

CONFIDENTIAL

REGISTER OF CASES OF
ANGIOSARCOMA OF THE LIVER (ASL)

Review date : October 1993

Collated by :

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INTRODUCTION

During the late fifties, some lesions such as acro-osteolysis or Raynaud's syndrome, were observed among workers in PVC producing plants, especially autoclave-cleaners (7).

In 1970, P.L. Viola reported the result of his research on the mechanisms of acro-osteolysis in experimental animals, (1-2). Surprisingly, rats exposed by inhalation to 30.000 ppm VCM presented tumours of various organs after 10 months of exposure.

A group of PVC producers (ICI, Montedison, Rhone-Poulenc and Solvay), alarmed by Dr Viola's report, entrusted to Prof. C. Maltoni a study about the carcinogenicity of VCM, in laboratory rodents. In 1974, he published his results, showing evidence of a dose-related incidence of tumours, especially of angiosarcoma of the liver (ASL) (3).

Simultaneously, Creech and Johnson reported three cases of ASL among workers of a PVC plant in USA (4). It was then recognised that ASL was likely to be caused by inhalation of VCM at high levels of concentrations over long periods. ASL is a very rare form of cancer whose annual incidence in the general population is reported to be in the order of 0.25 per million.

According to W. Freiesleben, "these findings initiated an urgent and dramatic worldwide revision of measures for protecting the health of people exposed to VCM. The PVC producing industry changed radically the technology to lower exposure levels" (5). A.W. Barnes, cited by W. Freiesleben, reports the weekly-average of VCM concentration (in ppm VCM in air) in the atmosphere of several polymerisation plants: 25 ppm in mid 74, 13 in late 74, 5 in Spring 75 (6).

At that time, the Vinyl Industry took the decision to maintain a register of the ASL cases linked to VCM, those cases being voluntarily reported by the producing companies, in order to assess the impact of those changes of technology on the occurrence of the ASL cases. Dr J. Stafford (ICI) took the responsibility of that Register until 1987. Dr B. Bennett (ICI) succeeded him until 1990 and Dr J. Drumwright (Vista) ensured the keeping of the Register until 1992.

So far, 173 ASL cases have been recorded in Western Europe, North America, Japan and Australia. There has been no case of ASL recorded in any worker first exposed since the reduction of VCM concentration in the atmosphere, in the mid-seventies. Since the average latency period is about 23 years, a few more cases can be expected during the next years. But it may be hoped that, in the near future, the ASL linked to VCM will become an illness of the past, at least in the plants where the VCM exposure has been drastically reduced.

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PREFACE

In September 1992, Dr J.R. Drumwright, who was in charge of the ASL Register, retired from Vista Chemical, USA. The keeping of the ASL Register was then entrusted to the Medical Working Group of the Vinyl Committee of the Association of Plastics Manufacturers in Europe (APME) in Brussels, Belgium, who passed on the responsibility to me.

1. WHAT IS NEW IN THIS ISSUE OF THE REGISTER?

Substantial changes have been brought to the presentation of the Register. A new software has allowed to produce graphs, making the various data more readable. ISO code which is internationally recognized, has been chosen for the identification of the countries.

The issue of the confidentiality of the medical data has been raised regularly. In order to answer to that legitimate concern, it has been decided, first, to give a code number to the various plants, secondly, to edit two registers. One register, intended for the management, will contain tables and graphs. The second register, which will be sent only to the medical officers, will include also medical data and plants codes. From now on, a yearly update will be edited, depending on the occurrence of new cases.

2. WHAT ABOUT THE ASL CASES?

Concerning the ASL cases, it is confirmed that two cases are still alive: US33 (date of diagnosis, 1982) and US36 (date of diagnosis, 1983). The cases FR15 and FR18, which were alive in 1991, died in the meantime.

Twelve new cases have been reported since the last edition. US48 was diagnosed in 1991 and died in 1992. GB18, GB19, GB20, GB21 were diagnosed and died in 1992. The other cases DE41, DE42, DE43, US44, US45, US46, US47 occurred in previous years. It has to be precised that the diagnosis of ASL of the two US cases which were under review in 1991, has not been confirmed.

All in all, the ASL Register includes 181 files. Along the years, eight cases have been deleted for various reasons (dubious diagnosis, lack of proof of the link to VCM ...): DE14, DE26, IT1, GB2, US14, US15, US24, US25.

Therefore, 173 ASL cases, histologically confirmed, are reported in this 1993 edition of the ASL Register.

3. WHAT DO YOU NEED TO REMEMBER?

To make the reading of the medical data and tables more understandable, two points have to be defined:

- Latency period means, in this context, the number of years from 1st exposure to diagnosis.
- Dates are indicated by day /month/ year. When dates are given in the medical data but day and/or month are unknown, it has been decided to write 15 for the day and 6 for the month.

4. HOW CAN YOU CONTRIBUTE TO THE REGISTER?

Finally, may I request that each recipient of the Register continues to keep me informed of any earlier or new cases, factory data, close-up date, change of owner etc... A blank data sheet is enclosed to assist you in reporting the appropriate information.

I would also appreciate to receive any relevant information about changes of addresses, retirements etc... for the Register mailing list.

I would like to thank all the persons, medical officers or managers, who have contributed to the up-date of that edition of the ASL Register by providing the appropriate information. Thanks to their help, the Register can thereafter be considered as a useful and reliable tool.

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BLANK DATA SHEET

- Initials
- Date of birth
- Company
- Plant (Plt.)
- First VC exposure
- Date at diagnosis
- Age at diagnosis
- Latency period = Years from 1st exposure to diagnosis
- Years of exposure (Yrs of expo.)
- Date of death
- Histological confirmation (Hist. Conf.)
- Comments
 - Estimated exposure level
 - Occupation
 - Additional medical information
 - Source of information

TABLE 1

DISTRIBUTION OF ASL CASES BY YEAR OF DIAGNOSIS

12/10/9.

Year of diagnosis	Number of cases
1955	1
1956	0
1957	1
1958	0
1959	0
1960	0
1961	1
1962	1
1963	0
1964	2
1965	0
1966	0
1967	3
1968	4
1969	2
1970	4
1971	2
1972	4
1973	10
1974	7
1975	11
1976	14
1977	5
1978	9
1979	10

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TABLE 1

DISTRIBUTION OF ASL CASES BY YEAR OF DIAGNOSIS (continued)

12/10/9

Year of diagnosis	Number of cases
1980	8
1981	5
1982	8
1983	11
1984	5
1985	11
1986	5
1987	6
1988	9
1989	7
1990	2
1991	1
1992	4
Total cases	173

