

# ENVIRONMENTAL PROTECTION AGENCY

## OFFICE OF ENFORCEMENT

EPA 330 2-80-022

HAZARDOUS SITE INSPECTION  
FIKE CHEMICALS, INC.

NITRO, WEST VIRGINIA

(December 11-14, 1979 and February 18, 1980)

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER

DENVER, COLORADO

June 1980



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
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Steven W. Sisk

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER - Denver  
and  
REGION III - Philadelphia

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## I. INTRODUCTION

Fike Chemicals, Inc. in Nitro, West Virginia, is a small-volume chemical manufacturing firm specializing in the development of new chemicals, speciality chemicals, byproduct recovery and custom manufacturing. Many of the chemicals are produced only as required and all are batch formulated. Production varies from a few hundred to about one million kilograms ( $2 \times 10^6$  lb)/year for individual products. Waste disposal has been accomplished by biological stabilization of "treatable" waste streams, evaporation/percolation lagoons for "non-treatable" waste streams and on-site burial for other wastes.

During October 3 through 7, 1977, at the request of Environmental Protection Agency (EPA) Region III, National Enforcement Investigations Center (NEIC) personnel investigated Fike Chemicals, Inc. (Fike), Coastal Tank Lines, and the jointly owned Cooperative Sewage Treatment, Inc. (CST) facilities [Figure 1]. The primary objectives of that study were to identify and quantify all toxic chemicals discharged to the Kanawha River from these plants. These data were also used to determine compliance with the NPDES permit for the CST facility.<sup>1</sup>

As a result of the 1977 survey findings and those of other regulatory investigators, the State entered into a consent decree with Fike on September 12, 1978. Coastal Tank Lines sold their interest in the CST to Fike shortly before this date. The consent decree and subsequently issued permits required:

1. In-plant segregation of various waste streams;
2. CST modifications;
3. Prohibition of priority pollutant discharges from the CST; and
4. Prohibition of discharges to existing toxic waste disposal lagoons until rehabilitation is effected.

Neither the consent decree nor the permits address the disposal and/or burial of hazardous wastes on plant grounds.

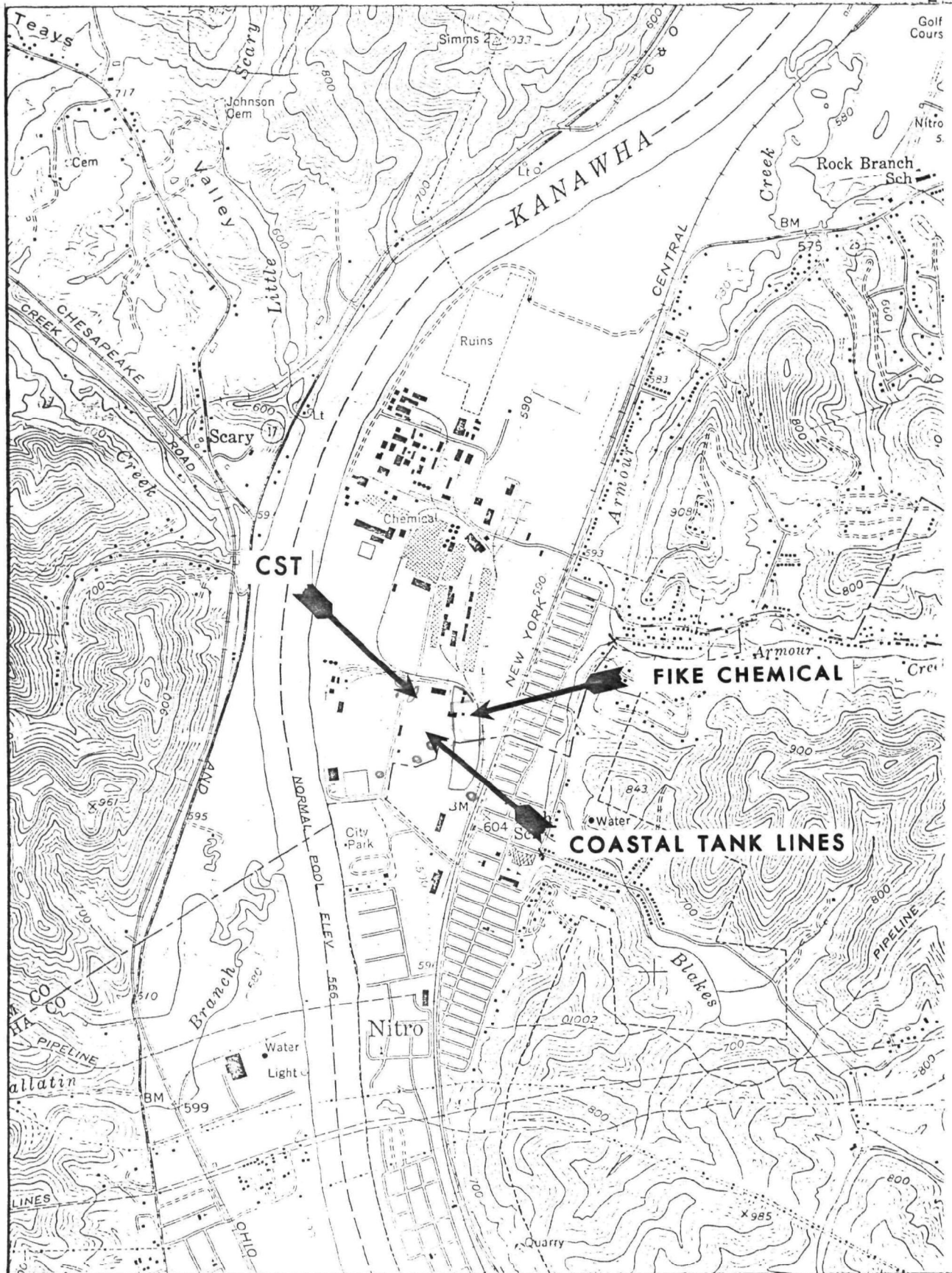


Figure 1. Location Map – Nitro, West Virginia

On August 28, 1979, EPA Region III requested NEIC to again investigate the Fike and CST plants to assess progress toward pollution control and abatement. Also, the Region wanted an evaluation of possible hazards and potential environmental impacts posed by these plants. At the time of this request, the consent decree regarding wastewater discharges and liquid waste disposal practices was still in effect with expiration on October 31, 1979.

During December 11 through 14, 1979, and on February 18, 1980, NEIC personnel investigated the Fike production and CST facilities to determine compliance with applicable State and Federal regulations. The primary objectives were to evaluate: (a) waste disposal practices, (b) the potential for offsite hazards resulting from these disposal practices, and (c) possible environmental impacts.

To accomplish these objectives, the NEIC investigation addressed:

1. Plant production;
2. Wastewater treatment;
3. Hazardous/toxic materials handling and disposal practices;
4. Onsite pollutant identification;
5. Avenues for offsite contaminant migration; and
6. Potential toxicity and health effects of identified pollutants.

A summary of the survey findings and conclusions follow.



## II. SUMMARY AND CONCLUSIONS

### SUMMARY OF INVESTIGATION

To determine current wastewater pollution control practices, Fike personnel were interviewed to obtain information regarding plant production, the status of wastewater treatment plant (CST) modifications, and present treatment procedures. Methods of handling hazardous and toxic wastes were ascertained through a site inspection and evaluation. Possible offsite hazards and environmental impacts posed by hazardous materials handling and disposal were assessed through sample collection and evaluation of the avenues by which pollutants could move offsite.

NEIC personnel collected 13 liquid/soil samples and 7 air samples. The liquid/soil sampling stations included the CST discharge, an old toxic waste disposal lagoon, groundwater monitoring wells, and areas potentially contaminated by spilled process wastes or raw materials. Air sampling stations included on and offsite locations at both the production facility and the CST. All samples were analyzed for organic compounds with emphasis on priority pollutants, toxic substances and compounds with readily available standards. Three liquid samples were analyzed for mutagenicity and one for metals. The compounds detected in the samples were evaluated for their toxicity and health effects on both humans and animals by searching established computer data bases. Compounds identified during the NEIC investigation were representative of samples collected. They were not, however, necessarily representative of additional contaminants stored in deteriorating drums, previously buried onsite, or of soil contamination in locations not sampled.

### Wastewater Pollution Control Practices

Fike has ceased production of 27 chemical compounds and added 12 since

the 1977 survey. Most of the processes that resulted in the discharge of priority pollutants from the CST have been eliminated. The CST is being modified to incorporate powdered activated carbon treatment, settling, and aeration upstream of the existing oxidation ditch. The ditch is followed by alum and polymer addition, settling, activated carbon columns, and final chlorination. The aeration basin and settling tank which follow initial carbon treatment were not complete and operational in December 1979. The oxidation ditch may be contributing pollutants to groundwater since it is not lined to prevent seepage.

During the December 11 to 14 inspection, the CST was discharging to the Kanawha River through both permitted Outfall 001 and a non-permitted storm sewer (storm water runoff) bypass via a drainage ditch. The permitted discharge contained 14 identifiable organic compounds and 11 metals. Of these, three organic compounds and four metals are priority pollutants (2,4,6-trichlorophenol, phenol, toluene, copper, nickel, lead, and zinc). The 2,4,6-trichlorophenol, toluene, copper, nickel, and zinc are categorically prohibited in the effluent by the State discharge permit. The storm water bypass discharge was found to contain nine identifiable organic compounds. Three of the nine are priority pollutants including phenol, toluene, and ethylbenzene. The bypass is prohibited by both Federal NPDES and State discharge permits under weather and flow conditions present during the survey period. Standard Ames mutagenicity tests conducted on samples of these discharges were inconclusive due to toxic effects on the test bacteria.

#### Hazardous and Toxic Waste Handling

Historically, hazardous wastes were either discharged to three non-lined evaporation/percolation lagoons, buried onsite, or discharged directly to plant grounds by spillage and other poor housekeeping practices. Two of the three disposal lagoon sites have been reclaimed. The sludge from the larger one was removed to a new onsite lined lagoon while that in the other was buried in place. Discharge to the remaining disposal lagoon

was discontinued in January 1979 a State permit issued subsequent to the consent decree required termination on October 11, 1978.

Company personnel reported that five pits, excavated in the vicinity of the disposal lagoons, each contain between 100 and 200 barrels of chemical wastes. The pits were covered with soil after they were filled with drums. Waste burial was reported to have been discontinued shortly after the 1977 survey. Several hundred drums containing raw and waste chemical materials are presently stored onsite including those containing several thousand kilograms of metallic sodium.

As noted in 1977, general housekeeping at the plant continues to be poor. Deteriorated drums releasing chemical contents, areas of chemical spills, leaks, and contaminated soils were noted throughout the plant. Strong chemical odors at both the production facility and the CST required NEIC personnel to use cartridge respirators as a safety precaution.

Surficial liquid/soil samples collected from plant grounds contained a total of seven organic compounds. Two of these, toluene and bis (2-ethylhexyl) phthalate, are priority pollutants. Toluene was detected at a concentration of 1500 ppb in a pool of rainwater runoff over one of the known drum disposal pits. Approximately 15 m (50 ft) south of this pool, runoff was draining into a hole in the ground. The hole probably feeds an old sewer system which predates Fike. Whether the runoff is carried into Fike's storm sewer or to some other point of discharge is not known.

Bis (2-ethylhexyl) phthalate, a priority pollutant, was detected in sludge from the remaining old disposal lagoon at a concentration of 160 mg/kg. Another chemical, tetrahydrofuran was identified in all surficial liquid samples from the plant grounds.

#### Offsite Pollutant Movement

Surface Water - Discharges of priority pollutants and other contaminants to the Kanawha River from the permitted CST effluent and the

non-authorized storm sewer bypass, via drainage ditches, were documented during this survey. Contaminated groundwater discharging to the river probably contributes additional toxic chemicals from Fike.

Groundwater - Three groundwater monitoring wells were installed in the vicinity of the disposal lagoons and drum burial areas between 1976 and 1978. All wells are about 16 m (54 ft) deep with the bottom 4.6 m (15 ft) of casing slotted for water entry. Aquifer materials have entered the casings and filled them to above the slotted section. Company personnel normally purge approximately 20 liters (5 gal) from each well prior to sample collection. Small purge volumes, such as this, substantially increases the chance for analysis of stagnant water in casing storage. This water would be expected to have lost some volatile and less stable compounds. Even so, company data indicate groundwater degradation at all well sites.

The Company plans to install additional wells to monitor subsurface pollutant movement as required by the disposal lagoon operating permit. To be useful for future monitoring; the existing wells need to be cleaned and appropriately screened to prevent encroachment of aquifer materials.

Samples collected from these wells during the December inspection, revealed 31 organic compounds in the groundwater. Fourteen of these are priority pollutants and include:

phenol	1,2,-dichloroethane
toluene	chloroform
ethylbenzene	1,2-trans-dichloroethylene
bis (2-ethylhexyl) phthalate	methylene chloride
bis (2-chloroethyl) ether	tetrachloroethylene
bis (2-chlorisopropyl) ether	butylbenzyl phthalate
benzene	trichloroethylene

All well samples contained priority pollutants with concentrations ranging from a low of 22 ppb benzene to a high of 6,000 ppb bis (2-chloroethyl) ether; both occurred in the well located approximately 6 m (20 ft) west of the remaining old disposal lagoon. The Standard Ames mutagenicity test conducted on this well sample was inconclusive due to toxic effects on the test bacteria.

Only one of the priority pollutants listed above, bis (2-ethylhexyl) phthalate, was identified in the disposal lagoon. Observed variances in compounds detected in the disposal lagoon and the monitoring wells suggest multiple groundwater pollutant sources and/or a single source whose chemical content varies over time. As previously noted, the Company has buried chemical wastes which could be a major source of detected groundwater contaminants.

Rainfall [114 cm (45 in)/yr] and permeable alluvial materials promote pollutant leaching from the buried hazardous chemical wastes and disposal lagoons as evidenced by the monitoring well data. Although the leaky toxic waste disposal lagoons are being eliminated, the buried chemical wastes have not been subjected to remedial actions. The underlying Kanawha River alluvial aquifer has been a major water source for local industries. The presence of toxic chemicals in this aquifer constitutes a hazard to present and potential users of groundwater in this area.

Air - Ambient air samples collected both on and offsite contained 27 organic chemicals including nine priority pollutants. Priority pollutant concentrations ranged from a low of 0.1 ppb trichloroethylene to a high of 27 ppb toluene. Eight of the nine priority pollutants, methylene chloride, chloroform, benzene, toluene, ethylbenzene, bis (2-chloroethyl) ether, and tetrachloroethylene, were also detected in the liquid/soil samples from Fike and the CST. Consequently, these airborne priority pollutants are attributed to Fike. Prevailing southwesterly winds would carry these toxic chemicals into nearby [approximately 0.40 km (0.25 mi)] residential areas.

#### Toxicity and Health Effects

Sixty-two organic compounds, including 16 priority pollutants and 4 priority pollutant metals were identified in samples collected at Fike and the CST. Analytical data were reviewed by the NEIC toxicologist to assess potential hazards to human health and the environment. Chemicals present in groundwater make it unfit for human consumption due to an unacceptably high cancer risk and a number of other potential adverse health effects.

Also, since there are no generally accepted safe levels of airborne carcinogens for long term exposure, Nitro residents living downwind from Fike have an elevated risk of cancer and other health problems due to air emissions.

### CONCLUSIONS

1. During the study period, the CST was discharging priority pollutants in excess of the amounts allowed by the State Water Pollution Control Permit.
2. A bypass discharge of untreated wastewater from the CST was observed which was prohibited by both Federal and State Discharge Permits.
3. Buried hazardous and toxic wastes, as well as these disposed in evaporation/percolation lagoons, are leaching into groundwater.
4. Pollutants were documented moving offsite via surface water, groundwater, and air.
5. Goundwater in the immediate vicinity of Fike has been rendered unfit for human comsumption because of high carcinogen concentrations and other chemicals known to cause adverse health effects.
6. Airborne carcinogens and chemicals known to cause adverse health effects are carried by prevailing winds into adjacent Nitro neighborhoods.
7. Corrective measures must be initiated by Fike to abate the release of hazardous and toxic chemicals to the environment from the CST, buried wastes remaining disposal lagoon, chemical spill areas, and process emissions.

### III. PLANT PRODUCTION AND WASTE DISPOSAL PRACTICES

#### PRODUCTION

As previously noted, Fike specializes in the development of new chemicals, speciality chemicals, byproduct recovery and custom manufacturing. In 1977, during the previous NEIC survey, more than 50 different chemicals were produced.\* Since that time, 27 chemicals have been dropped from production [Table 1] and 12 new ones have been added [Table 2]. Most of the products which resulted in the discharge of priority pollutants have been eliminated to comply with the consent decree and discharge permit limitations. Presently, about 41 chemicals are manufactured including three added to production in January 1980 [Table 2]. Twenty-four of the 41 compounds presently manufactured result in liquid/solid waste production.

#### PREVIOUS WASTE DISPOSAL PRACTICES

Historically, liquid/solid wastes have been disposed of in three ways. Wastewaters considered to be treatable have been discharged to the CST oxidation ditch which was constructed as a joint venture by Fike and Coastal Tank Lines, Inc. Most wastewaters considered to be non-treatable were disposed of in evaporation/percolation lagoons located on plant grounds. Used drums, still bottoms, and various reaction by-products were buried in pits excavated on plant grounds. The normal practice was to dig a pit in the southern area of the plant, place drummed wastes into it and then backfill with soil. Before backfilling, many drums rusted through and released the contained wastes.<sup>1</sup>

During the 1977 study, the CST discharge to the Kanawha River contained eight priority pollutants (anthracene, phenanthrene, phenol,

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\* See Table 2 in reference number 1.

