水混合
POLY 聚合反應

反 應 性
0 安定
1 熱安定性差
2 劇烈化學反應
3 震盪加熱可能爆炸
4 可能爆炸

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NFPA704危害物標示

HMIS Label

"Hazardous Materials Identification System"

ACETONE	
1	Health
3	Flammability
0	Reactivity
C	Protective Equipment

HAZARD RATING

4 EXTREME	1 SLIGHT
3 SERIOUS	0 MINIMIAL
2 MODERATE	

NFPA 704

- 化學物質之健康、火災及反應性危害等級判定標準
- 危害等級皆分為0~4，其中“0”可視為不具該項危害性，而“4”表示該危害性為極度危險。
- CSB統計將近60%的事故之化學品尚未被NFPA所評定是否具危害性，或被評定屬於NFPA 0級的“不具特殊危害”。只有10%事故之化學品屬於NFPA 3或4級之危險品。

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SEMI S2

§ 23 Chemicals

§ 23.1 Chemical inventory (chemical anticipated to be used or generated)

- HPMs, odorous, irritant chemicals

§23.2. & §23.2.1 Hazard analysis

- potential mixing of incompatible chemicals
- potential chemical emission during routine operation
- potential chemical emission during maintenance activities
- potential key failure points and trouble spots (e.g., fittings, pumps)

危險性工作場所審查暨檢查辦法-

物質相容性檢核表

表 3.2.1-2 （檢核表 B：物質相容性檢核表）

物質相容性查核表

場　　所:

日　　期:

考量化學品與化學品或與結構材質間所有可能反應之情況

危害之潛在性　　參考註解號數

✓重大

? 可能

— 無

?
2

→如:註解 2

查 核 表 B

有關化學物質危害性質之詳細資料，是否都已做了確認?

化學物質 / 反應特性 / 化學物質	氮氣	氧氣	氫氣	氬氣	氦氣	尼龍	人造橡膠	鑄鐵	Al	SS 304	SS 316	C.S	結構材質 / 化學物質
氮氣/液氮	—	—	—	—	—	—	—	—	—	—	—	—	氮氣/液氮
氧氣/液氧	—	—	✓ 2	—	—	✓ 1	✓ 1	✓ 1	✓ 1	✓ 3	✓ 3	—	氧氣/液氧

註：

1. 氧氣、液氧不可使用鑄鐵、人造橡膠、尼龍。
2. 氫氣應與氧氣隔離。
3. ．．．

ASTM E2012-06

- In a general sense, chemical incompatibility implies that there may be undesirable consequences of mixing these materials at a macroscopic scale. These consequences might be, in a worst case, a **fast chemical reaction** or an **explosion**, a **release of toxic gas**, or, in a less severe case, an **undesirable temperature rise** that might take the mixture **above its flash point** or cause **an unacceptable pressure increase** in the system.

So, 化學品不相容性可大致分類為:

- 美國環保署
  EPA-600/2-80-076 A Method for Determining the Compatibility of Chemical Mixtures

1. Heat Generation, H
2. Fire, F
3. Innocuous and non-flammable gas generation, G
4. Toxic Gas formation, GT
5. Flammable Gas formation, GF
6. Explosion, E
7. Violent Polymerization, P
8. Solubilization of toxic substance, S
9. May be hazardous, but Unknown, U

美國環保署系統

- EPA-600/2-80-076 A Method for Determining the Compatibility of Chemical Mixtures 。
- 主要依物質的反應性為基礎進行分類。
- 共分有41類。
- 以不同的代號來說明兩類物質接觸後所可能引發的不相容性，共有H、F、G、GT、GF、E、P、S及U等9種代號表示。

EPA's Chemical Compatibility Chart

EPA-600/2-80-076 April 1980

A METHOD FOR DETERMINING THE COMPATIBILITY OF CHEMICAL MIXTURES

Please Note: This chart is intended as an indication of some of the hazards that can be expected on mixing chemical wastes. Because of the differing activities of the thousands of compounds that may be encountered, it is not possible to make any chart definitive and all inclusive. It cannot be assumed to ensure compatibility of wastes because wastes are not classified as hazardous on the chart, nor do any blanks necessarily mean that the mixture cannot result in a hazard occurring. Detailed instructions as to hazards involved in handling and disposing of any given waste should be obtained from the originator of the waste.

#	REACTIVITY GROUP NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Acids, Mineral, Non-oxidizing																						
2	Acids, Mineral, Oxidizing																						
3	Acids, Organic		G H																				
4	Alcohols and Glycols	H	H F	H P																			
5	Aldehydes	H P	H F	H P																			
6	Amides	H	H GT																				
7	Amines, Aliphatic and Aromatic	H	H GT	H		H																	
8	Azo Compounds, Diazo Compounds and Hydrazines	H G	H GT	H G	H G	H																	
9	Carbamates	H G	H GT						G H														
10	Caustics	H	H	H		H				H G													
11	Cyanides	GT GF	GT GF	GT GF					G														
12	Dithiocarbamates	H,F GF	H,F GF	H,GT GF		GF GT		U	H G														
13	Esters	H	H F						H G		H												
14	Ethers	H	H F																				
15	Fluorides, Inorganic	GT	GT	GT																			
16	Hydrocarbons, Aromatic		H F																				
17	Halogenated Organics	H GT	H,F GT					H GT	H G		H GF	H											
18	Isocyanates	H G	H,F GT	H G	H P			H P	H G		H,P G	H G	U										
19	Ketones	H	H F						H G		H	H											
20	Mercaptans and Other Organic Sulfides	GT GF	H,F GT						H G									H	H	H			
21	Metals, Alkali and Alkaline Earth, Elemental	H,F GF	H,F GF	H,F GF	H,F GF	H,F GF	GF H	GF H	GF H	GF H	GF H	GF H	GF,H GT	GF H				H E	GF H	GF H	GF H		
22	Metals, Other Elemental & Alloys as Powders, Vapors, or Sponges	H,F GF	H,F GF	G F					H,F GT	U	GF H							H E	GF H		H,F GF		22

CODE	CONSEQUENCE
H	Heat Generation
F	Fire
G	Innocuous and non-flammable gas generation
GT	Toxic Gas formation
GF	Flammable Gas formation
E	Explosion
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4	醇類,二元醇類和酸類				4															
5	農藥,石綿等有毒物質					5														
6	醯胺類						6													
7	胺,脂肪族							7												
8	偶氮及重氮化合物,聯胺								8											
9	水									9										
10	鹼										10									
11	氰化物,硫化物及氰化物											11								
12	二磺氨基碳酸鹽												12							
13	酯類,醚類及酮類													13						
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15	強氧化劑(註二)															15				
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	產生無毒和不易燃氣體
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	產生易燃氣體
	爆炸
	劇烈聚合作用
	或許有危害性但不確定

範　例

	產生熱起火和毒性氣體

註一: 易爆物包括溶劑,廢棄爆炸物,石油廢棄物等.

註二: 強氧化劑包括鉻酸,氯酸,雙氧水,硝酸,高錳酸等.

歷史的教訓

- 2002年美國化學安全與危害調查委員會(U.S. Chemical Safety and Hazard Investigation Board, CSB)調查1980年1月至2001年6月美國境內因化學反應性危害所引起的167件重大事故，其中

  不相容反應 ➔ 36%

  失控反應 ➔ 35%

  撞擊敏感或熱敏感性物質引起 ➔ 10%

水能載舟亦能覆舟

- 運作化學物質時，物質的燃燒性及毒性是一般人最直接關切的危害，而對於物質所潛在的反應不相容性危害往往被忽略。

- 反應不相容性危害是指足以直接或間接引起人員、財產或環境損傷之潛在且無法控制的化學反應，其可能伴隨使溫度及壓力上升、氣體或能量釋放。

- 反應型態➔自反應(self-reacting)
  分解、聚合及重組反應
  化學交互作用反應(chemical interaction)
  失控及不相容反應

歷史的教訓

- 1984年印度Bhopal事件

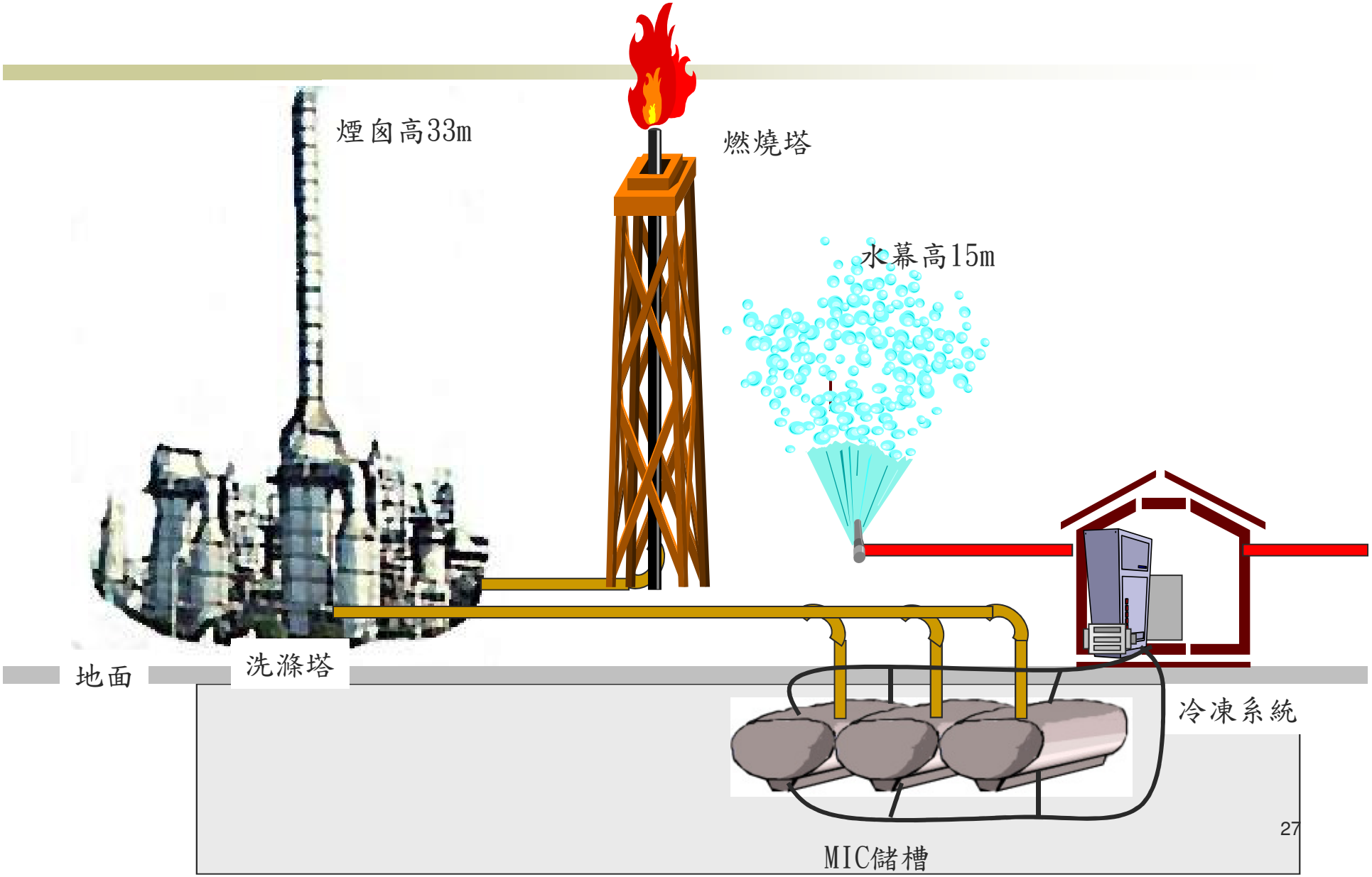
  MIC與水接觸，而造成23公噸的MIC外洩，並導致2153人死亡，近20萬人受害。

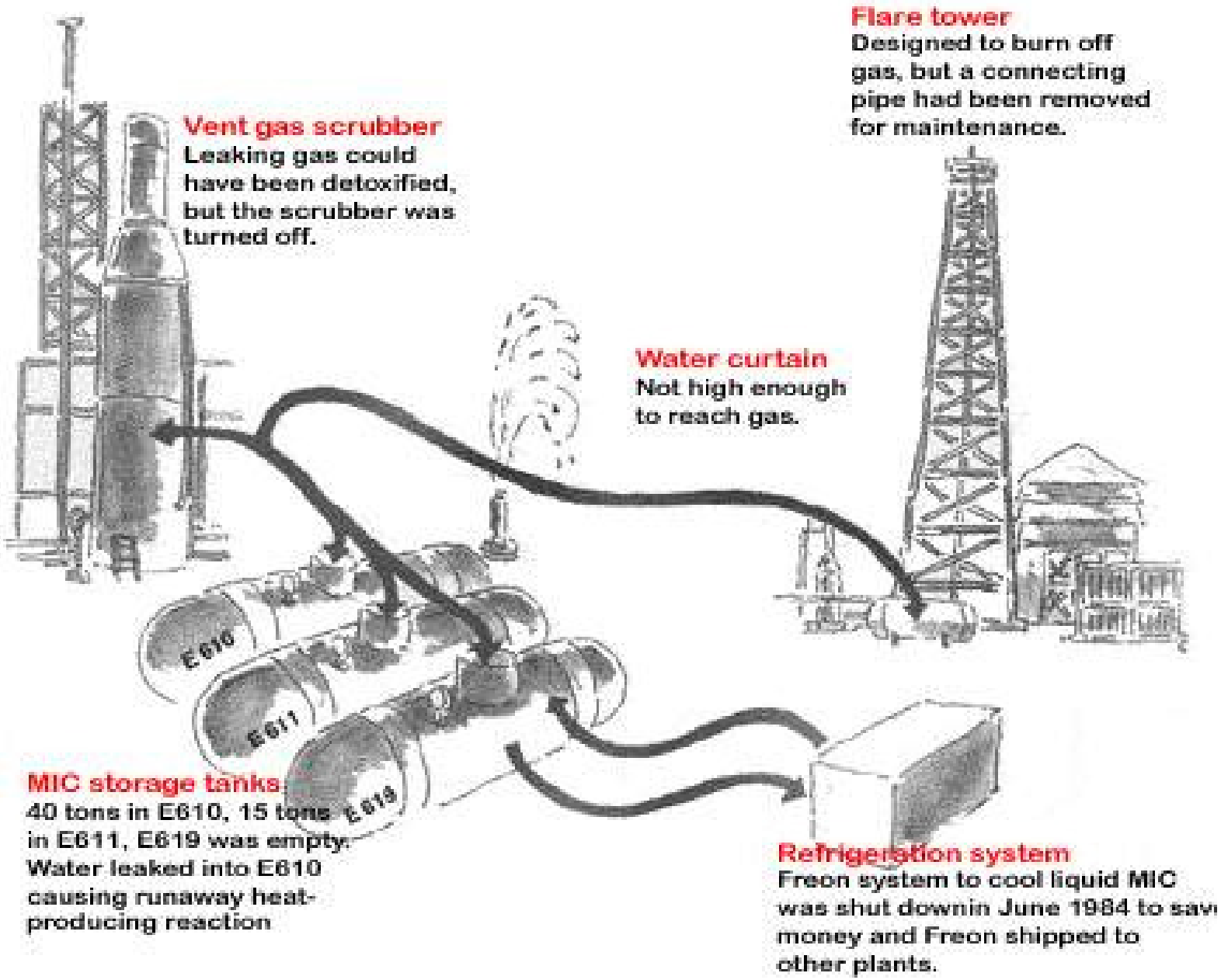
  異氰酸甲酯(methyl isocyanate, MIC) ← 禁水性

- 1999年國內某大學機械系實驗室

  處理廢液，不慎將異丙醇與無機酸混合，造成劇烈的 反應並發生氣爆，造成兩個HDPE筒被炸破，噴出的強酸使得技術員小腿與臉部受到灼傷。

Bhopal 廠安全保護系統




Flare tower
Designed to burn off gas, but a connecting pipe had been removed for maintenance.
Vent gas scrubber
Leaking gas could have been detoxified, but the scrubber was turned off.
Water curtain
Not high enough to reach gas.
E 610
E 611
E 619
MIC storage tanks
40 tons in E610, 15 tons in E611, E619 was empty. Water leaked into E610 causing runaway heat-producing reaction
Refrigeration system
Freon system to cool liquid MIC was shut downin June 1984 to sav money and Freon shipped to other plants.

The Disaster: Contributing Factors

Human Error

- Critical isolation valve not closed before pipes were flushed with water, causing the fatal pressurization of tank containing MIC.
- Flare for flame neutralization of escaping gas was shut down

Inadequate Safety Equipment

- Reach of sprayer for water neutralization of escaping gas was inadequate. Plant managers were aware of deficiency.
- Flare system lacked capacity for major gas leak.

Failure of Safety Equipment

- Stack scrubber, activated by operator during leak, failed.

Poor Maintenance

- Tank refrigerators inoperable; had been drained of freon
- Blockage in pipes meant to drain water that pressurized tank

The Disaster: Contributing Factors (cont.)

Inadequate Staffing

- Union-Carbide-trained supervisors had left Bhopal by 1984
- Staffing in MIC unit had been cut below half of recommended level
- Second-shift maintenance supervisor position eliminated weeks before disaster

Lack of Evacuation Plans

- Visiting Union Carbide engineers repeatedly stressed need for a plan to alert and evacuate population in the event of a gas leak
- UCIL claimed to have developed such plans
- City and state officials claimed no knowledge of such plans

Inadequate Response

- Warning siren activated upon leak, but only for a few minutes
- Public response panicked, evacuation slow and uncoordinated
- Response of medical workers hampered by lack of info about MIC

日常生活中的不相容反應案例

- 漂白水➔ 安全適當的使用 ➔ 清潔及消毒功能
  ➔ 使用不慎或混合使用 ➔ 不相容反應

  案例：2005年台灣

  室內游泳池，誤把鹽酸和漂白水混合，瞬間產生大量氯氣，造成20名泳客嗆傷。

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實驗室廢液危害的案例

- 八十九年六月某校機械系技士，因不慎將不相容的廢液混合引起爆炸，造成受傷的不幸事件。
- 八十八年電機系儲存強氧化性酸液的塑膠桶因為材料劣化破裂，造成強酸溢漏滿地，幸而無人受傷。

