

## 5. POTENTIAL FOR HUMAN EXPOSURE

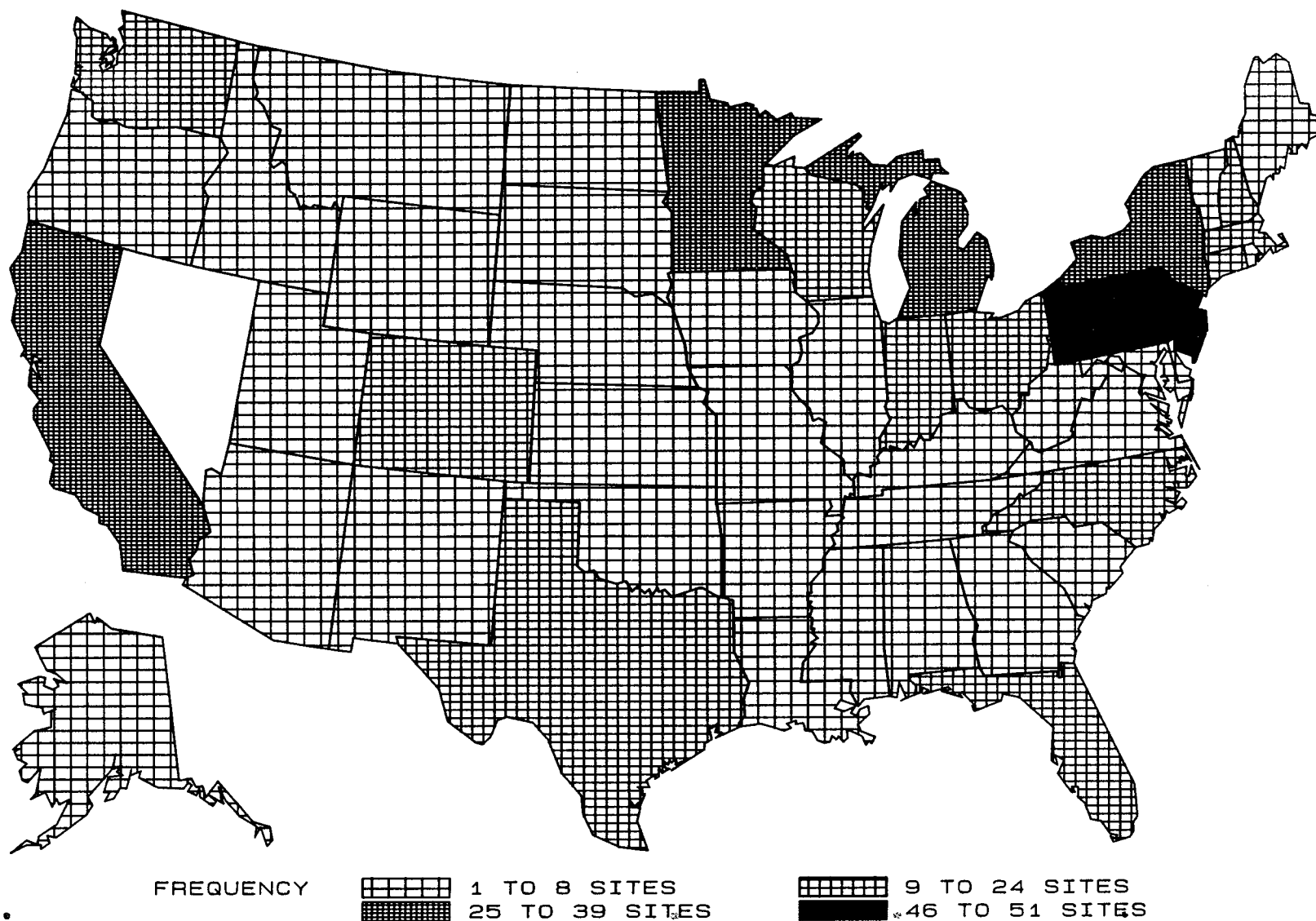
### 5.1 OVERVIEW

Acetone is emitted into the atmosphere both from natural and anthropogenic (man-made) sources. Natural sources of emission include plants and trees (Graedel et al. 1986; Isidorov et al. 1985; Khalil and Rasmussen 1992), volcanic eruptions (Isidorov et al. 1990), forest fires (Graedel et al. 1986), and insects and microbes (Graedel et al. 1986). Acetone is also produced endogenously and expired in human breath (Conkle et al. 1975). Some important anthropogenic sources of acetone in the air include vehicular exhaust (Graedel et al. 1986), chemical manufacturing (Graedel et al. 1986), tobacco smoke (Manning et al. 1983), wood burning and pulping (Graedel et al. 1986), refuse and polyethylene combustion (Graedel et al. 1986; Hodgkin et al. 1982; NAS 1976), petroleum production (Graedel et al. 1986), certain landfill sites (Hodgson et al. 1992; LaRegina et al. 1986), and solvent use (Graedel et al. 1986). The sensitized photoreaction of dissolved organic matters naturally produces acetone in seawater (Mopper and Stahovec 1986). Chemical manufacturing industries (Abrams et al. 1975), energy-related industries (Mohr and King 1985), and user industries (Abrams et al. 1975) release acetone to surface waters. Acetone is released into groundwater mainly as a result of leaching from municipal and industrial landfills (Brown and Donnelly 1988). The principal sources of acetone in soil are municipal and industrial discharge in landfills (EPA 1988b). Another source is atmospheric deposition (Grosjean and Wright 1983). Acetone is released in soil from natural sources, such as disposed agricultural and food wastes and animal wastes (Graedel et al. 1986).

Acetone has been identified in at least 560 of the 1,350 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (HAZDAT 1991). However, the number of sites evaluated for acetone is not known. The frequency of these sites within the United States can be seen in Figure 5-1. Of these sites, 559 are located in the United States and 1 is located in the Commonwealth of Puerto Rico (not shown).

The two processes that are important in determining the fate of acetone in the atmosphere are reaction with hydroxyl radicals and photolysis. The estimated half-life of acetone in the air due to combinations of these two reactions is 22 days (Meyrahn et al. 1986). Because of this reasonably long half-life, acetone is transported long distances from its source of emission. Wet deposition transports

FIGURE 5-1. FREQUENCY OF NPL SITES WITH ACETONE CONTAMINATION \*



FREQUENCY



1 TO 8 SITES



25 TO 39 SITES



9 TO 24 SITES



46 TO 51 SITES

\*Derived from HAZDAT 1991

atmospheric acetone to surface water and the terrestrial surface (Grosjean and Wright 1983). The most important fate determining process for acetone in water is biodegradation (Rathbun et al. 1982). Because of its high water solubility, acetone does not adsorb significantly to sediment and suspended solids in water. Acetone does not bioconcentrate in aquatic organisms (Rustung et al. 1931), and there is no data on acetone biomagnification in aquatic and terrestrial food chains. Biodegradation is the most important degradative process for acetone in sediment and soil (Rathbun et al. 1982). The important transport processes of acetone in soil are volatilization to the atmosphere and leaching into groundwater.