Table 1  
 CHEMICAL PRODUCTS ELIMINATED SINCE OCTOBER 1977  
 FIKE CHEMICALS, INC.  
 December 1979

Product	Associated Liquid Waste
Diphenolthiourea	Yes
Diammonium ethylene biscarbamate (Amdeam)	No
BCES (butyl carboethoxyethyl sulfide)	No
Bexide-EX0 (bis ethyl xanthogen)	Yes
Bristamine base	Yes
CMA	Yes
CMA-MIBK Mix	No
Diisopropyl carbodaime	Yes
Dimethyl acetoacetamide	No
Dimethyl phosphonate	No
Galvaplan	No
Glutaric anhydride	No
Hexamethyl phosphoramidate (HEMPA)	No
Latex sensitizer #3	Yes
Mercaptothiazoline	Yes
Millroom grinding - santowhite	No
N-acetyl ethanolamine (NAE)	Yes
Orthobenzylphenol (OBP)	Yes
PXD (bis isopropyl xanthogen)	Yes
R-2 Crystals (N methylene piperidinium cyclopentamethylene dithiocarbamate)	Yes
RWA 50 (sodium butyl o-phenyl phenol)	Yes
RWA 375 (butyl phenyl phenol sodium sulfonate)	Yes
R2-50 (50% solution N'N dibutylammonium N'N' dimethyl-cyclohexyldithiocarbamate)	No
RZ 100	No
Tetramethyl thiourea	No
Thioacetamide	Yes
Trimethyl thiourea	Yes



LISTING OF PRODUCTS MANUFACTURED BY FIKE CHEMICALS, INC.  
December 1979

Product	Liquid Waste Produced
<u>Group A<sup>a</sup></u>	
Allyl cyanide	Yes
Benzyl mercaptan	Yes
Butyl Ziram (zinc dibutyldithiocarbamate)	Yes
Cutain II (mixture of propylene thiourea and thiourea)	No
Cyclohexylamine	Yes
Dibutyl thiourea	No
Diethyl thiourea	No
Diisopropyl thiourea	Yes
Dimethylamine hydrochloride	No
Dimethyl thiourea	No
Di-o-tolyl thiourea ( $\alpha$ dimethyl thiocarbanalide)	Yes
Dithiooxamide (DTO)	Yes
EMI-24 (2 ethyl 4 methyl imidazole)	No
Ethanedithiol	Yes
Ethylene thiourea	Yes
Ethyl fluoroacetate	Yes
Fluoracetamide	Yes
Methoxy triglycol acetate	Yes
Methyl Ziram (zinc dimethyl dithiocarbamate)	Yes
Propylene Thiourea	Yes
R-235 (diethyloxadiazene thione)	Yes
R-240 (dimethyl oxadiazene thione)	Yes
ROCURE-7 (polyethylene tetrasulfide)	Yes
Sodium amide	No
Sodium fluoracetate	Yes
Sodium methylate	No
Sodium nickel cyanide	Yes
trichloromelamine	Yes
Vin Vat B-1 (mixture of sodium nickel cyanide and sodium formaldehyde sulfoxolate)	Yes
<u>Group B<sup>b</sup></u>	
Cresol disulfide	Yes <sup>c</sup>
Bi-phenol A and Methanol blending	No
Tall oil residue and fatty acids blending	No
Tri methylamine hydrochloride	No
chloroisopropylphenylcarbamate (CIPC)	Yes
Isopropylphenylcarbamate (IPC)	Yes
p-Chlorophenyl N-methyl carbamate (124)	Yes
Solubilized A hydroxyquinoline (Nilate)	No
3,3', 4,4'-Benzophenonetetra carboxylic dianhydride	No
<u>Group C<sup>d</sup></u>	
Dichlorobutane	No
Dichlorohexane	No
Dichlorooctane	No

a Group A compounds were listed products during the previous NEIC survey (October 3 through 7, 1977).

b Group B compounds went into production following the previous NEIC Survey.

c Wastestream (HCl) packaged and sold as product to oil well drillers.

d Group C compounds added to production in January 1980.

isophorone, carbon tetrachloride, 1,1,2-trichloroethylene, tetrachloroethylene, dimethylnitrosamine).

Isophorone and phenol maximum concentrations were 3.3 and 1.8 mg/l, respectively. All other priority pollutants were detected in concentrations of less than 0.3 mg/l. NPDES permit limitations for pH, oil and grease, phenols, ammonia, and surfactants were exceeded during the five-day monitoring period. Mutagenicity tests showed that potential carcinogens were present in the discharge. Samples collected from the old evaporation/percolation lagoon (lagoon No. 1) contained five priority pollutants (phenol, chloroform, tetrachloroethylene, 1,1,2-trichloroethylene, and dimethylnitrosamine). Samples collected from onsite monitoring wells in the vicinity of lagoon No. 1 confirmed degradation of groundwater by pollutants identified in the pond. Various other organic contaminants were detected in the groundwater which were not identified in the disposal lagoon or were detected in one well but not another.

Following the 1977 NEIC study, the State of West Virginia entered into a consent decree with Fike. The decree and subsequently issued operating permits contained the following requirements:

1. CST modification including incorporation of powdered activated carbon treatment and construction of sludge drying beds.
2. Prohibition of priority pollutant discharges from the CST.
3. In-plant modifications to contain contaminated surface water and process wastes around mixing tanks, holding tanks, raw materials, storage areas, etc.
4. Sewer line modifications to segregate contaminated from non-contaminated waste streams,
5. Removal and proper disposal of waste materials from lagoons 1 and 2 followed by complete reclamation of lagoon number 1 and rehabilitation/abandonment of number 2 (Company option).
6. Prohibition of discharges to lagoons 1 and 2 prior to completion of remedial work.
7. Construction of a new properly lined lagoon (No. 3) to receive wastes formerly discharged to lagoons 1 and 2.
8. Construction of a groundwater monitoring well upgradient from the existing lagoons.

9. Monthly monitoring of groundwater monitoring wells.
10. Determination of the extent of waste material movement from lagoons 1 and 2.

Neither the consent decree nor the permits addressed the disposal and burial of liquid/solid wastes on plant grounds. The status of waste disposal practices during the current investigation is described in the following subsections.

#### PRESENT WASTE DISPOSAL PRACTICES

##### CST

On August 30, 1978, just prior to the issuance of the consent decree, Fike bought Coastal's interest in the CST and became sole owner and waste contributor to the facility. In October 1977, the treatment facility consisted of a flow equalization pond, followed by an oxidation ditch and a final settling pond [Figure 2]. As required by the consent decree, the plant was modified to incorporate activated carbon treatment and improve sludge handling capabilities [Figure 3]. The modified treatment plant will include the following process units upon completion:

1. Aerated activated carbon contact basin (former equalization basin--Pond 1);
2. Settling cone for Pond 1 discharge;
3. Aeration basin with settling chamber (former final settling basin--Pond 2);
4. Oxidation ditch with inner race used for primary settling of storm sewer flow;
5. Settling cone for oxidation ditch discharge. Preceded by alum and polyelectrolyte addition,
6. Two activated carbon columns operated in parallel;
7. Chlorine contact tank; and
8. Two covered sludge drying beds.

Pond No. 2 and the settling cone following pond No. 1 were under construction during the December 1979 investigation. Other process units were

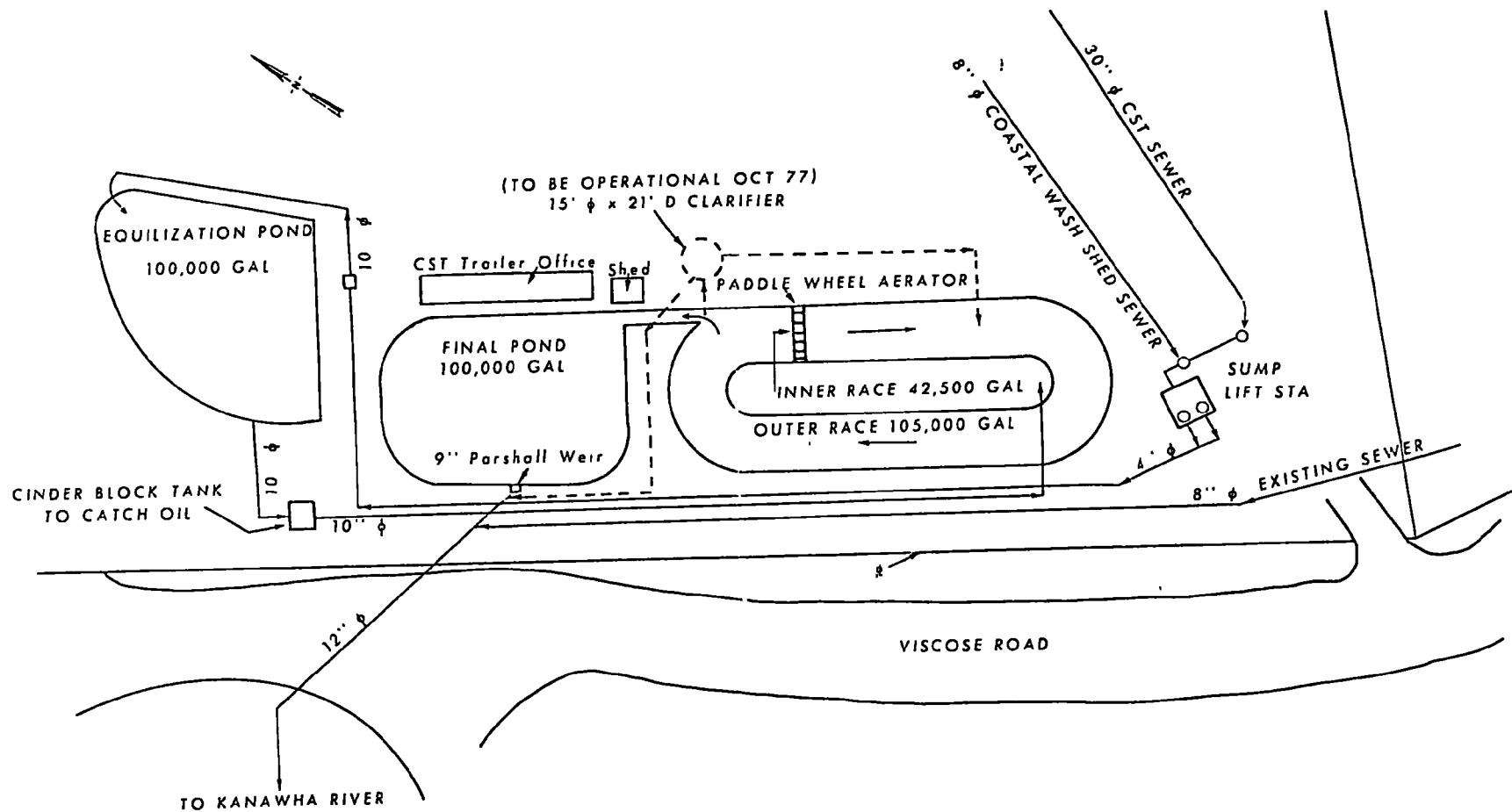


Figure 2. CST Biological Treatment for Fike Chemicals, Inc. (1977 Configuration)

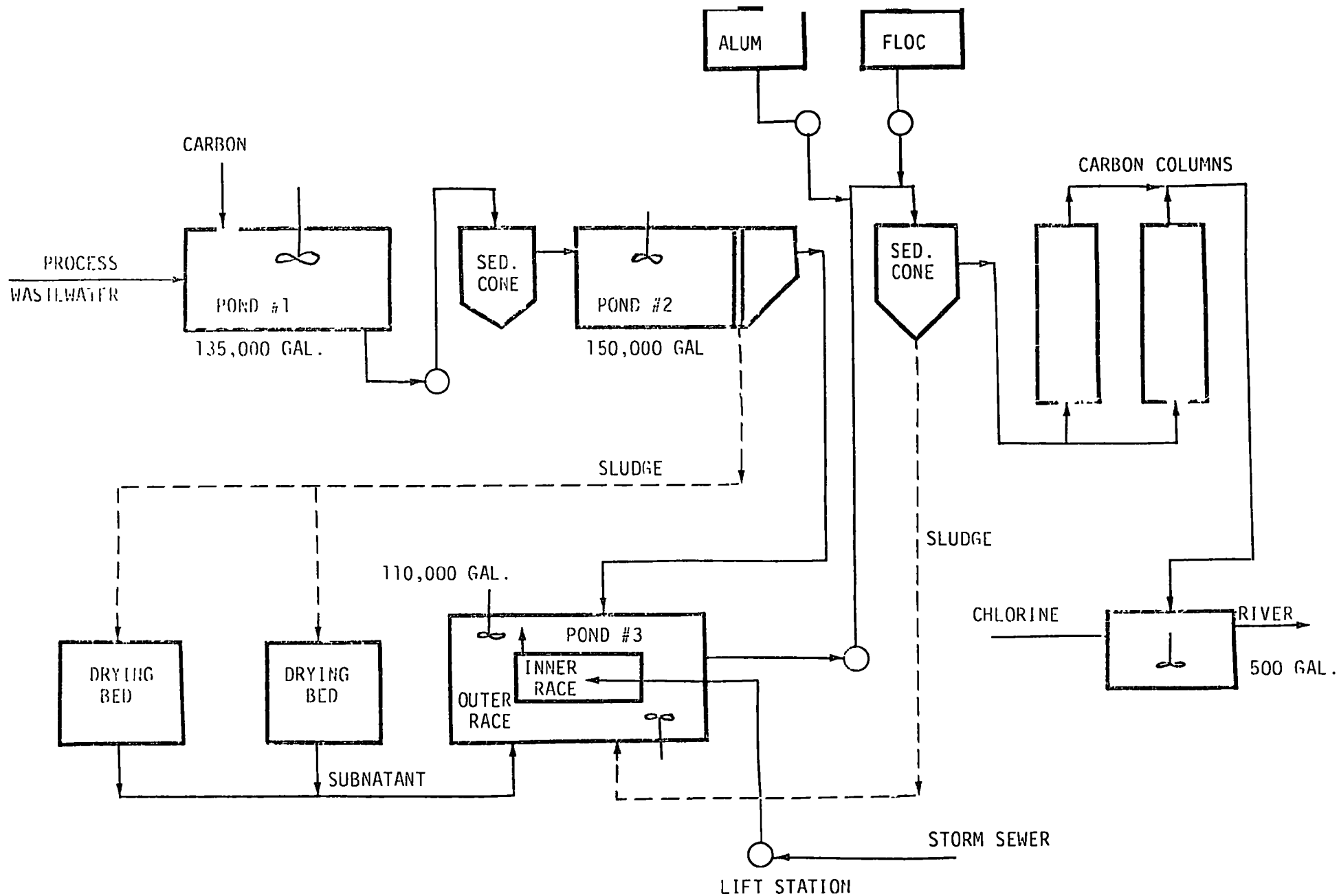


Figure 3  
CST Physical-Chemical Treatment Plant Schematic  
December 1979  
Fike Chemicals, Inc.

in place and operational except for the south activated carbon column which was out of service for repairs. Ponds 1 and 2 are concrete basins while the oxidation ditch is only lined with riprap to control erosion. The effluent from pond No. 1 was being pumped directly to the outer race of the oxidation ditch. Alum and polyelectrolyte are continuously added to the oxidation ditch effluent to improve sludge settling. Approximately 45 kg (100 lb) of alum and 2 kg (5 lbs) of polyelectrolyte are added to the waste stream daily. The settled sludge is recycled back to the outer race for several hours once/mo. Company personnel believe that most of the recycled sludge is alum rather than biological solids. Following the settling cone, the wastewater passes through two 3,600 kg (8,000 lb) activated carbon columns which are operated in parallel. The final effluent is chlorinated in a 1900 liters (500 gal) contact tank prior to discharge to the Kanawha River.

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Fike is  
source

When the plant is completed, effluent from the No. 2 pond will go to either the oxidation ditch or the settling cone which presently follows the ditch. Company personnel are considering elimination of the ditch or operating it in some other sequence in the treatment flow scheme.

Sewer lines within the production facility have been separated into a chemical line (process wastewater) and a storm sewer. The CST receives between 115 and 190 cu m/day (30,000 to 50,000 gpd) from Fike processes. Storm water received during low intensity rainfall is pumped to the inner race of the oxidation ditch. During high intensity rainfalls, the CST storm sewer lift station is shut down. The storm sewer and lift station wet well are allowed to overflow into surface ditches which drain to the Kanawha River. During the current survey, storm sewer flow was being bypassed in this manner. This discharge of non-treated wastewater is not authorized by either the NPDES or state discharge permit.

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B. ...  
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#### Evaporation/Percolation Lagoons

During the October 1977 NEIC inspection, two non-lined evaporation/percolation lagoons were present at the southern end of the plant [Figure 4].

Person



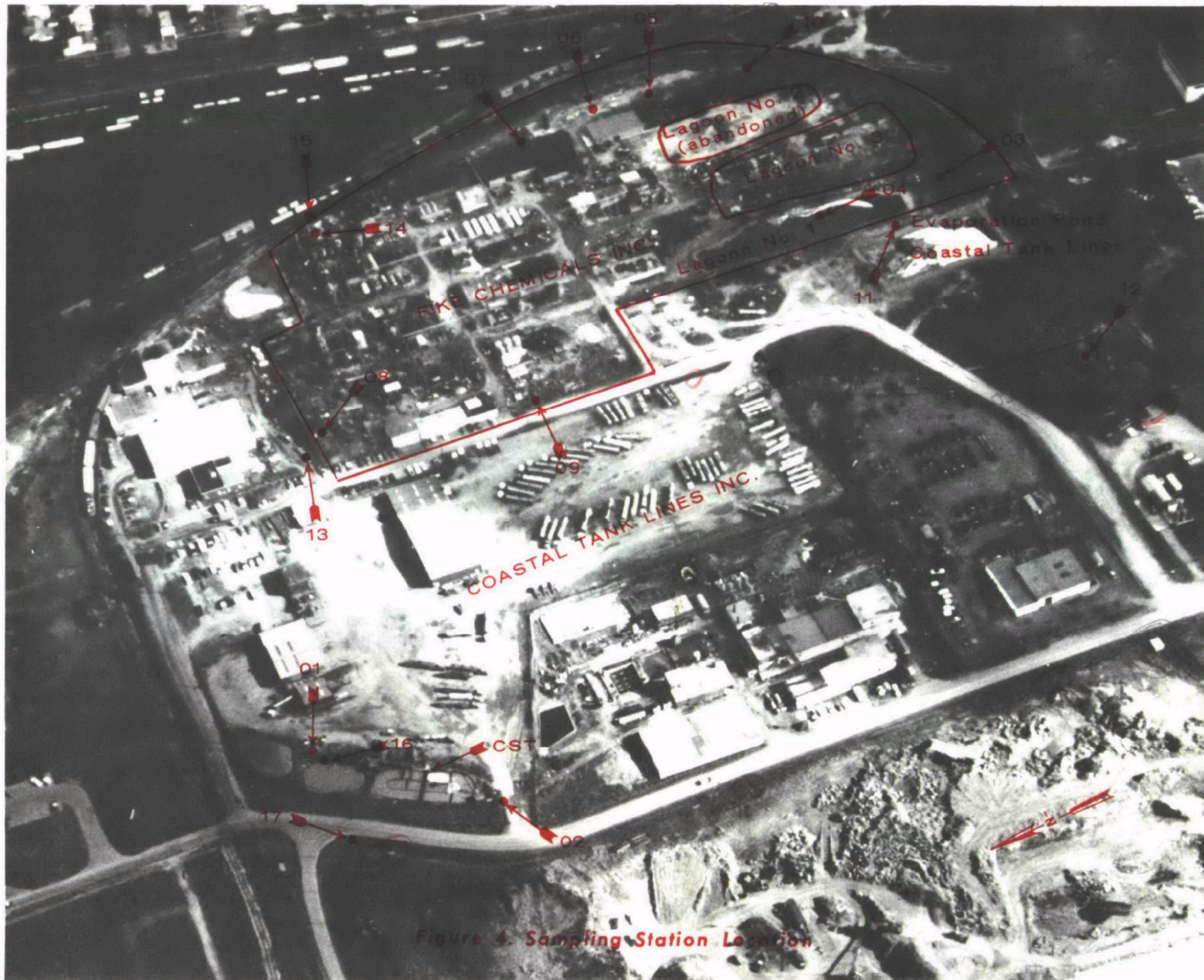


Figure 4. Sampling Station Location

Down  
Lead  
Pit 7  
City Property  
1200  
930

RR  
Altitude  
RR

597-28

St. Albans

7

Call 7-1-1

This area of the plant is underlain by permeable sandy floodplain materials characteristic of the area [See Section V: Offsite Pollutant Movement]. The eastern lagoon, designated as No. 1, was constructed in about 1969. Process wastewaters considered too toxic by Fike to be treated by the CST biosystem were being discharged to this lagoon for disposal. By design, disposal was accomplished through evaporation and seepage into the underlying aquifer. The lagoon has a capacity of approximately 650 cu m (170,000 gal).<sup>1</sup> In 1977, about 7.6 cu m (2,000 gal)/day was being discharged to it.<sup>1</sup> Discharge to lagoon No. 1 was terminated on January 9, 1979, according to Company personnel. The State Water Pollution Control Permit (IW-6017-78) required discharge termination on October 11, 1978. The smaller western lagoon was constructed just prior to the 1977 survey to receive transport cleaning wastes from Coastal Tank Lines. The capacity of this lagoon was determined from field measurements to be about 1,230 cu m (330,000 gal). State personnel reported that the western pond was back-filled with soil shortly after the previous NEIC survey. Company personnel stated that the disposed materials were not removed prior to reclamation.