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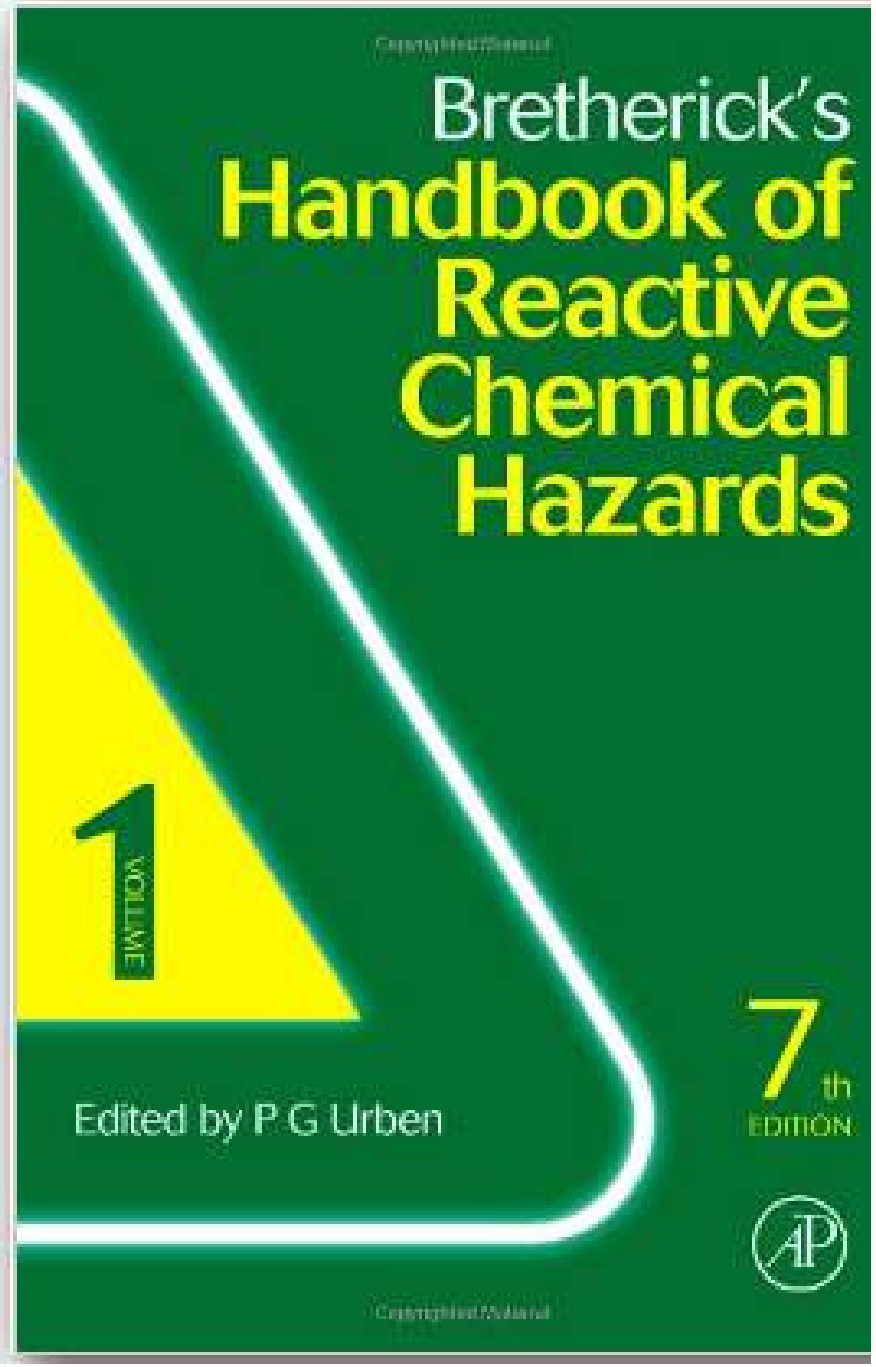
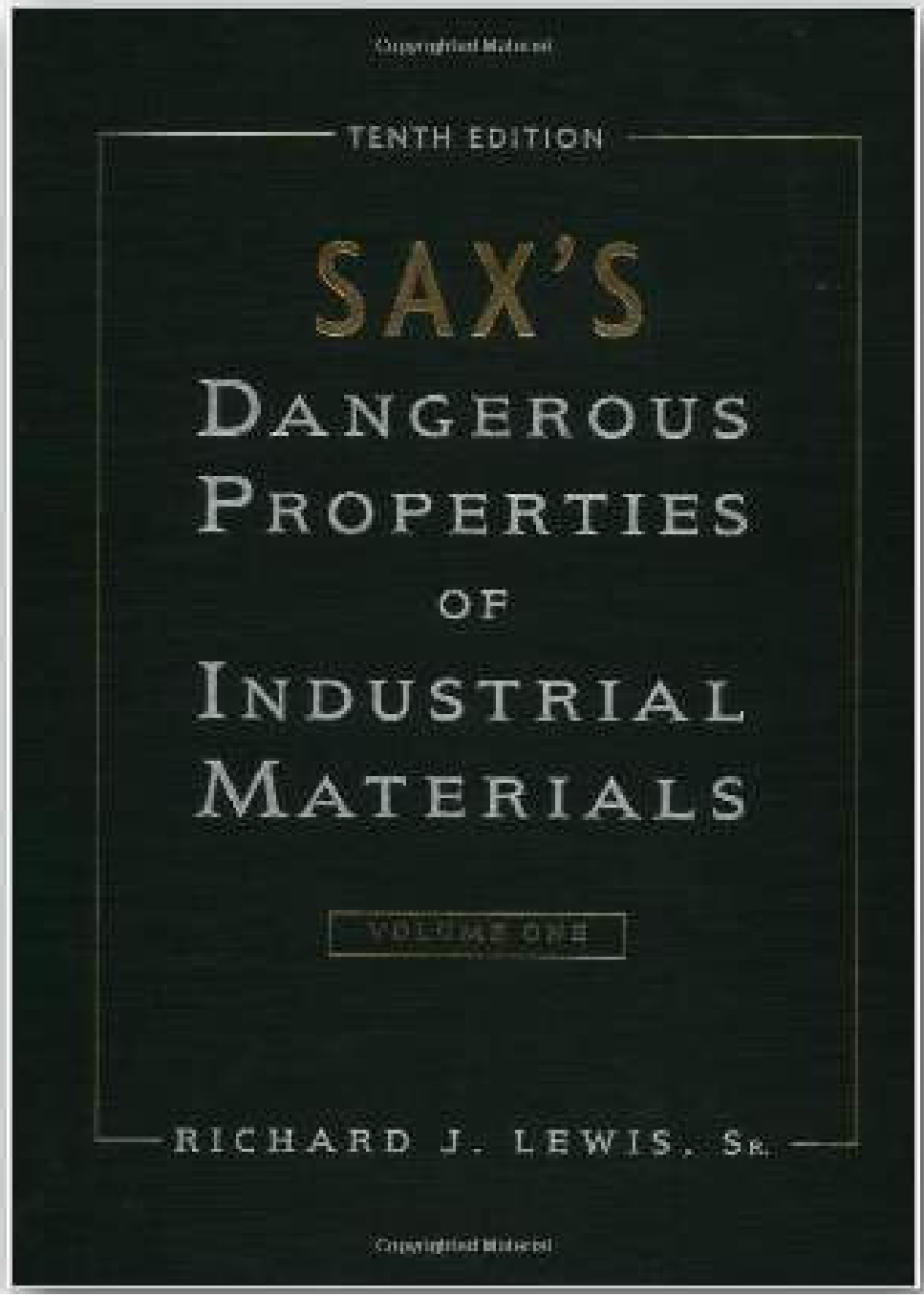
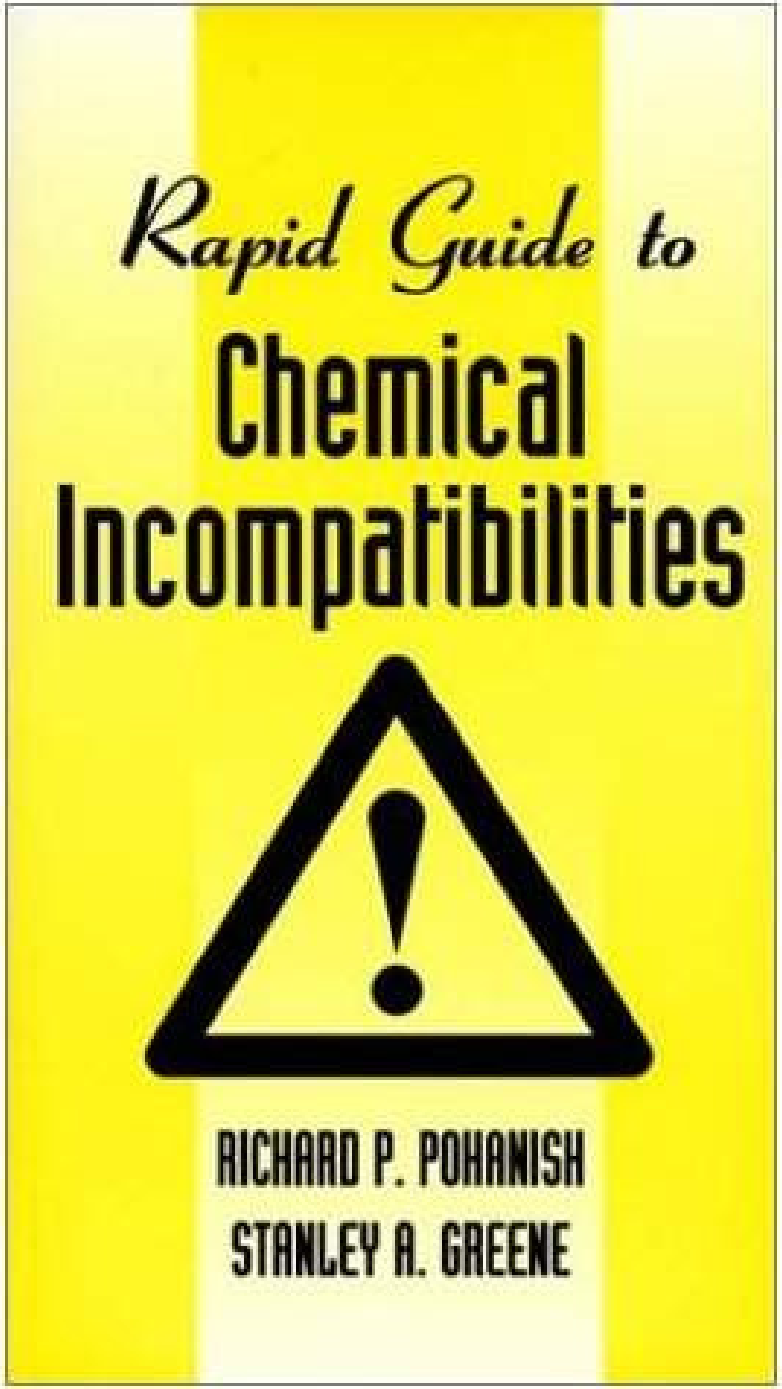
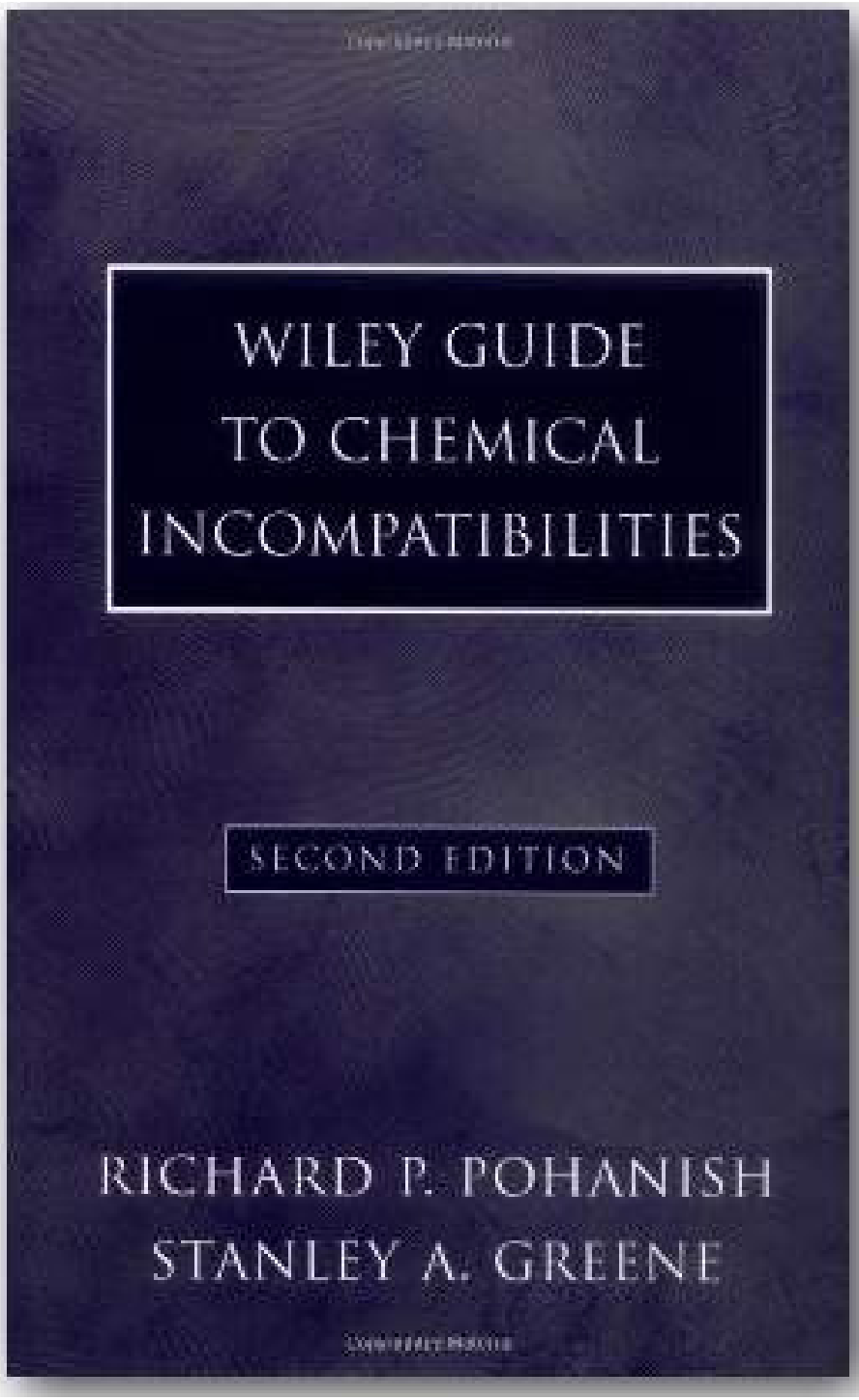
化學品不相容性資料來源

- Material Safety Data Sheets, MSDS
- Various Compatibility Charts
- Sax's Dangerous Properties of Industrial Materials
- Bretherick's Handbook of Reactive Chemical Hazards
- Wiley Guide to Chemical Incompatibilities
- NOAA Chemical Reactivity Worksheet


Bretherick's
Handbook of Reactive Chemical Hazards
1 VOLUME
7th EDITION
Edited by P G Urben


TENTH EDITION
SAX'S
DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS
VOLUME ONE
RICHARD J. LEWIS, SR.


Rapid Guide to
Chemical
Incompatibilities
RICHARD P. POHANISH
STANLEY A. GREENE


WILEY GUIDE
TO CHEMICAL
INCOMPATIBILITIES
SECOND EDITION
RICHARD P. POHANISH
STANLEY A. GREENE

Compatibility Chart

- **ASTM E2012-06 Standard Guide for the Preparation of a Binary Chemical Compatibility Chart**
  - **1. Scope**
  - **1.1 A binary chemical compatibility chart also called inter-reactivity chart, documents the hazards associated with the mixing of pairs of materials. This guide provides an aid for the preparation these charts. It reviews a number of issues that are critical in the preparation of such charts: accurate assessment of chemical compatibility, suitable experimental techniques for gathering compatibility information, incorporation of user-friendliness, and provision for revisions.**

Chemical Reactivity Worksheet

- 美國CCPS、NOAA、EPA與OR&R合作開發之Chemical Reactivity反應不相容性評估軟體。軟體之資料庫中包含超過5,000種化學品，並分類為47種不同的官能基，第二版為2009年3月更新的CRW2.0.2版。
- http://response.restoration.noaa.gov/chemaids/react.html

Chemical Reactivity Worksheet

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Search

Office of Response and Restoration

Home | Oil and Chemical Spills | Environmental Restoration | Marine Debris | Training and Education | Multimedia | About

Chemical Reactivity Worksheet

CRW Overview | Intro | Download/Install | Development History | FAQs

The Chemical Reactivity Worksheet (CRW) is a free software program you can use to find out about the chemical reactivity of thousands of common hazardous chemicals. (Reactivity is the tendency of substances to undergo chemical change, which can result in hazards—such as heat generation or toxic gas byproducts.)

The chemical datasheets in the CRW database contain information about the intrinsic hazards of each chemical and about whether a chemical reacts with air, water, or other materials. It also includes case histories on specific chemical incidents, with references.

You can also create your own custom chemical datasheets (for instance, if your facility produces a proprietary chemical that is not in the standard database).

Additionally, this chemical reactivity tool includes a reactivity prediction worksheet that allows you to virtually "mix" chemicals—like the ones in the photo of the derailed tank cars—to find out what dangers could arise from accidental mixing. (For instance, if the reaction is predicted to generate gases, the CRW will list the potential gaseous products, along with literature citations related to the prediction.)

New Search | Search Results | Glossary | Help

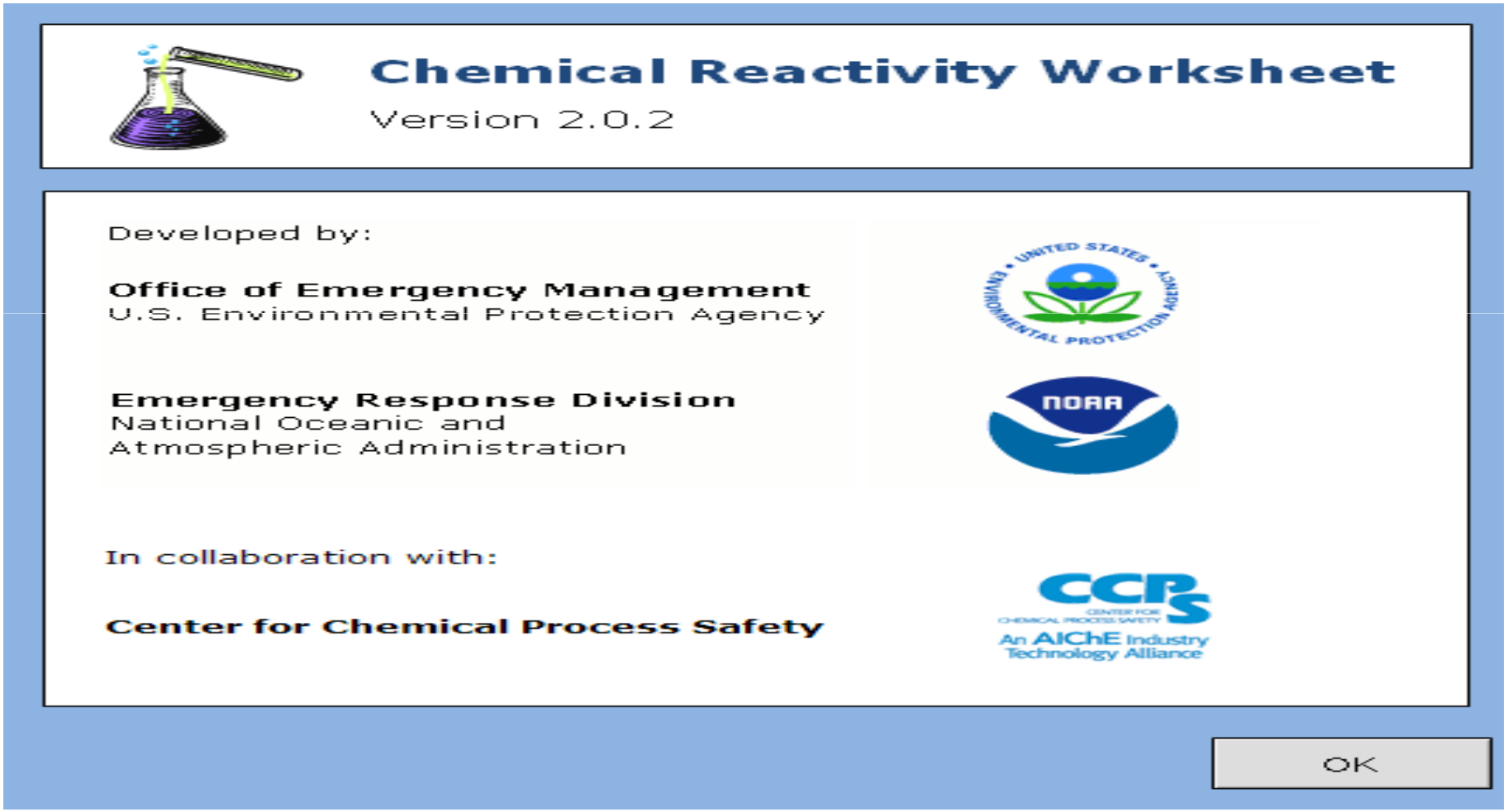
On Our Radar

Preparing for Oil Spills in the Arctic

Some Dolphins Severely Ill After Gulf Spill

What to Do If You Find

Chemical Reactivity Worksheet



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Chemical Reactivity Worksheet (CRW2)

CRW2 - [Worksheet]

File Edit Scripts Help

New Search | Search Results | Glossary | Help

Reactivity Worksheet

Begin by searching for a chemical to add to the mixture. Return here to add water, reactive groups, and custom chemicals.

Reactivity Mixture

Chemical Name	Reactive Hazard Numbers	Reactive Group Numbers

Remove All | Remove Selected Chemical | Add Custom Chemicals | Add Reactive Group | Add Water

Predicted Hazards | **Mixture Documentation** (for the reactive groups of the items in the mixture)

To print hazards or documentation: Copy all text in the field above and paste into a word processor program, format as desired, then print.

Save This Mixture | Predict Hazards | Show Compatibility Chart

Show Saved Mixtures | Preview Report

100 Browse

For Help, press F1

第三版 CRW3

- 美國EPA、NOAA、CCPS與Dow Chemical合作開發。
- 軟體之資料庫中包含超過5,200種化學品，並分類為64種不同的官能基，第三版(最新版)為2013年3月更新的CRW3.0.1版。
- 有Ipad版本
- http://response.restoration.noaa.gov/chemaids/react.html

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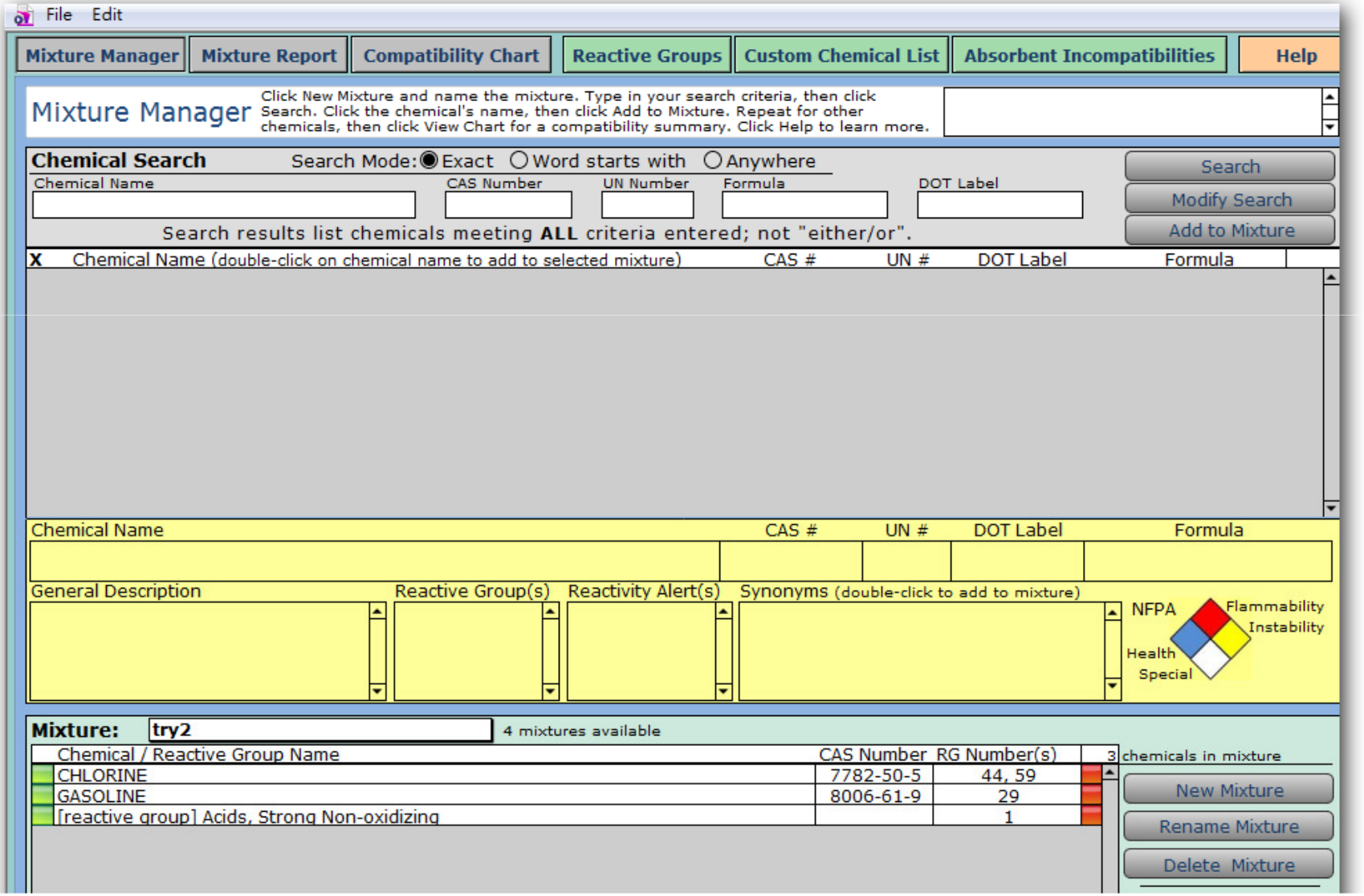
Chemical Reactivity Worksheet (CRW3)



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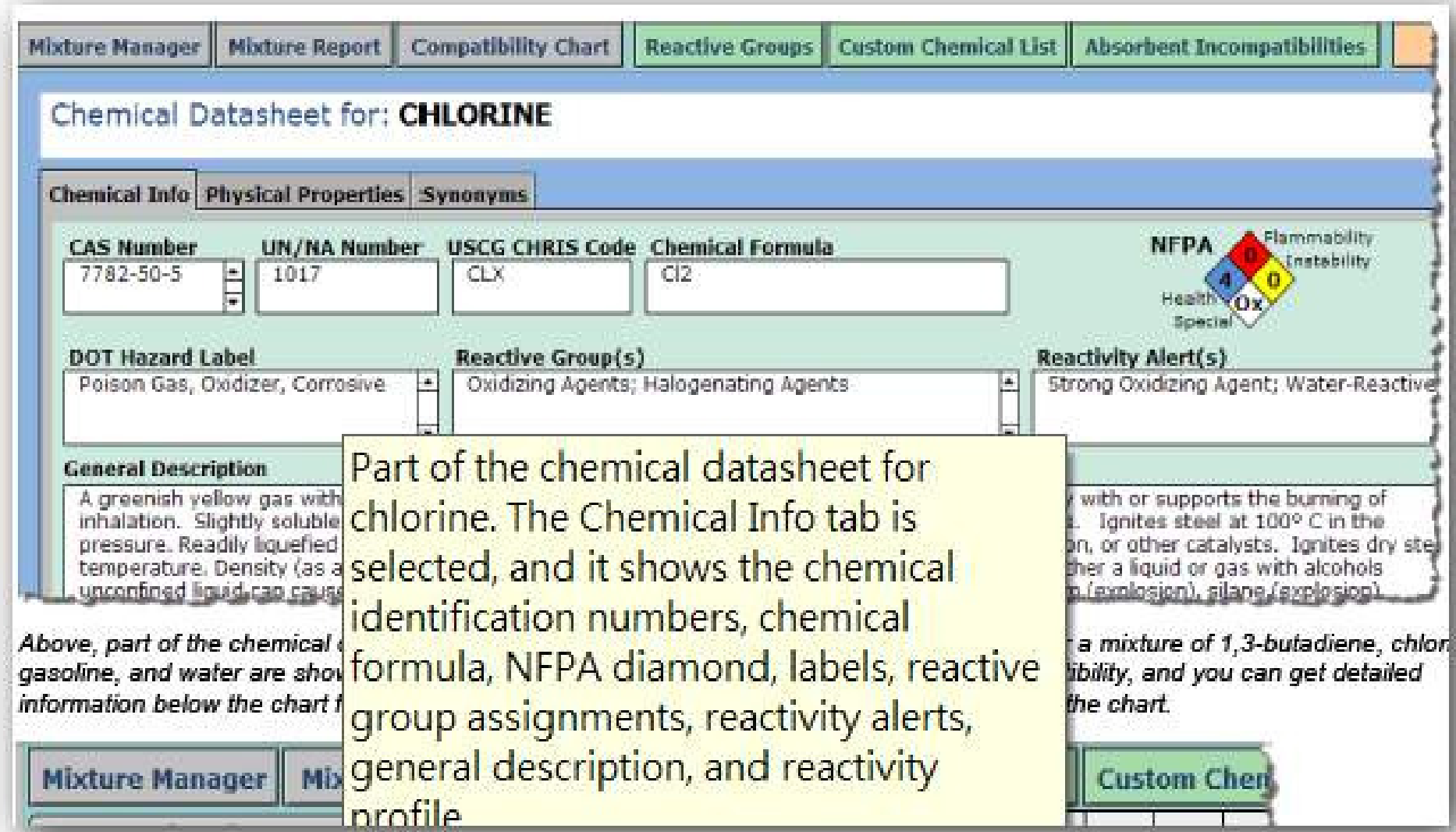
Chemical Reactivity Worksheet (CRW3)