The levels of acetone in ambient air and water are generally low. The concentration of acetone in the atmosphere in remote areas is  $\leq 1$  ppb (volume per volume [v/v]) (1 ppb=0.001 ppm) (Cavanagh et al. 1969; Arnold et al. 1986). Its mean concentration in the atmosphere of rural areas is  $< 3$  ppb (Shepson et al. 1991; Snider and Dawson 1985). The mean concentration of acetone in urban air in the United States is 6.9 ppb (Shah and Singh 1988). Acetone concentration in indoor air in the United States is generally slightly higher than outdoor air (8.0 ppb versus 6.9) (Shah and Singh 1988), due to the use of household consumer products containing acetone. The concentration of acetone in open seawater near the Bahamas was 0.35 ppb (Kieber and Mopper 1990). The concentration of acetone in the Potomac River in Virginia was below the detection limit of 40 ppb (Hall et al. 1987), and the level will be higher in water receiving industrial and municipal discharge containing acetone. An industrial landfill leachate in Michigan contained 62 ppm acetone (Brown and Donnelly 1988). An acetone concentration  $\leq 3,000$  ppb was detected in a drinking water well in New Jersey (Burmester 1982). The level of acetone in finished drinking water is generally low (Coleman et al. 1976; Keith et al. 1976), and the reported concentration in drinking water from Seattle, Washington, was 1 ppb (Keith et al. 1976). A concentration of 6 ppb acetone was detected in the sediment of a creek adjacent to a landfill in Louisville, Kentucky (Stonebraker and Smith 1980). Acetone has been detected in the volatile components of several fruits and vegetables (Bartley and Schwade 1989; Lovegren et al. 1979).

The general population is exposed to acetone by inhaling ambient air and by ingesting drinking water and food containing acetone. No data for the total daily intake of acetone for the general population were located. There is a great deal of evidence that workers in certain industries, such as certain paint, plastic, artificial fiber, and shoe factories are exposed to much higher levels of acetone than the general population (Kawai et al. 1990a; Pezzagno et al. 1986). Professional painters, and commercial and household cleaners are also likely to be exposed to higher acetone concentrations than the general

population. Among the general population, smokers, frequent users of nail polish removers and people who live near certain landfill sites (emitting higher than ambient levels of acetone) or other industrial sources of emission are susceptible to higher exposure concentrations of acetone.

## 5.2 RELEASES TO THE ENVIRONMENT

### 5.2.1 Air

Acetone is emitted into the atmosphere both from natural and anthropogenic (man-made) sources. Natural sources of emission include plants and trees. Acetone has been detected in a number of plant volatiles including onions, grapes, cauliflower, tomatoes, wild mustard, beans, and peas (HSDB 1992), and emissions have been detected from a variety of trees including willow, aspen, birch, balsam poplar, oak, fir, pine, juniper, cedar, and cypress (Isidorov et al. 1985; Khalil and Rasmussen 1992). Acetone is produced endogenously and released as a component of human breath (Conkle et al. 1975; Krotoszynski 1977; Trotter et al. 1971). Volatiles from animal wastes, microbes, and insects are also examples of natural sources of acetone in the air (Graedel et al. 1986). In addition, forest fires and volcanic eruptions emit acetone into the atmosphere (Graedel et al. 1986; Isidorov et al. 1990).

Some important anthropogenic sources of acetone in the air are automobile and diesel exhaust (Barber and Lodge 1963; Jonsson et al. 1985; Lloyd 1978), chemical manufacture (Graedel et al. 1986), tobacco smoke (Manning et al. 1983), wood burning and pulping (Graedel et al. 1986; Kleinienst et al. 1986; Lipari et al. 1984), polyethylene burning (Hodgkin et al. 1982), refuse combustion (NAS 1976), petroleum production (Graedel 1978), certain landfill sites (Hodgson et al. 1992; LaRegina et al. 1986; Militana and Mauch 1989), and solvent uses (Medinilla and Espigares 1988). Acetone is also formed in the atmosphere from the photochemical oxidation of propane (Arnold and Ziereis 1986; Singh and Hanst 1981) and possibly from propylene oxide and epichlorohydrin (Spicer et al. 1985). Atmospheric emissions are also likely from several consumer products including nail polish removers, particle board (Tichenor and Mason 1988), carpet backing (Hodgson et al. 1993), some paint removers (Hahn and Werschulz 1986), and a number of liquid/paste waxes or polishes (Knoeppel and Schauenburg 1989; Sack et al. 1992). Certain detergents/cleansers (Knoeppel and Schauenburg 1989; Sack et al. 1992), adhesives, and carburetor and choke cleaners (EPA 1989) are also known to contain acetone.

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Acetone released into air from facilities in each state in the United States that manufactured or processed acetone during 1990 are listed in Table 5-1 (TR190 1992). According to TR190 (1992), an estimated total of 180 million pounds of acetone, amounting to 96.7% of the total environmental release, was discharged to the air from manufacturing and processing facilities in the United States in 1990. The TRI data should be used with caution since only certain types of facilities were required to report. This is not an exhaustive list. From the monitoring data on levels of acetone in pristine areas and urban/suburban areas (see Section 5.4.1), it seems likely that the total emission of acetone in the atmosphere from anthropogenic sources exceeds the total emission from natural sources.

### 5.2.2 Water

Acetone is released into surface water as waste water from certain chemical manufacturing industries (Gordon and Gordon 1981; Hites and Lopez-Avila 1980; Junglaus et al. 1978). It is also released in water from energy-related industries, such as coal-gasification (Mohr and King 1985; Pellizzari et al. 1979) and oil shale processing (Hawthorne and Sievers 1984; Pellizzari et al. 1979). Acetone was found in 27 of 63 effluent waters from a wide range of chemical industries in the United States (Perry et al, 1979). A survey of industrial effluents indicates that acetone was detected in effluents from various industrial products such as, paper, plastic, pharmaceutical, specialty cleaning and polishing products, paint and allied products, gum and wood chemicals, cyclic intermediates, industrial organic chemicals, gypsum products, and paper board products (Abrams et al. 1975).