In 1978, another non-lined lagoon was constructed some distance east of lagoon No. 1 [Figure 4] to also receive toxic process wastewaters from Fike for disposal. This lagoon was subsequently identified as lagoon No. 2.

In response to the consent decree and subsequently issued permits, a third lagoon (No. 3) was constructed between lagoons 1 and 2. The State permit (IW-6017-78) required that it be lined with 0.6 m (2 ft) of clay having a final compacted permeability of  $10^{-7}$  cm/sec. Prior to the December 1979, waste materials in lagoon No. 2 were transferred to No. 3. The area occupied by lagoon No. 2 was then backfilled and reclaimed as usable land.

Both lagoon Nos. 1 and 3 were full of liquid/solid wastes when observed in December 1979. Company personnel reported that about 7.6 cu m (2000 gal) of cyanide containing wastewater is discharged to lagoon No. 3 each week. This lagoon was equipped with a series of risers and spray



nozzles to enhance wastewater evaporation. Evaporation enhancement is necessary since water percolation through the bottom is severely restricted by the clay liner, and rainfall exceeds average lake evaporation by 33 cm/yr (13 in).<sup>2,3</sup> This system was not observed in operation during the inspection.

### Solid Waste Disposal

Company personnel stated that no pits have been excavated for waste disposal since the previous NEIC inspection in 1977. There are reported to be five pits in the vicinity of lagoon No. 3, each containing between 100 and 200 drums. The pits have all been backfilled. Several drums in one such pit, just east of warehouse No. 3, had collapsed and were observed as small water-filled pits [Figure 4, Station 06]. Currently, empty drums are sold for scrap or stored onsite. Some drums are filled with waste materials and raw materials not currently utilized in plant production. There are between 2,300 and 4,600 kg (5,000 and 10,000 lb) of sodium metal stored onsite in drums. The sodium will be used in product if a saleable chemical compound can be developed.

General housekeeping at the plant is poor. Drums, reactors, and other debris are scattered throughout the site. Many areas of chemical spills, leaks, and contaminated soils were noted. A plant worker was observed draining drums onto the ground. The liquid was reported to be a 95% water and 5% glycol solution. Other drums in the immediate vicinity had labels reading "Petroleum Naptha" and "IRMO" (toluene). Approximately 100 of these drums were stored on their sides on a concrete pad just east of warehouse No. 2 [Figure 4, Station 07]. The ends of several drums were bowed, apparently due to excessive internal pressures. Elsewhere, drums in various stages of deterioration are stored on the north and south sides of warehouse No. 3. Materials had leaked from several of these drums onto plant grounds. Vapors in this area were identified by Company personnel as fuming nitric acid emanating from an open carboy. In the barrel recycling and cleaning area, residual raw materials and wastes are routinely spilled on plant grounds. Strong odors throughout the plant required use of organic cartridge respirators by NEIC personnel as a safety precaution.

## GROUNDWATER MONITORING WELLS

In February 1976, two alluvial groundwater monitoring wells were installed on the west side of lagoon No. 1 [Figure 4, Stations 11 and 12]. Groundwater flow is generally to the west toward the Kanawha River, therefore these wells are downgradient from the disposal lagoons. The well adjacent to lagoon 1 is identified as well No. 1 [Figure 4, Station 11] by Company and State personnel for self-monitoring purposes. The other well is identified as well No. 2 [Figure 4, Station 12]. Another older well (No. 3), located in the production area, was once used for groundwater monitoring and is referenced in the 1977 survey report but has been abandoned because of pump failure and sand heaving into the casing. In response to a consent decree requirement, a fourth well (No. 4) was constructed "upgradient" from the lagoons in December 1978 [Figure 4, Station 10].

Wells 1, 2, and 4 were all constructed in the same manner by a local water well driller. An open 15 cm (6 in) diameter steel casing was driven into the ground and alluvial materials entering the casing were removed with a bailer. The bottom section of each casing had been slotted with a cutting torch prior to installation.

The total lengths of the casing and slotted section for each well are as follows:

Well Number	Casing Length [m (ft)]	Slotted Section [m (ft)]
1	16.2 (53.2)	4.6 (15)
2	16.7 (54.7)	4.6 (15)
4	16.7 (55.0)	4.6* (15)

\* The drillers records indicate no exact length of the slotted section, however, the driller stated that the length was between 4.6 and 6.4 m (15 and 21 ft).

Groundwater was encountered at a depth of approximately 6 m (20 ft) below the ground surface.

The casing slots were approximately 0.3 cm wide and 10 cm long (0.12 by 4 in). Grain size distribution data for Kanawha River valley alluvium in the Nitro area indicate that approximately 50% of the surrounding materials would be expected to pass through the casing slots.<sup>2</sup> Open hole measurements made on each well revealed that the slotted portion of the casings are filled with alluvial materials. In fact, the fill extends above the slotted section by 4.3 m (14 ft) in well No. 1, 0.67 m (2.2 ft) in No. 2 and 0.88 m (2.9 ft) in No. 4. Since water cannot be drawn directly from the slotted casing section, it would be necessary to purge several casing volumes in order to get a truly representative sample.

Monthly samples have been collected from wells 1, 2, and 4 since December 1978, as required by the State issued lagoon permit. No samples were collected in January 1979. Samples are collected with a bailer which is not routinely cleaned between wells. Usually, less than 20 liters (5 gal) of water is purged from the wells prior to sampling. This is approximately equal to 1 m (3.4 ft) of water in the casing and is much less than the generally recommended 3 to 5 casing volumes. Small purge volumes prior to sample collection in this situation substantially increase the chance for analysis of stagnant water in casing storage. The stagnant water would be expected to have lost some volatile and less stable compounds.

The samples are analyzed for pH, dissolved solids, suspended solids, phenol, COD, and chlorides [Table 3]. Despite the probable inherent errors in the data resulting from well design and sampling techniques, which would produce conservative results, all well data indicate groundwater degradation. It should be noted that these wells are downgradient or adjacent to disposal lagoons and drum burial areas. Degradation is suggested by pH values and COD, dissolved solids, chlorides and phenol concentrations. For example, the COD values compare with that normally measured in raw domestic sewage (on the order of 250 mg/l) not that of clean groundwater (less than 25 mg/l). The seemingly erratic suspended solids concentrations could be due to sample turbidity induced by agitation of the casing fill by the bailer. It should also be noted that the March and April 1979 data are remarkably similar (i.e., identical).

Table 3  
SUMMARY OF SELF-MONITORING DATA FROM GROUNDWATER MONITORING WELLS<sup>a</sup>  
Fike Chemicals, Inc  
December 1978 to January 1980<sup>b</sup>

Date	12/78	2/79	3/79	4/79	5/79	6/79	7/79	8/79	9/79	10/79	11/79	12/79	1/80
<u>Well No 1</u>													
pH	7.3	7.3	6.5	6.5	6.6	7.3	6.8	6.4	7.2	6.5	6.8	6.8	7.5
Dissolved Solids	2704	2538	2168	2168	634	2583	2115	698	2152.5	2260	2486	3292	1460
Suspended Solids	996	134	3520	3520	48	140	112	54	116.67	26	31.2	7492	400
Phenol	0.8	1.0	1.0	1.0	0.1	1.0	0.8	0.2	0.8	0	0	0.31	1.72
COD	276.8	684.7	633.7	634	125	468.6	570.6	113	390.5	541.2	595.3	179.9	180.5
Chloride	1304.2	84.4	844.2	844.2	119	80	76.7	209	66.67	2563.7	3076.44	640.9	631.3
<u>Well No 2</u>													
pH	6.3	7.5	6.8	6.8	6.7	7.5	7.3	6.6	7.3	6.4	6.4	6.5	6.6
Dissolved Solids	1180	1276	1972	1972	2400	1267	1160	2448	1055.8	834	792.3	1740	712
Suspended Solids	566	32	2436	2436	852	30	29.1	140	25	6	5.8	1764	32
Phenol	1.0	0.1	1.0	1.0	1.0	0.099	0.09	0.6	0.08	0	0	0.12	1.48
COD	138.4	532.6	588.4	588.4	89	356.2	484.2	76.6	297	426.4	469.04	114.5	30.1
Chloride	372.2	75	838	838	831	78	68.2	692.75	65	44.9	413.6	64.1	48.1
<u>Well No 4</u>													
pH	6.8	8.0	7.7	7.7	7.8	8.0	8.0	8.3	7.8	8.2	8.0	7.1	7.2
Dissolved Solids	160	704	364	364	432	740	640	258	616.07	392	344.96	312	348
Suspended Solids	28	44	60	60	208	40	40	146	33.33	4	9.96	3612	48
Phenol	0	0	0.05	0.05	0.1	0	0.00	0.02	0	0	0	0.17	1.66
COD	4359.6	76.1	256.5	256.5	499.5	75	69.2	454.5	90	164	144.32	147.2	45.1
Chloride	186.3	25	37.5	37.5	43.8	30	22.7	41.8	36	25.6	21.25	64.1	9.6

a All values reported as mg/l except pH which is reported in standard units (S U ).

b No sample results were located in Company files for January 1979.

Company personnel expressed concern about the suitability of these monitoring wells for future use in defining the extent of pollutant movement from the lagoons as required by the permit. Other well types and construction techniques are currently being explored by Company personnel. Some of this work has been misdirected. For example, grain size analyses have been conducted on sediment recovered from the monitoring wells, which was mistakenly believed to represent typical alluvial materials.

If the existing wells are to be used for future monitoring, they should be cleaned out and appropriately screened to prevent future encroachment of aquifer materials. New permanent well installations should be preceded by preliminary studies to locate the vertical position of the leachate plume. Offsite upgradient wells should be installed to obtain true background water quality and water level data.

#### IV. MONITORING PROCEDURES AND RESULTS

Onsite pollutant identification through sample collection and analysis was conducted as a precursor to evaluation of potential offsite hazards and environmental impacts. This section presents the procedures and results of that monitoring activity.

##### SAMPLE COLLECTION

The sampling survey involved a three-phase approach including: (1) site evaluation, (2) sample station selection and location, and (3) sample collection. On the basis of the site evaluation, twelve soil/liquid sampling points were selected [Table 4, Figure 4]. Selections of soil and pooled liquid sampling stations were based on qualitative judgments as to probable points of contamination or past dumping practices. The Stations were separated into two categories, environmental and hazardous, prior to sample collection based on a field assessment of the probable level of pollutants present. Smaller sample aliquots were collected from the "hazardous" sites for safety reasons and shipping requirements.

The smaller aliquot size and special laboratory analysis procedures resulted in compound detection at high concentrations only. A discussion of analysis and detection limits for all samples is presented in Appendix A. Environmental samples were collected from the CST discharges (Stations 01 and 02) and from the three groundwater monitoring wells (Stations 10, 11, and 12). Hazardous liquid samples were collected at Stations 03, 04, 06, and 09, and solids from Stations 04, 05, 07, and 08.

Ambient air samples were collected at seven sites [Table 4, Figure 4]. Sampling methodology included mechanically drawing ambient air through a glass column packed with Tenax,\* a porous polymer resin, with an MSA\*

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\* Trade name.

Table 4

SAMPLE COLLECTION AND SAMPLING STATION DESCRIPTIONS  
 FIKE CHEMICALS, INC.  
 Nitro, West Virginia

Station	Date	Time	Description
01	12/13/79	0930 to 1530	<p>CST final effluent just upstream from 7.6 cm (3.0 in) rectangular weir in discharge channel located on second floor of control building. Composite sample comprised of six equal volume aliquots manually collected at 0930, 1030, 1150, 1240, 1420, and 1530 hours.</p> <p>Effluent flow rates are monitored at the 7.6 cm (3.0 in) weir with a bubbler type head level sensor. The level is recorded on a circular chart in the plant control room. The flow rate during the sample compositing period was a constant 150 liters (40 gal)/minute based on a head level of 0.08 m (0.26 ft).</p>
02	12/13/79	1000	Overflow from storm sewer influent line to CST at manhole in roadway just outside the south gate to the storm sewer lift station.
03	12/13/79	1045	Pooled liquid in drum disposal pit at extreme southwest corner of plant.
04	12/13/79	1100	Composite sample of liquid from lagoon No. 1. Sample comprised of 4 aliquots collected at approximately equally spaced points along the eastern dike.
	12/13/79	1105	Composite sample of sediment from lagoon No. 1. Sample comprised of 4 aliquots collected at approximately equally spaced points along the eastern dike.
	12/14/79	1000 to 1030	Ambient air sample collected at ground level at center of lagoon No. 1 east dike.
05	12/13/79	1115	Surface soil sample between railroad tracks and southeast corner of concrete pad on south side of warehouse No. 3.
06	12/13/79	1125	Liquid sample from standing water over collapsed buried drums about midway between warehouse No. 3 and the east plant fence.

Table 4 (cont'd)  
 SAMPLE COLLECTION AND SAMPLING STATION DESCRIPTIONS  
 FIKE CHEMICALS, INC.  
 Nitro, West Virginia

Station	Date	Time	Description
07	12/13/79	1135	Surface soil sample from east side of concrete pad on east side of warehouse No. 2.
08	12/13/79	1205	Surface soil sample from drum storage area at north end of plant just across roadway from production area No. 2.
	12/14/79	0844 to 0859	Ambient air samples in drum storage area, as described above, approximately 1 m (1 yd) above ground level.
09	12/13/79	1220	Composite liquid sample from two small pools in open area on south side of plant analytical laboratory. Area previously used for disposal of laboratory wastes.
10	12/13/79	1630	Liquid sample from monitoring well at extreme southeastern corner of plant grounds. Identified as both No. 4 and upgradient well. Sample collected with bailer following withdrawal of 22 liters (5.7 gal) from casing storage.
11	12/13/79	1700	Liquid sample from monitoring well near the south end of the lagoon No. 1 west dike. Identified as well No. 2 in previous NEIC report <sup>1</sup> and well No. 1 by West Virginia Water Resources Division. Sample collected with bailer following withdrawal of 14.5 liters (4.8 gal) from casing, storage.
12	12/13/79	1730	Liquid sample from monitoring well located approximately 100 m (110 yds) west of Station 11. Identified as well No. 3 in previous NEIC report and well No. 2 by West Virginia Water Resources Division. Sample collected with bailer following withdrawal of 22 liters (5.7 gal) from casing storage.



Table 4 (cont'd)  
SAMPLE COLLECTION AND SAMPLING STATION DESCRIPTIONS  
FIKE CHEMICALS, INC.  
Nitro, West Virginia

Station	Date	Time	Description
13	12/14/79	0849 to 0919	Ambient air sample from point 15 m (50 ft) north of Station 08. Station located just off plant grounds.
14	12/14/79	0938 to 0953	Ambient air sample at north end of east plant fence near storage tanks. Sample collected approximately 1 m (1 yd) above ground level.
15	12/14/79	0938 to 0953	Ambient air sample at point 7.6 m (25 ft) east of station 14 off plant property. Sample collected at ground level.
16	12/14/79	1047 to 1117	Ambient air sample at point approximately 1 m (1 yd) above ground level near center of west outside wall of CST control building.
17	12/14/79	1047 to 1117	Ambient air sample from southwest quadrant of Viscose Road and Allied Chemical access road intersection. Sample collected approximately 0.5 m (1.5 ft) above ground level at fence line.

personnel sampler at the rate of one liter/minute. Wind conditions during ambient air sampling were calm to light westerly breezes.

Most sites were documented with photographs. Except for the liquid sample collected at Station 02\* and the air samples, all samples were split with Company personnel.

All samples were packed in locked ice chests and transported to the NEIC laboratory in Denver, Colorado. Whenever applicable, EPA approved procedures, as promulgated pursuant to Section 304 (h) of the Clean Water Act, were used in the analysis of samples. New methods or modifications to existing methods were documented and are retained on file with other records of this investigation. Throughout the course of the study (sampling through analysis and reporting), sample and document control for evidentiary purposes were maintained.

## MONITORING RESULTS

### CST

The 6-hour composite sample of the CST effluent discharge (Station 01) was analyzed for organics, including priority pollutants, selected metals, and mutagenicity. Mutagenicity tests were also conducted on the storm sewer bypass and monitoring well No. 1 (Stations 02 and 11, respectively). Mutagenicity results are presented following the monitoring well section.

The CST permitted discharge was found to contain seven priority pollutants, 2,4,6-trichlorophenol, phenol, toluene, copper, nickel, lead, and zinc [Tables 5 and 6]. The 2,4,6-trichlorophenol and phenol were detected in concentrations of 1,000 and 2,000 ppb, respectively. The

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\* Company personnel collected a sample at station 02 approximately 1 hour before NEIC and declined the split.

Table 5  
SUMMARY OF ORGANIC ANALYSIS  
Results for CST and Groundwater Samples  
FIKE CHEMICALS, INC.  
December 13, 1979

Station	01 CST Effluent	02 Storm Sewer Bypass	10 Well No. 4	11 Well No. 1	12 Well No. 2
Concentration (ppb)					
<u>Priority Pollutant Compounds<sup>a</sup></u>					
benzene				22	>790
butylbenzylphthalate					90
chloroform				73	>2100
1,2 dichloroethane					96
1,2-trans-dichloroethylene				18	
bis (2-chloroethyl) ether			60	6000	
bis (2-chloroisopropyl) ether				2000	
✓ ethylbenzene		150		450 <sup>b</sup>	
methylene chloride				84 <sup>b</sup>	3700 <sup>b</sup>
✓ phenol	2000	1000	30		
bis (2-ethylhexyl) phthalate			50		200
tetrachloroethylene				81	31
trichloroethylene				77	
✓ toluene	18			150	
2,4,6-trichlorophenol	1000	82			
<u>Non-Priority Pollutant Compounds<sup>c</sup></u>					
aniline <sup>d</sup>	X				
4-hydroxy-4-methyl-2-pentanone			X		
✓ tetramethylthiourea				X	
9H-xanthen-9-one, hydroxyisomer					X
2-ethylhexanoic acid	X	X			
N-cyclohexylformamide	X				
✓ N,N'-bis (1-Methylethyl)urea	X			X	
benzoic acid	X				
3-chlorophenol	X				

Table 5 (cont'd)  
SUMMARY OF ORGANIC ANALYSIS  
Results for CST and Groundwater Samples  
FIKE CHEMICALS, INC.  
December 13, 1979

Station	01 CST Effluent	02 Storm Sewer Bypass	10 Well No. 4 Concentration (ppb)	11 Well No. 1	12 Well No. 2
1-methylethylphenyl carbamate	X				
3-(butyl thio)propionic acid	X			X	
p-cresol			X	X	
benzeneacetic acid			X	X	
phenylthiocyanate				X	
2,6-dimethylphenol				X	
dimethylphenol isomer				X	
methylethyl phenol isomer				X	
chlorophenol isomer		X		X	
hexamethylphosphoric triamide				X	
N-phenylformamide				X	
2-propenylbenzeneacetate				X	
pentanedinitrile		X			
1-ethyl-3-piperidone		X			
2 methoxyphenol		X			
1-methylethyl(3 chlorophenyl)carbamate		X			
4-methyl-2-pentanone	X				
methoxybenzene	X				
cyclohexane		X			
cyclohexanone		X			
tetrahydrothiophene			X		
bis (2-chloroethyl) ether <sup>e</sup>			X	X	
tetrahydrofuran					X
bis (1-chloroisopropyl) ether					X

a Samples were analyzed for all organic priority pollutants except bis(chloromethyl)ether, n-nitrosodimethylamine, and 2,3,7,8-tetrachlorodibenzodioxan.

b Methylene chloride was used to clean bailer prior to sampling of these wells.

c All compounds were identified but not quantified.

d Presence was verified with standard compound.

e This compound is a priority pollutant. It was measured quantitatively in a different analytical fraction.