FIGURE 1

12/10/93

ASL ALL CASES BY YEAR OF DIAGNOSIS

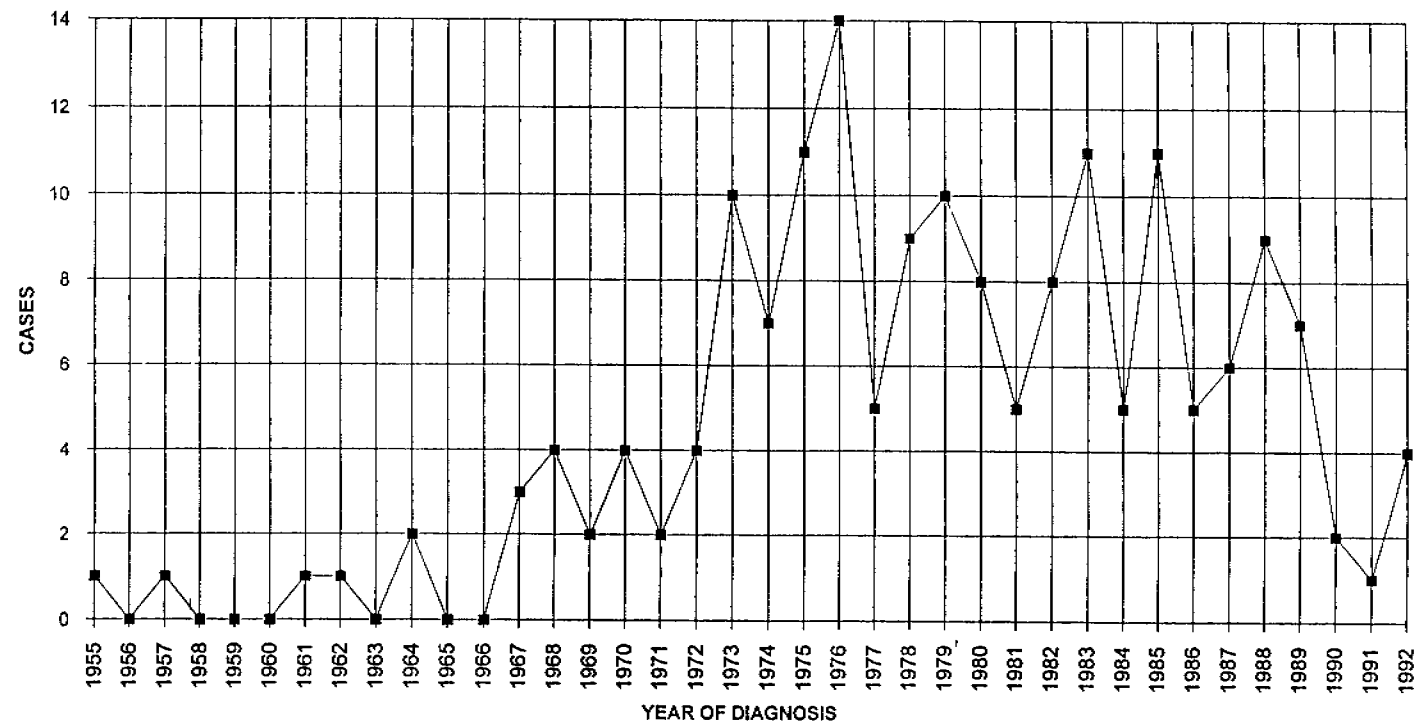


TABLE 2

DISTRIBUTION OF ASL CASES BY REGION

12/10/9

Region	Number of cases
Western Europe	106
North America	57
Eastern Europe	6
Japan	3
Australia	1
Total cases	173

FIGURE 2

12/10/93

ASL CASES FOR NORTH AMERICA AND WESTERN EUROPE

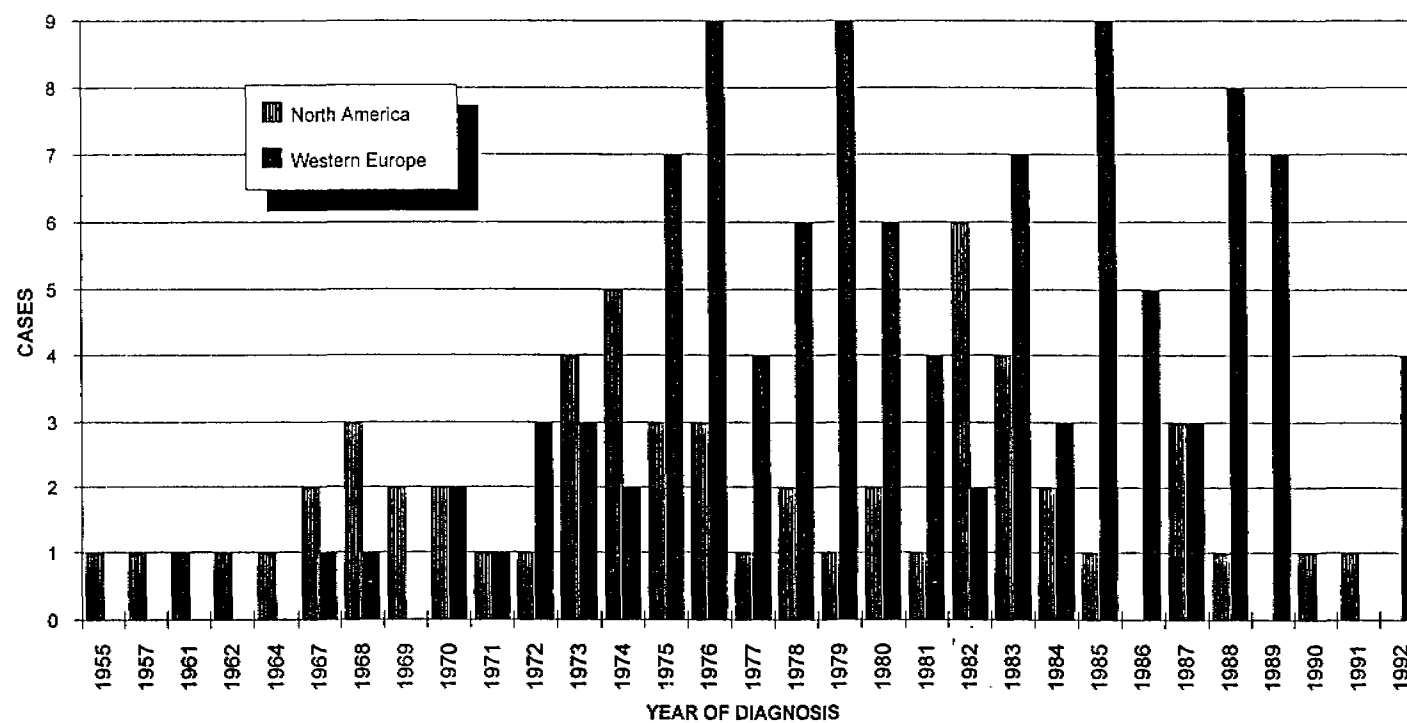


TABLE 3

DISTRIBUTION OF ASL CASES BY COUNTRIES

12/10/9

Country	Number of cases
United States	44
Germany	41
France	28
United Kingdom	20
Canada	13
Italy	8
Sweden	5
Croatia	4
Japan	3
Slovak Republic	2
Belgium	2
Norway	1
Spain	1
Australia	1
Total cases	173

TABLE 4

DISTRIBUTION OF ASL CASES IN PLANTS WITH 3 OR MORE CASES

12/10/9:

Western Europe

Country + Plant Code	Number of cases
Germany [4]	19
United Kingdom [2]	15
Germany [8]	12
France [3]	11
France [2]	8
France [5]	5
United Kingdom [1]	5
Sweden [1]	5
Germany [7]	3
Italy [3]	3
Germany [2]	3
Total cases	89

North America

United States [1]	16
United States [2]	12
Canada [1]	12
United States [3]	6
Total cases	46

Eastern Europe

Croatia [1]	4
Total cases	4

WESTERN EUROPE

There are 44 pre-1970 PVC/VCM plants in Western Europe.
23 had ASL cases.

Of the 106 West European cases, 80 have occurred in clusters in 8 factories.

NORTH AMERICA

There are 48 pre-1970 PVC/VCM plants in North America.
14 had ASL cases.

Of the 57 North American cases, 46 have occurred in clusters in 4 factories.

TABLE 5

DISTRIBUTION OF LATENCY PERIODS (YEARS)

12/10/93

Country	Average and distribution of latency period							Total cases	Average latency period
	0-9	10-14	15-19	20-24	25-29	30-34	35+		
Australia					1			1	25.00
Belgium			2					2	17.50
Canada		3		5	2	1	2	13	24.15
Croatia				4				4	21.25
Germany	1	5	12	10	6	6	1	41	21.66
Spain					1			1	25.00
France		1	4	3	10	3	7	28	28.50
United Kingdom	1		4	2	7	4	2	20	25.30
Italy			3	2	3			8	21.63
Japan			1	2				3	20.00
Norway				1				1	21.00
Sweden			2		2	1		5	24.40
Slovak Republic		1	1					2	15.00
United States		2	8	9	9	6	9	43	25.98
Total	2	12	37	38	41	21	21	172	22.60

Latency period for US 45 is unknown.
That ASL case is not included in the account.