Acetone is released to groundwater as a result of leaching from municipal and industrial landfills (Brown and Donnelly 1988; Gould et al. 1983; Sawhney and Raabe 1986; Steelman and Ecker 1984; Stonebraker and Smith 1980). Leaching from polyethylene distribution pipes may be a source of acetone in drinking water (Anselme et al. 1985). One of the sources of acetone in seawater is the sensitized photoreaction of dissolved organic matters (Mopper and Stahovec 1986). The releases of acetone to water from facilities that manufactured or processed acetone in states within the United States during 1990 are reported in Table 5-1 (TR190 1992). According to TR190 (1992), an estimated total of 1.28 million pounds of acetone, amounting to 0.7% of the total environmental release, was discharged to the water from manufacturing and processing facilities in the United States in 1990. In addition, these facilities discharged an estimated 12.2 million pounds of acetone, amounting to 6.6% of the total environmental release to municipal waste water of publicly owned treatment works (POTW) in 1990 (TR190 1992).

TABLE 5-1. Releases to the Environment from Facilities  
That Manufacture or Process Acetone<sup>a</sup>

State <sup>c</sup>	Number of facilities	Range of reported amounts released in thousands of pounds <sup>b</sup>						
		Air	Underground injection	Water	Land	Total Environment <sup>d</sup>	POTW <sup>e</sup> transfer	Off-site waste transfer
AK	1	22.5-22.5	0.0-0.0	2.5-2.5	0.0-0.0	25.0-25.0	0.0-0.0	0.0-0.0
AL	46	0.0-240.6	0.0-0.0	0.0-7.8	0.0-16.0	0.0-240.9	0.0-0.3	0.0-30.7
AR	50	0.3-540.0	0.0-0.0	0.0-14.9	0.0-0.3	0.3-540.0	0.0-0.0	0.0-41.3
AZ	24	0.0-1835.1	0.0-0.0	0.0-0.0	0.0-49.6	0.0-1835.1	0.0-43.0	0.0-68.5
CA	220	0.0-160.3	0.0-0.0	0.0-63.0	0.0-0.0	0.0-160.3	0.0-56.5	0.0-132.0
CO	17	0.0-228.1	0.0-0.0	0.0-0.0	0.0-0.0	0.0-228.1	0.0-12.9	0.0-38.2
CT	27	0.0-81.2	0.0-0.0	0.0-400.0	0.0-0.0	0.0-414.6	0.0-378.9	0.0-178.0
DE	12	0.1-71.7	0.0-0.0	0.0-0.0	0.0-0.0	0.1-71.7	0.0-40.5	0.0-41.1
FL	107	0.0-1114.6	0.0-64.0	0.0-6.3	0.0-0.3	0.1-1114.6	0.0-397.3	0.0-198.3
GA	80	0.0-950.0	0.0-0.0	0.0-17.0	0.0-0.8	0.0-952.2	0.0-290.0	0.0-201.5
HI	1	9.7-9.7	0.0-0.0	0.0-0.0	0.0-0.0	9.7-9.7	0.0-0.0	0.0-0.0
IA	36	0.0-490.0	0.0-0.0	0.0-0.3	0.0-0.2	0.0-490.0	0.0-0.8	0.0-14.8
ID	9	1.0-57.0	0.0-0.0	0.0-7.1	0.0-5.7	1.0-57.9	0.0-0.3	0.0-37.2
IL	110	0.0-862.0	0.0-0.0	0.0-6.0	0.0-0.3	0.0-862.0	0.0-302.6	0.0-259.5
IN	132	0.0-2480.0	0.0-0.0	0.0-0.9	0.0-0.3	0.0-2,480.0	0.0-190.0	0.0-2600.0
KS	34	0.0-330.0	0.0-0.0	0.0-7.0	0.0-0.0	0.0-337.0	0.0-92.8	0.0-39.6
KY	41	0.1-760.0	0.0-0.0	0.0-4.7	0.0-0.3	0.1-760.0	0.0-0.3	0.0-191.4
LA	37	0.0-128.0	0.0-1500.0	0.0-17.1	0.0-0.5	0.0-1510.9	0.0-0.0	0.0-70.5
MA	66	0.0-430.6	0.0-0.0	0.0-21.7	0.0-4.3	0.0-430.6	0.0-6.5	0.0-233.7
MD	17	0.0-57.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-57.0	0.0-30.0	0.0-54.1
ME	23	1.1-165.4	0.0-0.0	0.0-11.0	0.0-4.6	1.3-165.4	0.0-1.3	0.0-20.8
MI	140	0.0-824.0	0.0-775.9	0.0-7.5	0.0-1.5	0.0-1553.3	0.0-748.0	0.0-104.2
MN	63	0.3-175.6	0.0-0.0	0.0-19.0	0.0-0.1	0.3-175.6	0.0-25.4	0.0-62.1
MO	71	0.1-402.2	0.0-0.0	0.0-0.0	0.0-0.3	0.1-402.2	0.0-53.0	0.0-83.0
MS	31	0.0-435.2	0.0-0.0	0.0-13.0	0.0-0.1	0.0-435.2	0.0-0.0	0.0-7.3
MT	1	5.9-5.9	0.0-0.0	6.8-6.8	0.0-0.0	12.7-12.7	0.0-0.0	0.0-0.0
NC	154	0.0-503.4	0.0-0.0	0.0-9.3	0.0-0.3	0.0-503.4	0.0-141.0	0.0-60.0
ND	2	10.1-16.5	0.0-0.0	0.0-0.0	0.0-0.0	10.1-16.5	0.0-0.0	0.0-0.0
NE	17	0.2-68.2	0.0-0.0	0.0-0.0	0.0-0.0	0.2-68.2	0.0-0.0	0.0-15.9
NH	16	0.0-59.2	0.0-0.0	0.0-4.2	0.0-8.5	0.5-59.2	0.0-0.0	0.0-16.2
NJ	98	0.0-931.5	0.0-0.0	0.0-1.2	0.0-48.3	0.0-931.5	0.0-318.4	0.0-570.2
NM	8	1.0-53.0	0.0-0.0	0.0-0.0	0.0-0.3	1.0-53.0	0.0-0.0	0.0-2.4
NV	3	1.3-81.9	0.0-0.0	0.0-0.0	0.0-0.0	1.3-81.9	0.0-0.0	0.0-1.5
NY	89	0.0-2730.0	0.0-0.0	0.0-21.0	0.0-0.8	0.0-2730.3	0.0-340.0	0.0-456.7
OH	157	0.0-1369.0	0.0-630.0	0.0-4.3	0.0-3.7	0.0-1955.0	0.0-75.0	0.0-632.4
OK	13	0.5-165.2	0.0-0.0	0.0-0.0	0.0-0.0	0.5-165.2	0.0-1.7	0.0-46.4
OR	46	0.3-1305.8	0.0-0.0	0.0-7.5	0.0-0.3	0.3-1305.8	0.0-93.7	0.0-115.5
PA	130	0.0-335.1	0.0-0.0	0.0-2.5	0.0-2.5	0.0-335.1	0.0-1894.0	0.0-190.3
PR	25	0.0-1342.4	0.0-0.0	0.0-0.0	0.0-0.1	0.0-1342.4	0.0-201.6	0.0-153.2