Table 6  
METAL ANALYSIS RESULTS FROM CST EFFLUENT  
FIKE CHEMICALS, INC.  
December 13, 1979

Metal	Concentration (mg/l)	Detector Limit (mg/l)
Ag <sup>a</sup>	N.D. <sup>b</sup>	0.002
Al	3.55	0.027
Ba	N.D.	0.0007
Be <sup>a</sup>	N.D.	0.0006
Ca	41.4	0.008
Cd <sup>a</sup>	N.D.	0.002
Cr <sup>a</sup>	N.D.	0.006
Cu <sup>a</sup>	0.894	0.002
Fe	1.19	0.015
Mg	4.56	0.016
Mn	0.293	0.002
Mo	N.D.	0.028
Na	4,500	0.021
Ni <sup>a</sup>	0.790	0.030
Pb <sup>a</sup>	0.052	0.019
V	0.010	0.006
Zn <sup>a</sup>	0.014	0.002

a Designated as a priority pollutant.

b N.D. means not detected.

State Water Pollution Control Permit (IW-6043-79) for the CST contains the following requirement in Part A, "Effluent Limitations and Monitoring Requirements":

"There shall be no discharge in excess of trace amounts of any of the priority pollutants presently listed under, or included in the future under Section 307 of the Federal Water Pollution Control Act, as amended 1977, P.L. 92-500 (The Clean Water Act of 1977) with the exception of those listed in this permit."

The priority pollutants listed in the permit include phenol, arsenic, cadmium, lead, mercury, and hexavalent chromium. Those priority pollutants detected in the discharge which are categorically prohibited by the permit are:

2,4,6-trichlorophenol  
toluene  
copper  
nickel  
zinc

Ten additional non-priority pollutant organic compounds were identified in the discharge, but were not quantified. Seven non-priority metals were also identified in the discharge. Sodium was detected at a concentration of 4,500 mg/l [Table 6].

The bypass discharge sample was analyzed for organic compounds including priority pollutants. This discharge was found to contain the priority pollutants phenol, toluene, and ethylbenzene at concentrations of 1000, 82, and 150 ppb, respectively [Table 5]. Six non-priority pollutant organic compounds were also detected in the sample [Table 5]. Both the Federal NPDES (WV 0001651) and State discharge permits for the CST prohibit bypassing except under unusual circumstances such as when loss of life or severe property damage is imminent. These conditions were not present during this survey.

### Groundwater Monitoring Wells

Samples were collected from the three onsite groundwater monitoring wells with a clean 1.45 liters (0.383 gal) stainless steel bailer [Table 4 and Figure 4, Stations 10, 11, and 12]. Purge volumes were minimized because of the reconnaissance nature of the survey and the potential for contamination of surficial materials by large quantities of polluted groundwater. The samples were analyzed for organics, including priority pollutants.

In total, 14 priority pollutants were identified in the three monitoring wells, including three in the "upgradient" well [Table 5]. The priority pollutants detected are:

phenol	1,2-dichloroethane
toluene	chloroform
ethylbenzene	1,2-trans-dichloroethylene
bis (2-ethylhexyl) phthalate	methylene chloride*
bis (2-chloroethyl) ether	tetrachloroethylene
bis (2-chloroisopropyl) ether	trichloroethylene
benzene	butyl benzyl phthalate

Concentrations ranged from a low of 22 ppb benzene to a high of 6000 ppb bis (2-chloroethyl) ether, both in well No. 1. An additional 19 non-priority pollutant organic compounds were also detected, including five in the "upgradient" well.

### Mutagen Testing

The Ames standard bacterial assay for mutagenicity was performed on liquid sample concentrates from Stations 01, 02, and 11. The mutagenicity test did not demonstrate mutagenic activity in any of the three samples. All of the concentrated sample extracts exhibited toxicity to one or another of the five Salmonella test strains. The inability to detect mutagenic activity in the samples does not necessarily mean that these substances are absent, but that the mutagenic effect may be below the

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\* Used to clean bailer between sampling stations. Possible contamination of samples may have resulted.

detection limit of the test system used. The testing procedures and results are presented in more detail in Appendix B.

### Surficial Liquid Samples

Surficial liquid samples were collected from four stations on plant grounds [Figure 4, Stations 03, 04 06, and 09]. The samples were analyzed for organics only.

A total of six compounds were identified in the samples from these stations (toluene, tetrahydrofuran, cyclohexene, carbon disulfide and hexane) [Table 7]. The sample from Station 06 contained the priority pollutant, toluene, at a concentration of 1,500 ppb. All samples contained tetrahydrofuran. This compound was also identified in well No. 2 [Table 5, Station 12].

About 15 m (50 ft) south of Station 06, runoff was flowing into a hole in the ground approximately 0.3 m (1 ft) in diameter. Fike is located on the site of a World War I smokeless powder plant.<sup>4,5</sup> The hole probably drains into the old sewer system, part of which is currently used by Fike to convey stormwater. Whether the runoff flows into Fike's storm sewer or to some other point of discharge is not known.

### Solids Samples

Solids samples were collected at Stations 04, 05, 07, and 08. Only the sediment sample from lagoon No. 1 (Station 04) contained detectable organics. The single compound identified, bis (2-ethylhexyl) phthalate, was found in the concentration of 160 mg/kg. This compound, a priority pollutant, was also detected in well Nos. 2 and 4, but not in No. 1, as might be expected due to its proximity to the lagoon.



Table 7  
SUMMARY OF ORGANIC ANALYSIS  
RESULTS FOR "SURFICIAL" WATER SAMPLES  
FIKE CHEMICALS, INC.  
December 13, 1979

Station Organic Compounds	03 Pooled Water in drums dis- posal pit	Concentration (ppb)		09 Pooled water in lab waste disposal area
		04 Lagoon No. 1	06 Pit above burial drums	
toluene <sup>a</sup>	b		1500	
tetrahydrofuran	PNQ <sup>c</sup>	PNQ	PNQ	PNQ
cyclohexene		PNQ		
carbon disulfide			PNQ	
Oxirane			PNQ	
Hexane			PNQ	

a Designated as a Priority Pollutant.

b No result means not detected.

c Present but not quantified.

### Ambient Air Samples

As previously noted, both on and offsite ambient air samples were collected at Fike and the CST. Twenty-seven chemicals were measured in the samples [Table 8]. Nine priority pollutants were detected including methylene chloride, chloroform, trichloroethylene, benzene, toluene, ethylbenzene, 1,1,1-trichloroethane, bis (2-chloroethyl) ether, and tetrachloroethylene. All priority pollutants except 1,1,1-trichloroethane were detected in the solid/liquid samples collected at Fike and the CST. Priority pollutant concentrations ranged from 0.1 ppb (trichloroethylene at Station 04) to 27 ppb (toluene at Station 08). The priority pollutants methylene chloride, benzene, toluene, trichloroethylene, and ethylbenzene were detected in no less than six of the seven ambient air samples.

On and offsite ambient air sampling stations were selected as a series of two station sets. The sets were comprised of the following pairs:

Onsite Station	Offsite Station
08	13
14	15
16	17

The onsite samples show generally higher pollutant concentrations than the offsite samples. The largest concentration differences were exhibited by the priority pollutants methylene chloride and toluene [Table 9]. The consistency and magnitude of the concentration differences strongly suggest that Fike is the source of these airborne contaminants. Toluene is used as a raw material by Fike. It should be noted that several industries in the vicinity produce organic chemicals and that possibly not all of those compounds detected can be attributed to the Fike plant. One such compound, anisole, identified at Stations 04 and 16, is produced at the Chemical Formulators plant located just south of the CST.<sup>6</sup>

Table 8  
SUMMARY OF ORGANIC ANALYSIS RESULTS FOR AIR SAMPLES  
FIKE CHEMICALS, INC  
December 14, 1979

Name	04	08	Sample Station (Concentration in ppb)				17	Blank <sup>a</sup>	Det. Limits <sup>b</sup>
			13	14	15	16			
methylene chloride <sup>d</sup>	0.26	3.6	0.80	6.8	1.8	3.5	2.2	0.09	0.1
acetone	ND <sup>c</sup>	8.0	4.6	5.9	ND	12	ND	ND	0.2
1,2-trans-dichloroethylene <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	0.06
chloroform	0.21	ND	ND	ND	ND	ND	ND	ND	0.04
1,2-dichloroethane <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	0.07
trichloroethylene	0.10	0.14	0.13	0.16	0.13	0.11	ND	ND	0.07
benzene	0.90	1.3	1.3	1.3	1.1	1.2	1.2	0.04	0.04
n-hexane	1.8	ND	ND	1.2	0.87	1.2	1.0	ND	0.05
toluene	1.2	27	5.3	3.8	3.2	2.0	1.5	ND	0.03
chlorobenzene <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	0.04
ethylbenzene <sup>d</sup>	0.15	ND	0.28	0.48	0.26	0.53	0.21	ND	0.02
2-propanol <sup>e</sup>	ND	PNQ <sup>f</sup>	PNQ	PNQ	PNQ	PNQ	ND	ND	NA <sup>g</sup>
1,1,1-trichloroethane <sup>d,e</sup>	ND	ND	PNQ	ND	ND	ND	ND	ND	NA
1-butanol <sup>e</sup>	ND	ND	PNQ	ND	ND	ND	ND	ND	NA
cyclohexanone <sup>e</sup>	ND	ND	ND	PNQ	ND	PNQ	ND	ND	NA
tetrachloroethylene <sup>d,e</sup>	ND	ND	PNQ	PNQ	PNQ	ND	ND	ND	NA
bis (2-chloroethyl) ether <sup>d,e</sup>	ND	PNQ	ND	ND	ND	ND	ND	ND	NA
anisole <sup>e</sup>	PNQ	ND	ND	ND	ND	PNQ	ND	ND	NA
carbon disulfide	ND	ND	TEN	TEN	ND	ND	ND	ND	NA <sup>g</sup>
cyclohexane	TEN <sup>h</sup>	ND	ND	ND	ND	ND	ND	ND	NA
methylcyclopentane	TEN	ND	ND	ND	ND	ND	ND	ND	NA
3-methylhexane	TEN	TEN	TEN	TEN	ND	TEN	ND	ND	NA
2-methylhexane	TEN	TEN	TEN	ND	ND	TEN	TEN	ND	NA
2-chloropropane	ND	TEN	ND	TEN	TEN	ND	ND	ND	NA
methylcyclohexane	ND	TEN	ND	ND	ND	ND	ND	ND	NA
2-propen-1-ol	ND	ND	TEN	TEN	TEN	ND	ND	ND	NA
2-hexanone	ND	ND	TEN	ND	ND	ND	ND	ND	NA

a Values based on 30 liter sample size. All samples corrected for levels in blank.

b Detection limits are based upon levels necessary for identification and quantification based upon a 30 liter sample.

c ND means not detected.

d Designated as a Priority Pollutant.

e Identity is verified by mass spectrum and GC retention time. No quantification standard was available.

f Present but not quantified.

g Detection limit not determined.

h Tentatively identified. Not verified by analysis of a standard.

Table 9  
ON AND OFFSITE AMBIENT AIR CONCENTRATIONS OF  
METHYLENE CHLORIDE AND TOLUENE  
FIKE CHEMICALS, INC.  
December 14, 1979

Station	Methylene Chloride (ppb)	Toluene (ppb)
08 <sup>a</sup>	3.6	27
13 <sup>b</sup>	0.8	5.3
14 <sup>a</sup>	6.8	3.8
15 <sup>b</sup>	1.8	3.2
16 <sup>a</sup>	3.5	2.0
17 <sup>b</sup>	2.2	1.5

a Onsite sampling station.

b Offsite sampling station.

Wind conditions were nearly calm to slight westerly breezes during the period of sample collection. Air temperatures ranged just above 0°C (32°F) which would not promote volatilization. Summer conditions, with significantly elevated temperatures would enhance organic volatilization. Operation of the spray system on lagoon No. 3 (adjacent to Station 04) could produce potentially hazardous concentrations of airborne priority pollutants and other organic chemicals.

## V. OFFSITE POLLUTANT MOVEMENT

Offsite hazards posed by the pollutants identified at Fike and the CST are a function of actual and probable offsite movement and exposure to the general public and the environment. The principal avenues of pollutant transport include surface and groundwaters, and air. Movement along these transport avenues is governed primarily by a combination of climatic, topographic and geologic factors.

### SURFACE WATER

As previously noted, process wastewater is collected, treated, and discharged directly to the Kanawha River. The quality of this discharge was presented in Section IV and the presence of priority pollutants was noted. Storm water runoff provides another avenue of pollutant transport to the Kanawha River. The Fike plant is topographically downgradient from the City of Nitro so that contaminated runoff would remain in the industrial area as it flows toward the river. Rainwater contaminated by both airborne pollutants and those detected in soils) and pooled liquids ostensibly flows into plant storm sewers. The storm sewer system is comprised of both recently installed lines and some laid in 1918 by the Army during the construction of a smokeless powder plant at this site.<sup>4,5</sup> Exfiltration of priority-pollutant-containing runoff is suspected due to the age of these lines. These lines carry storm water to the CST for treatment unless flows are judged too great in which case the treatment system is bypassed through a non-authorized discharge to a roadside drainage ditch. During the current survey, the bypass discharge was observed, sampled, and found to contain priority pollutants.

## GROUNDWATER

Groundwater flow in floodplains is typically toward the river from the valley walls. Beneath the Fike plant, groundwater flow would be toward the Kanawha River from the east. There were no observed or previously reported industrial facilities east of Fike which would contribute the types of compounds found in the groundwater samples. In fact, the area to the east is old residential. Well water analytical results from both the present and previous\* NEIC surveys suggest multiple pollutant sources of groundwater contamination and/or one whose contaminants periodically change. This is evidenced by the number of compounds detected in one onsite well but not in another [Table 5]. The 1977 survey revealed not only chemical variances between wells, but also lagoon No. 1 which was receiving toxic wastes at that time and was considered a major source of groundwater contaminants. Since manufacturing is on a batch basis and chemical production varies substantially throughout the year, contaminants in the disposal lagoon are ever changing in both type and concentration. These changes would affect the quality of water percolating through the lagoon bottom and possibly explain the variations in groundwater quality. Leaching of waste deposits at several locations on the plant grounds could also produce the observed variations in groundwater quality and give the appearance of multiple sources. Further investigative work is warranted by these findings, and, in fact, was required by the lagoon permit.

The climate and topography of the plant area tends to promote both leaching and offsite movement of these pollutants. Rainfall averages approximately 114 cm (45 in)/year and is fairly uniformly distributed on a monthly basis.<sup>2</sup> This constitutes a significant source of water for leachate formation. Normal lake evaporation amounts to about 81 cm (32 in)/year.<sup>3</sup> This rainfall surplus suggests that the disposal lagoons had to lose water by percolation or they would have soon filled to capacity. The flat topography of the plant area promotes infiltration of rainfall into the permeable Kanawha River floodplain materials.

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\* See Table 20 in reference No. 1. .

This alluvial deposit constitutes the major groundwater aquifer of the area. The alluvial aquifer is 5 to 10 times as productive as the underlying, predominantly shale, bedrock aquifer.<sup>7</sup> These unconsolidated deposits are comprised primarily of well sorted silty sands with permeabilities on the order of  $10^{-3}$  to  $10^{-4}$  cm/sec. Most of the large groundwater developments for industrial use in the Nitro area have been in alluvial aquifer.<sup>2,7</sup> The historic major users of groundwater in the Nitro area include those plants located adjacent to and in the vicinity of Fike.<sup>2,7</sup> In more recent years, plant water supplies have been changed from groundwater to the Kanawha River and a private water company which obtains its water from the Elk River near Charleston.

The offsite movement of priority pollutants in the alluvial aquifer constitutes a hazard to present and potential users of groundwater in this area. The installation of the lined No. 3 lagoon and the elimination of the other disposal ponds will effectively eliminate one source of groundwater contamination. However, until buried wastes are isolated from leaching rainfall, groundwater contamination from this area of the plant will continue to be a problem. The potential for wastewater percolation out of the CST oxidation ditch is another problem which must be addressed.

### AIR

Residential areas of Nitro are within approximately 0.40 km (0.25 mi) of the Fike plant. Prevailing winds come from the southwest at a mean speed of about 11 km/hr (7 mi/hr) as determined by measurements made at nearby Charleston.<sup>8</sup> These wind conditions would carry airborne toxic pollutants into nearby residential areas.



## VI. TOXICITY AND HEALTH EFFECTS OF IDENTIFIED POLLUTANTS

Sixty-two organic compounds, including 15 priority pollutants, and 4 priority pollutant metals were detected in samples collected from Fike and the CST. Analytical results for these compounds were reviewed by the NEIC toxicologist to assess potential hazards to human health and the environment.

To aid in this evaluation, established computer data bases and the scientific literature were searched for pertinent information. A synopsis of the methodology is presented in Appendix C; compiled data is summarized and presented in Tables 10 (Pollutants in Water) and 11 (pollutants in air).

Most available toxicity data reflects short term (acute) high dosage testing in animals as opposed to low dosage long term (chronic) exposure to hazardous chemicals. The health effects produced by chronic exposure to combinations of two or more hazardous chemicals are generally not known. Such combinations could result in more severe effects than would be expected from the additive effects of each chemical in the mixture. This potential must be recognized when considering documented health effects of the identified pollutants.

### LIQUID/SOIL SAMPLE POLLUTANTS

Twenty-one of the 37 organic chemicals and all 4 priority pollutant metals detected in the liquid/soil samples have known or demonstrated adverse human health effects. Included are effects on the liver, kidneys, blood, gastrointestinal tract, lungs, central nervous system, skin, mucous membranes and eyes. Additionally, some compounds are known or suspected carcinogens, mutagen, and teratogens (causing birth defects).