Part of the chemical datasheet for chlorine. The Chemical Info tab is selected, and it shows the chemical identification numbers, chemical formula, NFPA diamond, labels, reactive group assignments, reactivity alerts, general description, and reactivity profile

On-line Help

Contents | Index | Search | - Search - | Go

- Learning about the CRW
  - Overview
  - About the CRW
  - New Features
- Searching for Chemicals
  - Overview
  - Basic Search
  - Advanced Search
  - Search Results
  - Chemical Datasheet
- Creating a Reactivity Mixture
  - Overview
  - Adding Chemicals
  - Adding Water
  - Adding Saved Mixtures
  - Adding Reactive Groups
  - Adding Custom Chemicals
- Viewing Reactivity Predictions
  - Overview
  - Compatibility Chart
  - Potential Gases
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  - Exporting the Chart
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Chemical Reactivity Worksheet Help

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Chemical Reactivity Worksheet (CRW2)

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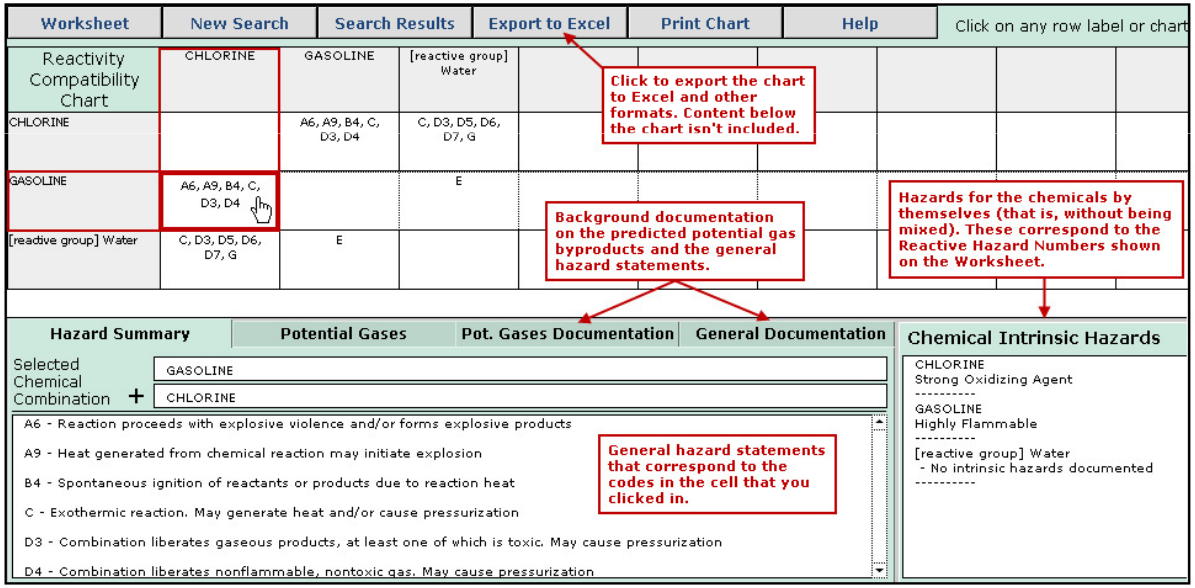
- Reference Information
  - Overview
  - How Reactivity is Predicted
  - Reactive Groups
  - Reactivity Predictions Documentation
  - Process Safety Progress Documentatic
  - Glossary

- **Hazard Summary:** A list of general hazard statements, which correspond to the codes in the chart.
- **Potential Gases:** A list of **potential gas byproducts**.
- **Pot. Gases Documentation:** **Background documentation** on the gas byproducts predictions.
- **General Documentation:** Background documentation on the general hazard statement predictions.

Tip: If you click on the names along the left side of the chart, the information from the Reactivity tab on each of the **chemical datasheets** is displayed in the Hazard Summary section below the chart. (If you click on a reactive group name, you'll see its definition.)



Interpreting the Compatibility Chart

To find out how a pair of chemicals* would react, find the intersecting cell:

- If a reaction is predicted for a pair of chemicals, then the intersecting cell will include a list of short codes that represent the reactive hazard predictions.
- If no reaction is predicted, the intersecting cell will be blank.

For example, to find the reactivity predictions for gasoline and chlorine on the chart above, find gasoline in the list of names at left and chlorine in the list of names along the top. Then, find the cell that is at the intersection of the row that begins with gasoline and the column that begins with chlorine (this is the cell with the thick, red border on all sides in the picture above).

不相容性表格（定量）

#34 Epoxides	B1 C1 D1	B1 B4 C1	C1 D1	C1 D1	C1		C1 D1	C1 D1 D4		C1 D1	C1 D1	F							C1 D1	C1 D1	C1 D1	C1					A9 C1 D1	C1 D1		C1 D1													
#35 Metal Hydrides, Alkyls and Aryls	A6 B1 C1	A7 B1 B5 C1	A6 B1 B5 C1	A6 A9 B1 B5 C1	C1	B5 C1 D2	B5 C1	B6 C1	B5 C1	C1	B1 C1 D2	B5 C1	B5 C1		C1	C1 D2	C1	B5 C1	B5 C1	C1	C1		B1 C1	C1	B5 C1		A6 B1 C1	B5 C1	B5 C1	F	C1											
#37 Anhydrides		A6 A9 C1 D3	C1	C1			C1	C1	C1	A6 C1	C1		C1							A6 B1 C1	B5 C1						C1 D3	C1		C1	C1 D1	C1											
#38 Salts, Acidic Inorganic/Organic	C1	C1 D2					C1	C1 D3		C1	B5 D2	C1								C1	B5 C1						A9 C1 D3			B5 C1 D2	C1 D1	B5 C1	C1										
#39 Salts, Basic Inorganic/Organic	C1	A9 B1 B6 C1	C1		C1					C1			C1				C1										D3	C1			C1 D1	B5 C1	C1	C1									
#40 Acid Halides	C1	C1	C1	C1 D2			C1 D2	C1	C1	C1	C1	C1 D2					C1	A9 B1	C1	B5 C1							A9 C1	C1 D2		C1		C1 D2	C1	C1	C1								
#42 Organometallics	E	E	E			E	E			E	E												E				C1 D4				C1 D1	C1	C1	E									
#44 Inorganic Oxidizing Agents	B4 C1 D2 D3	C1	C1 D2	B4 C1	C1 D1 D3	C1 D3	C1 D2 D3	A6 C1 D2 D3	C1 D2 D3	C1 D3	A6 C1 D2 D3	C1 D2	A8 C1	A8 C1	B1 C1	C1 D3	C1 D2 D3	C1	C1 D2 D3	A8 A9 B1 C1	A7 B4 C1	B1 C1	C1 D3	A1 A2 C1 D2	B1 C1	B1 C1	A9 C1 D3	B1 C1 D3	B6 C1 D2	B6 C1 D2	B1 C1 D3	A9 B1 C1	B1 C1 D3	C1 D3	C1 D2	F		A9 B1 C1					
#45 Inorganic Reducing Agents	B4 B6 C1 D2	A7 B4 B5 C1 D2	B6 C1	A6 B1 B5 C1	B5 C1	B5 C1	B1 B5 C1	B6 C1 D2	C1	C1		B6 C1 D2	B5 C1			C1	B5 C1 D2	B5 C1	B5 C1	C1			B5 C1	B5 C1			A7 A9 B1 C1	B5 C1	B6 C1 D2		C1	C1	C1	F	C1	C1 D2							
#46 Inorganic Compounds/Neither Reducing nor Oxidizing	E	E	E				E			E	E												E				C1 D3				C1 D1	C1						C1	C1					
#47 CFCs and HCFCs (chlorofluorocarbons and chlorofluorohydrocarbons)	C1	C1								C1																																	
#51 Nitrides, Phosphides, Carbides, and Silicides, Inorganic	B6 C1 D2	A6 B1 B4 B6 V1 D2	A6 B1 B5 C1 D2	A6 B1 B5 C1	B5 C1 D1 D2			F	B5 C1 D2	F	B5 C1 D2	B5 C1 D2	B5 C1			B5 C1 D2	F	B5 C1 D3	B6 C1	A6			B5 C1 D2	A2 B5 C1 D2			A2 B1 B5 C1 D2	B5 C1 D2			C1 D1	C1 D3	A9 C1	A9 B5 C1 D2		A9 C1		A9 B1 B5 C1 D2		F				
#55 Chlorosilanes	A9 B4 D2 D3	A9 B4 D2 D3	C1 D2	C1	D1	C1	A9	C1	F	A9	C1	D3	C1	C1	C1	C1	B4	B4 D1	D3	C1	C1		C1	C1	C1	C1	A9 B2 B4 C1	A9	C1	C1	A9 C1 D3	A9 B2 B4	C1	B2 B4	B2 B4	C1	C1 E	A6 A9	C1		A9 B2 B4	A9 B2 B4		
#59 Halogenating Agent, Strong	A9 D3	A9 D3	C1	A9 B2	D1	C1	A9	A9	B5 C1	A9	C1	B5 C1	C1	C1	A9 B2 B4	A9 B2 B4	A9	A9	A9	A9 B2 B4	A9 B2 B4		C1 D2	B2	A9 B2 B4	A9 B2 B4	A9 B2 B4	A9	C1	A9 B2 B4	C1	A9 B2 B4		B2 B4	B2 B4	B2 B4	A9 E	A9 B2 B4	A9 B2 B4	C1	A9 B2 B4	A9 B2 B4	A9 B2 B4	

Some Definitions:

物質本身的反應性危害特性

Reactive Hazard Number	Hazard Statement
101	Highly Flammable
102	Explosive
103	Polymerizable
104	Strong Oxidizing Agent
105	Strong Reducing Agent
106	Known Catalytic Activity
107	Water-Reactive
108	Air-Reactive
109	Pyrophoric
111	Peroxidizable Compound
400	Radioactive Material

Some Definitions:化學反應不相容性-爆炸性（Explosion）

Hazard Code	Hazard Statements
A1	Explosive when dry
A10	Increased sensitivity to detonation
A2	Risk of explosion by shock, friction, fire or other sources of ignition
A3	Forms very unstable explosive metallic compounds
A4	External heating may cause an explosion
A5	May form explosive peroxides
A6	Reaction proceeds with explosive violence and/or forms explosive products
A8	Explosive when mixed with combustible material
A9	Heat generated from chemical reaction may initiate explosion

Some Definitions:火災（Fire）

B1	May become highly flammable or may initiate a fire, especially if other combustible materials are present
B3	Spontaneously flammable in air
B4	Spontaneous ignition of reactants or products due to reaction heat
B5	Combination liberates gaseous products, at least one of which is flammable. May cause pressurization
B6	Combination liberates gaseous products, including both flammable and toxic gases. May cause pressurization

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Some Definitions:氣體產生/造成過壓（Gas Generation/Pressurization）

C	Exothermic reaction. May generate heat and/or cause pressurization
D1	Exothermic, potentially violent polymerization. May cause pressurization
D3	Combination liberates gaseous products, at least one of which is toxic. May cause pressurization
D4	Combination liberates nonflammable, nontoxic gas. May cause pressurization
D5	Combination liberates combustion-enhancing gas (e.g., oxygen). May cause pressurization
D6	Exothermic, generation of toxic and corrosive fumes
D7	Generation of corrosive liquid

Some Definitions:其他（Others）

E	Generates water soluble toxic products
F	May be hazardous but unknown
G	Reaction may be intense or violent
G1	Possible Gas: Carbon Dioxide
H	Possible exposure to radiation

Compatability Chart

CRW3 - [CRW3]

File Edit

Mixture Manager | Mixture Report | Compatibility Chart | Reactive Groups | Custom Chemical List | Absorbent Incompatibilities | Help

Print Chart

Export to Excel

Chemical Pairs

NFPA Health	Flammability	Instability	Special	try2 Compatibility Chart	1,3-BUTADIENE	CHLORINE	GASOLINE	WATER
2	4	2		1,3-BUTADIENE	SR			
4	0	0	Oxidize	CHLORINE	N			
1	3	0		GASOLINE	C	N		
				WATER	C	N	Y	

Chart Legend

Y : Compatible
No hazardous reactivity issues expected.

N : Incompatible
Hazardous reactivity issues are expected.

C : Caution
May be hazardous under certain conditions.

SR : Self-Reactive
Potentially Self-Reactive (e.g., polymerizable)

***Note:** If asterisk appears in cell, then compatibility decision was manually changed by the user from the CRW prediction to that shown.

Hazard Summary | Potential Gases | Documentation | User Comments

Selected Chemical Combination: GASOLINE, CHLORINE

Reaction products may be corrosive
Reaction products may be flammable
Reaction liberates gaseous products and may cause pressurization
Exothermic reaction at ambient temperatures (releases heat)
Reaction may be particularly intense, violent, or explosive
Reaction products may be toxic

Chemical Intrinsic Hazards

1,3-BUTADIENE
Highly Flammable; Polymerizable; Peroxidizable Compound

CHLORINE
Strong Oxidizing Agent; Water-Reactive

GASOLINE
Highly Flammable

WATER
- No intrinsic hazards documented

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CRW3版- Incompatible Hazards Statement

- Exothermic reaction at ambient temperatures (releases heat)
- Reaction products may be unstable above ambient temperatures
- Reaction may be particularly intense, violent, or explosive
- Polymerization reaction may become intense and may cause pressurization
- Reaction products may be explosive or sensitive to shock or friction
- Reaction products may be flammable
- Reaction liberates gaseous products and may cause pressurization
- Reaction products may be corrosive
- Reaction products may be toxic
- Reaction generates water soluble toxic products
- Possible exposure to radiation
- May be hazardous but unknown
- No known hazardous reaction

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Chemical Library (Chemical Name)

Worksheet | Browse | Help

Basic Chemical Search

Only chemicals that match **ALL** of your criteria will be included in the search results.

Text Field Operator

- (●) Contains characters
- ( ) Contains word starting with

Chemical Name

chlorine

CAS Number (with dashes)

UN/NA Number

Show More Search Fields | Cancel | Search

Contains characters with “chlorine”

CRW2 - [ChemicalLibrary]

File Edit Record Scripts Help

Browse

Worksheet | New Search | Help

Layout: Found Set

Record: 1

Found: 32

Total: 5430

Sorted

Chemical Search Results

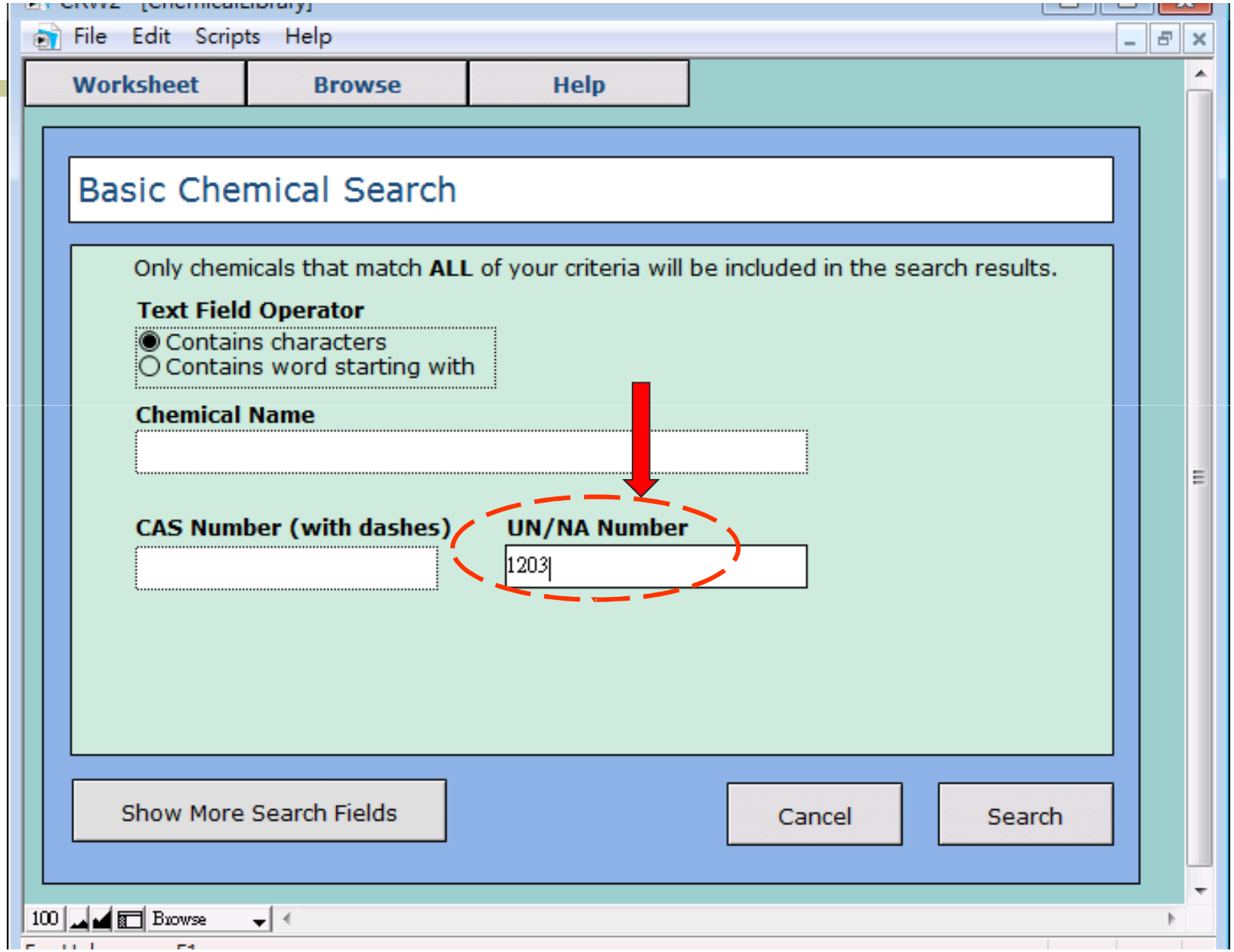
Results of search for: Chemical Name Contains characters chlorine

Chemical Name	CAS Number	UN/NA#	DOT Label	Formula
ARTICLES CONTAINING POLYCHLORINATED BIPHENYLS (PCB)	11096-82-5 11097-69-1	2315	CLASS 9	
BARIUM HYPOCHLORITE, WITH MORE THAN 22% AVAILABLE CHLORINE	13477-10-6	2741	OXIDIZER, POISON	Ba.2ClHO
BLEACHING POWDER		2208		CaCl(OCl)
CALCIUM HYPOCHLORITE MIXTURE, DRY, WITH MORE THAN 10% BUT NOT MORE THAN 39% AVAILABLE CHLORINE	7778-54-3	2208	OXIDIZER	Ca(ClO)2
CALCIUM HYPOCHLORITE MIXTURE, DRY, WITH MORE THAN 39% AVAILABLE CHLORINE (8.8% AVAILABLE OXYGEN)	7778-54-3	1748	OXIDIZER	Ca(ClO)2
CALCIUM HYPOCHLORITE, HYDRATED MIXTURE, WITH NOT LESS THAN 5.5% BUT NOT MORE THAN 10% WATER	7778-54-3	2880	OXIDIZER	Ca(ClO)2
CARBACHOL CHLORIDE	51-83-2			C6H15N2O2.Cl
CHLORATES, INORGANIC, N.O.S.	14866-68-3	1461	OXIDIZER	ClO3
CHLORINE	7782-50-5	1017	POISON GAS, CORROSIVE	Cl2
CHLORINE DIOXIDE, HYDRATE, FROZEN	10049-04-4 70377-94-5	9191	OXIDIZER, POISON	ClO2.xH2O, ClO2 (gas)
CHLORINE MONOXIDE	7791-21-1			Cl2O
CHLORINE PENTAFLUORIDE	13637-63-3	2548	POISON GAS, OXIDIZER, CORROSIVE	ClF5
CHLORINE TRIFLUORIDE	7790-91-2	1749	POISON GAS, OXIDIZER, CORROSIVE	ClF3
CHLORITES, INORGANIC, N.O.S.	14998-27-7	1462	OXIDIZER	ClO2
CHLOROWAX 40	108171-27-3 63449-39-8			C24H43Cl7
CHLOROWAX 500C	108171-26-2			C12H20Cl6
CYANOGEN CHLORIDE, INHIBITED	506-77-4	1589	POISON GAS, CORROSIVE	CNCl
HYDROBROMIC ACID, SOLUTION	10035-10-6	1791	CORROSIVE	HBr (aqueous)
HYPOCHLORITE SOLUTION, [CONTAINING > 7% AVAILABLE CHLORINE BY WEIGHT]		1791		

100 Browse

For Help, press F1

UN/NA Number (1203)



UN/NA# 1203 (Gasoline)

CRW2 - [ChemicalLibrary]