**TABLE 5-1. Releases to the Environment from Facilities That Manufacture or Process Acetone<sup>a</sup> (Continued)**

State <sup>c</sup>	Number of facilities	Range of reported amounts released in thousands of pounds <sup>b</sup>						
		Air	Underground injection	Water	Land	Total Environment <sup>d</sup>	POTW <sup>e</sup> transfer	Off-site waste transfer
RI	18	0.0-233.7	0.0-0.0	0.0-6.1	0.0-0.0	0.0-233.7	0.0-0.0	0.0-302.9
SC	55	0.0-2921.8	0.0-0.0	0.0-12.0	0.0-1.6	0.0-2923.8	0.0-1.7	0.0-301.8
SD	3	1.4-32.0	0.0-0.0	0.0-0.0	0.0-0.0	1.4-32.0	0.0-0.0	1.6-6.3
TN	83	0.3-31100.0	0.0-0.0	0.0-42.8	0.0-8.9	0.3-31123.0	0.0-47.2	0.0-85.0
TX	166	0.0-5223.8	0.0-326.0	0.0-9.0	0.0-5.9	0.0-5223.8	0.0-380.0	0.0-462.8
UT	16	0.0-98.2	0.0-0.0	0.0-0.0	0.0-0.0	0.0-98.2	0.0-7.2	0.0-6.6
VA	81	0.0-10530.0	0.0-0.0	0.0-3.8	0.0-5.4	0.0-10535.7	0.0-1889.7	0.0-60.6
VT	4	0.0-41.9	0.0-0.0	0.0-0.0	0.0-0.0	0.0-41.9	0.0-0.0	0.0-10.4
WA	65	0.0-404.2	0.0-0.0	0.0-12.0	0.0-2.7	0.0-404.2	0.0-1.5	0.0-93.1
WI	75	0.0-222.2	0.0-0.0	0.0-2.2	0.0-0.0	0.0-222.2	0.0-42.4	0.0-268.0
WV	16	0.1-3218.1	0.0-0.0	0.0-10.0	0.0-18.7	0.1-3222.4	0.0-483.0	0.0-116.9

<sup>a</sup>Derived from TRI90 (1992)

<sup>b</sup>Data in TRI are maximum amounts released by each facility. Quantities reported here have been rounded to the nearest hundred pounds, except those quantities >1 million pounds, which have been rounded to the nearest thousand pounds.

<sup>c</sup>Post office state abbreviation

<sup>d</sup>The sum of all releases of the chemical to air, land, water, and underground injection wells by a given facility

<sup>e</sup>POTW = publicly owned treatment works

### 5.2.3 Soil

Acetone leaches readily in soil (see Section 5.4.3). Therefore, the detection of acetone in leachate and groundwater from municipal and industrial landfills indicates the source of acetone in landfill soils is municipal and industrial discharge. Information regarding the release of acetone from facilities that manufactured or processed the compound in 1990 is reported in Table 5-1 (TR190 1992). Table 5-1 shows that the amount of acetone released into soil from these facilities accounts for 0.1% of the total environmental release of acetone. Other sources of acetone released into soil include disposal of agricultural and food waste, animal wastes (see Section 5.2.1), and atmospheric wet deposition. Household septic tank effluents are another source of acetone in soil because these effluents containing acetone are discharged into the soil (DeWalle et al. 1985). According to the HAZDAT of ATSDR, acetone was detected in 43% of the soil from Superfund sites tested for acetone (HAZDAT 1991). The information used from the HAZDAT includes data from NPL sites only.

## 5.3 ENVIRONMENTAL FATE

### 5.3.1 Transport and Partitioning

Organic compounds with ambient vapor pressure  $>10^{-4}$  mmHg should exist almost entirely in the vapor phase (Eisenreich et al. 1981). Since the vapor pressure of acetone is 181.72 mmHg at 20°C (see Table 3-2), acetone should exist exclusively in the vapor phase in the atmosphere. Furthermore, the collection methods used for the quantification of acetone in the atmosphere (Jarke et al. 1981; Juttner 1986; LaRegina et al. 1986) indicate that atmospheric acetone exists as vapor. Due to the atmospheric half-life, which is on the order of days (see Section 5.3.2.1), acetone will be transported long distances in the air. Although not a large sink (Chatfield et al. 1987), small amounts of acetone will be removed from the atmosphere by wet deposition (Grosjean and Wright 1983), which will transport acetone from the atmosphere to surface water and soil.

The complete miscibility of acetone in water suggests that partitioning of acetone from the water column to sediments and suspended solids in water is not significant. The estimated low value of 0.73 for  $\log K_{oc}$  (see Table 3-2) also suggests that adsorption of acetone to sediments and suspended solids is not significant. In the absence of water, acetone vapor adsorbs rather strongly to the clay component of soil by hydrogen bonding (Goss 1992; Steinberg and Kreamer 1993). The sorption is



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dependent on relative humidity, and increasing the humidity decreases sorption drastically. In water saturated soil or sediment, only organic carbon, as indicated by  $K_{oc}$ , and not hydrogen bonding may control the sorption of acetone (Steinberg and Kreamer 1992). The experimental adsorption studies with kaolinite, monkmorillonite, and stream sediments showed very little or no loss of acetone from water to the adsorbents (Rathbun et al. 1982). The transport of acetone from the water column to the atmosphere depends on the Henry's law constant. The Henry's law constant for acetone is  $4.26 \times 10^{-5}$  atm-m<sup>3</sup>/mol (see Table 3-2). Therefore, volatilization of acetone from water, although not very fast, is significant (Thomas 1982). The volatilization rate of a chemical depends on the characteristics of the chemical and the water and on other ambient conditions (e.g., water depth, suspended solid concentration, water current, wind speed, temperature). Based on an estimation method (Thomas 1982) and a Henry's law constant value of  $4.26 \times 10^{-5}$  atm-m<sup>3</sup>/mol, the volatilization half-life of acetone from a model river 1 m deep, flowing at a current of 1 m/second with a wind velocity of 3 m/second is about 18 hours. The mean volatilization coefficient for acetone in a model outdoor stream was in the range of  $7.15 \times 10^{-4}$  to  $14.8 \times 10^{-4}$ /minute (Rathbun et al. 1989, 1991). Therefore, the volatilization half-life of acetone from the model stream is in the range of 7.8-16.2 hours. It was concluded that volatilization will control the fate of acetone in water (Rathbun et al. 1989, 1991). Results of a laboratory study (Rathbun et al. 1982) also concluded that volatilization is one of the important fate determining processes for acetone in streams.