Eight of the 21 organic compounds and 2 of the metals are presently classified as carcinogens by one or more of the following groups: EPA Cancer Assessment Group (CAG), International Agency for Research on Cancer (IARC), and National Cancer Institute (NCI). These ten organic compounds and metals are:

benzene	phenol
chloroform	2,4,6 trichlorophenol
1,2-dichloroethane	bis (2-chloroethyl) ether*
tetrachloroethylene	lead*
trichloroethylene	nickel

Of these, the organics were only detected in groundwater while the metals were detected in the CST effluent (no metals analyses were conducted on groundwater samples).

At present there is no general agreement regarding safe concentrations of any carcinogen. EPA has proposed criteria for a number of carcinogens based on additional lifetime cancer risks ranging from no additional risk to an additional risk of  $1 \text{ in } 100,000$  ( $10^{-5}$ ).\*\* For maximum protection to human health, the acceptable intake level in food and water is zero. Under consideration are criteria for an interim target risk of  $10^{-5}$ ,  $10^{-6}$ , or  $10^{-7}$ .

For chloroform and benzene, the  $10^{-6}$  risk level corresponds to concentrations of 0.21 and 1.5  $\mu\text{g/l}$  (ppb), respectively.\*\* In groundwater monitoring well No. 2, chloroform was detected at 2,100 ppb (10,000 times the  $10^{-6}$  risk level concentration) and benzene at greater than 790 ppb (about 500 times the  $10^{-6}$  risk level concentration). The presence of these and six other known or potential human carcinogens would pose an unacceptable risk to anyone consuming this water.

Additional risk is inferred on the basis of more than 30 other chemicals present which could produce adverse health effects. Any

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\* Found to be animal carcinogens only in testing thus far.

\*\* Federal Register, Vol. 44, No. 52, March 15, 1979.

individual or industry tapping the zone of contaminated groundwater would be in danger of exposure to the hazards of these chemicals.

#### AIR SAMPLE POLLUTANTS

Twenty-four organic compounds, including nine priority pollutants were detected in the air samples [Table 8]. Seventeen of the 24 compounds have demonstrated health effects on humans and/or laboratory animals. These include adverse effects on the eyes, blood, central nervous system, liver, kidneys, mucous, and the mind.

Five of the 24 are known or suspected carcinogens (benzene, chloroform, tetrachloroethylene, trichloroethylene, and bis(2-chloroethyl) ether. As in the water/soil media, no agreement exists regarding safe ambient concentrations. Since prevailing winds would carry these pollutants into nearby neighborhoods, every effort should be made to minimize airborne concentrations.

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Aniline	C <sub>6</sub> H <sub>7</sub> N	62-53-3	TIm 96: 100-10 ppm	Skin-rabbit			511 mg	24H	Mild Irritation	TLV air. 5 ppm (skin)
				Skin-rabbit			500 mg	24H	Moderate Irritation	OSHA Std air: TWA 5 ppm (skin)
				Eye-rabbit			102 mg		Severe Irritation	
				Oral-human		LDLo:	50 mg/kg			
				Unreported-human		LDLo:	357 mg/kg			
				Unreported-man		LDLo:	150 mg/kg			
				Oral-rat		LD50:	440 mg/kg			
				Oral-rat		TDLo:	11 gm/kg	204DC	Neoplastic	
				Inhalation-rat		LCLo:	250 ppm	4H		
				Skin-rat		LD50:	1,400 mg/kg			
				Intraperitoneal-rat		LD50:	420 mg/kg			
				Oral-mouse		LD50:	464 mg/kg			
				Inhalation-mouse		LC50:	175 ppm	7H		
				Intraperitoneal-mouse		LD50:	492 mg/kg			
				Subcutaneous-mouse		LDLo:	480 mg/kg			
				Unreported-mouse		LD50:	572 mg/kg			
				Oral-dog		LD50:	195 mg/kg			
				Skin-dog		LDLo:	1,540 mg/kg			
				Intravenous-dog		LDLo:	200 mg/kg			
				Oral-cat		LDLo:	1,750 mg/kg			
				Inhalation-cat		LCLo:	180 ppm	8H		
				Skin-cat		LDLo:	254 mg/kg			
				Skin-rabbit		LD50:	820 mg/kg			
				Intraperitoneal-rabbit		LDLo:	200 mg/kg			
				Subcutaneous-rabbit		LDLo:	1,250 mg/kg			
				Oral-guinea pig		LDLo:	1,750 mg/kg			
				Skin-guinea pig		LD50:	1,290 mg/kg			
Aniline, N-Formyl-	C <sub>7</sub> H <sub>7</sub> NO	103-70-8		Oral-dog		LDLo:	400 mg/kg			
				Intravenous-dog		LDLo:	400 mg/kg			
				Oral-frog		LDLo:	800 ug/kg			
Anisole	C <sub>7</sub> H <sub>8</sub> O	100-66-3		Oral-rat		LD50:	3,700 mg/kg			
				Oral-mouse		LD50:	2,800 mg/kg			
Benzene	C <sub>6</sub> H <sub>6</sub>	71-43-2 <sup>f</sup>	TIm 96: 100-10 ppm	Skin-rabbit			15 mg	24H	Mild Irritation	
				Eye-rabbit			88 mg	open	Moderate Irritation	
				Oral-human		TDLo:	130 mg/kg		Central Nervous System	TLV (air) C1 25 ppm
				Oral-human		LDLo:	50 mg/kg			OSHA std (air). TWA 10 ppm, C1 25 ppm; Pk 50 ppm/10M/8H
				Inhalation-human		LCLo:	20,000 ppm	5M		
				Inhalation-human		TCLo:	210 ppm		Blood	
				Inhalation-man		TCLo:	2,100 mg/m <sup>3</sup>	4YI	Carcinogenic	

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
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Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Benzene (cont.)				Oral-rat		LD50:	3,800 mg/kg			NIOSH recm std (air): Cl 1 ppm/60M
				Inhalation-rat		LC50:	10,000 ppm	7H		
				Intraperitoneal-rat		LDLo:	1,150 mg/kg			
				Inhalation-human		TD:	400 ppm	8YI	Equivocal Tumorigenic Agent	
				Unreported-man		LDLo:	194 mg/kg			
				Oral-mouse		LD50:	4,700 mg/kg			
				Oral-mouse		TDLo:	1 mg/kg		Mutagenic	
				Intravenous-rabbit		LDLo:	88 mg/kg			
				Inhalation-mouse		LC50:	9,980 ppm			
				Skin-mouse		TDLo:	1,200 gm/kg	49WI	Neoplastic	
				Intraperitoneal-mouse		LD50:	468 mg/kg			
				Subcutaneous-mouse		TDLo:	2,700 mg/kg	13D (preg)	Teratogenic	
				Oral-dog		LDLo:	2,000 mg/kg			
				Inhalation-dog		LCLo:	146,000 mg/m <sup>3</sup>			
				Inhalation-cat		LCLo:	170,000 mg/m <sup>3</sup>			
				Intraperitoneal-guinea pig		LDLo:	527 mg/kg			
				Subcutaneous-frog		LDLo:	1,400 mg/kg			
				Inhalation-mammal		LCLo:	20,000 ppm	5M		
				Eye-rabbit			2 mg	24H	Severe Irritation	
				Subcutaneous-mouse		TDLo:	600 mg/kg	17WI	Equivocal Tumorigenic Agent	
				Parenteral-mouse		TDLo:	670 mg/kg	19WI	Equivocal Tumorigenic Agent	
Benzoic Acid	C <sub>7</sub> H <sub>6</sub> O <sub>2</sub>	65-85-0		Skin-human			22 mg	3DI	Moderate Irritation	
				Skin-rabbit			500 mg	24H	Mild Irritation	
				Eye-rabbit			100 mg		Severe Irritation	
				Skin-human		TDLo:	6 mg/kg	skin		
				Oral-human		LDLo:	500 mg/kg			
				Oral-rat		LD50:	2,530 mg/kg			
				Oral-mouse		LD50:	2,370 mg/kg			
				Intraperitoneal-mouse		LD50:	1,460 mg/kg			
				Oral-dog		LD50:	2,000 mg/kg			
				Oral-cat		LD50:	2,000 mg/kg			
				Oral-rabbit		LDLo:	2,000 mg/kg			
				Subcutaneous-rabbit		LDLo:	2,000 mg/kg			
				Intraperitoneal-guinea pig		LDLo:	1,400 mg/kg			
				Subcutaneous-frog		LDLo:	100 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Benzene, Ethyl-	C <sub>8</sub> H <sub>10</sub>	100-41-4 <sup>f</sup>	TLm 96: 100-10 ppm	Inhalation-human		TCLo:	100 ppm	8H	Irritant	TLV (air): 100 ppm
				Oral-rat		LD50:	3,500 mg/kg			
				Inhalation-rat		LCLo:	4,000 ppm	4H		OSHA std (air):
				Skin-rabbit		LD50:	5,000 mg/kg			TWA 100 ppm (skin)
				Inhalation-guinea pig		LCLo:	10,000 ppm			
				Skin-rabbit			15 mg	24H open	Mild Irritation	
				Eye-rabbit			100 mg		Irritation	
Carbon Disulfide	CS <sub>2</sub>	75-15-0	TLm 96 1,000-100 ppm	Oral-human		LDLo:	14 mg/kg			TLV air:
				Inhalation-human		LCLo:	4,000 ppm	30M		20 ppm (skin)
				Unreported-man		LDLo:	186 mg/kg			OSHA std air.
				Inhalation-rat		TCLo:	50 mg/m <sup>3</sup>	8H 1-210 (preg)	Teratogenic	TWA 20 ppm; Cl 30, Pk 100/30M
				Intraperitoneal-guinea pig		LDLo:	400 mg/kg			NIOSH recm std- air TWA 1 ppm,
				Inhalation-mammal		LCLo:	2,000 ppm	5M		Cl 10 ppm/15M
Chloroform (Trichloromethane)	CHCl <sub>3</sub>	67-66-3 <sup>f</sup>	TLm 96. 100-10 ppm	Oral-human		LDLo:	140 mg/kg			TLV (air) 25 ppm
				Inhalation-human		TCLo:	1,000 mg/m <sup>3</sup>	1Y	Systemic	
				Inhalation-human		TCLo:	5,000 mg/m <sup>3</sup>	7H	Central Nervous System	OSHA std (air): TWA 50 ppm
				Unreported-man		LDLo:	546 mg/kg			
				Oral-rat		LD50:	800 mg/kg			
				Oral-rat		TDLo:	70 gm/kg	78WI	Neoplastic	NIOSH recm std
				Inhalation-rat		LCLo:	8,000 ppm	4H		(air):
				Inhalation-rat		TCLo:	100 ppm	7H/6-15D (preg)	Teratogenic	Cl 2 ppm/60M
				Oral-mouse		LD50:	1,120 mg/kg			
				Oral-mouse		TDLo:	18 gm/kg	120DI	Carcinogenic	
				Oral-mouse		TDLo:	75 mg/kg	78WI	Carcinogenic	
				Inhalation-mouse		LC50:	28 gm/m <sup>3</sup>			
				Intraperitoneal-mouse		LD50:	1,671 mg/kg			
				Subcutaneous-mouse		LD50:	704 mg/kg			
				Oral-dog		LDLo:	1,000 mg/kg			
				Inhalation-dog		LC50:	100 gm/m <sup>3</sup>			
				Intraperitoneal-dog		LD50:	1,000 mg/kg			
				Intravenous-dog		LDLo:	75 mg/kg			
				Inhalation-cat		LCLo:	35,000 mg/m <sup>3</sup>	4H		
				Oral-rabbit		LDLo:	500 mg/kg			
				Inhalation-rabbit		LC50:	59 gm/m <sup>3</sup>			
				Subcutaneous-rabbit		LDLo:	3,000 mg/kg			
				Inhalation-guinea pig		LCLo:	20,000 ppm	2H		
				Inhalation-frog		LCLo:	6,000 mg/m <sup>3</sup>			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

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Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>f</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Chloroform (cont)				Inhalation-mammal		LCLo:	25,000 ppm	5M		
				Oral-rat		TD:	98 mg/kg	78WI	Neoplastic	
				Skin-rabbit			10 mg	24H	Mild	
				Eye-rabbit			148 mg	open	Irritation	
Copper	Cu	7440-50-8 <sup>f</sup>		Oral-human		TDLo:	120 µg/kg		Gastro-intestinal Tract	TLV (air). 0.2 mg/m <sup>3</sup> (fume) TLV (air): 1mg/m <sup>3</sup> (dusts, mists) TLV air: 5 ppm
p-Cresol	C <sub>7</sub> H <sub>8</sub> O	106-44-5		Skin-rabbit			517 mg	24H	Severe Irritation	
				Eye-rabbit			103 mg		Severe Irritation	
				Oral-rat		LD50:	207 mg/kg			
				Skin-rat		LD50:	750 mg/kg			
				Subcutaneous-rat		LDLo:	500 mg/kg			
				Oral-mouse		LD50:	344 mg/kg			
				Skin-mouse		TDLo:	4,800 mg/kg	12WI	Neoplastic	
				Intraperitoneal-mouse		LD50:	25 mg/kg			
				Subcutaneous-mouse		LDLo:	150 mg/kg			
				Unreported-mouse		LD50:	160 mg/kg			
				Subcutaneous-cat		LDLo:	80 mg/kg			
				Oral-rabbit		LDLo:	62 mg/kg			
				Skin-rabbit		LD50:	301 mg/kg			
				Subcutaneous-rabbit		LDLo:	300 mg/kg			
				Intravenous-rabbit		LDLo:	180 mg/kg			
				Subcutaneous-guinea Pig		LDLo:	200 mg/kg			
				Subcutaneous-frog		LDLo:	150 mg/kg			
Cyclohexane	C <sub>6</sub> H <sub>12</sub>	110-82-7	TLm 96: 100-10 ppm	Eye-human			5 ppm		Irritation	TLV (air). 300 ppm
				Skin-rabbit			1,548 mg	2DI	Irritation	
				Oral-human		LDLo:	500 mg/kg			
				Oral-rat		LD50:	29,820 mg/kg			OSHA std (air). TWA 300 ppm
				Oral-mouse		LD50:	1,297 mg/kg			
				Oral-rabbit		LDLo:	5,500 mg/kg			
				Intravenous-rabbit		LDLo:	77 mg/kg			
Cyclohexanone	C <sub>6</sub> H <sub>10</sub> O	108-94-1	TLm 96: 100-10 ppm	Eye-human			75 ppm		Irritation	TLV (air): 50 ppm
				Skin-rabbit			500 mg	open	Mild Irritation	
				Eye-rabbit			4,740 ug		Severe Irritation	OSHA std (air): TWA 50 ppm
				Inhalation-human		TCLo:	75 ppm		Irritant	
				Oral-rat		LD50:	1,620 mg/kg			
				Inhalation-rat		LCLo:	2,000 ppm	4H		NIOSH recm std (air): TWA 100 mg/m <sup>3</sup>
				Subcutaneous-rat		LD50:	2,170 mg/kg			
				Intraperitoneal-mouse		LD50:	1,350 mg/kg			

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SOIL/LIQUID SAMPLES COLLECTED AT  
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NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data					Exposure Limits <sup>e</sup>	
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>		Effects <sup>d</sup>
Cyclohexanone (cont)				Oral-mouse		LD50:	1,300 mg/kg			
				Subcutaneous-mouse		LDLo.	1,300 mg/kg			
				Intravenous-dog		LDLo	630 mg/kg			
				Oral-rabbit		LDLo:	1,600 mg/kg			
				Skin-rabbit		LD50.	1,000 mg/kg			
				Subcutaneous-frog		LDLo:	1,900 mg/kg			
Cyclohexene	C <sub>6</sub> H <sub>10</sub>	110-83-8							TLV (air): 300 ppm OSHA std (air). TWA 300 ppm (skin)	
Ethane, 1,2-Dichloro- (Ethylene Dichloride)	C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	107-06-2 <sup>f</sup>	TLm 96: 1,000-100 ppm	Inhalation-human		TCLo.	4,000 ppm	H	Central Nervous System	TLV (air) 50 ppm
				Oral-human		TDLo:	428 mg/kg		Gastro-intestinal Tract	OSHA std (air) TWA 50 ppm, Cl 100, Pk 200/5M/3H
				Oral-man		LDLo:	810 mg/kg			
				Oral-human		LDLo	500 mg/kg			
				Inhalation-rat		LCLo:	1,000 ppm	4H		
				Intraperitoneal-rat		LD50:	74 µg/kg			
				Subcutaneous-rat		LDLo	500 mg/kg			
				Oral-mouse		LDLo.	600 mg/kg			
				Inhalation-mouse		LCLo	5,000 mg/m <sup>3</sup>	2H		NIOSH recm std (air) TWA 1 ppm, Cl 2 ppm/15M
				Intraperitoneal-mouse		LD50.	40 µg/kg			
				Subcutaneous-mouse		LDLo	380 mg/kg			
				Oral-dog		LDLo:	2,000 mg/kg			
				Intravenous-dog		LDLo.	175 mg/kg			
				Oral-rabbit		LD50:	860 mg/kg			
				Inhalation-rabbit		LCLo	3,000 ppm	7H		
				Subcutaneous-rabbit		LDLo:	1,200 mg/kg			
				Inhalation-pig		LCLo.	3,000 ppm	7H		
				Inhalation-guinea pig		LCLo.	1,500 ppm	7H		
				Intraperitoneal-guinea pig		LDLo:	600 mg/kg			
				Skin-rabbit			625 mg	open	Mild Irritation	
				Eye-rabbit			63 mg		Severe Irritation	
				Oral-rat		TDLo:	26 gm/kg	78WI	Carcinogenic	
				Oral-mouse		TDLo:	81 gm/kg	78WI	Carcinogenic	
				Oral-rat		LD50:	680 mg/kg			



TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

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Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>	
				Route of Entry	Species	Type of Dose	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>		
Ether, Bis(2-chloroethyl)	C <sub>4</sub> H <sub>8</sub> Cl <sub>2</sub> O	111-44-4 <sup>f</sup>	TLm: 96 1,000-100 ppm	Skin-rabbit			10 mg	24H	Irritation	TLV (air): 5 ppm (skin)	
				Skin-rabbit			500 mg	open	Mild Irritation		
				Eye-rabbit			20 mg		Irritation	OSHA std (air). Cl 15 ppm (skin)	
				Oral-human		LDLo:	50 mg/kg				
				Oral-rat		LD50:	75 mg/kg				
				Inhalation-rat		LCLo:	1,000 ppm	45M			
				Oral-mouse		TDLo:	33 gm/kg	79WIC	Carcinogenic		
Skin-rabbit		LD50:	720 mg/kg								
Ethylene, 1,2-Dichloro-, (E)-	C <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub>	156-60-5 <sup>f</sup>		Inhalation-human		TCLo:	4,800 mg/m <sup>3</sup>	10M	Central Nervous System		
				Inhalation-mouse		LCLo:	75,000 mg/m <sup>3</sup>	2H			
				Inhalation-cat		LCLo:	43,000 mg/m <sup>3</sup>	6H			
Ethylene Oxide	C <sub>2</sub> H <sub>4</sub> O	75-21-8	TLm 96. 100-10 ppm	Skin-human			1 %	75 sec	Irritation	TLV air 50 ppm	
				Eye-rabbit			18 mg	6H	Moderate Irritation		
					Inhalation-human		TCLo:	12,500 ppm	10S	Irritant	OSHA std air: TWA 50 ppm
					Oral-rat		LD50:	72 mg/kg			
					Inhalation-rat		LC50:	1,462 ppm	4H		
					Inhalation-rat		TCLo:	1,000 ppm	4H	Mutagenic	
					Inhalation-mouse		LC50:	836 ppm	4H		
					Intraperitoneal-mouse		LDLo:	100 mg/kg			
					Intravenous-mouse		TDLo:	450 mg/kg	6-8D	Teratogenic	
					Inhalation-dog		LC50:	960 ppm	4H		
					Intravenous-rabbit		LDLo:	175 mg/kg			
					Oral-guinea pig		LD50:	270 mg/kg			
					Inhalation-guinea pig		LCLo:	7,000 ppm	150M		
					Inhalation-mammal		TCLo:	30 mg/m <sup>3</sup>		Mutagenic	
				Ethylene, Tetra-chloro- (Tetra-chloroethene)	C <sub>2</sub> Cl <sub>4</sub>	127-18-4 <sup>f</sup>	TLm 96: 100-10 ppm	Inhalation-human		TCLo:	200 ppm
Oral-human		LDLo:	500 mg/kg								
Inhalation-man		TCLo:	280 ppm					2H	Eye		
Inhalation-man		TCLo:	600 ppm					10M	Central Nervous System		
	Inhalation-rat		LCLo:					4,000 ppm	4H		NIOSH recm std (air): TWA 50 ppm, Cl 100 ppm/15M
	Oral-mouse		LD50:					8,850 mg/kg			
	Inhalation-mouse		LCLo:					23,000 mg/m <sup>3</sup>	2H		
	Intraperitoneal-mouse		LD50:					5,671 mg/kg			TLV (air). 100 ppm (skin)
	Oral-dog		LDLo:					4,000 mg/kg			
	Intraperitoneal-dog		LD50:					2,100 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data					Exposure Limits <sup>e</sup>	
				Route of Entry	- Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>		Effects <sup>d</sup>
Ethylene, Tetra-chloro-				Intravenous-dog		LDLo:	85 mg/kg			
				Oral-cat		LDLo:	4,000 mg/kg			
				Oral-rabbit		LDLo:	5,000 mg/kg			
				Subcutaneous-rabbit		LDLo:	2,200 mg/kg			
				Oral-mouse		TDLo:	86 gm/kg	41WC	Carcinogenic	
				Skin-rabbit			810 mg	24H	Severe Irritation	
				Eye-rabbit			162 mg		Mild Irritation	
Ethylene, Trichloro- (Trichloroethene)	C <sub>2</sub> HCl <sub>3</sub>	79-01-6 <sup>f</sup>	TIm 96: 1,000-100 ppm	Oral-human		LDLo	50 mg/kg			TLV (air) 100 ppm
				Inhalation-human		TCLo:	6,900 mg/m <sup>3</sup>	10M	Central Nervous System	OSHA std (air). TWA 100 ppm, C1 200, Pk 300/5H/2H
				Inhalation-human		TCLo:	160 ppm	83H	Central Nervous System	
				Inhalation-man		TCLo:	110 ppm	8H	Irritant	NIOSH recm std (air): TWA 100 ppm, C1 150 ppm/10M
				Oral-rat		LD50:	4,920 mg/kg			
				Inhalation-rat		LCLo:	8,000 ppm	4H		
				Oral-mouse		TDLo:	316 gm/kg	27WI	Carcinogenic	
				Inhalation-mouse		LCLo:	3,000 ppm	2H		
				Intravenous-mouse		LD50:	34 mg/kg			
				Oral-dog		LDLo:	5,860 mg/kg			
				Intraperitoneal-dog		LD50	1,900 mg/kg			
				Intravenous-dog		LDLo:	150 mg/kg			
				Subcutaneous-rabbit		LDLo	1,800 mg/kg			
				Oral-cat		LDLo:	5,864 mg/kg			
				Inhalation-cat		LCLo:	32,500 mg/m <sup>3</sup>	2H		
				Inhalation-guinea pig		LCLo:	37,200 ppm	40M		
				Eye-human			5 ppm		Irritation	
				Skin-rabbit			500 mg	24H	Severe Irritation	
				Eye-rabbit			20 mg	24H	Severe Irritation	
				Oral-human		LDLo:	7 gm/kg			
				Inhalation-human		TDLo:	812 mg/kg		Systemic	
				Inhalation-man		LCLo:	2,900 ppm			
				Intraperitoneal-mouse		LD50:	3,000 mg/kg			
				Subcutaneous-dog		LDLo:	150 mg/kg			
				Oral-rabbit		LDLo:	7,330 mg/kg			
Formamide, N-Cyclohexyl-	C <sub>7</sub> H <sub>13</sub> NO	766-93-8		Intravenous-mouse		LD50:	320 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Furan, Tetrahydro-	C <sub>4</sub> H <sub>8</sub> O	109-99-9		Oral-human		LDLo.	50 mg/kg		Central Nervous System	TLV air: 200 ppm
				Inhalation-human		TCLo:	25,000 ppm			OSHA std air TWA 200 ppm
				Oral-rat		LDLo:	3,000 mg/kg			
				Inhalation-rat		LCLo:	28,000 mg/m <sup>3</sup>	2H		
				Inhalation-mouse		LCLo:	24,000 mg/m <sup>3</sup>	2H		
Hexane	C <sub>6</sub> H <sub>14</sub>	110-54-3	TLm 96: over 1,000 ppm	Intraperitoneal-guinea pig		LDLo:	500 mg/kg		Irritation Central Nervous System	
				Eye-human			5 ppm			TLV air. 100 ppm
				Inhalation-human		TCLo.	5,000 ppm	10M		OSHA std (air): TWA 500 ppm
				Intraperitoneal-rat		LDLo:	9,100 mg/kg			NIOSH recm std (air) TWA 350 mg/m <sup>3</sup> , C1 1800 mg/m <sup>3</sup> /15M
				Inhalation-mouse		LCLo:	120 gm/m <sup>3</sup>			
Hexanoic Acid, 2-Ethyl-	C <sub>8</sub> H <sub>16</sub> O <sub>2</sub>	149-57-5		Skin-rabbit			10 mg		Irritation Mild Irritation Severe Irritation	
				Skin-rabbit			450 mg	24H open		
				Eye-rabbit			4,500 ug			
				Oral-rat		LD50:	3,000 mg/kg			
				Skin-rabbit		LD50:	1,260 mg/kg			
Lead	Pb	7439-92-1 <sup>f</sup>		Oral-woman		TDLo:	450 mg/kg	6Y	Central Nervous System	TLV (air). 0.15 mg/m <sup>3</sup>
				Intraperitoneal-rat		LDLo:	1,000 mg/kg			OSHA std (air): TWA 200 µg/m <sup>3</sup>
				Intravenous-hamster		TDLo:	50 mg/kg	8D (preg)		NIOSH recm std (air): TWA 0.10 mg/m <sup>3</sup>
Methane, Dichloro- (Methylene Chloride)	CH <sub>2</sub> Cl <sub>2</sub>	75-09-2 <sup>f</sup>	TLm 96 1,000-100 ppm	Inhalation-human		TCLo:	500 ppm	1YI	Central Nervous System	TLV (air). 200 ppm
				Oral-human		LDLo:	500 mg/kg			OSHA std (air) TWA 500 ppm; C1 1,000, PK 2,000/5M/2H
				Inhalation-human		TCLo:	500 ppm			
				Oral-rat		LD50:	167 mg/kg	8H		

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Methane, (cont) Dichloro				Inhalation-rat		LC50:	88,000 mg/m <sup>3</sup>	30M		NIOSH recm std (air): TWA 75 ppm, PK 500 ppm/15M
				Inhalation-mouse		LC50:	14,400 ppm	7H		
				Intraperitoneal-mouse		LD50:	1,500 mg/kg			
				Subcutaneous-mouse		LD50:	6,460 mg/kg			
				Oral-dog		LDLo:	3,000 mg/kg			
				Inhalation-dog		LCLo:	14,108 ppm	7H		
				Intraperitoneal-dog		LDLo:	950 mg/kg			
				Subcutaneous-dog		LDLo:	2,700 mg/kg			
				Intravenous-dog		LDLo:	200 mg/kg			
				Inhalation-cat		LCLo:	43,400 mg/m <sup>3</sup>	4.5H		
				Oral-rabbit		LDLo:	1,900 mg/kg			
				Subcutaneous-rabbit		LDLo:	2,700 mg/kg			
				Inhalation-guinea pig		LCLo:	5,000 ppm	2H		
				Skin-rabbit			810 mg	24H	Severe Irritation	
				Eye-rabbit			162 mg		Moderate Irritation	
				Eye-rabbit			10 mg		Mild Irritation	
				Eye-rabbit			17,500 mg/m <sup>3</sup>	10H	Irritation	
				Inhalation-rat		TCLo:	500 ppm	6H/2Y	Equivocal Tumorigenic Agent	
Nickel	Ni	7440-02-0 <sup>f</sup>		Inhalation-rat		TCLo:	15 mg/m <sup>3</sup>		Carcinogenic	TLV (air) 0.1 mg/m <sup>3</sup>
				Subcutaneous-rat		TDLo:	15 mg/kg	6WI	Neoplastic	
				Intramuscular-rat		TDLo:	1,000 mg/kg	17WI	Carcinogenic	OSHA std (air) TWA 1 mg/m <sup>3</sup> (skin)
				Intrapleural-rat		TDLo:	1,250 mg/kg	22WI	Neoplastic	
				Parenteral-rat		TDLo:	40 mg/kg	56WI	Carcinogenic	NIOSH recm std (air) TWA 15 µg/m <sup>3</sup>
				Intratracheal-rat		LDLo:	12 mg/kg			
				Implant-rat		TDLo:	250 mg/kg		Carcinogenic	
				Intravenous-mouse		LDLo:	50 mg/kg			
				Intramuscular-mouse		TDLo:	100 mg/kg		Carcinogenic	Neoplastic
				Intravenous-dog		LDLo:	10 mg/kg			
				Implant-rabbit		TDLo:	165 mg/kg	2YI		
				Oral-guinea pig		LDLo:	5 mg/kg			
				Inhalation-guinea pig		TCLo:	15 mg/m <sup>3</sup>	91WI	Carcinogenic	Carcinogenic Neoplastic
				Intramuscular-hamster		TDLo:	208 mg/kg	22W		
				Intramuscular-rat		TDLo:	58 mg/kg			
				Subcutaneous-guinea pig		LDLo:	500 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
2-Pentanone, 4-Hydroxy-4-Methyl	C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	123-42-2	Tlm 96: 1,000-100 ppm	Eye-human			100 ppm	15M	Irritation	TLV air: 50 ppm
				Skin-rabbit			10 mg	24H	Irritation	
				Skin-rabbit			500 mg	open	Mild	OSHA std (air): TWA 50 ppm
				Eye-rabbit			5 mg		Irritation Severe	
				Inhalation-human		TCLo:	100 ppm		Irritant	NIOSH recm std (air): TWA 240 mg/m <sup>3</sup>
				Oral-rat		LD50:	4,000 m/kg			
				Intraperitoneal-mouse		LD50:	933 mg/kg			
2-Pentanone, 4-Methyl	C <sub>6</sub> H <sub>12</sub> O	108-10-1	Tlm 96: over 1,000 ppm	Eye-human			200 ppm	15M	Irritation	TLV (air): 100 ppm (skin)
				Skin-rabbit			500 mg	24H	Moderate Irritation	
				Eye-rabbit			40 mg		Severe Irritation	OSHA std air: TWA 100 ppm
				Inhalation-human		TCLo:	200 ppm		Irritant	NIOSH recm std-air: TWA 200 mg/m <sup>3</sup>
				Oral-human		LDLo:	500 mg/kg			
				Oral-rat		LD50:	2,080 mg/kg			
				Inhalation-rat		LCLo:	4,000 ppm	15M		
Phenol	C <sub>6</sub> H <sub>6</sub> O	108-95-2 <sup>f</sup>	TLM 96: 100-10 ppm	Oral-mouse		LDLo:	2,850 mg/kg			
				Intraperitoneal-mouse		LD50:	268 mg/kg			
				Skin-rabbit			500 mg	24H	Severe Irritation	TLV (air): 5 ppm (skin)
				Skin-rabbit			535 mg	open	Severe Irritation	
				Eye-rabbit			5 mg		Severe Irritation	OSHA std (air): TWA 5 ppm (skin)
				Oral-human		LDLo:	140 mg/kg			
				Oral-rat		LD50:	414 mg/kg			
				Skin-rat		LD50:	669 mg/kg			
				Intraperitoneal-rat		LD50:	250 mg/kg			
				Subcutaneous-rat		LDLo:	650 mg/kg			NIOSH recm std (air): TWA 20 mg/m <sup>3</sup> , Cl 60 mg/m <sup>3</sup> /15M
				Oral-mouse		LD50:	300 mg/kg			
				Skin-mouse		TDLo:	4,000 mg/kg	20WI	Carcinogenic	
				Intraperitoneal-mouse		LD50:	360 mg/kg			
				Subcutaneous-mouse		LD50:	344 mg/kg			
				Intravenous-mouse		LD50:	112 mg/kg			
				Oral-dog		LDLo:	500 mg/kg			
				Parenteral-dog		LDLo:	2,000 mg/kg			
				Oral-cat		LDLo:	80 mg/kg			
				Subcutaneous-cat		LDLo:	80 mg/kg			
				Parenteral-cat		LDLo:	500 mg/kg			
				Oral-rabbit		LDLo:	420 mg/kg			
				Skin-rabbit		LD50:	850 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose <sup>b,f</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Phenol (cont)				Intraperitoneal-rabbit		LDLo:	620 mg/kg			
				Subcutaneous-rabbit		LDLo:	620 mg/kg			
				Intravenous-rabbit		LDLo:	180 mg/kg			
				Parenteral-rabbit		LDLo:	300 mg/kg			
				Intraperitoneal-guinea pig		LDLo:	300 mg/kg			
				Subcutaneous-guinea pig		LDLo:	450 mg/kg			
				Subcutaneous-frog		LDLo:	75 mg/kg			
				Parenteral-frog		LDLo:	290 mg/kg			
				Subcutaneous-frog		LDLo:	290 mg/kg			
Phenol, m-Chloro-	C <sub>6</sub> H <sub>5</sub> ClO	108-43-0		Oral-rat		LD50:	570 mg/kg			
				Intraperitoneal-rat		LD50:	355 mg/kg			
				Subcutaneous-rat		LD50:	1,390 mg/kg			
				Skin-mouse		TDLo:	6,000 mg/kg	15WI	Neoplastic	
Phenol, o-Methoxy-	C <sub>7</sub> H <sub>8</sub> O <sub>2</sub>	90-05-1		Oral-human		LDLo:	50 mg/kg			
				Oral-rat		LD50:	725 mg/kg			
Phenol, 2,4,6-trichloro-	C <sub>6</sub> H <sub>3</sub> Cl <sub>3</sub> O	88-06-2 <sup>f</sup>		Skin-rabbit			500 mg	24H	Moderate Irritation	
				Oral-human		LDLo:	500 mg/kg			
				Oral-rat		LD50:	820 mg/kg			
				Oral-rat		TDLo:	185 gm/kg	106WC	Carcinogenic	
				Intraperitoneal-rat		LD50:	276 mg/kg			
				Oral-mouse		TDLo:	441 gm/kg	105WC	Carcinogenic	
				Oral-mouse		TD:	29 gm/kg	78WI	Equivocal Tumorigenic Agent	
				Oral-mouse		TD:	882 gm/kg	105WC	Carcinogenic	
				Oral-rat		TD:	374 gm/kg	107WC	Carcinogenic	
				Eye-rabbit			250 ug	24H	Severe Irritation	
Phthalic Acid, Bis (2-Ethylhexyl) Ester	C <sub>24</sub> H <sub>38</sub> O <sub>4</sub>	117-81-7 <sup>f</sup>		Eye-rabbit			500 mg		Irritation	OSHA std (air)- TWA 5 mg/m <sup>3</sup>
				Oral-man		TDLo:	143 mg/kg		Gastro-intestinal Tract	
				Oral-rat		LD50:	31 gm/kg			
				Intraperitoneal-rat		LD50:	30,700 mg/kg			
				Intraperitoneal-rat		TDLo:	30 gm/kg	5-150 (preg)	Tetragenic	
				Intravenous-rat		LD50:	250 mg/kg			
				Oral-mouse		LD50:	30 gm/kg			
				Oral-mouse		TDLo:	7,500 mg/kg	80 (preg)	Teratogenic	

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Phthalic Acid, (cont) Bis (2-Ethylhexyl) Ester				Intraperitoneal-mouse		LD50:	14 gm/kg			
				Oral-rabbit		LD50:	34 gm/kg			
				Skin-rabbit		LD50:	25 gm/kg			
				Skin-guinea pig		LD50:	10 gm/kg			
				Skin-rabbit			500 mg	24H	Mild Irritation	
				Eye-rabbit			500 mg	24H	Mild Irritation	
Phthalic Acid, Benzyl Butyl Ester	C <sub>19</sub> H <sub>20</sub> O <sub>4</sub>	85-68-7 <sup>f</sup>	TLm 96: over 1,000 ppm	Intraperitoneal-mouse		LD50:	3,160 mg/kg			
Phosphoric Triamide, Hexamethyl-	C <sub>6</sub> H <sub>18</sub> N <sub>3</sub> OP	680-31-9		Oral-rat		LD50:	2,525 mg/kg			
				Inhalation-rat		TCLo	400 ppb	35WI	Carcinogenic	
				Skin-rat		LDLo	3,500 mg/kg			
				Intraperitoneal-mouse		TDLo:	100 mg/kg	12H	Mutagenic	
				Intravenous-mouse		LD50:	800 mg/kg			
				Skin-rabbit		LD50	2,600 mg/kg			
				Oral-guinea pig		LD50:	1,600 mg/kg			
				Skin-guinea pig		LD50:	1,175 mg/kg			
				Oral-chicken		LD50:	835 mg/kg			
Thiocyanic Acid, Phenyl Ester	C <sub>7</sub> H <sub>5</sub> NS	5285-87-0		Intraperitoneal-rat		LDLo:	40 mg/kg			
				Intravenous-rabbit		LDLo	40 mg/kg			
Toluene	C <sub>7</sub> H <sub>8</sub>	108-88-3 <sup>f</sup>	TLm 96. 100-10 ppm	Eye-human			300 ppm		Irritation	TLV (air): 100 ppm (skin)
				Oral-human		LDLo:	50 mg/kg			
				Inhalation-human		TCLo	200 ppm		Central Nervous System Psychotropic	OSHA std (air): TWA 200 ppm Cl 300, PK 500/10M
				Inhalation-man		TCLo:	100 ppm			
				Oral-rat		LD50:	5,000 mg/kg			
				Inhalation-rat		LCLo:	4,000 ppm	4H		NIOSH recm std (air) TWA 100 ppm; Cl 200 ppm/10M
				Intraperitoneal-rat		LDLo:	800 mg/kg			
				Inhalation-mouse		LC50	5,320 ppm	8H		
				Skin-rabbit		LD50:	14 gm/kg			
				Skin-rabbit			435 mg		Mild Irritation	
				Eye-rabbit			870 µg		Mild Irritation	
				Subcutaneous-frog		LDLo:	920 mg/kg			

TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	- Species	Type of Dose	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
1,3-Trimethylene-dinitrile	C <sub>5</sub> H <sub>6</sub> N <sub>2</sub>	544-13-8		Unreported-dog		LDLo:	50 mg/kg			
				Unreported-rabbit		LDLo:	18 mg/kg			
				Unreported-pigeon		LDLo:	1,200 mg/kg			
				Subcutaneous-frog		LDLo:	3,000 mg/kg			
Urea, 1,1,3,3-Tetramethyl-2-Thio-	C <sub>5</sub> H <sub>12</sub> N <sub>2</sub> S	2782-91-4		Oral-rat		LD50:	920 mg/kg			
				Oral-rat		TDLo:	1,250 mg/kg	6-15D (preg)	Teratogenic	
				Oral-rat		TDLo:	1,848 mg/kg	79WC	Carcinogenic	
2,6-Xylenol	C <sub>8</sub> H <sub>10</sub> O	576-26-1		Eye-rabbit			100 mg		Irritation	
				Oral-rat		LD50:	296 mg/kg			
				Oral-mouse		LD50:	980 mg/kg			
				Skin-mouse		LD50:	920 mg/kg			
				Skin-mouse		TDLo:	4,000 mg/kg	120WI	Neoplastic	
				Intraperitoneal-mouse		LD50:	150 mg/kg			
				Oral-rabbit		LD50:	700 mg/kg			
				Skin-rabbit		LD50:	1,000 mg/kg			
Zinc	Zn	7440-66-6 <sup>f</sup>		Skin-human			300 µg	3DI	Mild Irritation	
				Inhalation-human		TCLo:	124 mg/m <sup>3</sup>	50M	Pulmonary System	



TABLE 10  
TOXICITY OF COMPOUNDS  
SOIL/LIQUID SAMPLES COLLECTED AT  
FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

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- a Aquatic Toxicity: TIm 96: 96-hour static or continuous flow standard protocol, in parts per million (ppm)
- b Type of Dose.
- LD50 - lethal dose 50% kill
  - LCLo - lowest published lethal concentration
  - LC50 - lethal concentration 50% kill
  - LDLo - lowest published lethal dose
  - TDLo - lowest published toxic dose
  - TCLo - lowest published toxic concentration
  - TD - toxic dose
- c Duration:
- M - minute;
  - H - hour
  - D - day
  - W - week
  - Y - year
  - C - continuous
  - I - intermittent
- d Effects:
- Blood - Blood effects; effect on all blood elements, electrolytes, pH, protein, oxygen carrying or releasing capacity
  - Carcinogenic - Carcinogenic effects; producing cancer, a cellular tumor the nature of which is fatal, or is associated with the formation of secondary tumors (metastasis).
  - Central Nervous System - Includes effects such as headaches, tremor, drowsiness, convulsions, hypnosis, anesthesia.
  - Eye - Irritation, diplopia, cataracts, eye ground, blindness by affecting the eye or the optic nerve.
  - Gastrointestinal - diarrhea, constipation, ulceration.
  - Irritant - Any irritant effect on the skin, eye or mucous membrane.
  - Mutagenic - Transmissible changes produced in the offspring.
  - Neoplastic - The production of tumors not clearly defined as carcinogenic.
  - Psychotropic - Exerting an effect upon the mind.
  - Pulmonary - Effects on respiration and respiratory pathology.
  - Systemic - Effects on the metabolic and excretory function of the liver or kidneys.
  - Teratogenic - Nontransmissible changes produced in the offspring.
  - Equivocal Tumorigenic Agent - those studies reporting uncertain, but seemingly positive results.
- e Exposure Limits:
- NR - not reported
  - NIOSH - National Institute for Occupational Safety and Health
  - OSHA - Occupational Safety and Health Act of 1970
  - TWA - time-weighted average concentration
  - TLV - threshold limit value
  - Cl - ceiling
  - Pk - peak concentration
- f This chemical has been selected for priority attention as point source water effluent discharge toxic pollutant (NRDC vs Train consent decree)

Table 11  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>				
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>					
Acetone	C <sub>3</sub> H <sub>6</sub> O	67-64-1	TLm 96: over 1,000 ppm	Eye-human			500 ppm		Irritation	TLV (air). 1,000 ppm OSHA std (air). TWA 1,000 ppm				
				Oral-human		LDLo:	50 mg/kg							
				Inhalation-human		TCLo:	500 ppm							
				Inhalation-man		TCLo:	12,000 ppm	4H	Eye Central Nervous System	NIOSH recm std (air). TWA 590 mg/m <sup>3</sup>				
				Oral-rat		LD50:	9,750 mg/kg							
				Inhalation-rat		LCLo:	64,000 ppm	4H						
				Inhalation-mouse		LCLo:	110,000 mg/m <sup>3</sup>	62M						
				Intraperitoneal-mouse		LD50:	1,297 mg/kg							
				Oral-dog		LDLo:	24 gm/kg							
				Intraperitoneal-dog		LDLo:	8 gm/kg							
				Subcutaneous-dog		LDLo:	5 gm/kg							
				Oral-rabbit		LD50:	5,300 mg/kg							
				Skin-rabbit		LD50:	20 gm/kg							
				Subcutaneous-guinea pig		LDLo:	5,000 mg/kg							
				Unreported-man		LDLo:	1,159 mg/kg							
				Intraperitoneal-rat		LDLo:	500 mg/kg							
				Skin-rabbit			395 mg	open	Mild Irritation					
				Eye-rabbit			3,950 µg		Severe Irritation					
				Allyl Alcohol (2-Propen-1-ol)	C <sub>3</sub> H <sub>6</sub> O	107-18-6	TLm 96: 10-1 ppm	Eye-human				25 ppm		Severe Irritation
Skin-rabbit			10 mg					24H						
Eye-rabbit			4,270 ug						Severe Irritation					
Oral-human		LDLo:	50 mg/kg							Irritant				
Inhalation-human		TCLo:	25 ppm											
Oral-rat		LD50:	64 mg/kg											
Inhalation-rat		LC50:	165 ppm					4H						
Intraperitoneal-rat		LD50:	42 mg/kg											
Intraperitoneal-mouse		LD50:	42 mg/kg											
Oral-mouse		LD50:	96 mg/kg											
Oral-dog		LD50:	5 mg/kg											
Inhalation-monkey		LCLo:	1,000 ppm					4H						
Oral-rabbit		LDLo:	53 mg/kg											
Inhalation-rabbit		LCLo:	1,000 ppm											
Skin-rabbit		LD50:	53 mg/kg											
Anisole	C <sub>7</sub> H <sub>8</sub> O	100-66-3						Oral-rat			LD50:	3,700 mg/kg		
								Oral-mouse			LD50:	2,800 mg/kg		

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data					Exposure Limits <sup>e</sup>	
				Route of Entry	Species	Type of Dose <sup>f</sup>	Dose	Duration <sup>c</sup>		Effects <sup>d</sup>
Benzene, Ethyl-	C <sub>8</sub> H <sub>10</sub>	100-41-4 <sup>f</sup>	TLm 96: 100-10 ppm	Inhalation-human		TCLo:	100 ppm	8H	Irritant	TLV (air). 100 ppm
				Oral-rat		LD50:	3,500 mg/kg			
				Inhalation-rat		LCLo:	4,000 ppm	4H		OSHA std (air):
				Skin-rabbit		LD50:	5,000 mg/kg			TWA 100 ppm (skin)
				Inhalation-guinea pig		LCLo:	10,000 ppm			
				Skin-rabbit			15 mg	24H open	Mild Irritation	
Butyl alcohol (n-Butanol)	C <sub>4</sub> H <sub>10</sub> O	71-36-3	TLm 96: over 1,000 ppm	Eye-rabbit			100 mg		Irritation	TLV(air). 50 ppm (skin)
				Eye-human		LDLo:	50 ppm			OSHA std (air):
				Oral-human		TCLo:	500 mg/kg			TWA 100 ppm
				Inhalation-human		LD50:	25 ppm		Irritant	
				Oral-rat		LD50:	790 mg/kg			
				Intraperitoneal-rat		LDLo:	970 mg/kg			
				Oral-mouse		LDLo:	3,000 mg/kg			
				Oral-rabbit		LDLo:	4,250 mg/kg			
				Skin-rabbit		LD50:	4,200 mg/kg			
				Intravenous-cat		LDLo:	6 mg/kg			
				Unreported-rabbit		LDLo:	3,500 mg/kg			
				Eye-rabbit			1,620 µg		Severe Irritation	
				Eye-rabbit			20 mg	24H	Severe Irritation	
				Skin-rabbit			405 mg	24H	Moderate Irritation	
Skin-rabbit			500 mg	24H	Moderate Irritation					
Carbon Disulfide	CS <sub>2</sub>	75-15-0	TLm 96: 1,000-10 ppm	Oral-human		LDLo:	14 mg/kg			TLV air:
				Inhalation-human		LCLo:	4,000 ppm	30M		20 ppm (skin)
				Unreported-man		LDLo:	186 mg/kg			OSHA std air:
				Inhalation-rat		TCLo:	50 mg/m <sup>3</sup>	8H		TWA 20 ppm
								1-210 (preg)	Teratogenic	C1 30 Pk 100/30M
				Intraperitoneal-guinea pig		LDLo:	400 mg/kg			NIOSH recm std
						air: TWA 1 ppm				
							C1 10 ppm/15M			

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Benzene	C <sub>6</sub> H <sub>6</sub>	71-43-2 <sup>f</sup>	TLm 96: 100-10 ppm	Skin-rabbit			15 mg	24H open	Mild Irritation	TLV (air): Cl 25 ppm
				Eye-rabbit			88 mg		Moderate Irritation	
				Oral-human		TDLo:	130 mg/kg		Central Nervous System	
				Oral-human		LDLo:	50 mg/kg			
				Inhalation-human		LCLo:	20,000 ppm	5M		
				Inhalation-human		TCLo:	210 ppm		Blood	NIOSH recm std (air): Cl 1 ppm/60:1
				Inhalation-man		TCLo:	2,100 mg/m <sup>3</sup>	4YI	Carcinogenic	
				Oral-rat		LD50:	3,800 mg/kg			
				Inhalation-rat		LC50:	10,000 ppm	7H		Equivocal Tumorigenic Agent
				Intraperitoneal-rat		LDLo:	1,150 mg/kg			
				Inhalation-human		TD:	400 ppm	8YI		
				Unreported-man		LDLo:	194 mg/kg			Mutagenic
				Oral-mouse		LD50:	4,700 mg/kg			
				Oral-mouse		TDLo:	1 mg/kg			
				Intravenous-rabbit		LDLo:	88 mg/kg			Neoplastic
				Inhalation-mouse		LC50:	9,980 ppm			
				Skin-mouse		TDLo:	1,200 gm/kg	49WI		
				Intraperitoneal-mouse		LD50:	468 mg/kg			Teratogenic (preg)
				Subcutaneous-mouse		TDLo:	2,700 mg/kg	13D		
				Oral-dog		LDLo:	2,000 mg/kg			
				Inhalation-dog		LCLo:	146,000 mg/m <sup>3</sup>			Severe Irritation
				Inhalation-cat		LCLo:	170,000 mg/m <sup>3</sup>			
				Intraperitoneal-guinea pig		LDLo:	527 mg/kg			
				Subcutaneous-frog		LDLo:	1,400 mg/kg			Equivocal Tumorigenic Agent
				Inhalation-mammal		LCLo:	20,000 ppm	5M		
				Eye-rabbit			2 mg	24H		
				Subcutaneous-mouse		TDLo:	600 mg/kg	17WI		Equivocal Tumorigenic Agent
				Parenteral-mouse		TDLo:	670 mg/kg	19WI		

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Chloroform (Trichloromethane)	CHCl <sub>3</sub>	67-66-3 <sup>f</sup>	Tlm 96: 100-10 ppm	Oral-human		LDLo:	140 mg/kg			TLV (air) 25 ppm
				Inhalation-human		TCLo:	1,000 mg/m <sup>3</sup>	1Y	Systemic Central Nervous System	OSHA std (air): TWA 50 ppm
				Inhalation-human		TCLo:	5,000 mg/m <sup>3</sup>	7M		
				Unreported-man		LDLo:	546 mg/kg			
				Oral-rat		LD50:	800 mg/kg			
				Oral-rat		TDLo:	70 gm/kg	78WI	Neoplastic	NIOSH recm std (air)
				Inhalation-rat		LCLo:	8,000 ppm	4H		
				Inhalation-rat		TCLo:	100 ppm	7H/6-15D (preg)	Teratogenic	Cl 2 ppm/60M
				Oral-mouse		LD50:	1,120 mg/kg			
				Oral-mouse		TDLo:	18 gm/kg	120DI	Carcinogenic	Carcinogenic
				Oral-mouse		TDLo:	75 mg/kg	78WI		
				Inhalation-mouse		LC50:	28 gm/m <sup>3</sup>			
				Intraperitoneal-mouse		LD50:	1,671 mg/kg			
				Subcutaneous-mouse		LD50:	704 mg/kg			
				Oral-dog		LDLo:	1,000 mg/kg			
				Inhalation-dog		LC50:	100 gm/m <sup>3</sup>			
				Intraperitoneal-dog		LD50:	1,000 mg/kg			
				Intravenous-dog		LDLo:	75 mg/kg			
				Inhalation-cat		LCLo:	35,000 mg/m <sup>3</sup>	4H		
				Oral-rabbit		LDLo:	500 mg/kg			
				Inhalation-rabbit		LC50:	59 gm/m <sup>3</sup>			
				Subcutaneous-rabbit		LDLo:	3,000 mg/kg			
				Inhalation-guinea pig		LCLo:	20,000 ppm	2H		
				Inhalation-frog		LCLo:	6,000 mg/m <sup>3</sup>			
				Inhalation-mammal		LCLo:	25,000 ppm	5M		
				Oral-rat		TD:	98 mg/kg	78WI	Neoplastic Mild Irritation	
				Skin-rabbit			10 mg	24H open		
				Eye-rabbit				148 mg		
Cyclohexane	C <sub>6</sub> H <sub>12</sub>	110-82-7	Tlm 96: 100-10 ppm	Eye-human			5 ppm		Irritation	TLV (air): 300 ppm
				Skin-rabbit			1,548 mg	2DI		
				Oral-human		LDLo:	500 mg/kg			
				Oral-rat		LD50:	29,820 mg/kg			OSHA std (air): TWA 300 ppm
				Oral-mouse		LD50:	1,297 mg/kg			
				Oral-rabbit		LDLo:	5,500 mg/kg			
				Intravenous-rabbit		LDLo:	77 mg/kg			
Cyclohexane, Methyl-	C <sub>7</sub> H <sub>14</sub>	108-87-2		Oral-human		LDLo:	500 mg/kg		OSHA std (air) TWA 500 ppm	
				Oral-rabbit		LDLo:	4,000 mg/kg			

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Cyclohexanone	C <sub>6</sub> H <sub>10</sub> O	108-94-1	TLM 96: 100-10 ppm	Eye-human			75 ppm	open	Irritation Mild	TLV (air): 50 ppm
				Skin-rabbit			500 mg			
				Eye-rabbit			4,740 µg			
				Inhalation-human		TCLo:	75 ppm	4H	Irritation Severe	OSHA std (air): TWA 50 ppm
				Oral-rat		LD50:	1,620 mg/kg			
				Inhalation-rat		LCLo:	2,000 ppm			
				Subcutaneous-rat		LD50:	2,170 mg/kg			
				Intraperitoneal-mouse		LD50:	1,350 mg/kg			
				Oral-mouse		LD50:	1,300 mg/kg			
				Subcutaneous-mouse		LDLo:	1,300 mg/kg			
				Intravenous-dog		LDLo:	630 mg/kg			
				Oral-rabbit		LDLo:	1,600 mg/kg			
Skin-rabbit		LD50:	1,000 mg/kg							
Subcutaneous-frog		LDLo:	1,900 mg/kg							
Cyclopentane, Methyl-	C <sub>6</sub> H <sub>12</sub>	96-37-7	TLM 96: over 1,000 ppm	Inhalation-mouse		LCLo:	95,000 mg/m <sup>3</sup>			
Ethane, 1,1,1-Trichloro- (methyl chloroform)	C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub>	71-55-6 <sup>f</sup>	TLM 96: 100-10 ppm	Inhalation-man		LCLo:	27 gm/m <sup>3</sup>	10H		TLV (air) 350 ppm
				Inhalation-man		TCLo:	350 ppm			
				Inhalation-human		TCLo:	920 ppm	70H		
				Oral-rat		LD50:	14,300 mg/kg			
				Inhalation-rat		LCLo:	1,000 ppm			
				Inhalation-mouse		LCLo:	11,000 ppm			
				Intraperitoneal-mouse		LD50:	4,700 mg/kg			
				Oral-dog		LD50:	750 mg/kg			
				Intraperitoneal-dog		LD50:	3,100 mg/kg			
				Intravenous-dog		LDLo:	95 mg/kg			
				Oral-rabbit		LD50:	5,660 mg/kg			
				Subcutaneous-rabbit		LDLo:	500 mg/kg			
				Oral-guinea pig		LD50:	9,470 mg/kg			
				Eye-man			450 ppm	8H	Irritation Mild	
				Skin-rabbit			5 gm			
				Skin-rabbit			500 mg	24H	Irritation Moderate	
				Eye-rabbit			100 mg			
				Eye-rabbit			2 mg	24H		

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No.	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Ether, Bis(2-chloroethyl)	C <sub>4</sub> H <sub>8</sub> Cl <sub>2</sub> O	111-44-4 <sup>f</sup>	TLm. 96 1,000-100 ppm	Skin-rabbit			10 mg	24H	Irritation	TLV (air): 5 ppm
				Skin-rabbit			500 mg	open	Mild Irritation	(skin)
				Eye-rabbit			20 mg		Irritation	OSHA std (air):
				Oral-human		LDLo:	50 mg/kg			Cl 15 ppm
				Oral-rat		LD50:	75 mg/kg			(skin)
				Inhalation-rat		LCLo:	1,000 ppm	45H		
				Oral-mouse		TDLo:	33 gm/kg	79WIC	Carcinogenic	
Ethylene, Tetra-chloro-	C <sub>2</sub> Cl <sub>4</sub>	127-18-4 <sup>f</sup>	TLm 96. 100-10 ppm	Skin-rabbit		LD50:	720 mg/kg			
				Inhalation-human		TCLo:	200 ppm		Systemic	TLV (air)
				Oral-human		LDLo:	500 mg/kg			100 ppm (skin)
				Inhalation-man		TCLo:	280 ppm	2H	Eye	OSHA std (air):
				Inhalation-man		TCLo:	600 ppm	10M	Central Nervous System	TWA 100 ppm;
										Cl 200,
				Inhalation-rat		LCLo:	4,000 ppm	4H		PK 300/5H/3H
				Oral mouse		LD50:	8,850 mg/kg			
				Inhalation-mouse		LCLo:	23,000 mg/m <sup>3</sup>	2H		NIOSH recm std (air):
				Intraperitoneal-mouse		LD50:	5,671 mg/kg			TWA 50 ppm,
				Oral-dog		LDLo:	4,000 mg/kg			Cl 100 ppm/15M
				Intraperitoneal-dog		LD50:	2,100 mg/kg			
				Intravenous-dog		LDLo:	85 mg/kg			
				Oral-cat		LDLo:	4,000 mg/kg			
				Oral-rabbit		LDLo:	5,000 mg/kg			
				Subcutaneous-rabbit		LDLo:	2,200 mg/kg			
				Oral-mouse		TDLo:	86 gm/kg	41WC	Carcinogenic	
Ethylene, Trichloro-	C <sub>2</sub> HCl <sub>3</sub>	79-01-6 <sup>f</sup>	TLm 96: 1,000-100 ppm	Skin-rabbit			810 mg	24H	Severe Irritation	
				Eye-rabbit			162 mg		Mild Irritation	
				Oral-human		LDLo:	50 mg/kg			TLV (air): 100 ppm
				Inhalation-human		TCLo:	6,900 mg/m <sup>3</sup>	10M	Central Nervous System	OSHA std (air):
										TWA 100 ppm;
				Inhalation-human		TCLo:	160 ppm	83M	Central Nervous System	Cl 200,
										PK 300/5M/2H
				Inhalation-man		TCLo:	110 ppm	8H	Irritant	NIOSH recm std (air):
				Oral-rat		LD50:	4,920 mg/kg			TWA 100 ppm;
				Inhalation-rat		LCLo:	8,000 ppm	4H		Cl 150 ppm/10M
				Oral-mouse		TDLo:	316 gm/kg	27WI	Carcinogenic	
				Inhalation-mouse		LCLo:	3,000 ppm	2H		
				Intravenous-mouse		LD50:	34 mg/kg			
				Oral-dog		LDLo:	5,860 mg/kg			
				Intraperitoneal-dog		LD50:	1,900 mg/kg			
				Intravenous-dog		LDLo:	150 mg/kg			