TABLE 6

ASL CASE NUMBERS BY YEAR OF DIAGNOSIS AND GEOGRAPHICAL LOCATION

12/10/93

Year of diagnosis	Western Europe	North America	Other
1955		CA1	
1956			
1957		CA2	
1958			
1959			
1960			
1961		US8	
1962		CA3	
1963			
1964		US5	SK2
1965			
1966			
1967	FR1	CA4 US4	
1968	DE1	CA5 US7 US10	
1969		US12 US16	
1970	DE2 SE1	US2 US11	
1971	NO1	CA6	
1972	GB1 IT2 SE2	CA7	
1973	DE3 DE35 DE5	CA8 US1 US3 US23	CT1 CT2 SK1
1974	DE4 GB3	CA9 US6 US9 US13 US17	
1975	DE6 DE7 DE8 FR2 FR3 FR8 IT3	US18 US19 US26	JP1

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TABLE 6 ASL CASE NUMBERS BY YEAR OF DIAGNOSIS AND GEOGRAPHICAL LOCATION (continued) 12/10/93

Year of diagnosis	Western Europe	North America	Other
1976	BE1 DE9 DE36 FR4 FR5 FR6 FR7 FR9 SE3	CA10 US20 US22	CT3 JP2
1977	DE10 DE11 DE12 SE4	US21	
1978	DE13 DE15 DE16 DE17 FR10 FR11	US27 US28	CT4
1979	BE2 DE18 DE19 DE21 DE23 FR12 FR13 GB4 GB5	US32	
1980	DE20 DE22 DE30 GB6 GB7 SE5	US29 US30	
1981	DE25 FR14 GB8 IT4	US31	
1982	DE24 FR15	CA12 US33 US34 US42 US45 US47	
1983	DE27 DE29 DE33 FR16 FR17 GB9 IT5	US35 US36 US38 US46	
1984	FR18 FR19 GB10	US37 US39	
1985	DE28 DE31 DE32 DE34 DE37 FR20 GB11 GB12 IT6	CA11	JP3
1986	DE39 DE42 FR21 GB13 IT7		
1987	DE40 FR22 GB14	CA13 US40 US41	
1988	DE38 FR23 FR24 FR25 FR26 FR27 GB15 GB16	US43	
1989	DE41 DE43 ES1 FR28 GB17 IT8 IT9		
1990		US44	AU1
1991		US48	
1992	GB18 GB19 GB20 GB21		
	Total for Western Europe: 106	Total for North America: 57	Total for other countries: 10

TABLE 7 ASL CASE NUMBERS BY YEAR OF FIRST EXPOSURE AND GEOGRAPHICAL LOCATION 12/10/93

Year 1st exposure	Western Europe	North America	Other
1941	FR11 FR16	CA3 US27 US46	
1942	FR28	US13 US29 US40	
1943	FR14 FR24	CA2 CA11 US19	
1944	FR23 GB1	CA1 CA5 US5 US7 US28 US35	
1945	SE2	CA4 CA12 US3 US9	
1946	FR1 FR3 SE4	CA7 CA9 US8 US11 US21 US31	
1947	SE3	CA6 US22 US26	
1948	FR9 FR17	US1	
1949	FR4 FR12	US12 US41	
1950	DE43 FR7 GB8 GB9 MO1	US16	CT2 SK2
1951	DE30 FR20 GB5 SE1	US10 US32	
1952	DE3	US4	
1953	DE15 DE31 DE33 DE36 IT3	CA10 US37	CT1 JP1
1954	DE7 DE8 DE19 DE38 FR27 GB4	US18 US33 US48	CT3
1955	DE11 DE16 DE18 DE23 DE27 DE32 DE41 DE42 FR15	US2 US17 US20 US34 US43 US44	
1956	DE1 DE34 FR10 GB15	US36	
1957	DE2 DE4 FR8 GB12 GB19 GB20 IT2	CA13	SK1
1958	BE1 FR6 FR22 IT7	US47 US23	CT4 JP2
1959	FR2 FR19 FR21 GB18 IT4		
1960	DE13 DE25 DE28 DE5 IT6	US39	
1961	DE9 DE10 DE12 DE17 DE20 DE22 IT8	CA8	

TABLE 7 ASL CASE NUMBERS BY YEAR OF FIRST EXPOSURE AND GEOGRAPHICAL LOCATION (continued) 12/10/93

Year 1st exposure	Western Europe	North America	Other
1962	BE2 DE6 DE21 DE29 FR25 GB6	US6	
1963	FR13 FR18 FR26 GB7 GB16 GB17	US38	
1964	ES1 SE5	US30	
1965	FR6 GB11 GB21		AU1 JP3
1966	GB3 GB10 GB14		
1967	IT5		
1968	DE35 DE39 DE40 GB13	US42	
1969	DE24 DE37		
1970			
1971			
1972	IT9		
	Total for Western Europe: 106	Total for North America: 56	Total for other countries: 10

Date of 1st exposure for US 45 is unknown.
That ASL case is not included in the account.

TABLE 8 LATENCY PERIOD OF ASL CASES TABULATED BY YEAR OF FIRST EXPOSURE FOR PLANTS WITH 10 OR MORE CASES 12/10/93

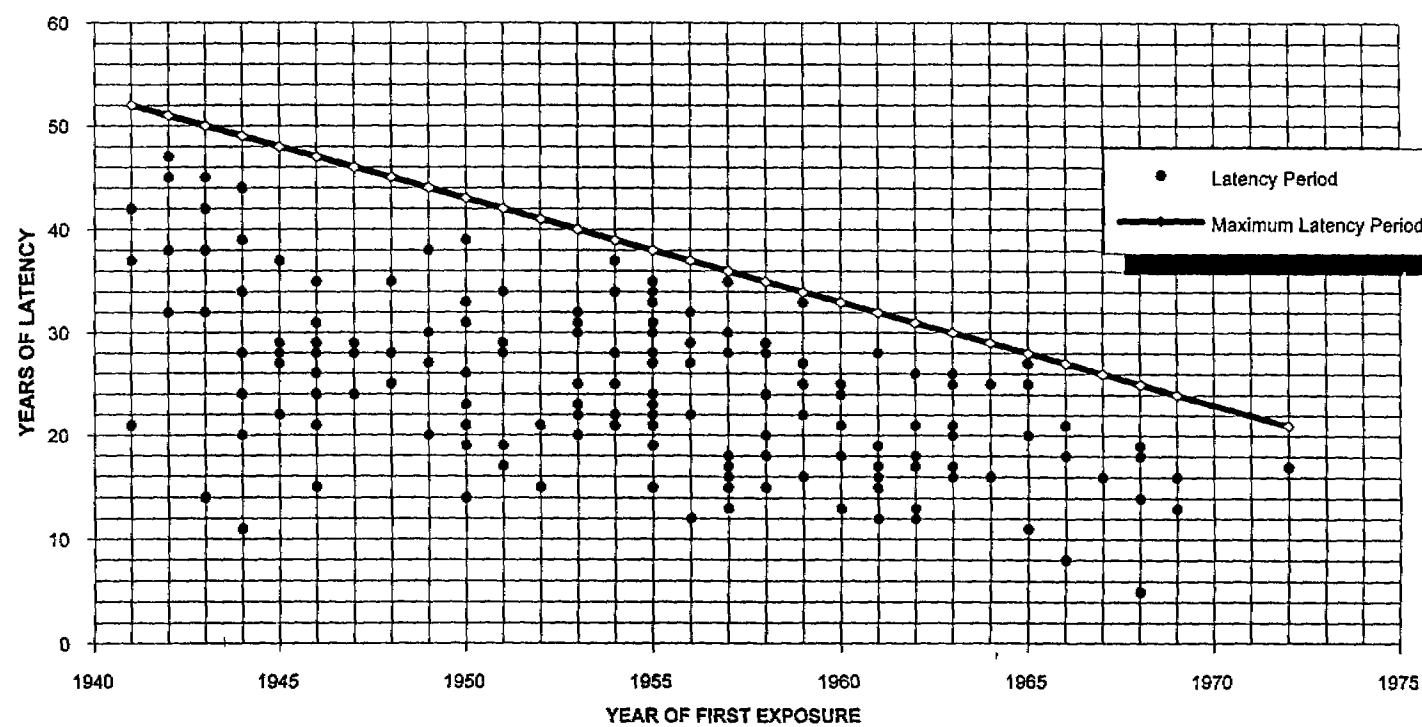
Year 1st exposure	Germany [4]	United Kingdom [2]	Germany [8]	France [3]	United States [1]	United States [2]
1941				37 42		42 37
1942				47	45	38 32
1943				38		32
1944				44	20	24 39 34
1945					29 28	
1946				29		35 31
1947					29 28	
1948				28 35	25	
1949						
1950		33 31	39		19	
1951	29	28				
1952					15	
1953	23		32 30 25		31	
1954	34 21,25		21	34	37 28	
1955	23 28		24 30 31 22	27	27 19 15	
1956	29 12	32		22		
1957	13	35 35	17			
1958						24
1959		33				
1960			21			

TABLE 8 LATENCY PERIOD OF ASL CASES TABULATED BY YEAR OF FIRST EXPOSURE FOR PLANTS WITH 10 OR MORE CASES (continued) 12/10/93

Year 1st exposure	Germany [4]	United Kingdom [2]	Germany [8]	France [3]	United States [1]	United States [2]
1961	19 16 19 17					
1962	17	18			12	
1963		17				
1964						
1965		27 20				
1966		8 18 21				
1967						
1968	5 18 19	18				
1969	16		13			
1970						
1971						
1972						
1973						
	Total cases: 19 Average : 20.16	Total cases: 15 Average : 24.93	Total cases: 12 Average : 25.42	Total cases: 11 Average : 34.82	Total cases: 16 Average : 25.44	Total cases: 12 Average : 30.67