The log  $K_{ow}$  value of -0.24 (see Table 3-2) suggests that bioconcentration of acetone in aquatic organisms is not significant. The measured bioconcentration factor for acetone in adult haddock exposed to acetone under static conditions at 7-9°C was <1 (Rustung et al. 1931). No data regarding the biomagnification potential of acetone in aquatic organisms were located; however, the low  $K_{ow}$  value suggests that biomagnification of acetone from animals of lower to higher trophic level is unlikely.

The two significant transport properties for acetone in soil are volatilization and leaching. Leaching transports acetone from soil to groundwater. The rate of leaching from soil by rainwater depends on the sorption characteristics of acetone in soil. Since acetone may be controlled by  $K_{oc}$  in water-saturated soil and has a low  $K_{oc}$  value, sorption of acetone in such soil will be weak. The low retention ability will permit acetone to leach into groundwater. A sorption study with moist clay soils indicates that aqueous acetone causes swelling in these soils (Green et al. 1983), and this process may allow the retention of a small fraction of acetone. Groundwater monitoring studies (see Section 5.4.2)

at landfill sites provided evidence of the importance of acetone leaching from soil. Volatilization transports acetone from soil to the atmosphere. The volatility rate of acetone from soil depends on the soil characteristics (moisture content, soil porosity, etc.). Since the acetone is weakly sorbed to soil, the volatility depends primarily on the moisture content of the soil. In dry soil, the volatilization rate from soil surfaces is high due to the high vapor pressure of acetone. In moist soil, the rate of volatilization is similar to acetone in water and depends on the Henry's law constant. Acetone volatilizes moderately under these conditions. The detection of acetone at higher concentrations in downwind air of a landfill site, compared to upwind air (Militana and Mauch 1989), indicates the importance of volatilization as a transport process in soil.

No data regarding the transport of acetone from soil to plants were located.

### 5.3.2 Transformation and Degradation

#### 5.3.2.1 Air

The reactions of acetone vapor with nitrogen oxides, hydroxyl radicals (OH), singlet molecular oxygen ( $^1\Delta_g$ , singlet atomic oxygen ( $O(^3P)$ )), and nitrate radicals have been studied. Given the second order rate constants for the reactions of acetone with  $^1\Delta_g$  (Datta and Rao 1979) and  $O(^3P)$  (Lee and Timmons 1977), and the concentrations of singlet molecular and atomic oxygen in the atmosphere (Graedel 1978), these reactions are insignificant in determining the fate of acetone in the atmosphere. The reaction of acetone with nitrate radicals in the atmosphere was also determined to be insignificant (Boyd et al. 1991). Smog chamber studies with acetone and nitrogen oxides conclude that acetone has low reactivity in terms of ozone and nitrogen dioxide formation and that the rate of disappearance of acetone by this process is low (Altshuller and Cohen 1963; Dimitriadis and Joshi 1977; Yanagihara et al. 1977). The photochemical oxidation of acetone in the presence of nitrogen oxides produces small amounts of peroxyacetic acid and peroxyacetyl nitrate (Hanst and Gay 1983).

The two significant processes in determining the fate of acetone in the atmosphere are reaction with hydroxyl radicals and photolysis. The rate constant for the reaction of hydroxyl radicals with acetone at 25°C is in the range of  $2.2\text{--}5.0 \times 10^{-13}$  cm<sup>3</sup>/molecule-second (Cox et al. 1980; Cox et al. 1981; Meyrahn et al. 1986). The estimated average lifetime of acetone due to reaction with hydroxyl radicals is 44.5 days (Meyrahn et al. 1986). The probable pathways for the reaction of acetone with

hydroxyl radicals in the troposphere have been postulated, and methylglyoxal is the primary product of this reaction (Altshuller 1991). Acetone underwent significant photolysis with an artificial light (cutoff wavelength of 270 nm) with a maximum emission intensity of 300 nm (Fujiki et al. 1978). Besides free radicals, the primary products of acetone photolysis in sunlight are carbon dioxide and acetylperoxynitrate (Altshuller 1991). The lifetimes of acetone due to photolysis under cloudless conditions at 40° N latitude, and at sea level during winter and summer are estimated to be 83 and 19 days, respectively (Martinez et al. 1992). Other investigators have estimated that the average atmospheric lifetime of acetone due to photolysis at 40° N latitude is 115.7 days/year (Meyrahn et al. 1986). The estimated average lifetime of acetone at 40° N due to combined hydroxyl radical reaction and photolysis is 32 days/year (Meyrahn et al. 1986), corresponding to a half-life of 22 days. Due to the pressure dependence of the quantum yield, the rate of photodissociation will increase as altitude increases, whereas the reaction rate with hydroxyl radicals will decrease because temperature decreases at higher altitudes. Therefore, the lifetime of acetone in the atmosphere will remain approximately constant with respect to altitude. However, the rate will show a pronounced dependence on latitude with greater losses of acetone occurring near the equator, compared to the poles (Meyrahn et al. 1986).

### 5.3.2.2 Water

Based on the rate constant for the reaction of acetone with hydroxyl radicals in water at pH 7 ( $5.8-7.7 \times 10^7/\text{M}\cdot\text{second}$ ) (Anbar and Neta 1967) and the concentration of hydroxyl radicals in eutrophic waters ( $3 \times 10^{-17}\text{M}$ ) (Mill and Mabey 1985), this reaction will not be significant in water. When distilled water or natural water containing acetone were exposed to sunlight for 2-3 days, no photodecomposition of acetone was observed (Rathbun et al. 1982). Therefore, photolysis of acetone in water is not an important process.

Many aerobic biodegradation screening studies with mixed microorganisms from waste-treatment plant effluents, activated sludge, or sewage have examined the biodegradability of acetone (Babeu and Vaishnav 1987; Bhattacharya et al. 1990; Bridie et al. 1979; Ettinger 1956; Gaudy et al. 1963; Hatfield 1957; Heukelekian and Rand 1955; Lamb and Jenkins 1952; Price et al. 1974; Stafford and Northup 1955; Thorn and Agg 1975; Urano and Kato 1986a, 1986b). These studies indicate that acetone is easily biodegradable with acclimatized microorganisms or after a suitable lag period ( $\approx 1$  day) (Urano and Kato 1986a, 1986b), as long as the initial concentration of acetone is not at a toxic level. For example, acetone at a concentration of 500 mg/L was toxic to microorganisms when biooxidation of

acetone by activated sludge was attempted (Gerhold and Malaney 1966). Biodegradation of acetone was much slower in seawater than in fresh water (Takemoto et al. 1981). After a suitable lag period (5 days), acetone biodegraded quantitatively under anaerobic conditions with anaerobic acetate enriched culture medium (Chou et al. 1979). A biodegradation study of acetone in natural water collected from Lago Lake near Athens, Georgia, determined that the biodegradation kinetics is multiphasic in nature and depends on the substrate concentration. The determined rate of degradation was faster at higher initial concentrations (the maximum concentration used was 0.5 mg/L) (Hwang et al. 1989).