File Edit Record Scripts Help

Browse

Layout: Found Set

Record: 1

Found: 3

Total: 5430

Sorted

100 Browse

Worksheet | New Search | Help

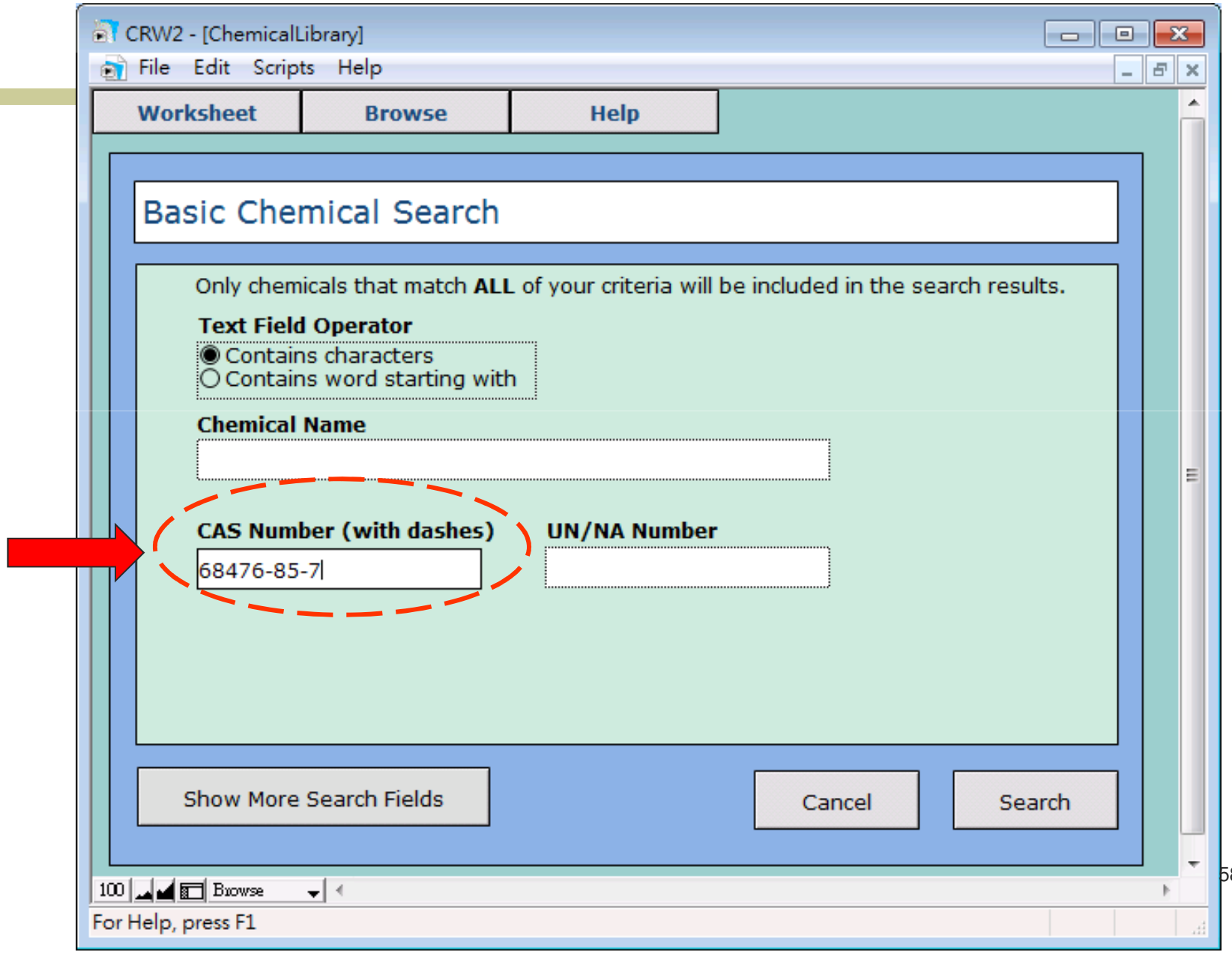
Chemical Search Results

Results of search for: UN/NA Number Contains characters 1203

Chemical Name	CAS Number	UN/NA#	DOT Label
GASOHOL		1203	
GASOLINE	8006-61-9 86290-81-5	1203	FLAMMABLE LIQUID
PETROL		1203	

For Help, press F1

CAS Number (68476-85-7)



CAS Number (68476-85-7)

CRW2 - [ChemicalLibrary]

File Edit Record Scripts Help

Browse

Worksheet | New Search | Help

Layout: Found Set

Chemical Search Results

Results of search for: CAS # Contains characters 68476-85-7

Chemical Name	CAS Number	UN/NA#	DOT Label
LIQUEFIED PETROLEUM GAS	68476-85-7	1075	FLAMMABLE GAS

Record: 1

Found: 1

Total: 5430

Sorted

100 Browse

For Help, press F1

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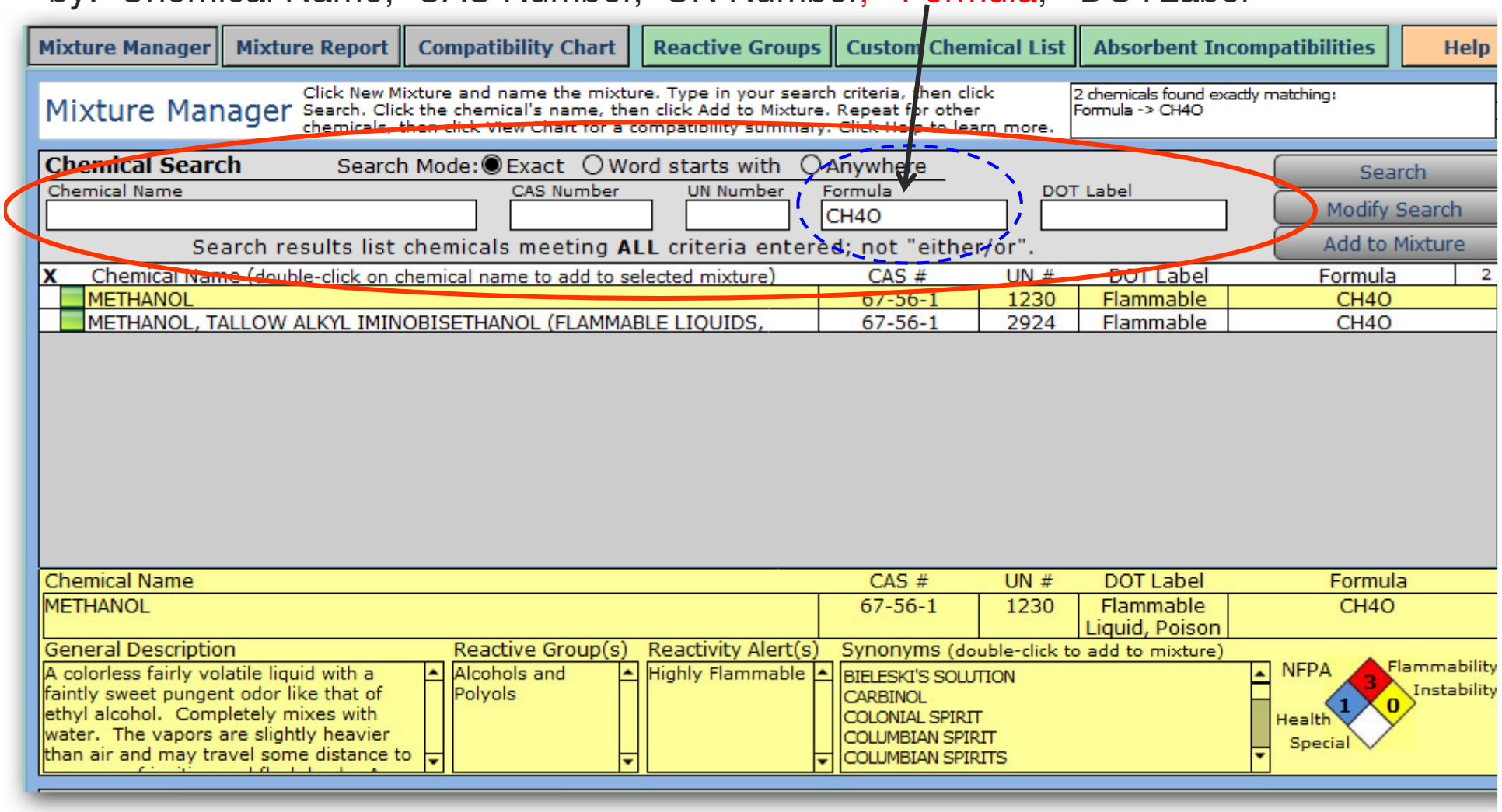
CRW3版- Chemical Search

by: Chemical Name, CAS Number, UN Number, Formula, DOTLabel



Chemical Datasheet (Example: ClF3)

CRW2 - [ChemicalLibrary]

File Edit Record Scripts Help

Browse

Layout: Chemical

Record: 13

Found: 32

Total: 5430

Sorted

Worksheet | New Search | Search Results | Help

Chemical Datasheet

General Info | Reactivity | Synonyms

Chemical Name: CHLORINE TRIFLUORIDE

Chemical Formula: ClF3

CAS Number	UN/NA Number	USCG CHRIS CODE	DOT Hazard Label	DOT Hazard Class	Reactive Group Numbers
7790-91-2	1749	CTF	POISON GAS, OXIDIZER, CORROSIVE		59

General Description

A colorless gas or green liquid with a pungent odor. Boils at 53°F. It reacts with water to form chlorine and hydrofluoric acid with release of heat. Contact with organic materials may result in spontaneous ignition. It is corrosive to metals and tissue. Prolonged exposure to low concentrations or short term exposure to high concentrations may result in adverse health effects. Under prolonged exposure to fire or intense heat the container may violently rupture and rocket.

Special Hazards

Strong Oxidizing Agent; Water-Reactive

Add Chemical to Worksheet

Chemical Datasheet (Example: Reactivity)

Worksheet | New Search | Search Results | Help

Chemical Datasheet

General Info | **Reactivity** | **Synonyms**

AIR AND WATER REACTIONS:
A violent reaction occurs with water or ice generating acidic HF and chlorine, [Sidgwick, 1156(1950)]. The release of Chlorine Trifluoride to the atmosphere rapidly generates two toxic reaction products: HF and Chlorine Dioxide, [Lombardi, D.A. and M.D. Cheng 1996. "Modeling Accidental Releases of Chlorine Trifluoride to the Atmosphere," Paper No. 96-WP66B.02, presented at the 89th Annual Meeting of the Air and Waste Management Association, Nashville, Tennessee, June 23-26].

CHEMICAL PROFILE:
CHLORINE TRIFLUORIDE is a low-boiling liquid (b.p. 12° C), in gaseous state irritating and toxic. A highly reactive oxidant reagent, spontaneously flammable, used as a rocket propellant. Incompatible with fuels, nitro compounds. Interaction with water is violent and may be explosive, even with ice [Sidgwick, 1950, p. 1156]. Immediate explosive reaction with hydrocarbons or halocarbons even at -70° C [Brower, K. R., J. Fluorine Chem., 1986, 31, p. 333]. Solution with carbon tetrachloride capable of detonation, solutions with nitroaryl compounds (TNT, hexanitrobiphenyl) or highly chlorinated compounds are extremely shock-sensitive. Violent, sometimes explosive reaction with hydrogen containing materials, e.g., acetic acid, ammonia, benzene, ether, coal gas, hydrogen, hydrogen sulfide, methane, or fluoroamino compounds. Ignition with fibrous materials (cotton, paper, wood). [Mellor, 1956, vol. 2, suppl. 1, p. 155]. Explosive gaseous products (chlorodifluoroamine) formed with ammonium fluoride or ammonium hydrogen fluoride [Gardner, D. M. et al., Inorg., Chem., 1963, 2, p. 413]. Ignition on contact with iodine, boron-containing materials (boron powder, tetraboron carbide, boron-aluminum), fibrous or finely divided refractory materials (asbestos, glass, wool, sand, tungsten carbide). Violent reaction with mineral acids (nitric acid, sulfuric acid), chromium trioxide, ruthenium metal, selenium tetrafluoride. [Bretherick, 5th ed., 1995, p. 1235]. Chlorine trifluoride is a hypergolic oxidizer and contact with a number of metals and their oxides (aluminum, antimony, arsenic, calcium, copper, iridium, iron, lithium, lead, magnesium, molybdenum, osmium, potassium, rhodium, sodium, selenium, silver, tellurium, tin, tungsten, zinc), nonmetals (phosphorus, silicon, sulfur), salts (mercury iodide, potassium iodide, silver, nitrate, potassium carbonate) will result in a violent reaction often followed by ignition [Mellor, 1956, vol. 2, suppl. 1, p. 155; Sidgwick, 1950, p. 1156].

REACTIVE GROUPS:
Halogenating Agents, Strong

CRW2 - [Worksheet]

File Edit Scripts Help

New Search | Search Results | Glossary | Help

Reactivity Worksheet

Begin by searching for a chemical to add to the mixture. Return here to add water, reactive groups, and custom chemicals.

Reactivity Mixture

Chemical Name	1 chemical(s) and/or reactive group(s) in mixture	Reactive Hazard Numbers	Reactive Group Numbers
CHLORINE TRIFLUORIDE		104, 107	59

Remove All | Remove Selected Chemical | Add Custom Chemicals | Add Reactive Group | Add Water

Predicted Hazards | **Mixture Documentation** (for the reactive groups of the items in the mixture)

To print hazards or documentation: Copy all text in the field above and paste into a word processor program, format as desired, then print.

Save This Mixture | Predict Hazards | Show Compatibility Chart

Show Saved Mixtures | Preview Report

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Add Reactive Group (47個官能團)

CRW2 - [Worksheet]

File Edit Scripts Help

New Search | Search Results | Glossary | Help

Reactivity Worksheet

Begin by searching for a chemical to add to the mixture. Return here to add water, reactive groups, and custom chemicals.

Reactivity Mixture

Chemical Name	2 chemical(s) and/or reactive group(s) in mixture	Reactive Hazard Numbers	Reactive Group Numbers
CHLORINE TRIFLUORIDE		104, 107	59
ISOPROPANOL		101, 111	4

Remove All | Remove Selected Chemical | Add Custom Chemicals | Add Reactive Group | Add Water

Predicted Hazards | **Mixture Documentation** (for the reactive groups of the items in the mixture)

To print hazards or documentation: Copy all text in the field above and paste into a word processor program, format as desired, then print.

Save This Mixture | Predict Hazards | Show Compatibility Chart
Show Saved Mixtures | Preview Report

Reactive Groups (Aldehydes, Diazo, Ethers, …)

CRW2 - [Worksheet]

File Edit Scripts Help

Worksheet | Glossary | Help

Add Reactive Group to Worksheet

What are reactive groups, and how are they used in the Worksheet?

Reactive Groups

- Alcohols and Polyols
- Aldehydes
- Amides and Imides, Organic
- Amines
- Anhydrides
- Azo, Diazo, and Azido Compounds
- Bases
- Carbamates
- Carboxylic Acids
- CFCs and HCFCs (chlorofluorocarbons and
- Chlorosilanes
- Cyanides, Inorganic
- Epoxides
- Esters
- Ethers
- Halogenated Organic Compounds
- Halogenating Agents, Strong
- Hydrocarbons, Aliphatic Saturated
- Hydrocarbons, Aliphatic Unsaturated
- Hydrocarbons, Aromatics
- Inorganic Compounds/Neither Reducing nor Oxidizing
- Inorganic Oxidizing Agents
- Inorganic Reducing Agents
- Insufficient Information for Classification
- Isocyanates and Isothiocyanates, Organic

Description for Selected Reactive Group:

Chlorosilanes RG# 55

GENERAL INFORMATION-

FLAMMABILITY-
Flammable or pyrophoric.

REACTIVITY-
Chlorosilanes are compounds in which silicon is bonded to from one to four chlorine atoms with other bonds to hydrogen and/or alkyl groups. Chlorosilanes react with water, moist air, or steam to produce heat and toxic, corrosive fumes of hydrogen chloride. They may also produce flammable gaseous H2. They can serve as chlorination agents. Chlorosilanes react vigorously both organic and inorganic acids and with bases to generate toxic or flammable gases.

TOXICITY-
Poisonous by ingestion and inhalation and a poisonous irritant to the skin, eyes, and mucous membranes. The toxicity is based on that of HCl, which forms by the reaction of chlorosilanes with water.

OTHER CHARACTERISTICS-

EXAMPLES-
Allyltrichlorosilane, methyldichlorosilane, silicon tetrachloride, vinyl trichlorosilane, trimethylchlorosilane, trichlorosilane, propyltrichlorosilane, phenyltrichlorosilane, methyl trichlorosilane.

Done/Return to Worksheet | Add Selected Group to Worksheet

Example- Incompatibility of "ClF3, IPA, Chlorosilanes"

CRW2 - [Worksheet]

File Edit Scripts Help

Worksheet | New Search | Search Results | Export to Excel | Print Chart | Help | Click on any row label or chart cell to show hazards for that cl

Reactivity Compatibility Chart	CHLORINE TRIFLUORIDE	ISOPROPANOL	[reactive group] Chlorosilanes
CHLORINE TRIFLUORIDE		A6, A9, B1, C, D3	A9, B4, D3
ISOPROPANOL	A6, A9, B1, C, D3		C, D3
[reactive group] Chlorosilanes	A9, B4, D3	C, D3	

Hazard Summary | Potential Gases | Pot. Gases Documentation | General Documentation

Selected Chemical Combination: ISOPROPANOL + CHLORINE TRIFLUORIDE

A6 - Reaction proceeds with explosive violence and/or forms explosive products

A9 - Heat generated from chemical reaction may initiate explosion

B1 - May become highly flammable or may initiate a fire, especially if other combustible materials are present

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

Chemical Intrinsic Hazards

CHLORINE TRIFLUORIDE
Strong Oxidizing Agent; Water-Reactive

ISOPROPANOL
Highly Flammable; Peroxidizable Compound

[reactive group] Chlorosilanes
- No intrinsic hazards documented

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Chemical Reactivity Worksheet

CRW2 - [Worksheet]

File Edit Scripts Help

Worksheet | New Search | Search Results | Export to Excel | Print Chart | Help

Reactivity Compatibility Chart	CHLORINE TRIFLUORIDE	ISOPROPANOL					
CHLORINE TRIFLUORIDE		A6, A9, B1, C, D3					
ISOPROPANOL	A6, A9, B1, C, D3						

Hazard Summary | Potential Gases | Pot. Gases Documentation | General Documentatic

Selected Chemical Combination

ISOPROPANOL

+ CHLORINE TRIFLUORIDE

A6 - Reaction proceeds with explosive violence and/or forms explosive products

A9 - Heat generated from chemical reaction may initiate explosion

B1 - May become highly flammable or may initiate a fire, especially if other combustible materials are present

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

Exercise 1

- Why should isopropenylbenzene (α-甲基苯乙烯) be stored in an air-tight container?

isopropenylbenzene (α－甲基苯乙烯)

See: Chemical Datasheet - “Air and Water Reactions”

CRW2 - [ChemicalLibrary]

File Edit Record Scripts Help

Browse

Layout: Chemical

Record: 7

Found: 11

Total: 5430

Sorted

Worksheet | New Search | Search Results | Help

Chemical Datasheet

General Info | Reactivity | Synonyms

AIR AND WATER REACTIONS:
Flammable. Oxidizes readily in air to form unstable peroxides that may explode spontaneously [Bretherick, 1979 p.151-154, 164]. Insoluble in water.

CHEMICAL PROFILE:
ISOPROPENYLBENZENE is easily peroxidizable; the peroxide may initiate exothermic polymerization of the bulk material. Reacts violently with strong oxidizing agents [Handling Chemicals Safely, 1980 p. 866; Bretherick, 1979 p. 160].

REACTIVE GROUPS:
Hydrocarbons, Aromatics; Hydrocarbons, Aliphatic Unsaturated

Comment for Exercise 1

- Isopropenylbenzene is flammable. Easily peroxidizable: in air, it oxidizes easily to form peroxides that are unstable enough to explode spontaneously.
- Check the Chemical Profile for isopropenylbenzene to see this information.

Exercise 2

- A metal fabrication and finishing plant has a large warehouse containing several chemicals. One chemical stored in the warehouse has a "Caustic Liquid" label. Another chemical arrives at the plant with a label reading, "Muriatic (Hydrochloric) Solution."
- Should the new chemical be stored next to the caustic liquid solution?

Chemical Reactivity Worksheet

CRW2 - [Worksheet]

File Edit Scripts Help

Worksheet | New Search | Search Results | Export to Excel | Prin

Reactivity Compatibility Chart	CAUSTIC SODA, SOLUTION	HYDROCHLORIC ACID, SOLUTION			
CAUSTIC SODA, SOLUTION		B4, C, D3, D5, D6, D7, G			
HYDROCHLORIC ACID, SOLUTION	B4, C, D3, D5, D6, D7, G				

Hazard Summary | Potential Gases | Pot. Gases Documentation

Selected Chemical Combination

CAUSTIC SODA, SOLUTION

+ HYDROCHLORIC ACID, SOLUTION

B4 - Spontaneous ignition of reactants or products due to reaction heat

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

D5 - Combination liberates combustion-enhancing gas (e.g., oxygen). May cause pressurization

D6 - Exothermic, generation of toxic and corrosive fumes

D7 - Generation of corrosive liquid

Comment for Exercise 2

- **No, these chemicals are incompatible. The Mixture Worksheet shows that the combination of a caustic liquid and muriatic acid solution generates corrosive liquid and fumes, heat, may cause fire, and may cause pressurization.**

Exercise 3

- A freight train has derailed, and now a tank car of hydrogen fluoride is lying in a ditch next to the tracks, surrounded by containers of phosphorus pentachloride(五氯化磷). If you mix these two chemicals in the Reactivity Worksheet, you'll find that heat would be generated. If these chemicals accidentally mix, or if there is a fire associated with the incident, should the responders use water to reduce the temperature?