12/10/93

LATENCY PERIOD OF ASL CASES FOR ALL COUNTRIES



12/10/93

LATENCY PERIOD OF ASL CASES FOR WESTERN EUROPE

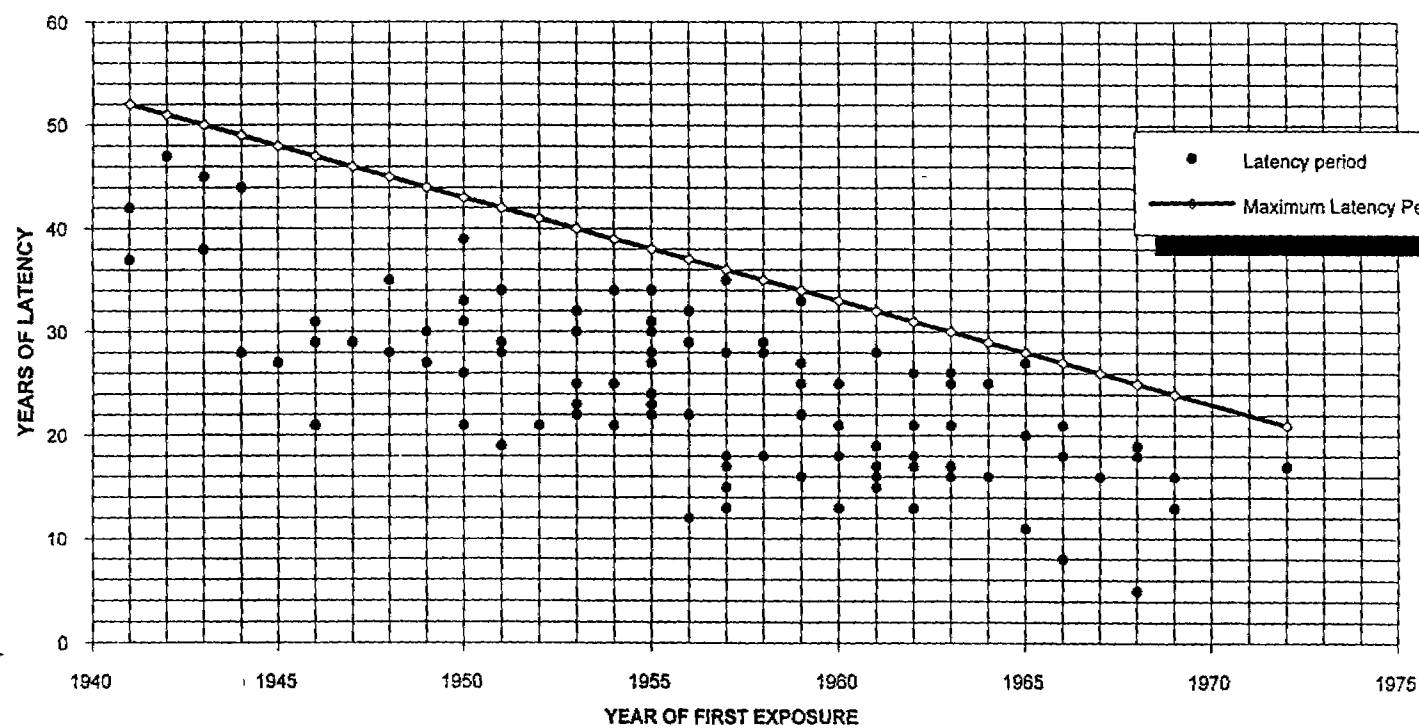
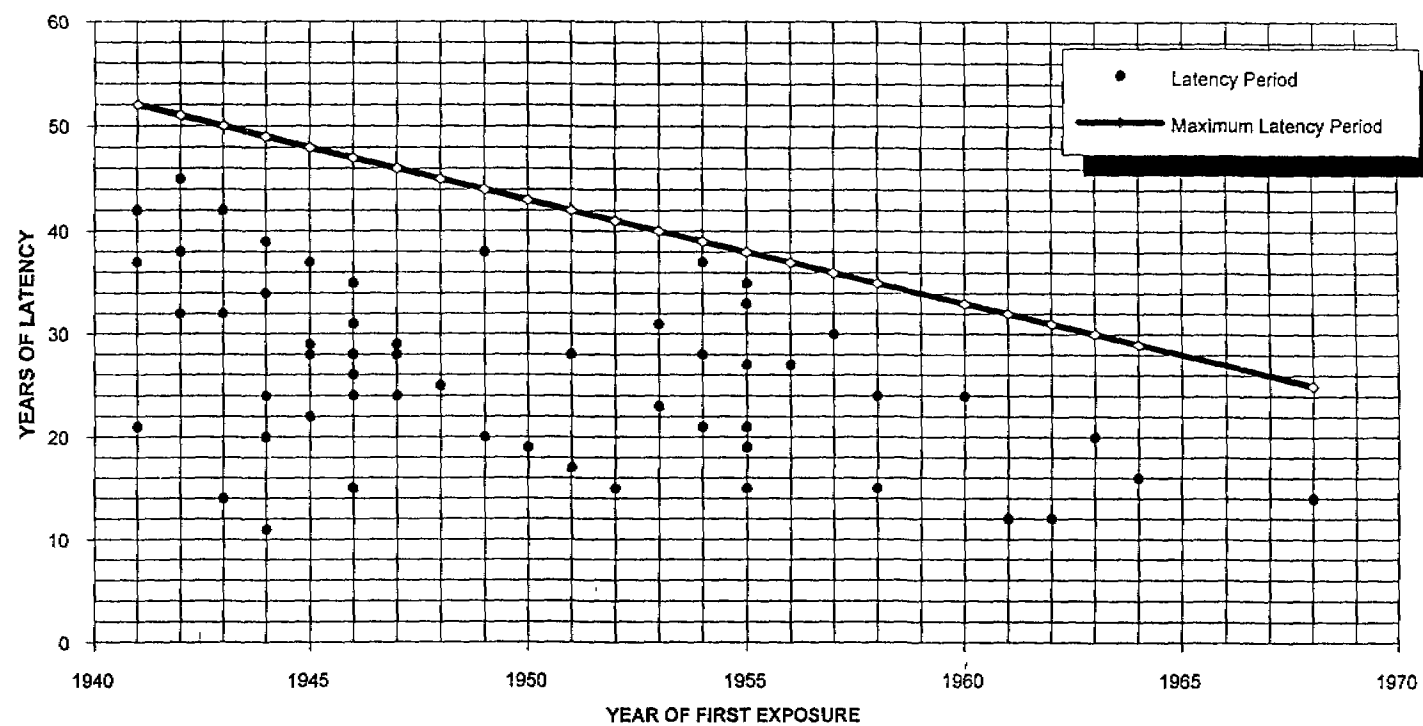