In a laboratory experiment with natural stream water and sediment, no acetone was lost in 338 hours under sterile conditions in closed flasks. However, with nonsterile natural sediment, 100% of the acetone was lost in 500 hours following a lag period of 90 hours. (Rathbun et al. 1982). The authors of this study concluded that biodegradation was one of the important processes for the loss of acetone in streams. Significant loss of acetone due to biodegradation was not observed in a later study where acetone was injected continuously in an outdoor model stream (Rathbun et al. 1988, 1989, 1991, 1993). Attempts to induce biodegradation by adding glucose and a nutrient solution containing bacteria acclimated to acetone were unsuccessful. The authors concluded that the residence time of acetone in the model stream (6 hours) was too short for the bacteria to become acclimated in the water before initiation of biodegradation. However, this explanation may not be valid if attached bacteria, rather than free-floating bacteria, dominate the biodegradation process. As an alternative explanation, the authors indicated that the observed limitation in the nitrate concentration in the stream may be responsible for the lack of acetone biodegradation.

### **5.3.2.3 Sediment and Soil**

The biodegradation studies discussed in Section 5.3.2.2 indicate that biodegradation of acetone in sediment and soil will be significant. However, laboratory or field data examining the biodegradability of acetone in soil are lacking. No evidence was located to suggest that any degradation process other than biodegradation is important in sediment and soil.

## 5.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT

### 5.4.1 Air

Acetone is a volatile compound and is stable in air. Therefore, some monitoring data for the levels of acetone in air are available. The levels of acetone in urban, rural, and remote areas in the United States and the level in the troposphere are shown in Table 5-2.

It is obvious from Table 5-2 that the concentration of acetone in the air around urban areas will be higher than rural and remote areas because of higher emission rates from a larger number of sources. Besides these data, air monitoring data from an urban area (Tulsa, Oklahoma), a rural area (Rio Blanco County, Colorado), and a remote area (Smoky Mountain, Tennessee) are also available (Arnts and Meeks 1981). These data are not presented in Table 5-2 because the samples were collected in Tedlar bags that are known to contaminate air samples with acetone. As a result, the reported acetone concentrations were consistently higher than the values given in Table 5-2. Table 5-2 also indicates that the indoor concentration of acetone is generally higher than the outdoor concentration. Other investigators reported similar results (Jarke et al. 1981). The reason for the higher indoor air concentration is the use of acetone-containing consumer products inside homes. The potential for intrusion of acetone present as soil gas into a house adjacent to a landfill by diffusive and advective routes was found to be low (Hodgson et al. 1992). However, only a single house was studied, and the ambient air in the basement of the house was estimated on two separate occasions and found to be 12 and 82 ppb (v/v).

### 5.4.2 Water

In a National Organics Reconnaissance Survey (NORS) by EPA involving drinking water supplies from 10 cities in the United States, acetone was qualitatively detected in all 10 water samples. The 10 cities in this survey were Cincinnati, Ohio, Miami, Florida, Ottumwa, Indiana, Philadelphia, Pennsylvania, Seattle, Washington, Grand Forks, North Dakota, Lawrence, Kansas, New York, New York, Terrebonne Parrish, Louisiana, and Tucson, Arizona (Bedding et al. 1982; Coleman et al. 1976; Keith et al. 1976). The determined concentration of acetone in one of the drinking water samples (Seattle, Washington) was 1 ppb (Keith et al. 1976). Acetone has also been detected in water from several artesian wells adjacent to a landfill in Wilmington, Delaware and at a concentration of 0.3 ppb

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**TABLE 5-2. Acetone Levels in the Troposphere and Urban, Rural, and Remote Areas in the United States and Canada**

Location	Monitoring year	Concentration ppb (v/v)	Reference
Tucson, AZ	1982	12.0	Snider and Dawson 1985
Houston, TX	1987–1988	6.1	Lagrone 1991
U.S. outdoor	1980–1986	6.9	Shah and Singh 1988
U.S. indoor	1980–1986	8.0	Shah and Singh 1988
Indoor air of a newly constructed office building, Portland, OR	1987–1988	12.1–28.1	Hodgson et al. 1991
Rural, AZ	1982	2.8	Snider and Dawson 1985
Rural, Ontario	1988	1.7	Shepson et al. 1991
Background, clean air	1988	0.38	Zhou and Mopper 1993
Point Barrow, AK	1967	1.1	Cavanagh et al. 1969
Troposphere (lower)	—	0.7	Dilling 1982
Troposphere (lower)	1984–1985	0.47	Arnold et al. 1986
Troposphere (upper)	1984–1985	0.12	Arnold et al. 1986

in finished drinking water from one of the wells (DeWalle and Chian 1981). The concentration of acetone was  $\leq 3,000$  ppb in a drinking water well in New Jersey (Burmester 1982; Steelman and Ecker 1984).

The concentration of acetone in open ocean water (Tongue of the Ocean, Bahamas) was 6 nM (0.35 ppb) (Kieber and Mopper 1990) whereas the reported mean concentrations in seawater from Straits of Florida and the Eastern Mediterranean were 20 and 30 ppb, respectively (Corwin 1969). The concentration of acetone in the Potomac River, VA was below the detection limit of 40 ppb (Hall et al. 1987). Acetone has been detected in the effluent from a textile plant (Gordon and Gordon 1981) and in effluent water from a specialty chemicals manufacturing plant at a concentration of 200-230 ppm (Jungclaus et al. 1978). The compound has also been detected in groundwater, leachate, and run-off waters from landfill sites (Brown and Donnelly 1988; DeWalle and Chian 1981; Gould et al. 1983; Sawhney and Raabe 1986; Stonebraker and Smith 1980). The concentration of acetone in an industrial landfill leachate in Michigan was in the range of 0.05 to 62.0 ppm (Brown and Donnelly 1988). However, the quality of the reported data is uncertain. Acetone was detected at a mean concentration of 56 ppb in a landfill leachate in Orange County, Florida (Hallbourg et al. 1992).

#### **5.4.3 Sediment and Soil**

There are few data regarding the level of acetone in soil and sediment. Acetone has been detected in 43% of the soil samples in Superfund sites for which acetone determination has been made so far. The maximum concentration of acetone in soils from Vega Alta Public Supply well sites in Puerto Rico was 9,500 ppb (ATSDR 1988). The mean concentration of acetone in soil from Summit National Site, Ohio, was 9,484 ppb (dry weight) (EPA 1988b). Acetone has been qualitatively detected in river sediment that received effluents from a specialty chemicals manufacturing plant (Hites and Lopez-Avila 1980). A concentration of 6 ppb  $\mu\text{g}/\text{kg}$  acetone was detected in the sediment of a creek adjacent to a landfill in Louisville, Kentucky (Stonebraker and Smith 1980). Because of its high water solubility and low sediment adsorption coefficient, most acetone in an aquatic system will be found in water, rather than in sediment.