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Chemical Reactivity Worksheet

Water-Reactive, Air-Reactive

File Edit Scripts Help

Worksheet | New Search | Search Results | Export to Excel | Print Chart | Help | Click on any row label

Reactivity Compatibility Chart	HYDROFLUORIC ACID	PHOSPHORUS PENTACHLORIDE
HYDROFLUORIC ACID		A9, C, D3, D6, D7
PHOSPHORUS PENTACHLORIDE	A9, C, D3, D6, D7	

Hazard Summary | Potential Gases | Pot. Gases Documentation | General Documentation

Selected Chemical Combination
PHOSPHORUS PENTACHLORIDE
+ HYDROFLUORIC ACID

A9 - Heat generated from chemical reaction may initiate explosion

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

D6 - Exothermic, generation of toxic and corrosive fumes

D7 - Generation of corrosive liquid

Chemical Intrinsic Haza

HYDROFLUORIC ACID
Water-Reactive; Air-Reactive

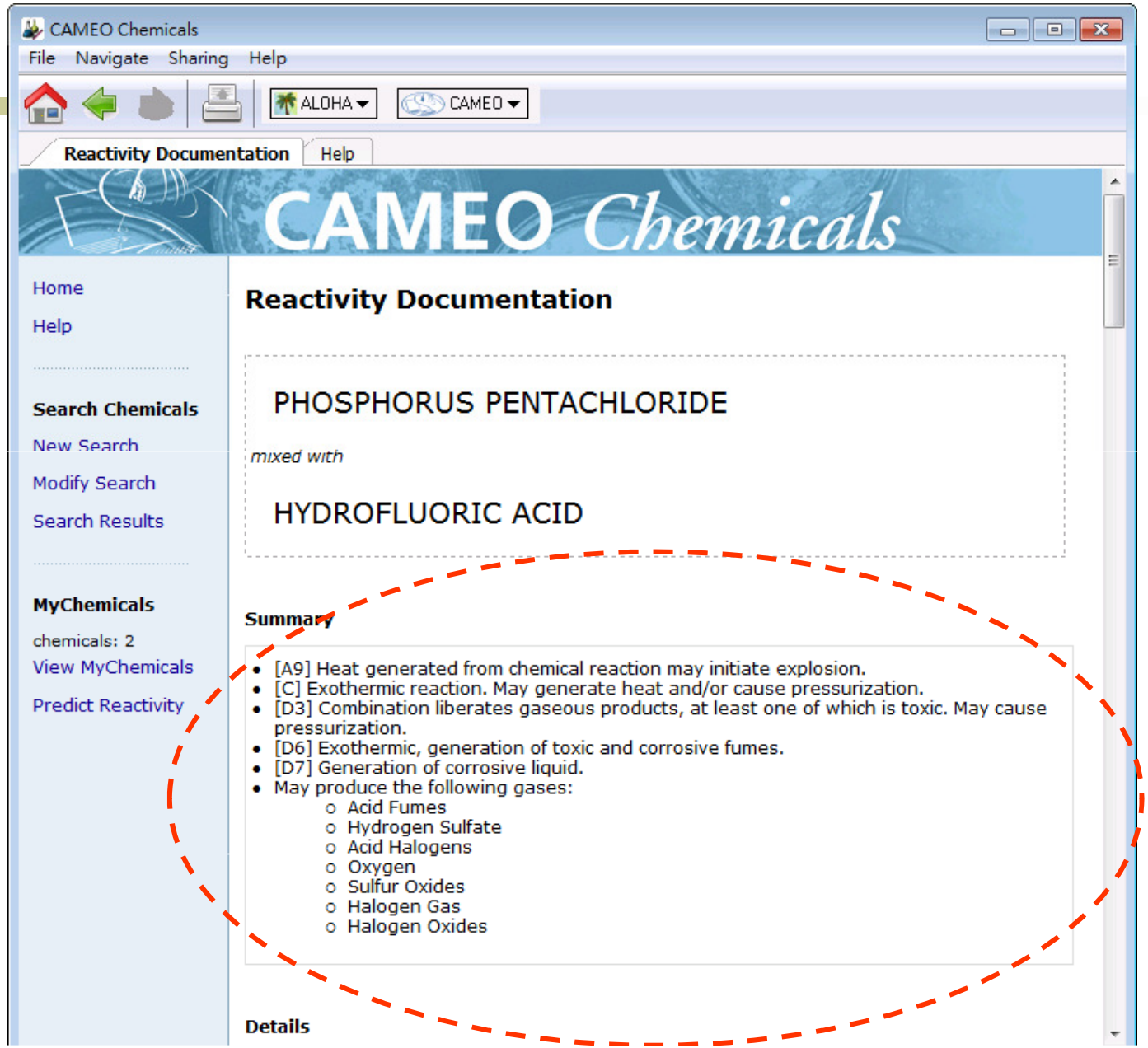
PHOSPHORUS PENTACHLORIDE
Water-Reactive; Air-Reactive

Browse

Comment for Exercise 3

- **CAMEO, for both chemicals, recommends using water spray to knock down vapors, but it also recommends against putting water on phosphorus pentachloride. Hydrogen chloride gas would result from the reaction between hydrogen fluoride and phosphorus pentachloride. Generally, using water spray to knock down the hydrogen chloride gas (which is readily knocked down by water) while avoiding spraying water on the mixture itself, would be an effective response.**

from CAMEO Chemicals



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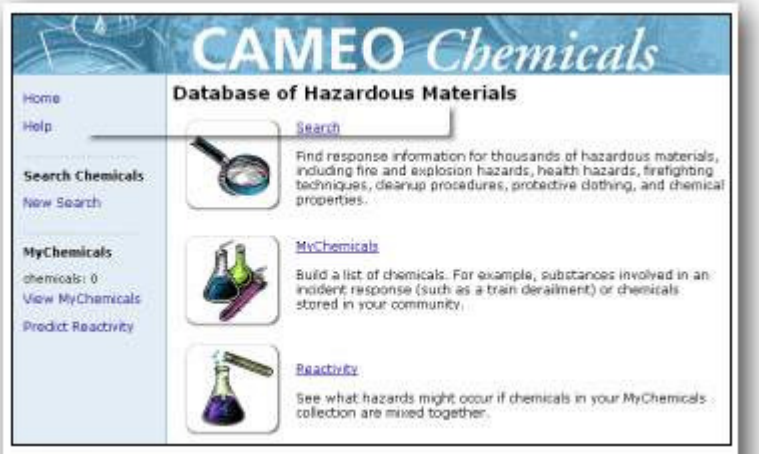
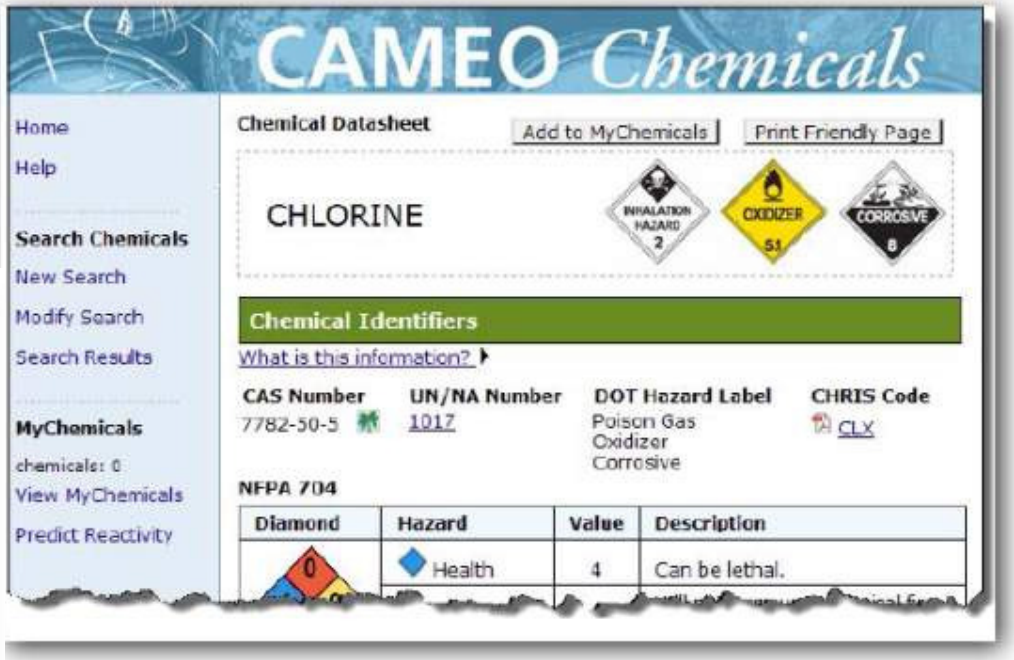
CAMEO Chemicals



CAMEO Chemicals homepage.



- **Computer-Aided Manahement of Emergency Operations (CAMEO)**
- ***CAMEO Chemicals 2.4.1版***
- http://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/response-tools/cameo-chemicals.html

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Absorbent Incompatible Chemicals List

Mixture Manager | Mixture Report | Compatibility Chart | Reactive Groups | Custom Chemical List | Absorbent Incompatibilities | Help

Absorbent Incompatibilities

Absorbent Class Information | Situations To Watch Out For | About This Information

Absorbent Class

- (●) Cellulose-Based Absorbents
- ( ) Mineral-Based & Clay-Based Absorbents
- ( ) Expanded Polymeric Absorbents
- ( ) Sand
- ( ) Dirt/Earth

Example(s)

Slikwik® (ground corn cobs)

Saw dust

Peat moss, Sphagnum moss

Incompatibility Summary | Incompatible Chemicals List

Potentially incompatible with the following chemicals: 1748

1-OCTACOSANOL
1-PENTOL
1-UNDECANOL
1,1-DI-(TERT-BUTYLPEROXY)-3,3,5-TRIMETHYL CYCLOHEXANE
1,1-DI-(TERT-BUTYLPEROXY)-3,3,5-TRIMETHYL CYCLOHEXANE, [<= 57% IN SOLUTION]
1,1-DI-(TERT-BUTYLPEROXY)-3,3,5-TRIMETHYL CYCLOHEXANE, [<= 58% WITH INERT SOLID]
1,1-DI-(TERT-BUTYLPEROXY)CYCLOHEXANE, [<= 40% WITH INERT INORGANIC SOLID, WITH >=
1,1-DI-(TERT-BUTYLPEROXY)CYCLOHEXANE, [<= 50% WITH PHLEGMATIZER]
1,1-DI-(TERT-BUTYLPEROXY)CYCLOHEXANE, [<= 77% IN SOLUTION]
1,1-DI-(TERT-BUTYLPEROXY)CYCLOHEXANE, [TECHNICALLY PURE]
1,1-DICHLORO-1-NITROETHANE
1,1-DIMETHYL-1-(2-HYDROXYPROPYLAMINE)METHACRYLIMIDE
1,1-DIMETHYL-1-(2-HYDROXYPROPYLAMINE)TETRADECANIMIDE
1,1-METHYLENE BIS(4-ISOCYANATOCYCLOHEXANE)
1,1,1,3,3,3-HEXAFLUORO-2-PROPANOL
1,1,3,3-TETRAMETHYLBUTYL HYDROPEROXIDE
1,1,3,3-TETRAMETHYLBUTYL PEROXY-2-ETHYLHEXANOATE
1,1',1''-NITRILOTRIS-2-BUTANOL
1,2-DIMETHYL-3-NITROBENZENE
1,2-DIMETHYL-4-NITROBENZENE
1,2,3,6-TETRAHYDROBENZALDEHYDE
1,3-BIS(2-CHLOROETHYL)-1-NITROSOUREA
1,3-BIS(METHYLISOCYANATE)CYCLOHEXANE
1,3-DICHLORO-2-PROPANOL
1,3-DICHLORO-5,5-DIMETHYLHYDANTOIN
1,3-DICHLOROPROPANOL-2
1,3-DIMETHYL-2-NITROBENZENE
1,3-DIMETHYL-4-NITROBENZENE
1,3-DIMETHYL-5-NITROBENZENE
1,3-DINITRONAPHTHALENE

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Creating Custom Chemicals

Chemical Datasheet for: **Caprolactone**

Help | Done

Chemical Info | Physical Properties | Synonyms

Edit custom chemical information. A unique Chemical Name and at least one Reactive Group are required for each custom chemical.

CAS Number(s): 502-44-3

UN/NA Number:

USCG CHRIS Code:

Chemical Formula: C6H10O2

NFPA: Flammability 1, Instability 0, Health 2, Special ☐W ☐Ox

Select option(s) from pull-down lists. For multiple option selection, Control-click on appropriate options, then press the "Return" or "Enter" key.

DOT Hazard Label:

Reactive Group(s): 13 — Esters, Sulfate Esters, Phosphate Esters, Thiophosphate Esters, and Borate Esters

Reactive Groups

Reactivity Alert(s): 107 — Water-Reactive

General Description

Clear, colorless liquid that is miscible with more organic solvents (except aliphatic hydrocarbons). Caprolactone is a monomer used in the manufacture of various polymers, including polycaprolactone. It is also used in synthetic fibers, polyurethane elastomers, plastics, adhesive fabrics, and coatings.

Reactivity Profile

Caprolactone is incompatible with oxidizing agents and amines. The lactone ring is easily opened with nucleophiles including alcohols and water.

Air and Water Reactions

Health Hazards

Potentially Incompatible Absorbents

Absorbent Incompatibilities

- ☐ Cellulose-Based Absorbents
- ☐ Mineral-Based & Clay-Based
- ☐ Expanded Polymeric Absorbents
- ☐ Sand
- ☐ Dirt/Earth

Done

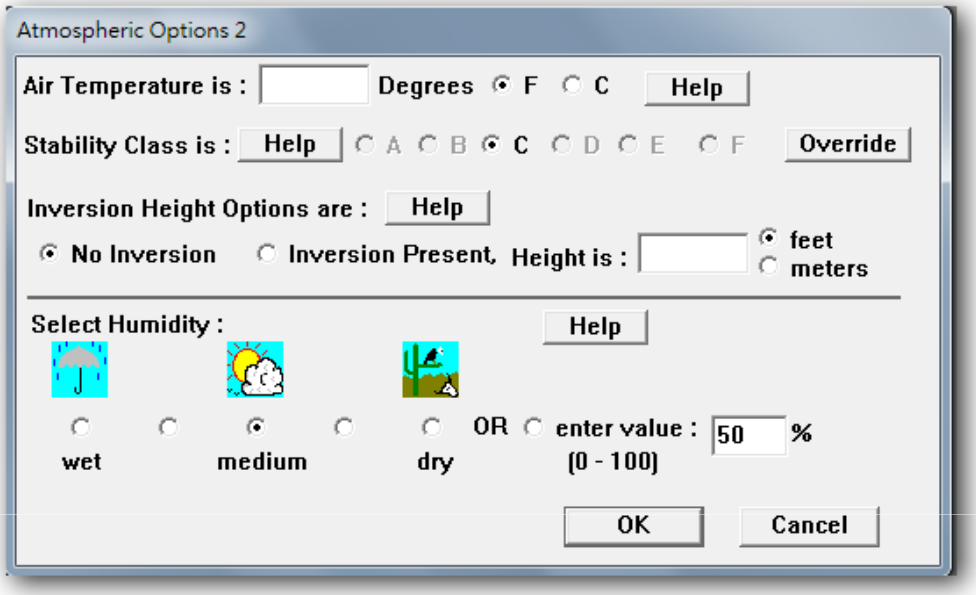
ALOHA

(Areal Locations of Hazardous Atmospheres)

http://www.epa.gov/emergencies/content/cameo/aloha.htm

美國環保署(US EPA)
化學品災害後果模擬軟體

ALOHA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wet
medium
dry
OR enter value : 50 %
(0 - 100)
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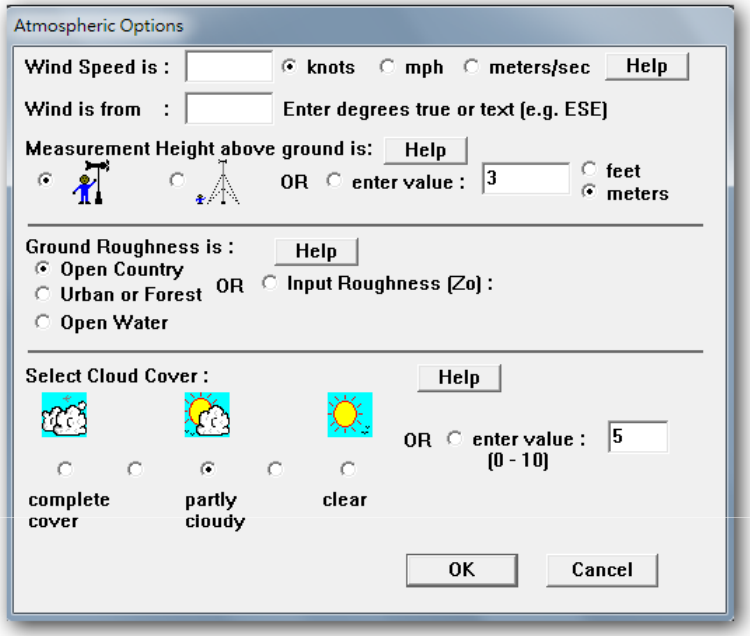
Cancel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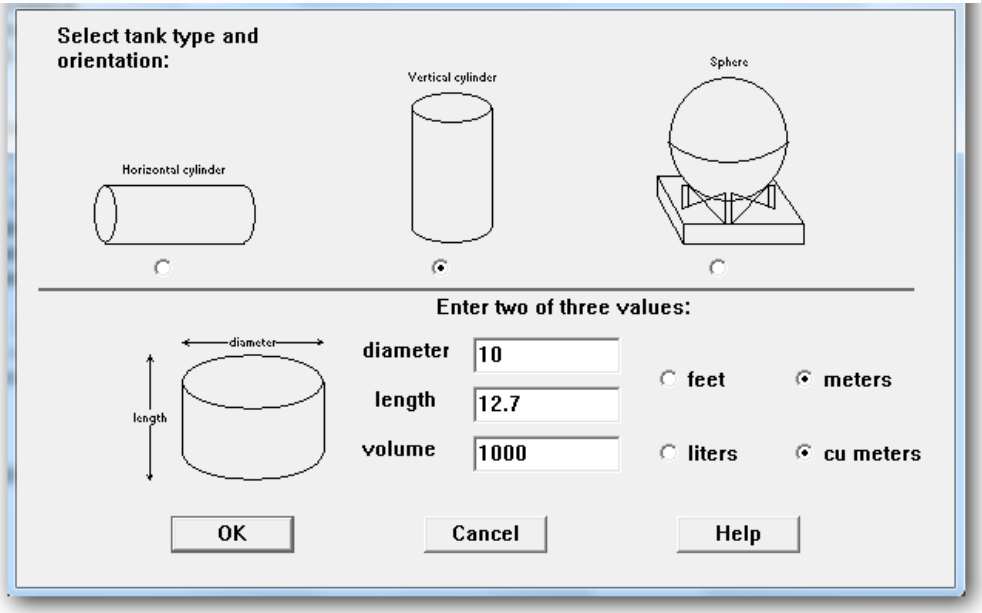
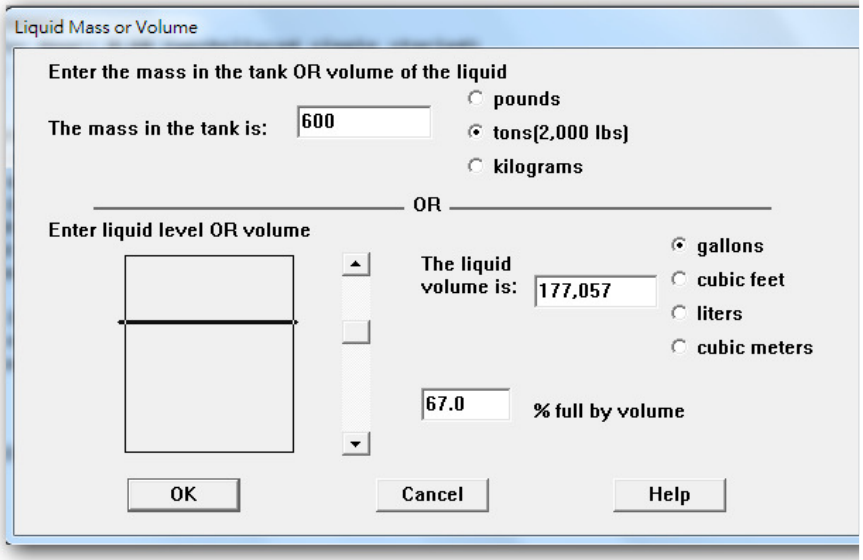
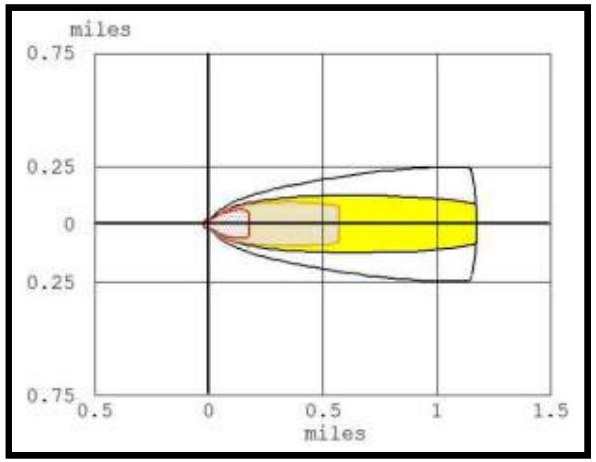
Wind is from :
Enter degrees true or text (e.g. ESE)
Measurement Height above ground is:
Help
OR enter value : 3
feet
meters
Ground Roughness is :
Help
Open Country
Urban or Forest
Open Water
OR Input Roughness (Zo) :
Select Cloud Cover :
Help
complete cover
partly cloudy
clear
OR enter value : 5
(0 - 10)
OK
Cancel


Select tank type and orientation:
Horizontal cylinder
Vertical cylinder
Sphere
Enter two of three values:
diameter
length
diameter 10
length 12.7
volume 1000
feet
meters
liters
cu meters
OK
Cancel
Help

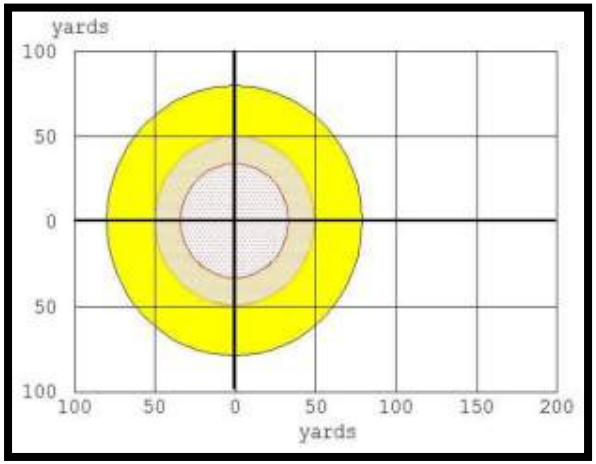

Liquid Mass or Volume
Enter the mass in the tank OR volume of the liquid
The mass in the tank is: 600
pounds
tons(2,000 lbs)
kilograms
OR
Enter liquid level OR volume
The liquid volume is: 177,057
gallons
cubic feet
liters
cubic meters
67.0
% full by volume
OK
Cancel
Help

ALOHA

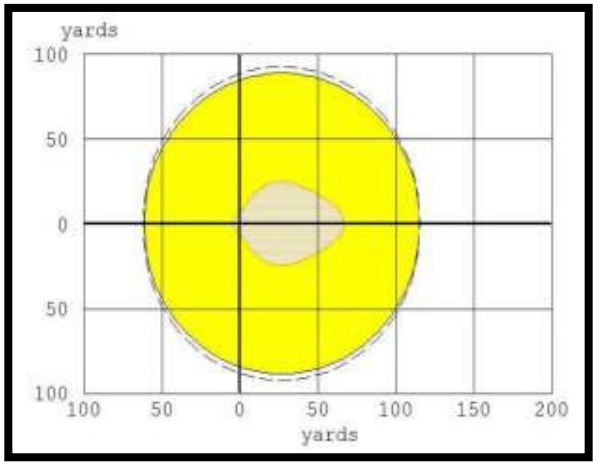
Vulnerability Analysis (Toxic, Thermal & Explosion)