FIGURE 6

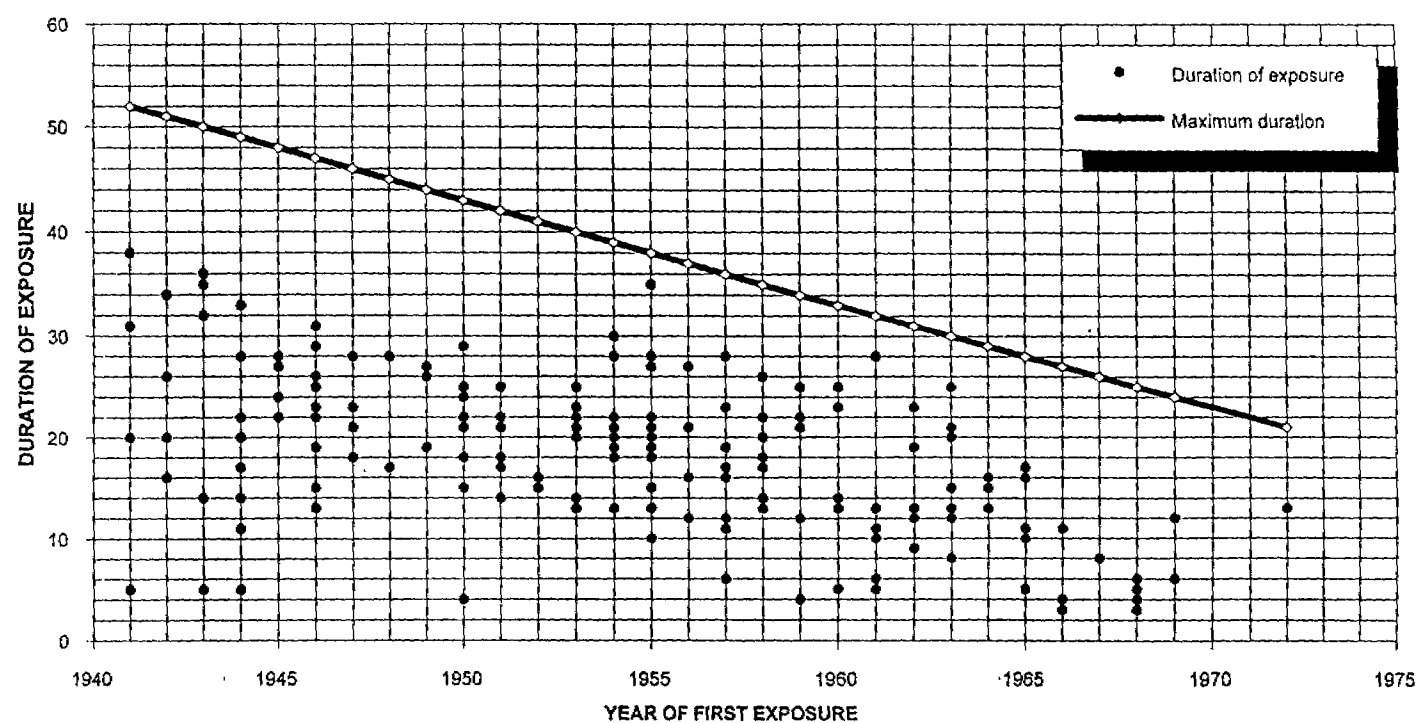
12/10/93

LATENCY PERIOD OF ASL CASES FOR NORTH AMERICA



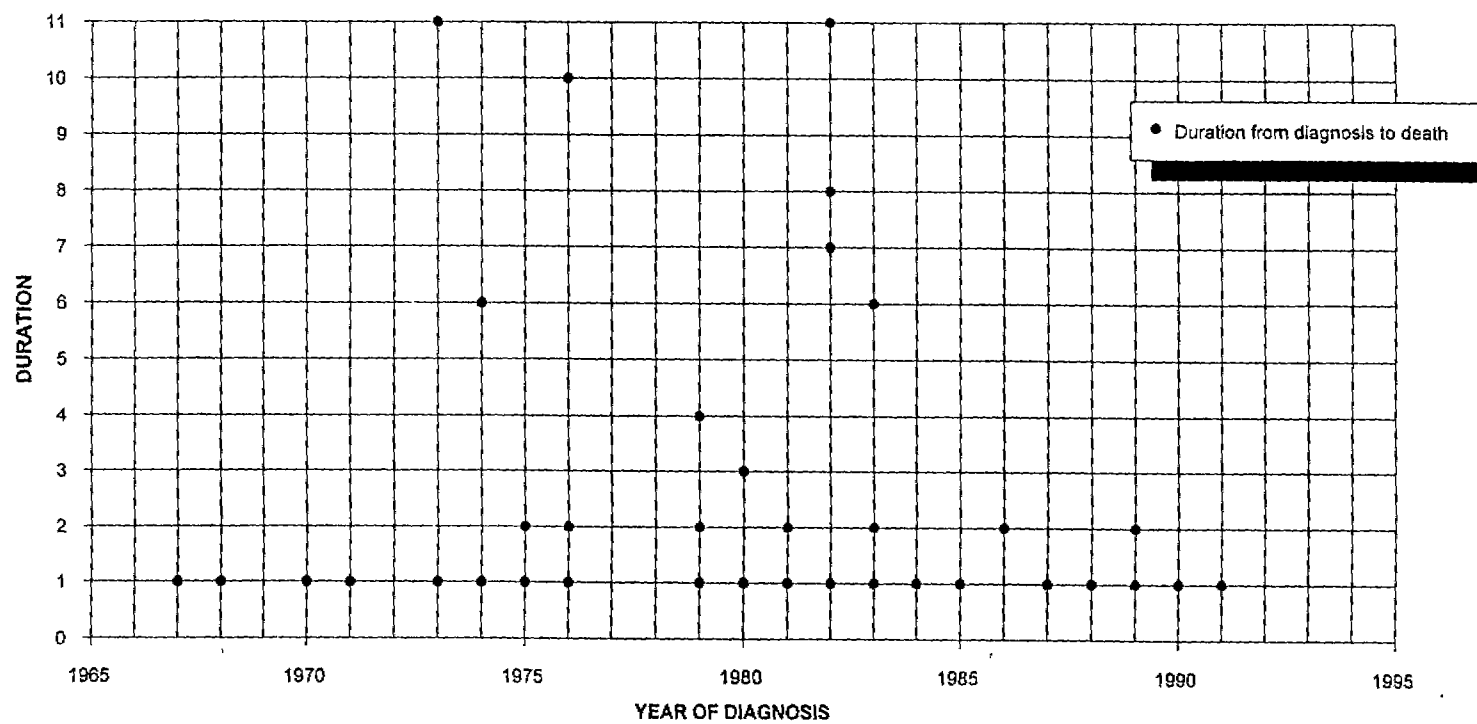
12/10/93

DURATION OF EXPOSURE OF ASL CASES FOR ALL COUNTRIES



12/10/93

DURATION FROM DIAGNOSIS TO DEATH FOR ALL COUNTRIES (if $\geq$ one year)



Year of diagnosis	ISO code	Case number	Duration
1967	CA	4	1
1967	US	4	1
1968	DE	1	1
1970	US	2	1
1970	DE	2	1
1971	NO	1	1
1973	DE	5	1
1973	DE	35	11
1974	US	6	1
1974	US	9	1
1974	US	17	6
1975	US	19	1
1975	FR	8	2
1976	FR	9	1
1976	CA	10	1
1976	DE	9	2
1976	DE	36	10
1979	US	32	1
1979	DE	19	1
1979	DE	21	1
1979	DE	23	2
1979	BE	2	4
1980	DE	22	1
1980	DE	30	3
1981	US	31	1

Year of diagnosis	ISO code	Case number	Duration
1981	DE	25	2
1982	DE	24	1
1982	US	34	1
1982	US	45	7
1982	US	47	8
1982	FR	15	11
1983	DE	27	1
1983	DE	29	1
1983	DE	33	2
1983	US	46	6
1984	FR	19	1
1985	DE	32	1
1985	CA	11	1
1985	DE	31	1
1985	DE	37	1
1985	IT	6	1
1986	DE	42	2
1987	DE	40	1
1987	GB	14	1
1987	FR	22	1
1988	FR	23	1
1988	FR	27	1
1988	US	43	1
1989	FR	28	1
1989	DE	43	2

COMPLEMENT TO FIGURE 7

DURATION FROM DIAGNOSIS TO DEATH FOR ALL COUNTRIES (if >=one year) (continued) 12/10/9