#### 5.4.4 Other Environmental Media

Acetone has been qualitatively detected as a volatile component of a number of foods including blue cheese (Day and Anderson 1965), baked potatoes (Coleman et al. 1981), roasted filbert nuts (Kinlin et al. 1972), meat (Grey and Shrimpton 1967; Shahidi et al. 1986), and nectarines (Takeoka et al. 1988). In a study carried out in Czechoslovakia, the concentrations of acetone in samples of milk and cream culture were 79.5 and 0.11 mg/100 kg, respectively (Palo and Ilkova 1970). Acetone also has been qualitatively detected in breast milk of working mothers, although the study did not identify whether the concentrations of acetone were higher than normal physiologic levels (Giroux et al. 1992). Acetone has been qualitatively detected in 8 of 12 mothers' milk samples collected from two locations in New Jersey, Bridgeville, Pennsylvania, and Baton Rouge, Louisiana (Pellizzari et al. 1982). In kiwi fruit, the acetone concentration comprised 0.2% of total volatile components (Bartley and Schwade 1989). The concentrations of acetone in dry legumes, such as beans (mean of several varieties), split peas, and lentils were 880, 530, and 230 ppb, respectively (Lovegren et al. 1979). The level of acetone in headspace volatiles of Bisbee Delicious apples ranged from 111 to 912 pL/kg-hour (Mattheis et al. 1991). The percent of acetone (of the total) in commercial concentrated aqueous orange essences ranged from 0.003 to 0.009 (Moshonas and Shaw 1990).

Acetone has been detected in occasional rain samples collected in Hanover, Germany (Levsen et al. 1990). The authors were not sure whether the detection of acetone in the rain water was due to contamination of samples during analysis. The concentration of combined acetone and acrolein was 0.05 ppm in a rain water sample from Los Angeles, California (Grosjean and Wright 1983). The investigators could not separate acetone from acrolein by the method used for the determination of carbonyl compounds.

### 5.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE

Acetone is endogenously produced by all humans. The general population is exposed to acetone by inhaling ambient air, ingesting food, and drinking water containing acetone. Dermal exposure to acetone may result from skin contact with certain consumer products (e.g., certain nail polish removers, paint removers, and household cleaning and waxing products) (see Section 5.2.1). However, no quantitative data for dermal exposure to acetone from consumer products were located. Assuming concentrations of acetone are 8.0 ppb (18.99  $\mu\text{g}/\text{m}^3$ ) in indoor air and 6.9 ppb (16.38  $\mu\text{g}/\text{m}^3$ ) in outdoor



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air (Shah and Singh 1988) and that a person inhales 15 m<sup>3</sup>/day of indoor air and 5 m<sup>3</sup>/day of outdoor air, the estimated inhalation rate of acetone is 0.37 mg/day. No experimental or estimated data were located regarding the daily intake of acetone in the general population in the United States from ingestion of drinking water and food. However, if the concentration of acetone in drinking water is  $\leq 1$  ppb (see Section 5.4.2), the daily intake for acetone (assuming a person consumes 2 L of drinking water/day) from this source would be negligible.

The acetone concentrations in body fluids and expired air of healthy and diabetic patients are given in Table 5-3. The concentration of acetone in whole blood does not differ from that in plasma (Gavin0 et al. 1986). Even in healthy subjects, the level of acetone in blood/plasma varies with fasting or nonfasting conditions and depends on the weight of the subject. Generally, the blood/plasma acetone concentrations are higher in fasted than nonfasted subjects and higher in subjects who are not obese, compared to obese subjects (Haff and Reichard 1977).

Workers in industries that manufacture and use acetone can be exposed to much higher concentrations of acetone than the general population. For example, the concentrations of acetone in the breathing zone air in a paint factory, a plastics factory, and an artificial fiber factory in Italy were  $>3.48$  mg/m<sup>3</sup> (Pezzagno et al. 1986). The concentration of acetone in the breathing zone air of a fiber-reinforced plastic plant in Japan, where bathtubs were produced, was  $\leq 108$  mg/m<sup>3</sup> (Kawai et al. 1990a). The inhalation exposure for workers to acetone in a shoe factory in Finland ranged from 25.4 to 393.4 mg/m<sup>3</sup> (Ahonen and Schimberg 1988). Concentrations of acetone in the breathing zone air in shoe factories in Italy were also high (Brugnone et al. 1978). The concentration of acetone in the breathing zone air of a solvent recycling plant in the United States ranged from not detected to 43 mg/m<sup>3</sup> (Kupferachmid and Perkin 1986). High levels of acetone were detected in the occupational air in other industries including chemical, plastic button, and paint manufacturing industries in Italy (Ghittori et al. 1987). Isopropyl alcohol is known to oxidize in the liver and is converted to acetone (Kawai et al. 1990b). Therefore, occupational exposure (printing plants) or accidental ingestion of isopropyl alcohol also produce acetone in expired air, blood, and urine. The National Occupational Exposure Survey (NOES) statistically estimated that 1.51 million workers were potentially exposed to acetone in the United States in 1980 (NIOSH 1989). The NOES database does not contain data on the frequency, duration, concentration, or route of exposure of workers to chemicals.

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**TABLE 5-3. Concentrations of Acetone in Body Fluids and Expired Air of Humans**

Subject	Medium	Concentration	Reference
Healthy (nonfasted)	Blood	0.016 mM (0.93 mg/L)	Gavino et al. 1986
Healthy (fasted)	Plasma	0.8 mM (46.5 mg/L)	Haff and Reichard 1977
Healthy (nonfasted)	Plasma	0.03 mM (1.74 mg/L)	Trotter et al. 1971
Ketoacidotic	Plasma	7.3 mM (424 mg/L)	Trotter et al. 1971
Ketoacidotic	Plasma	5.0 mM (290 mg/L)	Haff and Reichard 1977
Healthy	Urine	4–7 $\mu$ M (0.23–0.41 mg/L)	Kobayashi et al. 1983
Healthy (endogenous)	Urine	13.1 $\mu$ M (0.76 mg/L)	Pezzagno et al. 1986
Diabetic	Urine	11–155 $\mu$ M (0.64–9.0 mg/L)	Kobayashi et al. 1983
Healthy	Expired air	0.52 ppm (1.23 $\mu$ g/L)	Jansson and Larsson 1969
Healthy	Expired air	0.02 $\mu$ M (1.16 $\mu$ g/L)	Trotter et al. 1971
Healthy	Expired air	0.023 $\mu$ M (1.3 $\mu$ g/L)	Phillips and Greenberg 1987
Healthy	Expired air	101.3 ng/L <sup>a</sup> (0.1 $\mu$ g/L)	Krotoszynski et al. 1979

<sup>a</sup>The reason for the lower value reported by these investigators is not known with certainty but may be due to different sampling procedures (e.g., Teflon<sup>®</sup> versus polyester sampling bags).