擴散影響範圍頂視圖



熱輻射影響範圍頂視圖



爆炸過壓範圍頂視圖

Toxic Threat Zone

C_6H_6	Conc.	Distance
ERPG-2	150 ppm	922 m

Thermal Radiation from Pool Fire

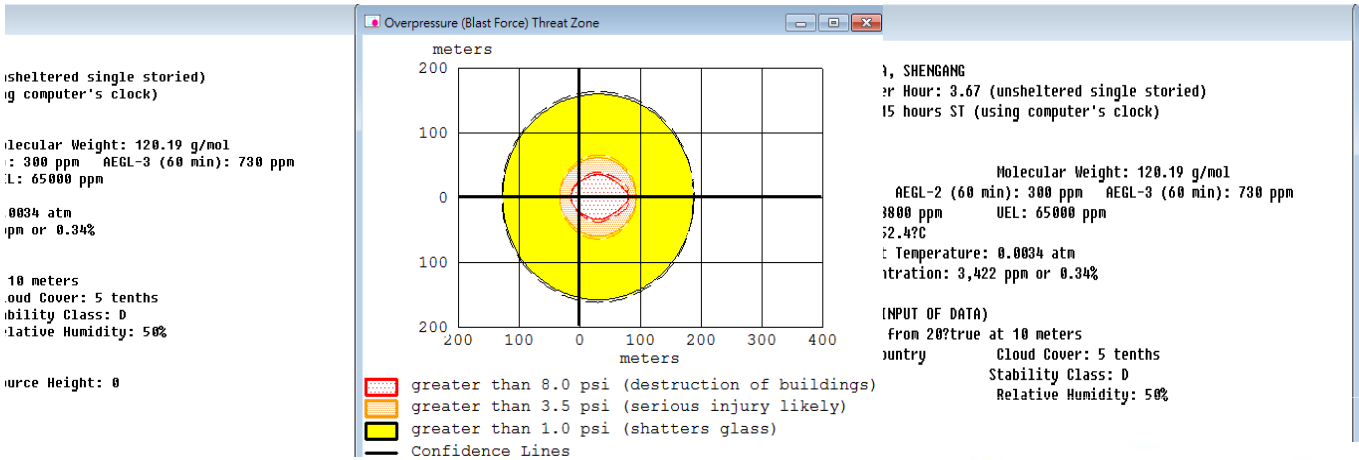
Radiation Levels	Distance
5 kW/m^2	45 m

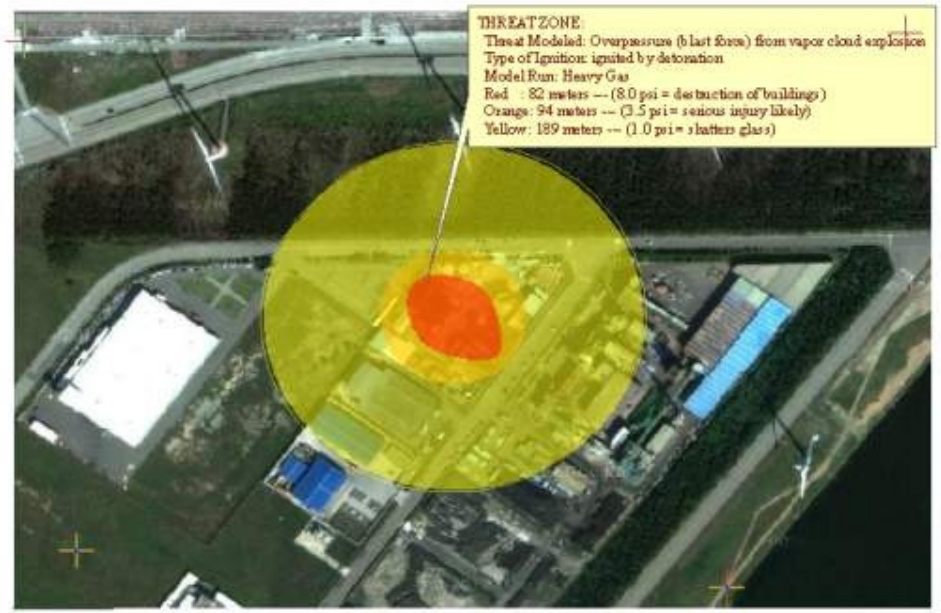
Overpressure from vapor cloud explosion

Overpressure	Distance
3.5 psi	60 m

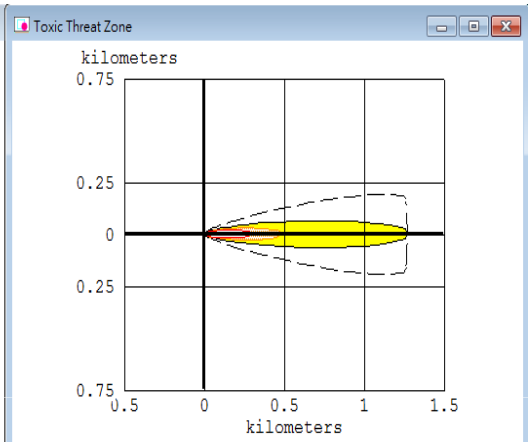
Consequence Mapping

BLEVE





Toxic



ALOHA
(Areal Locations of Hazardous Atmospheres)

Blast area of vapor cloud explosion

ALOHA 5.4.1.2

File Edit SiteData SetUp Display Sharing Help

Text Summary

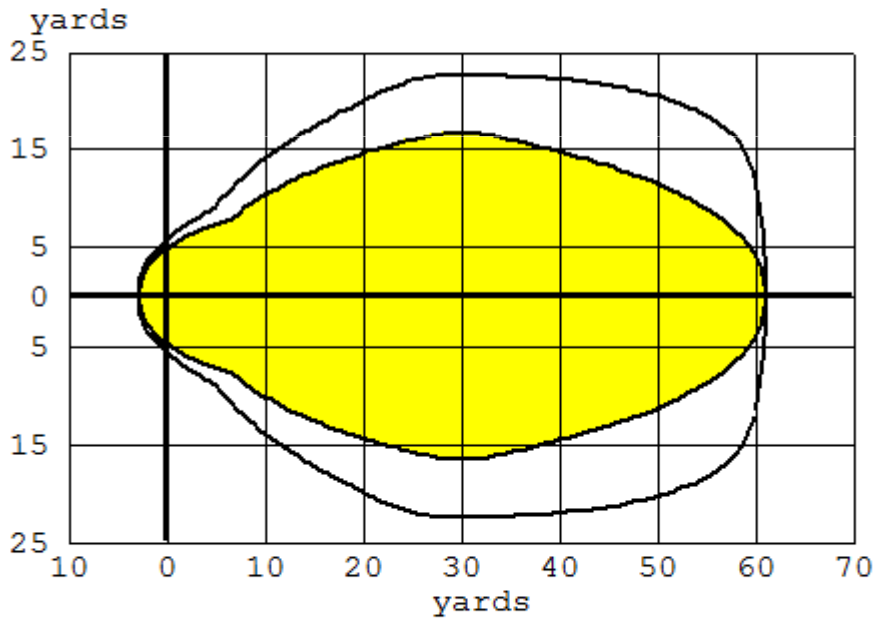
```
SITE DATA:
  Location: ANAHEIM, CALIFORNIA
  Building Air Exchanges Per Hour: 0.62 (unshelte
  Time: July 27, 2011  0003 hours PDT (using comp

CHEMICAL DATA:
  Chemical Name: HYDROGEN                  Molecula
  TEEL-1: 65000 ppm   TEEL-2: 230000 ppm   TEEL-3
  LEL: 40000 ppm     UEL: 750000 ppm
  Ambient Boiling Point: -423.0° F
  Vapor Pressure at Ambient Temperature: greater
  Ambient Saturation Concentration: 1,000,000 ppm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 5 meters/second from ese at 10 meters
  Ground Roughness: urban or forest        Cloud Co
  Air Temperature: 30° C                  Stability
  No Inversion Height                      Relative

SOURCE STRENGTH:
  Flammable gas escaping from pipe (not burning)
  Pipe Diameter: 2 inches                  Pipe Len
  Unbroken end of the pipe is connected to an inf
  Pipe Roughness: smooth                   Hole Are
  Pipe Press: 5 atmospheres                Pipe Tem
```

Overpressure (Blast Force) Threat Zone



>= 8.0 psi = destruction of buildings

>= 3.5 psi = serious injury likely

>= 1.0 psi = shatters glass

Confidence Lines

ALOHA
(Areal Locations of Hazardous Atmospheres)

Flammable area of vapor cloud

ALOHA 5.4.1.2

File Edit SiteData SetUp Display Sharing Help

Text Summary

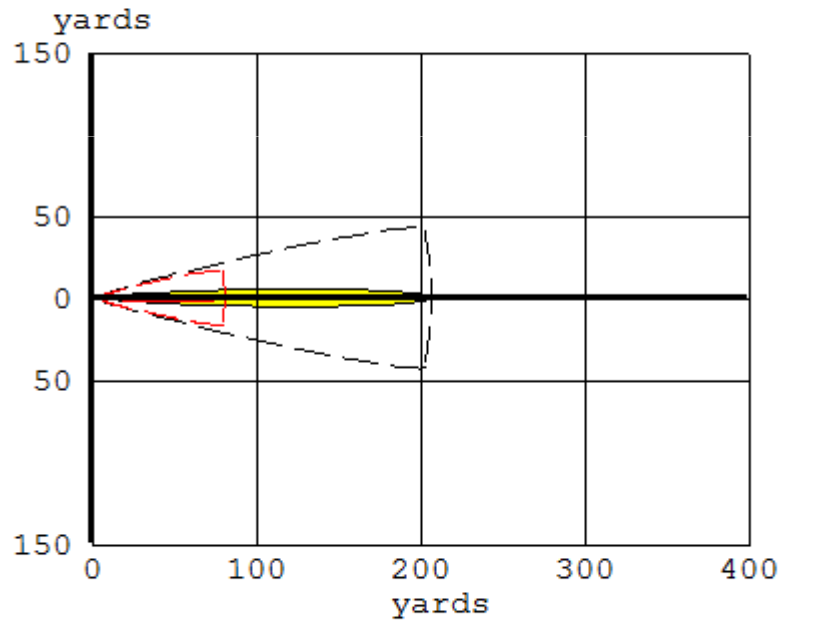
```
SITE DATA:
  Location: ANAHEIM, CALIFORNIA
  Building Air Exchanges Per Hour: 0.62 (unsheltere
  Time: July 27, 2011  0003 hours PDT (using comput

CHEMICAL DATA:
  Chemical Name: HYDROGEN                  Molecular
  TEEL-1: 65000 ppm   TEEL-2: 230000 ppm   TEEL-3:
  LEL: 40000 ppm     UEL: 750000 ppm
  Ambient Boiling Point: -423.0° F
  Vapor Pressure at Ambient Temperature: greater th
  Ambient Saturation Concentration: 1,000,000 ppm o

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 5 meters/second from ese at 10 meters
  Ground Roughness: urban or forest        Cloud Cove
  Air Temperature: 30° C                  Stability C
  No Inversion Height                      Relative H

SOURCE STRENGTH:
  Flammable gas escaping from pipe (not burning)
  Pipe Diameter: 2 inches                  Pipe Lengt
  Unbroken end of the pipe is connected to an infin
  Pipe Roughness: smooth                   Hole Area:
  Pipe Press: 5 atmospheres                Pipe Tempe
```

Flammable Threat Zone



>= 24,000 ppm = 60% LEL = Flame Pockets

>= 4,000 ppm = 10% LEL

Confidence Lines

GHS化學品資料庫

行政院勞工委員會
GHS
化學品全球調和制度
GHS背景
GHS國際公告文件
GHS危害物資訊查詢
最新消息
宣導資料
相關網站連結
Global Harmonized S
首頁>危害物質危害數據資料
危害物質危害數據資料
APEC G.R.E.A.T.網站
危害物質危害數據資料
新增
查詢
此物質列在第一階段列管物質名單中
基本資料
中文名稱
丙烷、二甲基甲烷、液化石油氣
英文名稱
Propane、Dimethylmethane、Liquified petroleum gas、Propyl hydride
CAS No.
74-98-6
UN No.
1978
處理原則
115
EAC碼 [解釋]
2YE
運輸圖式

環保署毒化物查詢

行政院環境保護署

業務使用專區 | 毒災宣導 | 問答集 | 毒化物查詢 | 電子報 | 網路資源 | 資源下載

毒災應變諮詢中心
Emergency Response Information Center

使用身分:一般民眾

列管毒化物查詢

化學品
列管編號
CAS NO
查詢方式 模糊 精確
查詢

- 列管毒化物查詢
- 最新關切化學品危害資料

相關化學物質查詢

- 緊急應變指南
- GHS危害物質資訊查詢

目前位置： 毒災應變諮詢中心→毒化物查詢

毒化物查詢

總筆數：271 | 總下載次數：1175369

列管毒化物危害資料 99 年版

列管編號	序號	中文名稱	英文名稱	GHS SDS	防救手冊	緊急應變程序卡	下載次數
001	01	多氯聯苯	Polychlorinated biphenyls	下載	下載	下載	19655
002	01	可氯丹	Chlordane	下載	下載	下載	5805
003	01	石綿	Asbestos	下載	下載	下載	7413
004	01	地特靈	Dieldrin	下載	下載	下載	5265
005	01	滴滴涕	4,4-Dichlorodiphenyl-trichloroethane (DDT)	下載	下載	下載	6673
006	01	毒殺芬	Toxaphene	下載	下載	下載	4845
007	01	五氯酚	Pentacholorophenol	下載	下載	下載	5489

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美國 CSB化學安全與危害調查委員會

CSB U.S. CHEMICAL SAFETY BOARD

An independent federal agency investigating chemical accidents to protect workers, the public, and the environment.

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CSB Investigation Finds Three DuPont Accidents in Belle, West Virginia, Resulted from Numerous Safety Deficiencies including Lack of Safe Equipment Design, Ineffective Mechanical Integrity Programs, and Incomplete Investigations of Previous Near Misses

July 07, 2011

Investigation Details:
DuPont Phosgene Release

Charleston, West Virginia, July 7, 2011— A series of preventable safety shortcomings -- including failure to maintain the mechanical integrity of a critical phosgene hose -- led to a string of three serious accidents that occurred over a 33-hour period on January 22 and 23, 2010, at the DuPont Corporation's Belle, West Virginia, chemical manufacturing plant, according to the draft report of the U.S. Chemical Safety Board (CSB) which was issued today. In one of the accidents, a worker died following exposure to phosgene, a gas used as a chemical weapon in World War I.

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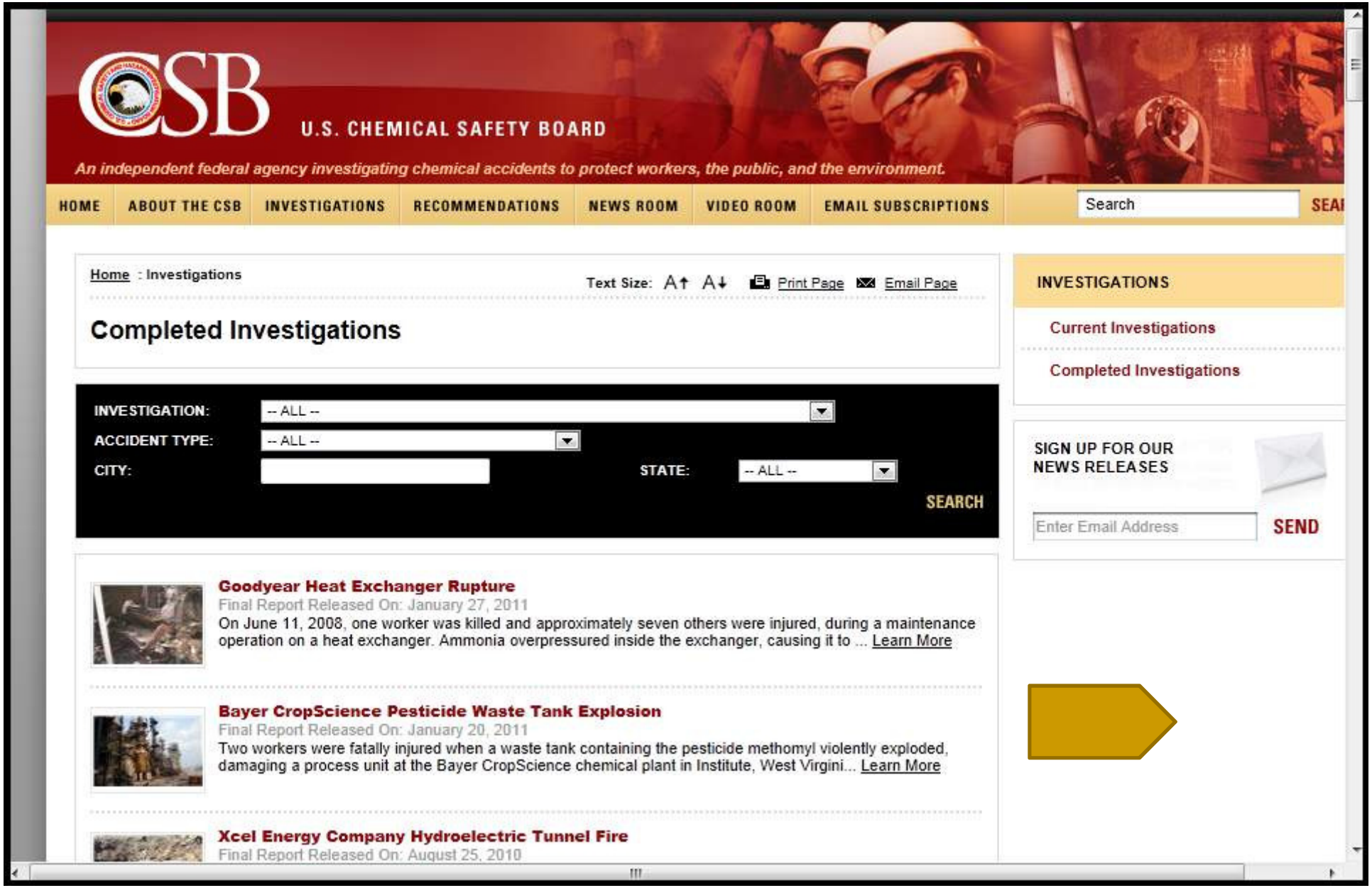
CSB Invetigations



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CSB Safety videos 動畫影片

CSB U.S. CHEMICAL SAFETY BOARD

An independent federal agency investigating chemical accidents to protect workers, the public, and the environment.

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Animation of January 23, 2010 Phosgene Accident
7/7/2011
Animation of January 23, 2010 Phosgene Accident ... More

U.S. Chemical Safety Board Iron Dust Testing May 26, 2011
6/3/2011
Video of testing on metal dust collected after the January 31, 2011, incident at the Hoeganaes Corporation in Gallatin, TN. The video shows two different tests, the first clip is filmed at normal speed followed by the two tests filmed in slow motion at 1,000 frames a second.... More

Fire in the Valley
3/21/2011
A CSB safety video depicting events leading to the August 28, 2008, catastrophic explosion and fire at the Bayer CropScience facility in Institute, WV, that fatally injured two workers. ... More

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Email Page

Fatal Exposure: Tragedy at DuPont

From:
September 22, 2011

DESCRIPTION

Three accidents occur over a 33-hour period at the Dupont plant in Belle, WV.

Investigation Details:
DuPont Corporation Toxic Chemical Releases

Download Options:
QuickTime Video
Windows Video

RSS Video Link

CSB Video Podcast

CSB Safety Videos on YouTube

CSB Safety Messages on YouTube

Safety Videos

Safety Messages

DVD Request Form

Video Feedback

FEATURED COMMENTS

Safety Rep
April 05, 2011
I recently used your video on the Dangers of Hot Work in a new hire training class. It was some of the best feedback from a video I've ever had. I think it's one of the few videos that makes the reality of the Hot Work hazard personal. Thank you

Mechanical Technologist
March 24, 2011
One of the best presentations I've seen in my 30 years in the Oil and Gas industry. Having personally 25+ years of operating experience as Unit Operator, Control Room Operator and Shiftleader, I can certainly relate to the safety and business impacts that a disfunctional culture can create. Now having 4 years of technical experience has shown me how important original design and it's suitability to present operating conditions is to process safety.

Senior Compliance Specialist
March 17, 2011
CSB case study videos are a regular staple during HAZMAT response and safety training to convey the consequences of improper action or inaction. We find these videos to be informative and an invaluable resource.

Post Comment

MOST VIEWED VIDEOS

Dangers of Hot Work
June 07, 2010
Read More

Surveillance video from July 19, 2009, fire and explosion at the CITGO Corpus Christi Refinery
December 09, 2009

Exercise 4

- At your chemical processing plant, to save space, the production engineers would like to combine 80 liters of waste that is predominately nitric acid with the contents of a nearly-full drum of waste containing mostly methylene chloride. Should you allow them to combine the contents of these two drums?

Chemical Reactivity Worksheet

CRW2 - [Worksheet]

File Edit Scripts Help

Worksheet | New Search | Search Results | Export to Excel | Print Ch

Reactivity Compatibility Chart	NITRATING ACID, MIXTURE, (WITH > 50% NITRIC ACID)	METHYL CHLORIDE			
NITRATING ACID, MIXTURE, (WITH > 50% NITRIC ACID)		A2, B1, C, D3, D7			
METHYL CHLORIDE	A2, B1, C, D3, D7				

Hazard Summary | Potential Gases | Pot. Gases Documentation | G

Selected Chemical Combination

NITRATING ACID, MIXTURE, (WITH > 50% NITRIC ACID)

+ METHYL CHLORIDE

A2 - Risk of explosion by shock, friction, fire or other sources of ignition

B1 - May become highly flammable or may initiate a fire, especially if other combustible materials are present

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

D7 - Generation of corrosive liquid

Comment for Exercise 4

- You should not. The Mixture Worksheet shows that combining nitric acid and methylene chloride could **become highly flammable or cause a heat-generating reaction that could generate a toxic gas.** Also, as a general rule, it's inadvisable to combine mixtures of chemicals if you don't know the complete composition of both mixtures.