Year of diagnosis	ISO code	Case number	Duration
1990	US	44	1
1991	US	48	1

FIGURE 8

12/10/93

AGE AT DIAGNOSIS OF ASL CASES FOR ALL COUNTRIES

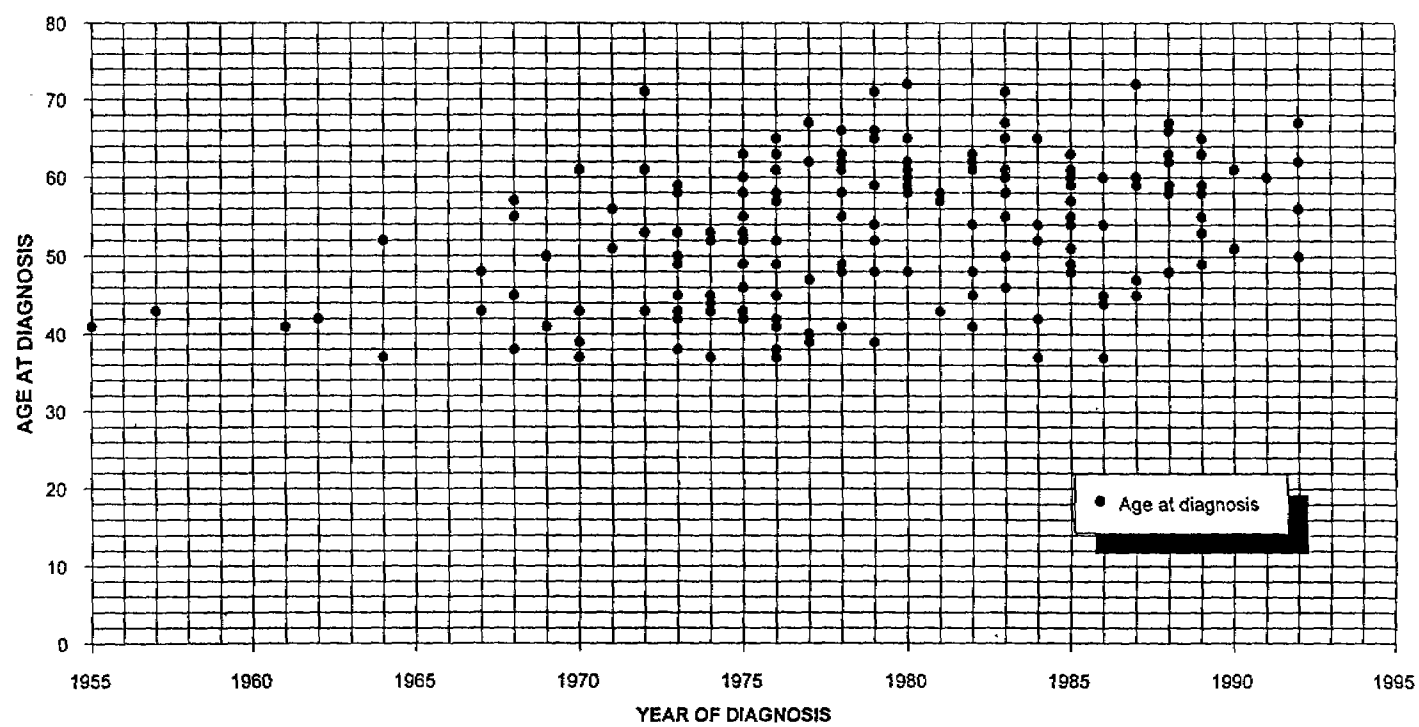


TABLE 9

Western Europe

PVC/VCM PRODUCERS

12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1931	DE	BASF	Ludwigshafen	
1933	DE	WACKER	Burghausen	
1935	DE	TREUHAND	Schkopau	
1938	IT	MONTECATINI (closed)	Acna	
1939	FR	RHONE-POULENC/ELF-ATOCHM	St Fons	
1940	GB	ICI/EVC	Hillhouse	
1940	GB	ICI/EVC (closed 1948 - restarted 1970)	Runcorn	
1945	SE	KEMANORD	Sundsvall	1988
1946	FR	RHONE-POULENC	Roussillon	1987
1948	GB	BP/EVC	Barry	
1948	DE	CWH/HÜLS	Marl	
1949	BE	SOLVAY	Jemeppe	
1950	FR	PEUK/ELF-ATOCHM	Brignoud	
1950	FR	RHONE-POULENC/ELF-ATOCHM	St Auban	
1950	NL	SHELL/ROVIN	Pernis	
1950	NO	NORSK	Heroya	
1951	DE	DYNAMIT/HÜLS	Troisdorf	1975
1951	CH	LONZA/EVC	Sins	
1952	IT	MONTEDISON/EVC	Porto Marghera	
1952	IT	MOPLFAN (closed)	Terni	
1953	FR	SOLVAY	Tavaux	
1953	IT	SOLVAY	Ferrara	
1953	DE	HOECHST	Gendorf	
1953	ES	RIO RODANO/ELF-ATOCHM	Hernani	
1953	GB	NORSK	Aycliffe	
1953	AT	HALVIC/SOLVAY	Hallein	
1955	DE	DYNAMIT/HÜLS	Rheinfelden	
1955	ES	MONSANTO IBERIA/AISCONDEL	Monzon	
1955	DE	STATE COMPANY	Bitterfeldt	
1955	DE	HOECHST	Frankfurt	1968
1956	ES	HISPAVIC/SOLVAY	Torrelavega	1983
1958	DE	SOLVAY	Rheinberg	
1960	IT	ANIC/EVC	Ravenna	
1960	DE	LONZA/ICI/EVC	Waldshut	1990
1960	SE	KEMANORD/NORSK	Stenungsund	
1961	PT	CIRES	Estarreja	

TABLE 9 Western Europe PVC/VCM PRODUCERS (continued) 12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1963	IT	EVC	Brindisi	
1965	FR	RHONE-POULENC closed	Montluçon	
1965	IT	PANSAC	Mira-Venice	
1965	IT	POZZI	Ferrandina	
1965	DE	WACKER	Köln	
1966	DE	HOECHST	Knapsack	
1967	FR	ATOCHM/ELF-ATOCHM	Balan	
1967	ES	RIO RODANO/ELF-ATOCHM	Miranda De Ebro	
1967	GR	ESSO PAPPAS/EKO	Thessaloniki	
1968	BE	BADIPHIL/BASF	Antwerp	
1969	IT	RUMANICA/EVC	Cagliari	
1969	IT	SIR/EVC	Porto Torres	
1969	GB	NORSK	Staveley	1986
1970	NL	ROVIN	Botlek	
1971	ES	HISPAVIC/SOLVAY	Martorell I	
1971	GB	BP	Baglan Bay	1982
1972	FI	PEKEMA/NESTE	Svartbach/Kulloo	
1972	NL	DSM/LVM	Beek Geleen	
1972	ES	VINICLOR/SOLVAY	Martorell II	
1972	BE	LVM	Tessenderlo	
1976	FR	CDF/LVM	Mazingarbe	
1976	ES	MONSANTO IBERIA/ATSCONDEL	Tarragona	
1978	NO	NORSK	Rafnes	
1980	DE	ICI/EVC	Wilhelmshaven	
1981	FR	ELF-ATOCHM/VINYLFOS	Fos-sur-Mer	
1981	FR	SHELL	Berre	
1983	FR	ELF-ATOCHM	Lavera	

TABLE 10

Eastern Europe

PVC/VCM PRODUCERS

12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1941	SU	STATE COMPANY	Vladimir	
1950	CT	JUGO VINIL	Split	
1951	SK	STATE COMPANY	Novaky	
1956	RO	STATE COMPANY	Icechim	
1957	RO	STATE COMPANY	Tirnaveni Turda	
1957	PL	STATE COMPANY	Oswiecim Dwory	
1958	RO	STATE COMPANY	Risnov	
1959	HU	STATE COMPANY	Borsodchem	
1961	RO	STATE COMPANY	Borzesti	
1963	CT	OHIS	Skopje	
1965	BG	STATE COMPANY	Varna	
1967	PL	STATE COMPANY	Tarnow	
1969	SU	STATE COMPANY	Djerjinsk	
1970	SU	STATE COMPANY	Volgograd	
1970	RO	STATE COMPANY	Rimnicu Vilcea	
1972	CT	VINILPLASTIKA	Zadar	
1975	CS	STATE COMPANY	Neratovice	
1975	SU	STATE COMPANY	Kalush Area	
1976	CT	HIP	Pancevo	
1977	RO	STATE COMPANY	Rimnicu Vilcea 2	

TABLE 11

North America

PVC/VCM PRODUCERS

12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1939	US	UNION CARBIDE	S Charleston	1979
1942	US	BF GOODRICH	Louisville	
1943	CA	CANADIAN RESINS/SHAWINIGAN/GULF/GOODRICH	Shawinigan	1993
1946	US	UNION CARBIDE	Texas City	
1947	US	GOODYEAR	Niagara Falls	
1948	US	FIRESTONE/OCCIDENTAL	Pottstown	
1948	US	UNIROYAL	Painesville	1975
1948	US	DOW	Freeport	1982
1950	US	MONSANTO	Springfield	1975
1951	US	BF GOODRICH	Avon Lake	
1951	CA	MONSANTO	La Salle	1975
1952	US	DOW	Midland	1975
1953	US	DIAMOND SHAMROCK/BF GOODRICH	Deer Park	
1953	US	BF GOODRICH	Calvert City	
1954	US	GEN. TIRE/DIVERSITECH(c7.83)/VYGEN(op.86)	Ashtabula	
1956	US	GREAT AMERICAN PLASTICS	Fitchburg	1983
1956	US	PANTASOTE	Passaic	1984
1956	US	AIR PRODUCTS/WESTLAKE	Pensacola	
1956	US	BORDEN	Leominster	1984
1956	US	CONOCO	Hebronville	1975
1956	US	HOOKER	Hicksville	1980
1957	CA	GOODRICH	Niagara Falls	
1957	US	TENNECO/OCCIDENTAL	Flemington	1985
1958	US	AIR PRODUCTS/WESTLAKE	Calvert City	
1958	US	KEYSOR CORPORATION	Saugus	
1960	US	BF GOODRICH	Long Beach	
1960	US	BORDEN	Illioopolis	
1960	CA	DOW	Sarnia	1993
1962	US	TENNECO/OCCIDENTAL	Burlington NJ	
1963	US	CONOCO/VISTA	Aberdeen Miss.	
1963	US	STAUFFER	Long Beach	1982
1965	US	CONOCO/OLIN	Assmet	1975
1965	US	ETHYL	Baton Rouge	1984
1966	CA	ESSO IMPERAIL OIL/EXXON	Sarnia	
1966	US	DIAMOND/GEORGIA GULF	Delaware City	
1966	US	GEN. TIRE/PANTASOTE	Mt Pleasant	1982