## 5.6 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Workers in industries that manufacture or use acetone are one segment of the population at an especially high risk of acetone exposure compared to the general population (see Section 5.5). Professional painters and commercial and household cleaners (certain detergents, cleansers, waxes, or polishes contain acetone) are also likely to be exposed to acetone at higher concentrations than the general population, although experimental data regarding the extent of exposures for this segment of workers were not located. Among the general population, high exposure to acetone may occur among several subgroups. Cigarette smoke contains  $\leq 0.54$  mg acetone/cigarette (Manning et al. 1983); therefore, smokers are exposed to higher concentrations of acetone than nonsmokers. The content of acetone in certain nail polish removers is high; therefore, individuals who frequently use nail polish removers are exposed to higher levels of acetone than the general population. People who live near landfill sites that emit acetone or those who live near industrial sources of emission (e.g., refinery, incinerator, close to high vehicular traffic areas) are also susceptible to higher exposure concentrations of acetone than the general population that does not reside near these sites. People who consume contaminated well water (see Section 5.4.2) as drinking water are subject to high exposures. People who consume food containing acetone excessively would also be subject to high exposure, especially if associated with other risks.

## 5.7 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of acetone is available. Where adequate information is not available, ATSDR, in conjunction with the NTP, is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of acetone.

The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that if met would reduce the uncertainties of human health assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

### 5.7.1 Identification of Data Needs

**Physical and Chemical Properties.** Information regarding the physical and chemical properties of acetone necessary to predict its environmental fate and transport processes in the environment is available (see Table 3-2). However, experimental determination of a value for the soil sorption coefficient of acetone from water would be helpful in assessing the potential for leaching and volatility of acetone in different soils.

**Production, Import/Export, Use, Release, and Disposal.** Data regarding the past and present production volume for acetone and the projected future trend (increase/decrease) in the production volume are known (CMR 1990). In 1990, the reported total production volume of acetone in the United States was 2,330 million pounds (USITC 1991). Recent export and import data for acetone would be helpful. The use pattern of acetone is known. Acetone is present in several household consumer products, but by far a larger amount of acetone is used in industry. Acetone is naturally present in many fruits and vegetables, and there is no information available to indicate that acetone is present in food as a contaminant, due to food processing or packaging. Air is the most likely environmental medium in which significant quantities of acetone contamination will occur during its production and use (TRI90 1992). More data on the rate of acetone release from household consumer products would be useful. The regulations governing the disposal of acetone are well defined. However, more information about the proportion of discarded acetone recovered from recycling, and the proportion lost due to evaporation, ground burial, and incineration would be useful in determining the relative importance of the different routes of exposure.

According to the Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. Section 11023, industries are required to submit chemical release and off-site transfer information to the EPA. The Toxics Release Inventory (TRI), which contains this information for 1988, became available in May of 1990. This database will be updated yearly and should provide a list of industrial production facilities and emissions.

**Environmental Fate.** The environmental fate of acetone, for the most part, has been well studied (see Section 5.3). Acetone will undergo transport from one environmental medium to another (Grosjean and Wright 1983; Rathbun et al. 1982). Due to its reasonably long half-life in air (22 days) (Meyrahn et al. 1986) and restricted volatilization from groundwater, the atmosphere and groundwater

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may act as sinks for acetone. More experimental data regarding the rate of sorption and biodegradation of acetone in soil and its biodegradability in groundwater would be useful to assess the relative importance of the different fate processes.

**Bioavailability from Environmental Media.** Acetone is readily absorbed in the lung and gastrointestinal tract following inhalation and ingestion. Acetone can also be absorbed from the skin (see Section 2.3). The low value for  $K_{oc}$  (see Table 3-2) and a moderate value for Henry's law constant (Rathbun and Tai 1987) suggest that bioavailability of acetone from contaminated water and soil as a result of skin contact may be significant. However, quantitative data regarding the rate and extent of dermal absorption of acetone from contaminated water and soil are lacking. The high water solubility and low  $K_{oc}$  value for acetone suggest that bioavailability from ingested soil (e.g., children playing at or near contaminated sites) will be high, but quantitative absorption data are lacking. Data on bioavailability of acetone from ingested plant food were not located but would be helpful.

**Food Chain Bioaccumulation.** Acetone does not bioaccumulate in aquatic organisms. There is no indication of biomagnification of acetone along the aquatic food chain. Studies indicating the potential for acetone transfer from soil and plants and biomagnification in terrestrial food chains would be useful to confirm its potential for food chain bioaccumulation.

**Exposure Levels in Environmental Media.** Data regarding the level of acetone in ambient air are available (Lagrone 1991; Shah and Singh 1988; Snider and Dawson 1985). There is a paucity of data regarding the level of acetone in drinking water (Bedding et al. 1982; Coleman et al. 1976; Keith et al. 1976). More comprehensive data on the levels of acetone in the air and water consumed by people who live near acetone-containing hazardous waste sites would be useful in estimating the daily intake from these sources. Although the levels of acetone in the volatile components of several fruits and vegetables are available (see Section 5.4.4), development of data regarding the level of acetone in the total diet would be useful. There are few data regarding the level of acetone in background soil samples.

Reliable monitoring data for the levels of acetone in contaminated media at hazardous waste sites are needed so that the information obtained on levels of acetone in the environment can be used in combination with the known body burden of acetone to assess the potential risk of adverse health effects in populations living in the vicinity of hazardous waste sites.

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**Exposure Levels in Humans.** The levels of acetone in blood/plasma and urine of healthy people, occupationally exposed groups, and diabetic patients are available (see Table 5-3 and Section 5.5). However, data on the levels of acetone in body fluids or tissues of general populations living near sites with higher (than normal) exposure potential (e.g., hazardous waste sites) were not located. This information is useful for assessing the need to conduct health studies on these populations.

**Exposure Registries.** No exposure registries for acetone were located. This substance is not currently one of the compounds for which a subregistry has been established in the National Exposure Registry. The substance will be considered in the future when chemical selection is made for subregistries to be established. The information that is amassed in the National Exposure Registry facilitates the epidemiological research needed to assess adverse health outcomes that may be related to exposure to this substance.

### 5.7.2 On-going Studies

No on-going study that would fill the data gaps regarding the transport and fate of acetone in the environment or that evaluates its exposure potential in general population groups susceptible to higher levels of exposure was located.

As part of the Third National Health and Nutrition Evaluation Survey, the Environmental Health Laboratory Sciences Division of the National Center for Environmental Health and Injury Control, Centers for Disease Control, will be analyzing human blood samples for acetone and other volatile organic compounds. These data will give an indication of the frequency of occurrence and background levels of these compounds in the general population.