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Fab 製程清洗液不相容性範例

- **Wet Bench** 溼式清洗製程

污染物	名稱	化學溶液的混合種類 (所有潔淨完後用DI水沖洗)	化學式
微粒	Piranha(SPM)	硫酸/過氧化氫/DI水	H2SO4/H2O2/H2O
	SC-1(APM)	氫氧化氨/過氧化氫/DI水	NH4OH/H2O2/H2O
有機物	SC-1(APM)	氫氧化氨/過氧化氫/DI水	NH4OH/H2O2/H2O
金屬（非銅）	SC-2(HPM)	氯化氫/過氧化氫/DI水	HCl/H2O2/H2O
	Piranha(SPM)	硫酸/過氧化氫/DI水	H2SO4/H2O2/H2O
	DHF	氫氟酸/水溶液(不能移除銅)	HF/H2O
原生氧化物	DHF	氫氟酸/水溶液(不能移除銅)	HF/H2O
	BHF	稀釋之氫氟酸	NH4F/HF/H2O

Fab 製程清洗液不相容性範例

- Piranha (SPM) + IPA
- 物質－過氧化氫(31 wt%) +硫酸(98 wt%) +異丙醇(100 wt%) (from彭登志，2002)
- 混合比例(wt%): 30% (15.08g):50%(25.33g):20%(10.13g)
- 實驗測得，於開放空間進行不相容性探討，結果產生瞬間混合溶液溫度驟昇（最大溫度變化為36秒鐘內，混合溶液溫度由26.6℃昇至158.1℃）、滾沸、溢流與雙相排放等，冒出500 ml燒杯等不相容反應現象 (SPM-item29)

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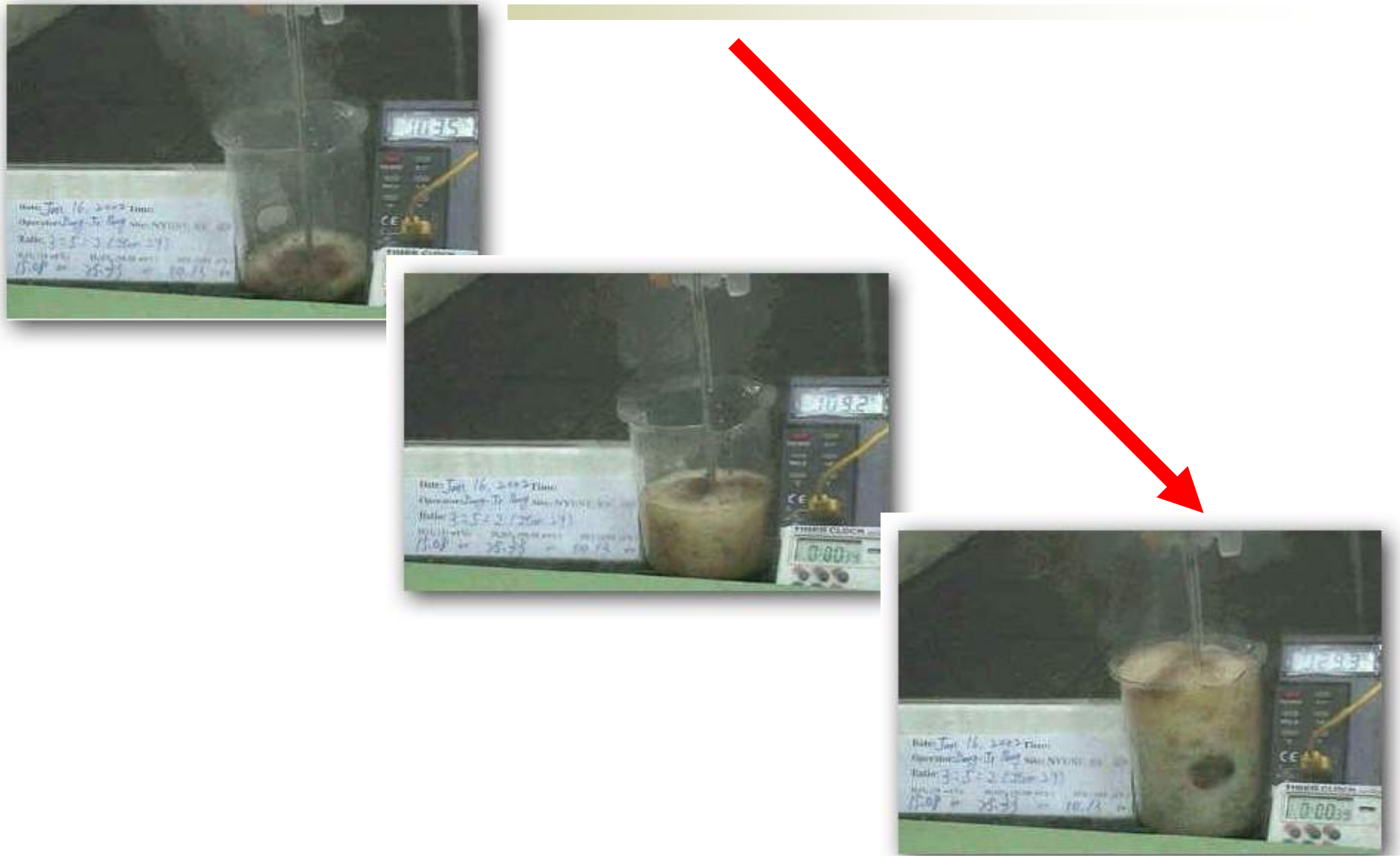
不相容反應實驗溢流(Overflow)圖



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Fab不相容反應實驗溢流(Overflow)圖

Piranha (SPM) + IPA

物質－過氧化氫(31 wt%) +硫酸(98 wt%) +異丙醇(100 wt%)

(from彭登志，2002)

混合比例(wt%): 30%(15.08g):50%(25.33g):20%(10.13 g)

實驗測得，於開放空間進行不相容性探討，結果產生瞬間混合溶液溫度驟昇（最大溫度變化為36秒鐘內，混合溶液溫度由26.6℃昇至158.1℃）、滾沸、溢流與雙相排放等，冒出500 ml燒杯等不相容反應現象

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Fab製程範例

- 過氧化氫+硫酸+異丙醇

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Worksheet | New Search | Search Results | Export to Excel | Print Chart | Help

Reactivity Compatibility Chart	HYDROGEN PEROXIDE, AQUEOUS SOLUTION, WITH	ISOPROPANOL	SULFURIC ACID			
HYDROGEN PEROXIDE, AQUEOUS SOLUTION, WITH NOT LESS THAN 20% BUT NOT MORE		A3, A6, B4, C, D3	A6, A8, A9, B6, C, D6, D7			
ISOPROPANOL	A3, A6, B4, C, D3		A9, B1, B6, C			
SULFURIC ACID	A6, A8, A9, B6, C, D6, D7	A9, B1, B6, C				

Hazard Summary | Potential Gases | Pot. Gases Documentation | General Documentati

Selected Chemical Combination

HYDROGEN PEROXIDE, AQUEOUS SOLUTION, WITH NOT LESS THAN 20% BUT NOT MORE THAN 60% HYDROGEN PEROXIDE (STABILIZED AS NECESSARY)

\+ SULFURIC ACID

A6 - Reaction proceeds with explosive violence and/or forms explosive products

A8 - Explosive when mixed with combustible material

A9 - Heat generated from chemical reaction may initiate explosion

B6 - Combination liberates gaseous products, including both flammable and toxic gases. May cause pressurization

C - Exothermic reaction. May generate heat and/or cause pressurization

D6 - Exothermic, generation of toxic and corrosive fumes

實驗室廢液不相容性評估範例

- 在一般化學實驗室的廢液處理
- 物質－丙酮、硝酸
- 實驗測得，於開放空間進行不相容性探討，結果混合溶液溫度會先緩慢上昇至丙酮沸點（約56 ℃）以上，造成使混合溶液滾沸，溫度再迅速上昇至104℃，並溢流與雙相排放等不相容反應現象

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實驗室廢液不相容性評估範例

- 丙酮+硝酸

File Edit Scripts Help

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Reactivity Compatibility Chart	ACETONE	NITRATING ACID, MIXTURE, (WITH <= 50% NITRIC ACID)			
ACETONE		A6, B4, C, D3			
NITRATING ACID, MIXTURE, (WITH <= 50% NITRIC ACID)	A6, B4, C, D3				

Hazard Summary | Potential Gases | Pot. Gases Documentat

Selected Chemical Combination	
	ACETONE
+	NITRATING ACID, MIXTURE, (WITH <= 50% NITRIC ACID)

A6 - Reaction proceeds with explosive violence and/or forms explosive products

B4 - Spontaneous ignition of reactants or products due to reaction heat

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

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實際案例

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實際案例

《非典型肺炎中的化學》特稿二： 漂白水意外篇 - Microsoft Internet Explorer

http://www.pohtyh.edu.hk/lwh/dailylife/san2.htm

非典型肺炎事件

（以下部份資料節錄自明報和太陽報）

漂白水意外

2003 年 4 月 13 日《太陽報》報道：筲箕灣東熹苑逸熹閣昨晨由清潔工人清潔消毒時發生意外，一名女工疑將有漂白水成分的洗地水，與洗石水混合調校清洗走廊時，產生化學作用引起輕微爆炸，清潔劑濺傷女工雙眼及右手，成為非典型肺炎襲港以來，首宗使用洗地水混入其他清潔劑發生意外事件。幸好傷者經送院敷治後已出院。

2003 年 4 月 13 日《明報》也有報導同一宗新聞，報道指出：該名清潔工人曾將管理公司提供的漂白水，與洗石水混合後盛載於膠樽內，並把其搖勻，期間膠樽突然

化學知識

（李 Sir 提供）

引致今次意外的其中一位主角是漂白水！使用漂白水洗地本來是不錯的消毒方法，但是如果在漂白水中胡亂混入其他清潔劑，滿以為「加倍清潔」的話，後果真的可大可小！

在工業上，製造漂白水是透過電解濃鹽水 (electrolysis of concentrated brine) 獲得氫氧化鈉 (sodium hydroxide / NaOH) 和氯氣 (chlorine / Cl_2)。然後再把兩者混合而製成漂白水。化學方程式 (equation) 如下：

$$Cl_2 + 2\ NaOH \longrightarrow NaCl + NaOCl + H_2O$$ 或

$$Cl_2 + 2\ OH^- \longrightarrow Cl^- + OCl^- + H_2O$$

正如之前所說，一般漂白水的有效成份為次氯酸鈉 (sodium hypochlorite / NaOCl)。正確一點來說，次氯酸鈉中的次氯酸根離子 (hypochlorite ion / OCl^-) 才是真正的有效成份。必須注意的是，除次氯酸根離子之外，漂白水中還含有大量的氯離子 (chloride ion / Cl^-)。

至於意外中的另一位主角洗石水，種類卻有很多，化學成份也較為複雜。一般洗石水適用於清洗學校、泳池及工商業住宅大廈內之樓梯、地台、洗手間、外牆等。不同種類的洗石水對於不同的管料

實際案例

- 在一般居家常使用的清潔用品
- 物質－漂白水 ➔ 含12%次氯酸鈉(NaOCl)
  清潔劑 ➔ 酸 或 鹼
- 94年7月10日一間室內游泳池，加錯消毒劑產生氯氣傷人的意外，大約有20名泳客嗆傷，至於氯氣產生的原因，是員工在消毒時，誤把鹽酸和漂白水混合，才會瞬間產生大量氯氣。

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實際案例

- 漂白水+鹽酸

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Reactivity Compatibility Chart	HYDROCHLORIC ACID, SOLUTION	SODIUM CHLORITE SOLUTION, [<= 42% SODIUM CHLORITE]			
HYDROCHLORIC ACID, SOLUTION		A9, B4, C, D3, D5, D6, D7, G			
SODIUM CHLORITE SOLUTION, [<= 42% SODIUM CHLORITE]	A9, B4, C, D3, D5, D6, D7, G				

Hazard Summary | Potential Gases | Pot. Gases Documentati

Selected Chemical Combination

HYDROCHLORIC ACID, SOLUTION

\+ SODIUM CHLORITE SOLUTION, [<= 42% SODIUM CHLORITE]

A9 - Heat generated from chemical reaction may initiate explosion

B4 - Spontaneous ignition of reactants or products due to reaction heat

C - Exothermic reaction. May generate heat and/or cause pressurization

D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization

D5 - Combination liberates combustion-enhancing gas (e.g., oxygen). May cause pressurization

D6 - Exothermic, generation of toxic and corrosive fumes

Closing Remarks

- 運作化學不單僅需關切物質的燃燒性及毒性，對於不相容性亦是需要加以辨識及考量
- 常因人員對物質不相容性的不瞭解，而引發不相容反應發生導致嚴重傷害發生
- 不相容性資料可藉由文獻資料或試驗測得
- 不相容性辨識結果可作為製程操作安全之設計及規劃危害消弭措施與緊急應變之參考
- 詳細之定量化學反應不相容性數據(放熱量、放熱速率、壓力、產生物質...)，需透過專門設計之儀器，量測分析與評估而得

簡報完畢！

化學反應性測試技術

(1)熱分析技術(DSC, DTA)

- 快速測得物質的放熱量、放熱速率、放熱起始溫度等。

(2)絕熱卡計技術(ARC, VSP2, PHI-TEC II, Dewar)

- 量測物質絕熱狀態，自加熱過程中溫度與壓力的變化情形。

(3)緊急排放DIERS技術(RSST, VSP2, PHI-TEC II)

- 快速測得物質失控反應的壓力與溫度數據，以進行緊急排放系統設計。

(4)反應卡計技術（RC1, C-80）

- 模擬批式/半批式反應製程及製程參數改變之效應。

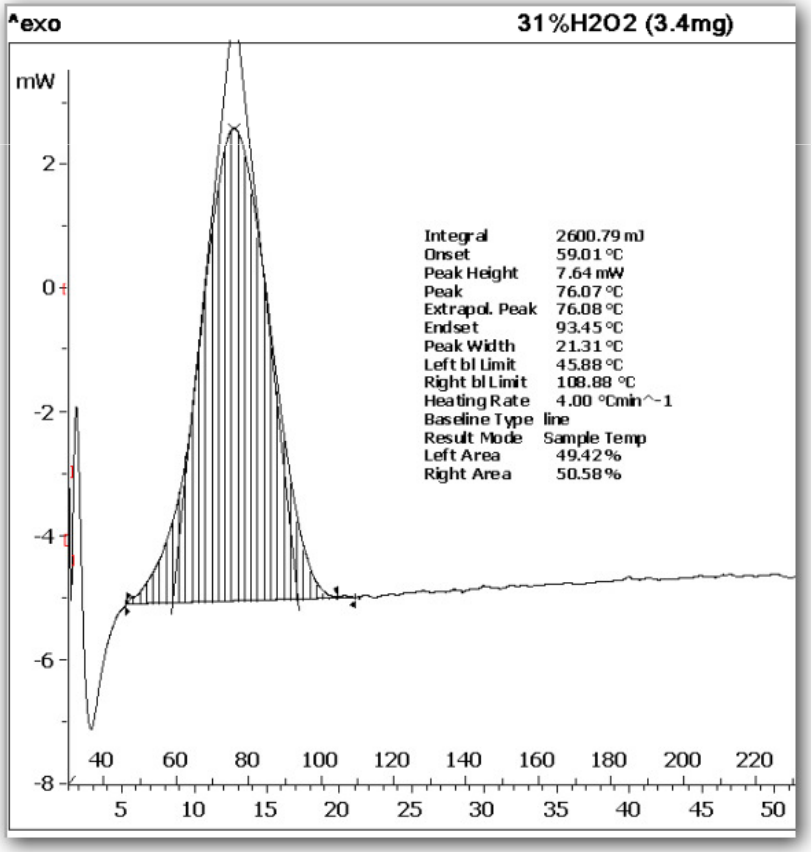
(5)恆溫卡計技術(TAM, MS-80)

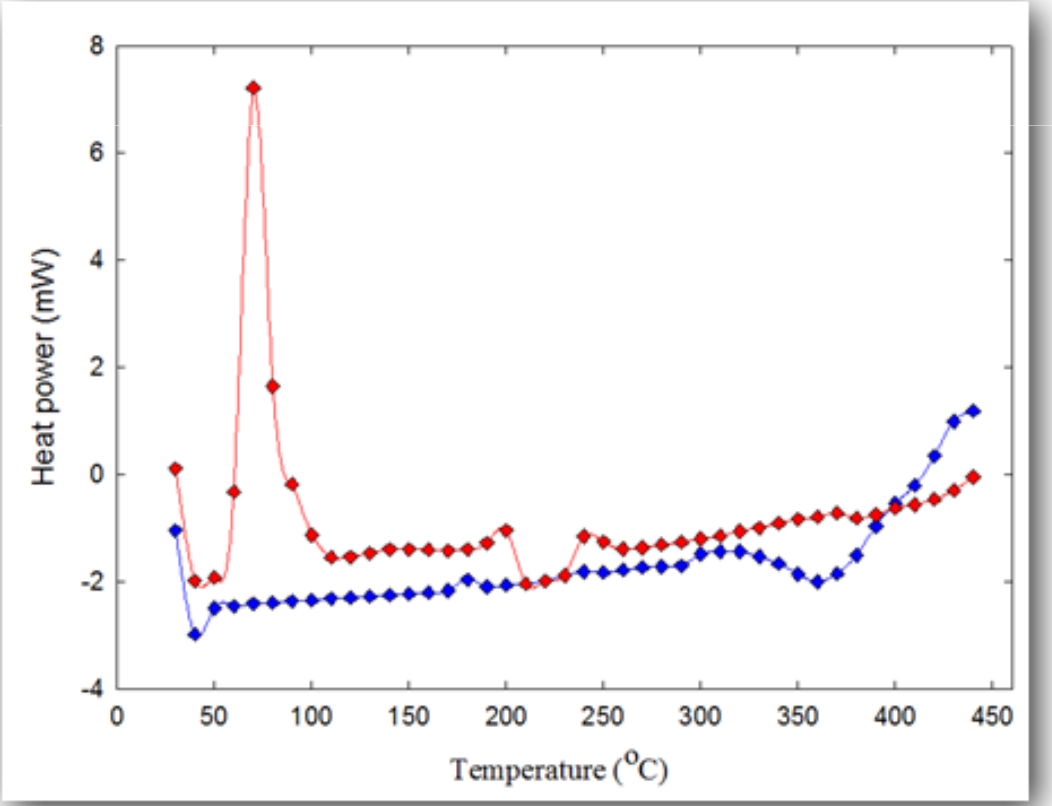
- 物質運輸/儲存之最高溫物測定。

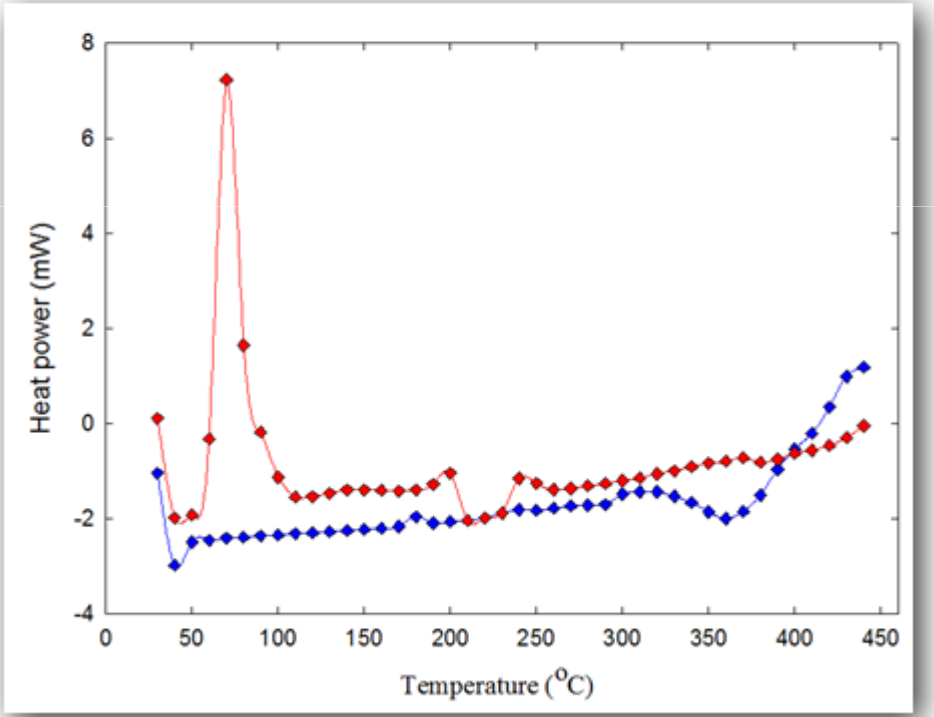
DSC 測試(放熱量)

ASTM E537- 07 Test Method for The Thermal Stability Of Chemicals By Differential Scanning Calorimetry

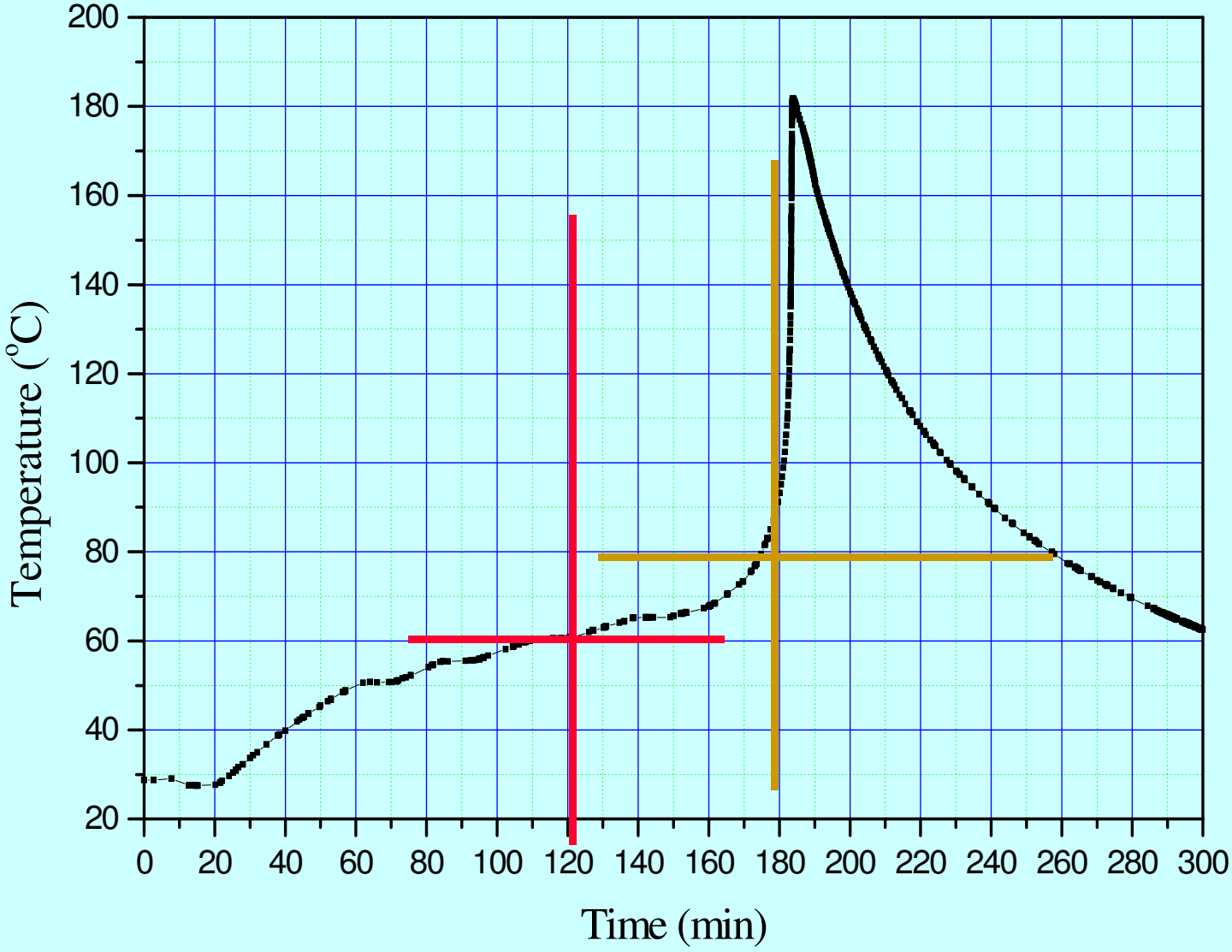
ASTM E2550 – 11 、 ASTM E1981 - 98(2004)



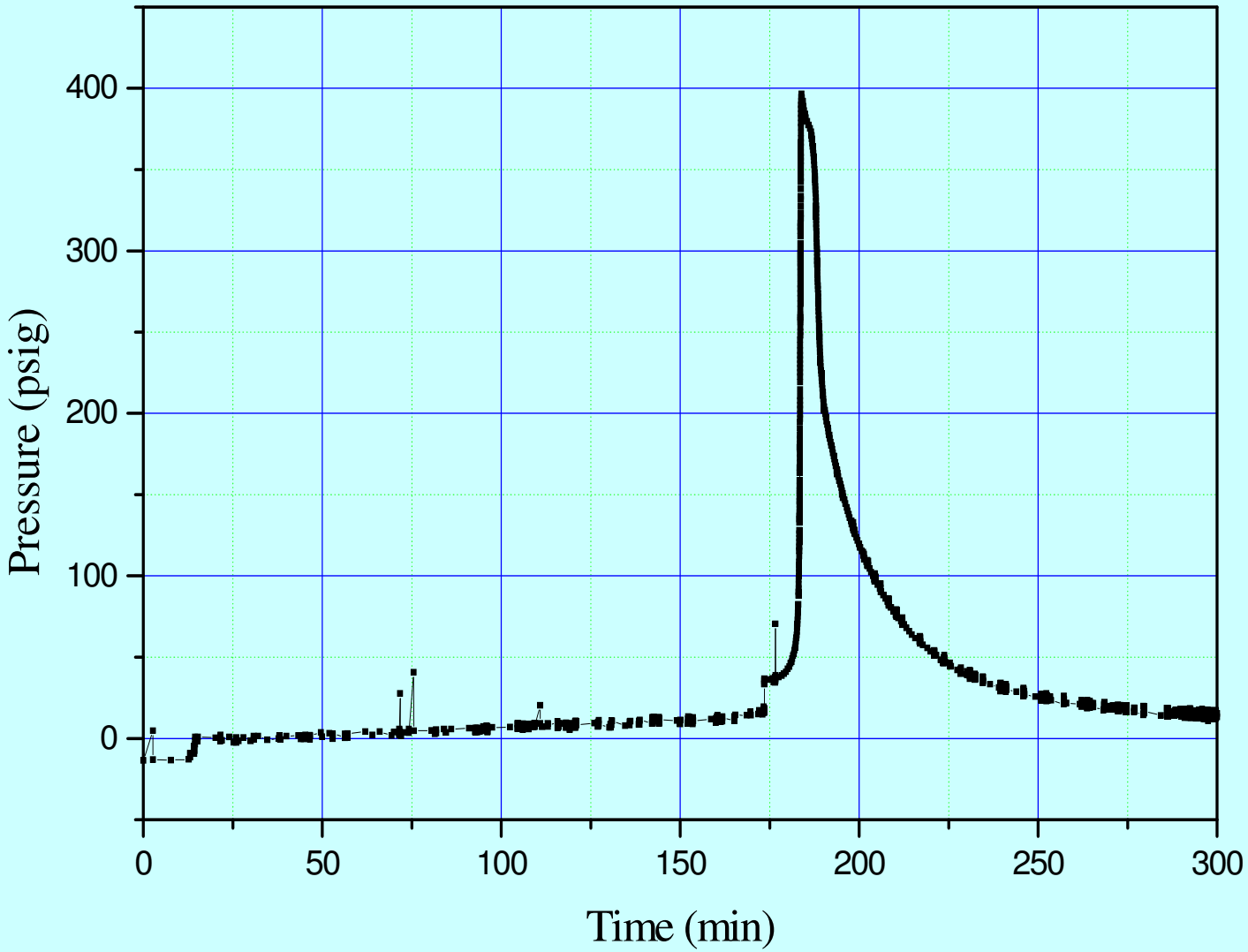



Heat power (mW)
8
6
4
2
0
-2
-4
0
50
100
150
200
250
300
350
400
450
Temperature (°C)