TABLE 11

North America

PVC/VCM PRODUCERS (continued)

12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1966	US	BF GOODRICH	Henry III.	
1966	US	STAUFFER/FORMOSA	Delaware City	
1967	US	ALLIED/ROBINTEC/GEORGIA PACIFIC	Painesville	
1967	US	PPG	Lake Charles	
1968	US	FIRESTONE/OCCIDENTAL	Perryville	1982
1968	US	GOODYEAR/BF GOODRICH	Plaquemine	
1968	US	FORMOSA PLASTICS	Baton Rouge I	
1969	US	GEORGIA GULF	Tiptonville	
1969	US	DOW	Oyster Creek	
1969	US	SHELL	Deer Park	
1970	US	BF GOODRICH	Pedricktown	
1971	US	CONOCO/VISTA	Oklahoma City	
1972	US	NAT. STARCH (closed)	Meredosia III.	
1973	US	BORDEN	Springfield	
1974	US	ATLANTIC TUBING/TALLYRAND	Cranston	1982
1974	US	SHINTECH	Freeport	
1975	US	CERTAIN-TEED	Lake Charles	
1975	US	GEORGIA PACIFIC/GEORGIA GULF	Plaquemine	
1975	US	TENNECO/OCCIDENTAL	Passadena	
1977	US	DOW	Plaquemine II	
1978	US	BF GOODRICH	La Porte	
1979	CA	DIAMOND SHAMROCK /BF GOODRICH	Fort Saskatchewan	
1979	US	FIRESTONE/OCCIDENTAL	Addis	
1979	CA	DOW	Fort Saskatchewan	
1980	US	GEORGIA GULF	Gallman	
1983	US	FORMOSA	Point Comfort	
1984	US	BF GOODRICH	Terra Haute	
1992	US	FORMOSA PLASTICS	Baton Rouge II	

TABLE 12 Japan PVC/VCM PRODUCERS 12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1949	JP	CHISSO CORP	Minamata	
1950	JP	KANEGAFUCHI	Osaka	
1950	JP	TEKKOSHA/TOHOKU TOSOH	Sakata	
1951	JP	mitsui toatsu	Nagoya	1985
1951	JP	DENKI KAGAKU KOGYO/CO DENKI	Shibukawa	
1951	JP	NIPPON CARBIDE	Uozu	1972
1951	JP	NIPPON ZEON	Kambara	1967
1951	JP	SUMITOMO CHEM. (closed)	Ehime	
1952	JP	mitsubishi monsanto / mitsubishi vinyl	Yokkaichi	
1953	JP	TOAGOSEI CHEM.	Nagoya	1960
1956	JP	NISSHIN CHEM.	Takefu	
1956	JP	KUREHA CHEM./KUREHA KAGAKU	Nishiki	
1956	JP	NIPPON ZEON	Takaoka	
1957	JP	SHIN-ETSU CHEM.	Naoetsu	1973
1959	JP	NIPPON CARBIDE	Hayatsuki	
1960	JP	DENKI KAGAKU KOGYO/CO DENKI	Ohmi	1992
1960	JP	KANEGAFUCHI	Takasago	
1961	JP	TOAGOSEI	Tokushima	
1963	JP	CHISSO CORP. (closed)	GoI	
1966	JP	TOKUAYAMA SEKISUI	Nanyo	
1967	JP	SUN ARROW	Tokuyama	
1967	JP	SUMITOMO CHEM.	Chiba	
1968	JP	NIKKA CHEM./mitsubishi vinyl	Mizushima	
1968	JP	SHIN-ETSU CHEM.	Nanyo	1988
1969	JP	NIPPON ZEON	Mizushima	
1970	JP	CHISSO CORP.	Mizushima	
1970	JP	DENKI KAGAKU KOGYO/CO DENKI	Chiba	
1970	JP	KANEGAFUCHI	Kashima	
1970	JP	KAWASAKI YUKI.	Kawasaki	
1970	JP	mitsui toatsu chem.	Osaka	
1970	JP	SHIN-ETSU CHEM.	Kashima	
1970	JP	TEKKOSHA/TOSOH CORP.	Yokkaichi	
1971	JP	NISSAN CHEM/NISSAN KAGAKU	Chiba	1989
1981	JP	TOSOH CORP.	Nanyo	

TABLE 13	Australia	PVC/VCM PRODUCERS	12/10/93
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Start-up year	ISO code	Company name	Plant Location	Close-up year
1955	AU	ICI AUSTRALIA	Botany Sydney	
1960	AU	BF GOODRICH	Melbourne	
1979	AU	ICI AUSTRALIA	Laverton	

TABLE 14

Central and South America PVC/VCM PRODUCERS

12/10/93

Start-up year	ISO code	Company name	Plant Location	Close-up year
1953	MX	MONSANTO MEXICO	Lecheria	
1954	MX	POLICYD	Mexico	
1955	BR	GEON DO BRAZIL	Sao Paulo	
1956	BR	ELCLOR/SOLVAY	Santo Andre	
1960	AR	ELECTROCHLOR	Capitan Bermudez	
1960	AR	VIPLASTIC	Mendoza	
1961	AR	INDUPA	Cinco Saltos	
1965	CO	PET COLUMBIANA	Cartagena	
1966	CO	CARBURU DE COL	Medellin	
1967	MX	PLASTICOS OMEGA	Mexico	
1967	PE	SOC PARAMONGA	Paramonga	
1968	MX	PRIMEX	Puebla	
1970	NI	POLICASA	Managua	
1970	CL	PETRO DOW	Concepcion	
1971	MX	POLIMEROS MEX	St Martin Puebla	
1972	BR	BRASIL/SOLVAY	Santo Andre	
1975	PR	RICO CHEMICALS	Guyanilla	
1976	VE	PETROPLAS	El Tablazo	
1977	MX	INDUST. RESISTOC	Tlaxcala	
1978	MX	POLICYD	Coatzacoalcos	
1978	BR	HÜLS/BRAZIL	Cubato	
1978	SV	POLYCHEM	El Salvador	
1979	BR	PET CAMACARI	Camacari Bahia	

TABLE 15	Middle East	PVC/VCM PRODUCERS	12/10/93
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Start-up year	ISO code	Company name	Plant Location	Close-up year
1986	SV	NATIONAL PLASTIC	Al-Jubail	

TABLE 16

PRESENT WEST EUROPEAN PVC/VCM PRODUCERS AND PLANTS LOCATION

<u>COMPANY</u>	<u>PLANT</u>		<u>START-UP-YEAR</u>	
AISCONDEL	ES	MONZON	PVC/VCM	1955
	ES	TARRAGONA	PVC/VCM	1976
BASF	BE	ANTWERP	PVC/VCM	1968
	DE	LUDWIGSHAFEN	PVC/VCM	1931
	DE	SCHWARZHEIDE		
CIRES	PT	ESTARREJA	PVC	1961
EKO	GR	THESSALONIKI	PVC	1967
ELF-ATOCHEM	FR	BALAN	PVC	1967
	FR	BRIGNOUD	PVC	1950
	FR	SAINT AUBAN	PVC/VCM	1950
	FR	SAINT FONS	PVC	1939
	ES	HERNANI	PVC	1953
	ES	MIRANDA	PVC	1967
	FR	LAVERA	VCM	1983
EVC	DE	WALDSHUT	PVC	1960
				closed 1990
	DE	WILHELMSHAVEN	PVC/VCM	1980
	IT	BRINDISI	PVC	1963
			VCM	1969
	IT	CAGLIARI	PVC/VCM	1969
	IT	PORTO MARGHERA	PVC/VCM	1952
	IT	PORTO TORRES	VCM	1969
			PVC	1970
	IT	RAVENNA	PVC/VCM	1960
	CH	SINS	PVC	1951
	GB	BARRY	PVC	1948
	GB	HILLHOUSE	PVC/VCM	1940
	GB	RUNCORN	PVC/VCM	1970
HOECHST	DE	GENDORF	PVC/VCM	1953
	DE	KNAPSACK	PVC/VCM	1966
HÜLS	DE	MARL	PVC/VCM	1948