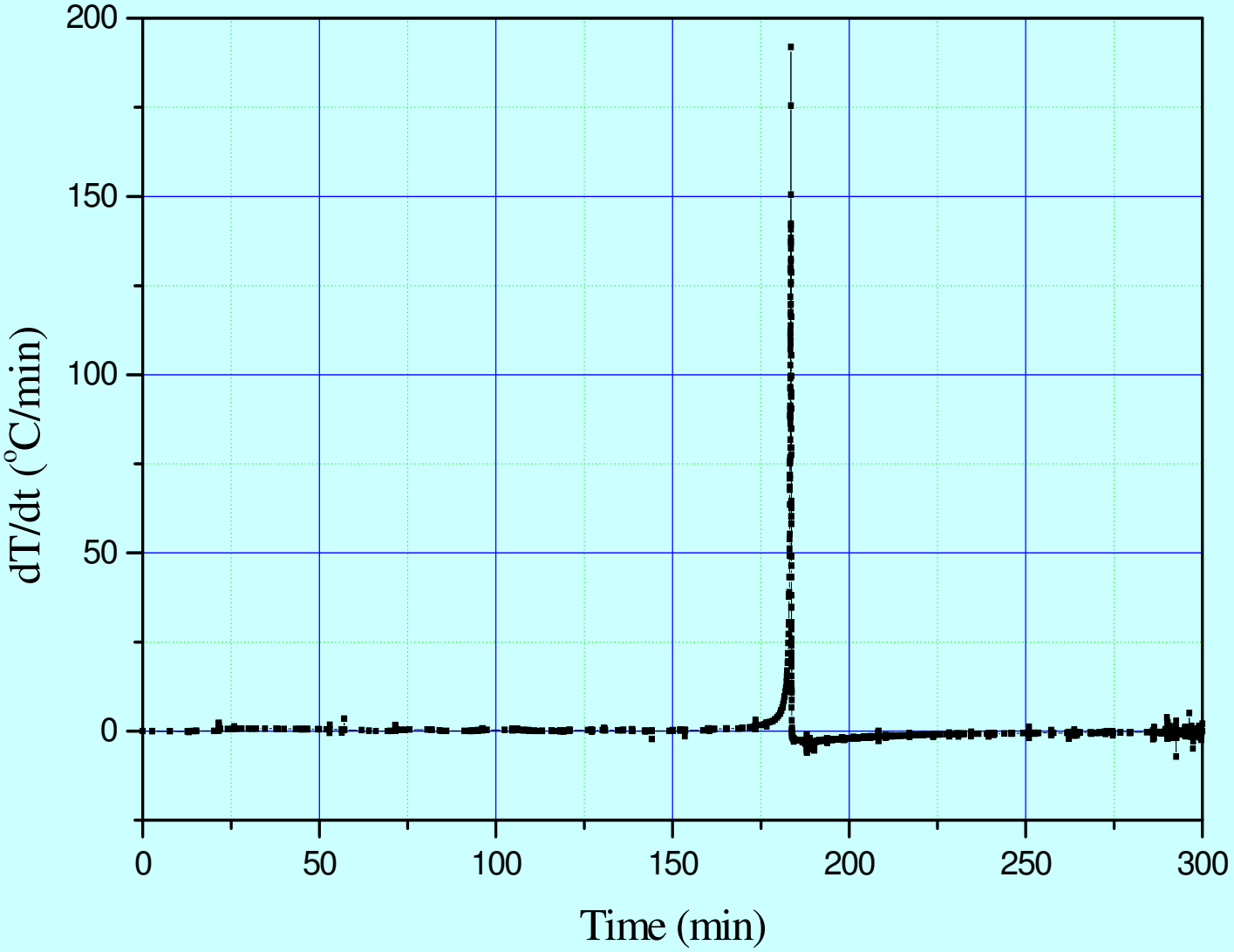
失控反應溫度上升情形


Temperature (°C)
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Time (min)

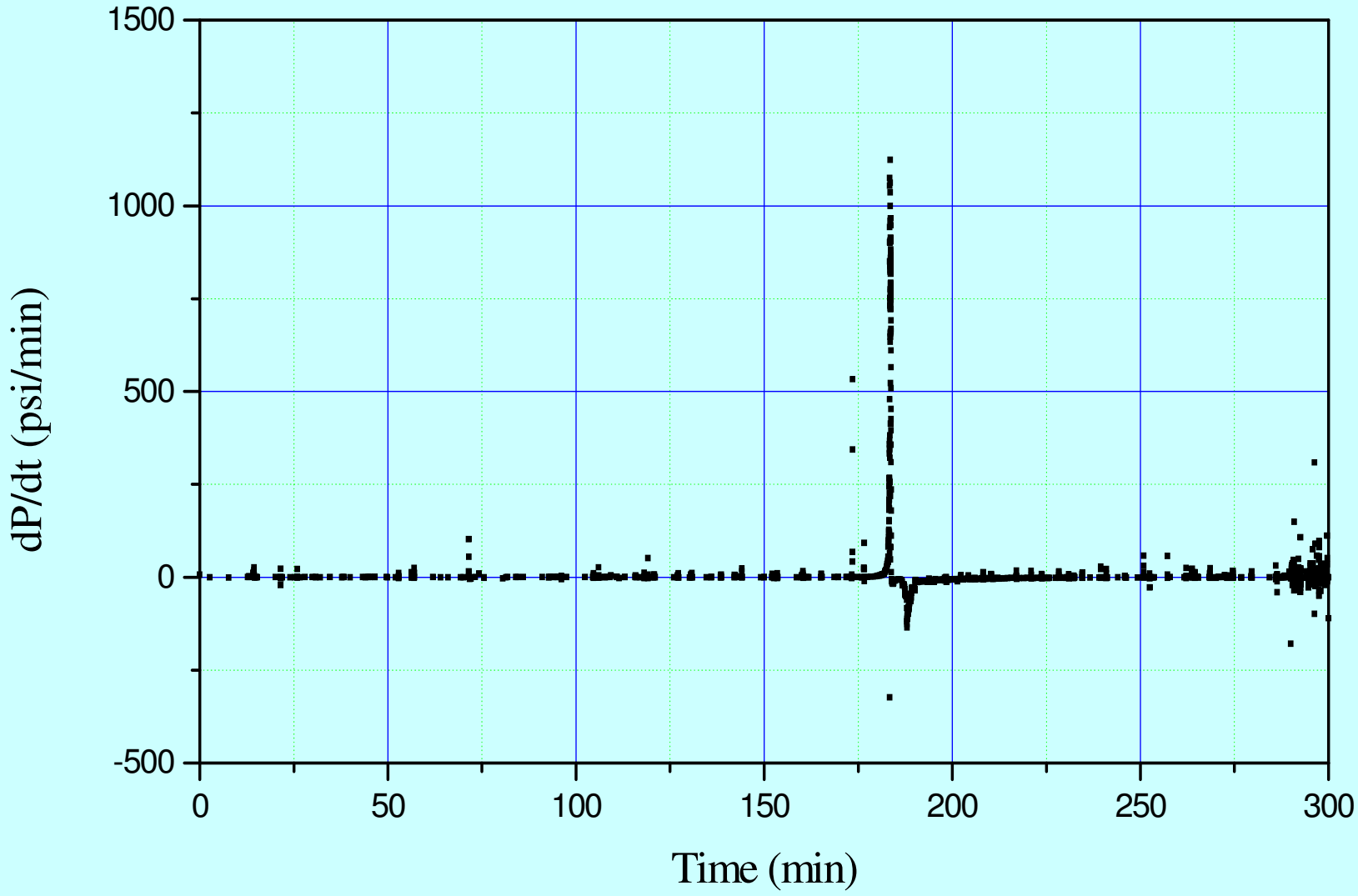
失控反應壓力上升情形


Pressure (psig)
400
300
200
100
0
0
50
100
150
200
250
300
Time (min)

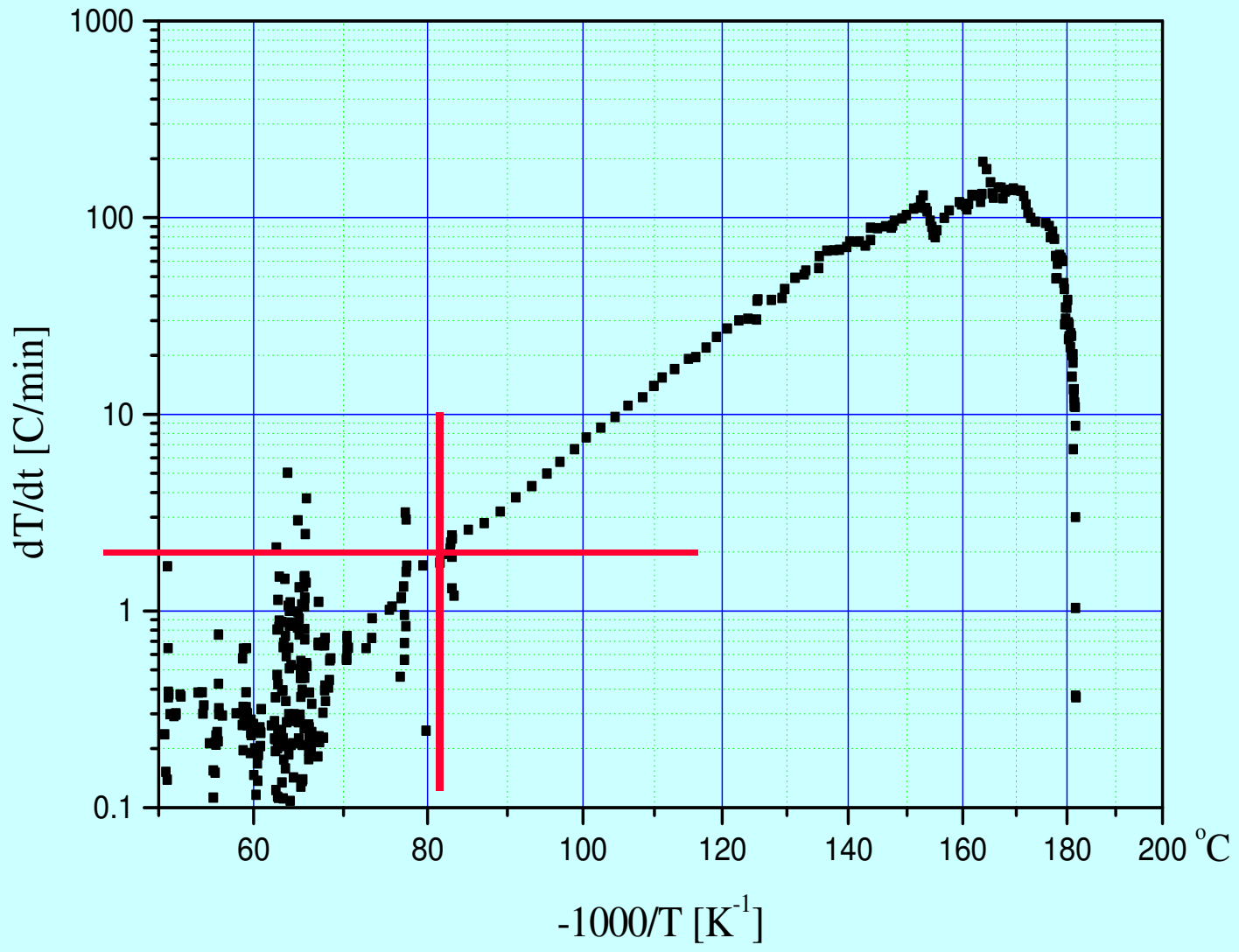
失控反應升溫速率



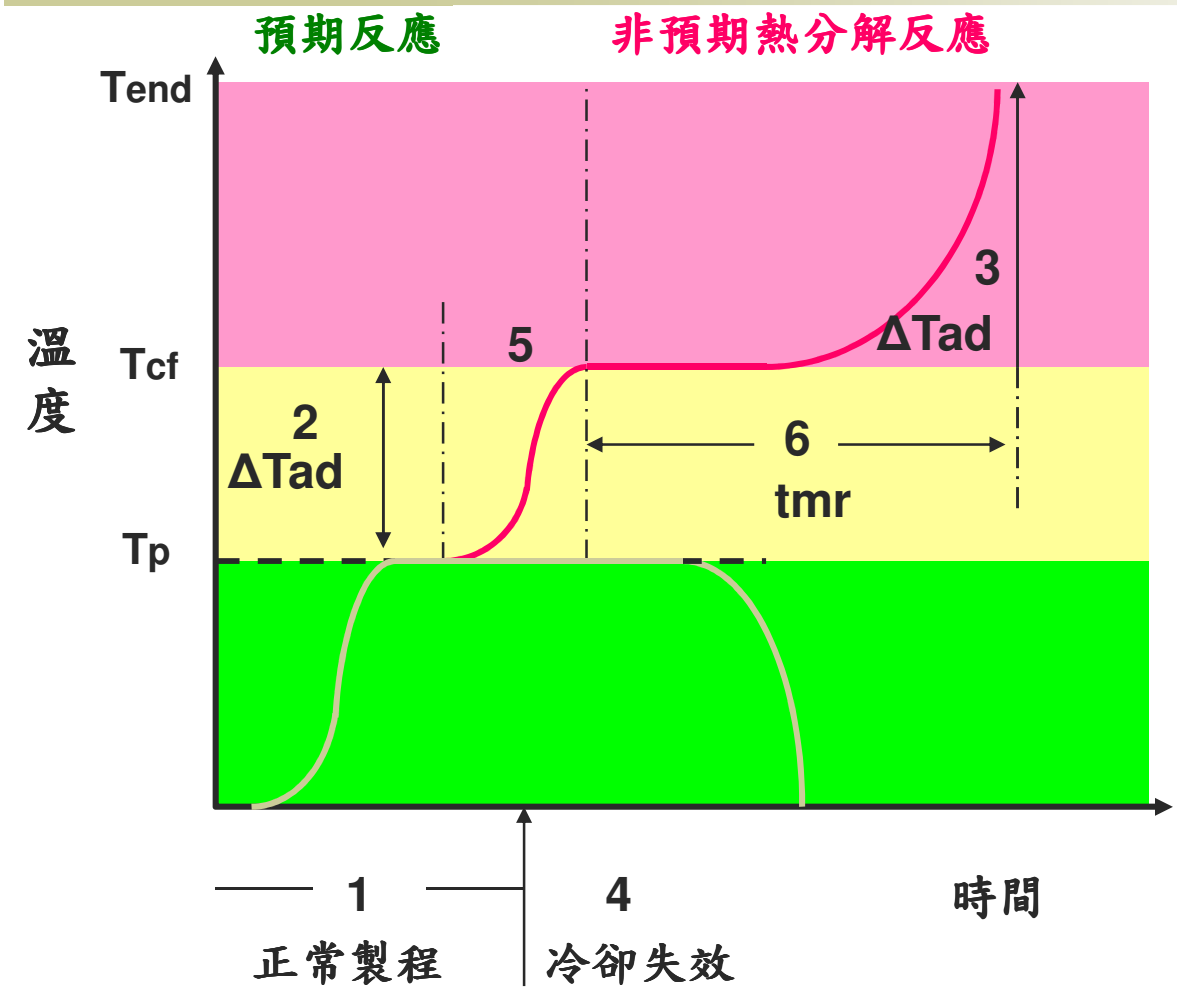
失控反應升壓速率


1500
1000
500
0
-500
dP/dt (psi/min)
0
50
100
150
200
250
300
Time (min)

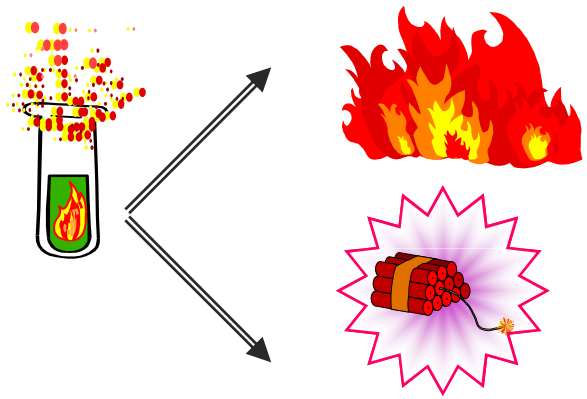
升溫速率與溫度關係圖

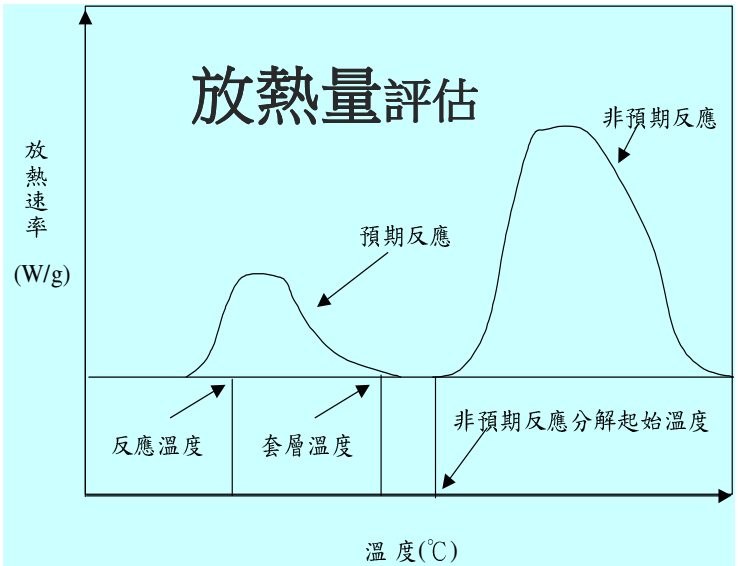

1000
100
10
1
0.1
dT/dt [C/min]
60
80
100
120
140
160
180
200 °C
-1000/T [K-1]

Adiabatic Temperature Rise

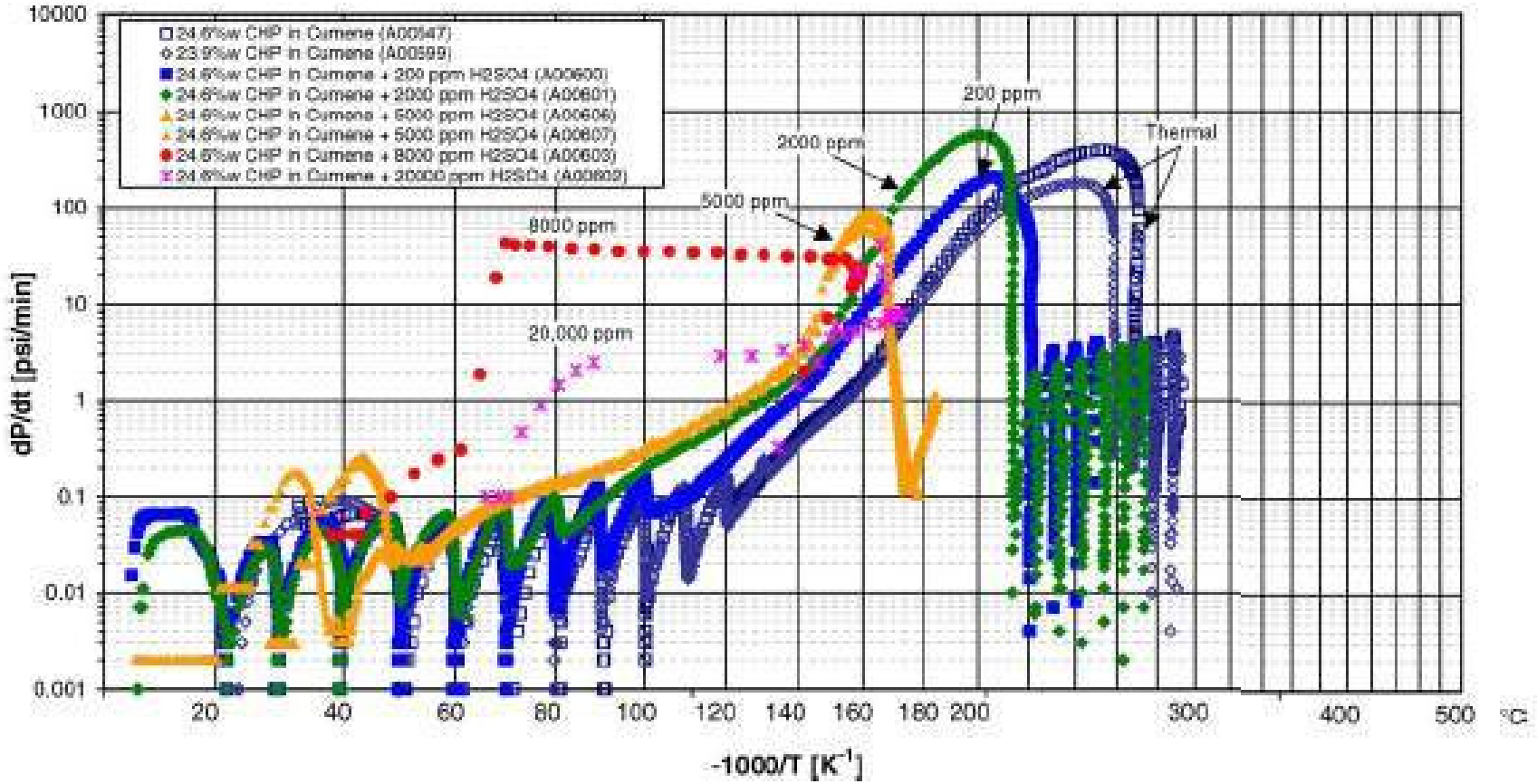


$$\triangle H = mCp\triangle T$$





CHP + H_2SO_4 (VSP測試:升壓速率)



Pressure rate vs. temperature behavior for CHP + acid.
APTAC experiments; in nitrogen