TABLE 16

INDUSTRIE GENERALE	IT	SAMARATE	PVC	
L.V.M.	FR	MAZINGARBE	PVC	1976
	NL	BEEK GELEN	PVC	1972
	BE	TESSENDERLO	VCM	1972
NESTE	FI	KULLOO	PVC	1972
NORSK	NO	HEROYA	PVC	1950
	SE	STENUNGSUND	PVC/VCM	1960
	GB	AYCLIFFE	PVC	1953
	NO	RAFNES	VCM	1978
ROVIN	NL	PERNIS	PVC	1950
	NL	BOTLEK	VCM	1970
SHELL	FR	BERRE	PVC	1981
SOLVAY	AT	HALLEIN	PVC	1953
	BE	JEMEPPE	PVC/VCM	1949
	FR	TAVAU	PVC/VCM	1953
	DE	RHEINBERG	PVC/VCM	1958
	IT	FERRARA	PVC	1953
	ES	MARTORELL	PVC	1971
	ES	MARTORELL/ VINICLOR	VCM	1972
TREUHAND	DE	SCHKOPAU	PVC/VCM	1935
VINYLFOS/ ELF-ATOCHEM	FR	FOS-SUR-MER	VCM	1981
WACKER	DE	KÖLN	PVC	1965
	DE	BURGHAUSEN	PVC/VCM	1933

TABLE 17

PRESENT NORTH AMERICAN PVC/VCM PRODUCERS AND PLANTS LOCATION

<u>COMPANY</u>	<u>PLANT</u>		<u>START-UP-YEAR</u>
AIR PRODUCTS (WESTLAKE)	US CALVERT CITY	PVC	1958
	US PENSACOLA	PVC	1956
BORDEN	US GEISMAR	PVC/VCM	.
	US ILLIOPOLIS	PVC	1960
	US SPRINGFIELD	PVC	1973
CERTAIN TEED	US LAKE CHARLES	PVC	1975
DOW	CA FORT SASKATCHEWAN	VCM	1979
	CA SARNIA	VCM	1960
			closed 1993
	US OYSTER CREEK	VCM	1969
	US PLAQUEMINE II	VCM	1977
EXXON	CA SARNIA	PVC	1966
FORMOSA PLASTICS	US BATON ROUGE I	VCM	1968
	" " II	VCM	1992
	US DELAWARE CITY	PVC	1966
	US POINT COMFORT	PVC/VCM	1983
GEORGIA GULF	US DELAWARE CITY	PVC	1966
	US TIPTONVILLE	PVC	1969
	US PLAQUEMINE	PVC/VCM	1975
	US GALLMAN	PVC	1980
GOODRICH/ GEON COMPANY	CA SHAWINIGAN	PVC	1943
			closed 1993
	CA NIAGARA FALLS	PVC	1957
	CA FORT SASKATCHEWAN	PVC	1979
	US AVON LAKE	PVC	1952
	US DEER PARK	PVC/VCM	1953
	US LA PORTE	PVC	1978
	US LONG BEACH	PVC	1960
	US HENRY	PVC	1966
	US LOUISVILLE	PVC	1940

TABLE 17

GOODRICH (cont.)	US PEDRICKTOWN	PVC	1969
	US PLAQUEMINE	PVC	1969
	US TERRA HAUTE	PVC	1984
GOODYEAR	US NIAGARA FALLS	PVC	1947
KEYSOR CORP.	US SAUGUS	PVC	1958
OCCIDENTAL	US ADDIS	PVC	1979
	US BURLINGTON	PVC	1962
	US CORPUS CHRISTIE	VCM	1990
	US DEER PARK	VCM	1969
	US PASADENA	PVC	1975
	US POTTSTOWN	PVC	1948
PPG	US LAKE CHARLES	VCM	1967
SHINTECH	US FREEPORT	PVC	1974
UNION CARBIDE	US TEXAS CITY	PVC	1946
VISTA	US ABERDEEN	PVC	1963
	US LAKE CHARLES	VCM	
	US OKLAHOMA	PVC	1971
VYGEN	US ASHTABULA	PVC	1986
WESTLAKE	US CALVERT CITY	PVC/VCM	1958
	US PENSACOLA	PVC	1956

TABLE 18

PRESENT JAPANESE PVC/VCM PRODUCERS WITH PLANTS LOCATION

<u>COMPANY</u>	<u>PLANT</u>		<u>START-UP-YEAR</u>
CHIBA VCM	JP CHIBA	VCM	
CHISSO CORP.	JP CHIBA	PVC	
	JP MINAMATA	PVC	1949
	JP MIZUSHIMA	PVC	1970
CHUO PVC SALES CO ASAHI G	JP HAYATSUKI	PVC	1959
			closed 1988
DENKI KAGACU	JP OHMI	VCM	1960 closed 1990
DAI-TCHI PVC	JP CHIBA	PVC	1992
FIRST PVC SALES CO NIPPON	JP MIZUSHIMA	PVC	1969
	JP TAKAOKA	PVC	1956
JAPAN PVC SALES CO DENKI	JP CHIBA	PVC	1970
	JP OHMI	PVC	1960
	JP SHINBUKAWA	PVC	closed 1992 1951
KANEGAFUCHI	JP KASHIMA	PVC	1970
	JP OSAKA	PVC	1950
	JP TAKASAGO	PVC/VCM	1960
KUREHA KAGAKU	JP NISHIKI	PVC	1956
KYODO PVC SALES CO CENTRE	JP KAWASAKI	PVC	1970
MITSUBISHI VINYL	JP MIZUSHIMA	PVC	1968
	JP YOKKAICHI	PVC	1952
MITSUI TOATSU	JP SENBOKU	PVC/VCM	
	JP NAGOYA	VCM	1951
NISSAN KAGAKU	JP CHIBA	PVC/VCM	1971
		VCM	closed 1988

TABLE 18

RYONICHI	JP MIZUSHIMA	VCM	
SANYO MONOMER	JP MIZUSHIMA	VCM	
SHIN ETSU	JP KASHIMA	PVC/VCM	1970
	JP TOKUYAMA	PVC	
	JP KAWASAKI	VCM	
SUMITOMO	JP CHIBA	PVC	1967
	JP KIKUMOTO	PVC/VCM	
SUN ARROW	JP TOKUYAMA	PVC/VCM	1967
TOA GOSEI	JP TOKUSHIMA	PVC	1961
TOKUYAMA SEKISUI	JP TOKUYAMA	PVC	
TOYO SODA	JP NANYO	PVC/VCM	
	JP YOKKAICHI	PVC/VCM	

ISO code	Country
AF	Afghanistan
AL	Albania
AR	Argentina
AT	Austria
AU	Australia
BE	Belgium
BG	Bulgaria
BO	Bolivia
BR	Brazil
CA	Canada
CH	Swiss
CI	China
CL	Chile
CO	Colombia
CS	Czech Republic
CT	Croatia
DE	Germany
DK	Denmark
EG	Egypt
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
GR	Greece
HK	Hong Kong
HU	Hungary
ID	Indonesia
IE	Ireland
IL	Israel
IN	India
IQ	Iraq
IR	Iran
IS	Iceland
IT	Italy
JO	Jordan
JP	Japan

ISO code	Country
KP	North Korea
KR	South Korea
KW	Kuwait
LB	Liban
LU	Luxemburg
MX	Mexico
NI	Nicaragua
NL	Holland
NO	Norway
NZ	New Zealand
PE	Peru
PH	Philippines
PL	Poland
PR	Puerto Rico
PT	Portugal
RO	Rumania
SA	Arabie Saoudite
SE	Sweden
SG	Singapour
SK	Slovak Republic
SU	Russia
SV	Salvador
SY	Syria
TH	Thailand
TR	Turkey
TW	Taiwan
US	United States
UY	Uruguay
VE	Venezuela
ZA	South Africa