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data						Exposure Limits <sup>e</sup>
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	
Ethylene, (cont) Trichloro-				Subcutaneous-rabbit		LDLo:	1,800 mg/kg			
				Oral-cat		LDLo:	5,864 mg/kg			
				Inhalation-cat		LCLo:	32,500 mg/m <sup>3</sup>	2H		
				Inhalation-guinea pig		LCLo:	37,200 ppm	40M		
				Eye-human			5 ppm		Irritation	
				Skin-rabbit			500 mg	24H	Severe Irritation	
				Eye-rabbit			20 mg	24H	Severe Irritation	
				Oral-human		LDLo:	7 gm/kg			
				Inhalation-human		TDLo:	812 mg/kg		Systemic	
				Inhalation-man		LCLo:	2,900 ppm			
				Intraperitoneal-mouse		LD50:	3,000 mg/kg			
				Subcutaneous-dog		LDLo:	150 mg/kg			
				Oral-rabbit		LDLo:	7,330 mg/kg			
n-Hexane	C <sub>6</sub> H <sub>14</sub>	110-54-3	TLm 96: over 1,000 ppm	Eye-human			5 ppm		Irritation	TLV (air): 100 ppm
				Inhalation-human		TCLo:	5,000 ppm	10M	Central Nervous System	OSHA std (air): TWA 500 ppm
				Intraperitoneal-rat		LDLo:	9,100 mg/kg			
				Inhalation-mouse		LCLo:	120 gm/m <sup>3</sup>			NIOSH recm std (air) TWA 350 mg/m <sup>3</sup> , Cl 1800 mg/m <sup>3</sup> /15M
2-Hexanone	C <sub>6</sub> H <sub>12</sub> O	591-78-6		Eye-rabbit			100 mg		Irritation	TLV (air) 100 ppm (skin)
				Oral-rat		LD50:	2,590 mg/kg			
				Intraperitoneal-rat		LDLo:	914 mg/kg			
				Oral-mouse		LDLo:	1,000 mg/kg			OSHA std (air): TWA 100 ppm
				Oral-guinea pig		LDLo:	914 mg/kg			
										NIOSH recm std (air). TWA 4 mg/m <sup>3</sup>
Isopropyl Alcohol (Isopropanol)	C <sub>3</sub> H <sub>8</sub> O	67-63-0	TLm 96: 1,000-100 ppm	Inhalation-human		TCLo:	400 ppm		Irritant	TLV (air): 400 ppm (skin)
				Oral-rat		LD50:	5,840 mg/kg			
				Oral-mouse		LDLo:	192 mg/kg			OSHA std (air): TWA 400 ppm
				Intraperitoneal-mouse		LD50:	933 mg/kg			
				Subcutaneous-mouse		LDLo:	6,000 mg/kg			
				Intravenous-dog		LDLo:	5,120 mg/kg			NIOSH recm std (air) TWA 400 ppm; Cl 800 ppm/15M
				Intravenous-cat		LDLo:	1,963 mg/kg			
				Oral-rabbit		LDLo:	5,000 mg/kg			
				Skin-rabbit		LD50:	13 gm/kg			
				Intravenous-rabbit		LDLo:	8,230 mg/kg			
				Subcutaneous-mammal		LDLo:	6 mg/kg			
				Oral-man		LDLo:	8,600 mg/kg			
				Unreported-man		LDLo:	2,770 mg/kg			
				Eye-human			20 ppm		Irritation	
				Eye-rabbit			16 mg		Irritation	
				Oral-human		TDLo:	15,710 mg/kg		Central Nervous System	
				Oral-dog		LD50:	6,150 mg/kg			



Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

Compound Name	Molecular Formula	Chemical Abstracts Service No	Aquatic Toxicity <sup>a</sup>	Other Toxicity Data							
				Route of Entry	Species	Type of Dose <sup>b</sup>	Dose	Duration <sup>c</sup>	Effects <sup>d</sup>	Exposure Limits <sup>e</sup>	
Methane, Dichloro- (methylene chloride)	CH <sub>2</sub> Cl <sub>2</sub>	75-09-2 <sup>f</sup>	TLM 96 1,000-100 ppm	Inhalation-human		TCLo:	500 ppm	1Y1	Central Nervous System	TLV (air): 200 ppm	
				Oral-human		LDLo:	500 mg/kg			OSHA std (air) TWA 500 ppm, C1 1,000, PK 2,000/5M/2H	
				Inhalation-human		TCLo:	500 ppm	8H	Blood		
				Oral-rat		LD50:	167 mg/kg				
				Inhalation-rat		LC50:	88,000 mg/m <sup>3</sup>	30M			
				Inhalation-mouse		LC50:	14,400 ppm	7H		NIOSH recm std (air)	
				Intraperitoneal-mouse		LD50:	1,500 mg/kg			TWA 75 ppm,	
				Subcutaneous-mouse		LD50:	6,460 mg/kg			PK 500 ppm/15M	
				Oral-dog		LDLo:	3,000 mg/kg				
				Inhalation-dog		LCLo:	14,108 ppm	7H			
				Intraperitoneal-dog		LDLo:	950 mg/kg				
				Subcutaneous-dog		LDLo:	2,700 mg/kg				
				Intravenous-dog		LDLo:	200 mg/kg				
				Inhalation-cat		LCLo:	43,400 mg/m <sup>3</sup>	4.5H			
				Oral-rabbit		LDLo:	1,900 mg/kg				
				Subcutaneous-rabbit		LDLo:	2,700 mg/kg				
				Inhalation-guinea pig		LCLo:	5,000 ppm	2H			
				Skin-rabbit			810 mg	24H	Severe Irritation		
									Moderate Irritation		
									Mild Irritation		
									Irritation		
					Irritation						
					Equivocal Tumorigenic Agent						
Toluene	C <sub>7</sub> H <sub>8</sub>	108-88-3 <sup>f</sup>	TLM 96 100-10 ppm	Eye-human			300 ppm		Irritation	TLV (air): 100 ppm (skin)	
				Oral-human		LDLo:	50 mg/kg				
				Inhalation-human		TCLo:	200 ppm		Central Nervous System	OSHA std (air): TWA 200 ppm; C1 300; PK 500/10M	
									Psychotropic		
				Inhalation-man		TCLo:	100 ppm				
				Oral-rat		LD50:	5,000 mg/kg				
				Inhalation-rat		LCLo:	4,000 ppm	4H		NIOSH recm std (air): TWA 100 ppm, C1 200 ppm/10H	
				Intraperitoneal-rat		LDLo:	800 mg/kg				
				Inhalation-mouse		LC50:	5,320 ppm	8H			
				Skin-rabbit		LD50:	14 gm/kg				
				Skin-rabbit			435 mg		Mild Irritation		
									Mild Irritation		
				Eye-rabbit			870 µg				
				Subcutaneous-frog		LDLo:	920 mg/kg				
				Eye-rabbit			2 mg	24H	Severe Irritation		

Table 11 (continued)  
TOXICITY OF COMPOUNDS  
AIR SAMPLES COLLECTED AT FIKE CHEMICAL COMPANY  
NITRO, WEST VIRGINIA

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a	Aquatic Toxicity:	TLm 96	96-hour static or continuous flow standard protocol, in parts per million (ppm)
b	Type of Dose.	LD50	- lethal dose 50% kill
		LCLo	- lowest published lethal concentration
		LC50	- lethal concentration 50% kill
		LDLo	- lowest published lethal dose
		TDLo	- lowest published toxic dose
		TCLo	- lowest published toxic concentration
		TD	- toxic dose
c	Duration	M	- minute;
		H	- hour
		D	- day
		W	- week
		Y	- year
		C	- continuous
		I	- intermittent
d	Effects:		
		Blood	- Blood effects; effect on all blood elements, electrolytes, pH, protein, oxygen carrying or releasing capacity
		Carcinogenic	- Carcinogenic effects; producing cancer, a cellular tumor the nature of which is fatal, or is associated with the formation of secondary tumors (metastasis)
		Central Nervous System	- Includes effects such as headaches, tremor, drowsiness, convulsions, hypnosis, anesthesia.
		Eye	- Irritation, diplopia, cataracts, eye ground, blindness by affecting the eye or the optic nerve
		Gastrointestinal	- diarrhea, constipation, ulceration.
		Irritant	- Any irritant effect on the skin, eye or mucous membrane
		Mutagenic	- Transmissible changes produced in the offspring
		Neoplastic	- The production of tumors not clearly defined as carcinogenic.
		Psychotropic	- Exerting an effect upon the mind.
		Pulmonary	- Effects on respiration and respiratory pathology.
		Systemic	- Effects on the metabolic and excretory function of the liver or kidneys.
		Teratogenic	- Nontransmissible changes produced in the offspring.
		Equivocal Tumorigenic Agent	- those studies reporting uncertain, but seemingly positive results.
e	Exposure Limits:	NR	- not reported
		NIOSH	- National Institute for Occupational Safety and Health
		OSHA	- Occupational Safety and Health Act of 1970
		TWA	- time-weighted average concentration
		TLV	- threshold limit value
		Cl	- ceiling
		Pk	- peak concentration
f	This chemical has been selected for priority attention as point source water effluent discharge toxic pollutant (NRDC vs Train consent decree)		

## REFERENCES

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4. Brown, S., 1920. The Story of Ordnance in the World War. Washington, D.C.: James William Bryan Press, p. 98.
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APPENDIX A  
SAMPLE ANALYSIS

ENVIRONMENTAL PROTECTION AGENCY  
OFFICE OF ENFORCEMENT  
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER  
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

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TO Steve Sisk, Project Coordinator

DATE February 19, 1980

Concurrence: 

FROM O. J. Logsdon II

SUBJECT Hazardous Waste Investigation, Fike Chemical Company, Nitro, West Virginia, Proj. 611,  
Organic Priority Pollutant Analytical Results

Five (5) environmental samples for priority pollutant extractable organic analysis and priority pollutant volatile organic analysis and eight (8) hazardous waste samples for priority pollutant extractable organic analysis were received. Four of the eight hazardous samples were analyzed for volatile organic priority pollutants. Four (4) water and four (4) soil samples were analyzed for priority pollutant pesticides and PCB's. All of the samples were received under chain-of-custody procedures on December 14, 1979. The hazardous waste samples were taken to the Quail Street regulated laboratory and prepared for analysis. The Chemistry and Biology Branches split the extracts of the environmental samples. The Chemistry Branch analyzed the sample extracts for priority pollutants. The Biology Branch tested the sample extracts for mutagenicity. Attachment I is a summary of the samples received by the Chemistry Branch, Organic Characterization Section.

Attachment II is a compilation of the results of the analysis of the environmental samples for organic extractable priority pollutant compounds (bases, neutrals, acids, pesticides) and volatile organic priority pollutants (VOA's). Included in the compilation are the VOA quality control results for the sample from Station 10. The average percent recovery of standard compounds spiked into the sample at concentrations of 50-250 ug/l was 62%. The base/neutral/acid extractable quality control data was declared invalid because the aliquots were not removed from the sample in accordance with acceptable quality control procedures. Few priority pollutants were detected in the environmental samples. Phenol was detected at Station 02, bis(2-chloroethyl) ether and bis(2-chloroisopropyl) ether at Station 11, chloroform and methylene chloride at Station 12. Other compounds detected include benzene, toluene, ethylbenzene, bis(2-ethylhexyl) phthalate, butylbenzylphthalate, 1,2-dichloroethane, trichloroethylene and tetrachloroethylene.

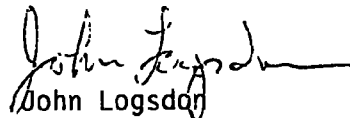
Attachment III (a,b,c) lists non-priority pollutant extractable compounds detected in the samples, but not verified or quantified. Only aniline and tetramethylthiourea were verified after comparison to standard compounds. Bis(2-chloroethyl) ether was detected in the sample from Station 11 analyzed for VOA's and the sample from Station 11 analyzed for bases/neutrals/acids.

Attachment IV tabulates the results of the analysis of the hazardous waste samples for volatile and extractable organic priority pollutants. Because of the suspected hazardous nature of these samples, they were prepared with special handling to detect compounds at high concentrations only. Minimum detection limits for solid samples were 100-500 ppm, bases/neutrals/acids in liquid samples were 25-100 mg/l, and VOA's in liquids were 0.3 mg/l (acrolein, acrylonitrile were 15 mg/l). Nominal detection

limits for pesticides and PCB's in hazardous waste samples range from 25 ug/l to 1250 ug/l for liquids and from 100 ug/kg to 5000 ug/kg for solids. None of the water or soil samples analyzed contained detectable amounts of pesticides or PCB's. Only phenol in the Station 06 sample was detected at these levels.

Because of the potential significance of the samples from Station 04 these samples are being reanalyzed under conditions to enhance the detection limits. Included in Attachment IV are the quality control data for hazardous liquid and solid samples. The average percent recovery of base/neutral and acid compounds spiked into liquid sample 04-01 at the detection limits was 68%. Pesticides were recovered from spikes of 125 to 1250 ug/l at an average of 90%. No compounds were detected in the solid sample from Station 07. The average percent recovery of base/neutrals and acids spiked into the sample at the detection limits was 33%. Pesticides were recovered from spikes of 500 to 5000 ug/kg at an average of 85%. The average percent recovery for spiked compounds was 87% for VOA's analyses. Attachment V lists non-priority pollutant volatiles detected in the samples, but not verified or quantified.

Environmental samples were extracted and analyzed using methods similar to the proposed 304 (h) Method 625 for priority pollutants. The hazardous waste samples were prepared by extraction and dilution to get concentrations in the range of environmental extracts. The analyses for all samples were then conducted using the procedures similar to the proposed 304 (h) Methods 608 (pesticides and PCB's), 624 (volatile organics) and 625 (base/neutrals and acids). Exceptions to these methods and the hazardous waste sample preparation procedures are documented and included in the complete raw data documentation package for reference.

  
John Logsdon

Attachments

### Detection Limits and Analytical Quality Control Data

Environmental

## ORGANIC PRIORITY POLLUTANTS - DATA REPORT

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STATION	SEQUENCE	DATE	TIME	TAG #	DESCRIPTION	Lower Limit of Detection <sup>c</sup>
BASE/NEUTRALS UNITS <u>ug/L</u>		BASE/NEUTRALS UNITS <u>ug/L</u>		PESTICIDES UNITS		
1	NAPHTHENE	<u>10</u>	56	NITROBENZENE	<u>25</u>	89 ALDRIN
5	GLNZIDINE	<u>25</u>	62	N-NITROSODIPHENYLAMINE (A)	<u>10</u>	90 DIELDRIN
1	1, 2, 4-TRICHLOROBENZENE	<u>10</u>	63	N-NITROSODI-N-PROPYLAMINE	<u>25</u>	91 CHLORDANE
1	HEXACHLOROBENZENE	<u>10</u>	66	BIS(2-ETHYLHEXYL)PHTHALATE	<u>10</u>	92 4, 4'-DDT
12	HEXACHLOROCYCLOHEPTANE	<u>10</u>	67	BUTYLBENZYLPHTHALATE	<u>10</u>	93 4, 4'-DDE
18	BIS(2-CHLOROETHYL)ETHER	<u>10</u>	68	DI-N-BUTYLPHTHALATE	<u>10</u>	94 4, 4'-DDD
0	2-CHLORONAPHTHALENE	<u>10</u>	69	DI-N-OCTYLPHTHALATE	<u>25</u>	95 A-ENDOSULFAN-ALPHA
15	1, 2-DICHLOROBENZENE	<u>10</u>	70	DIETHYLPHTHALATE	<u>10</u>	96 B-ENDOSULFAN-BETA
26	1, 3-DICHLOROBENZENE	<u>10</u>	71	DIMETHYLPHTHALATE	<u>10</u>	97 ENDOSULFAN SULFATE
17	1, 4-DICHLOROBENZENE	<u>10</u>	72	BENZO(A)ANTHRACENE	<u>10</u>	98 ENDRIN
13	3, 3'-DICHLOROBENZIDINE	<u>40</u>	73	BENZO(A)PYRENE	<u>50</u>	99 ENDRIN ALDEHYDE
25	2, 4-DINITROTOLUENE	<u>25</u>	74	3, 4-BENZOFLUORANTHENE	<u>50</u>	100 HEPTACHLOR
36	2, 6-DINITROTOLUENE	<u>25</u>	75	BENZO(K)FLUORANTHENE	<u>50</u>	101 HEPTACHLOR EPOXIDE
17	1, 2-DIPHENYLHYDRAZINE (B)	<u>10</u>	76	CHRYSENE	<u>10</u>	102 A-BHC-ALPHA
39	FLUORANTHENE	<u>10</u>	77	ACENAPHTHYLENE	<u>25</u>	103 B-BHC-BETA
40	4-CHLOROPHENYLPHENYLETHER	<u>10</u>	78	ANTHRACENE	<u>10</u>	104 BHC-GAMMA (LINDANE)
41	4-BROMOPHENYLPHENYLETHER	<u>10</u>	79	BENZO(G, H, I)PERYLENE	<u>50</u>	105 BHC-DELTA
42	BIS(2-CHLOROISOPROPYL)ETHER	<u>25</u>	80	FLUORENE	<u>10</u>	106 PCB-1242
43	BIS(2-CHLOROETHOXY)METHANE	<u>25</u>	81	PHENANTHRENE	<u>10</u>	107 PCB-1254
52	HEXACHLOROBUTADIENE	<u>10</u>	82	DIBENZO(A, H)ANTHRACENE	<u>50</u>	108 PCB-1221
53	HEXACHLOROCYCLOPENTADIENE	<u>50</u>	83	INDENO(1, 2, 3-C, D)PYRENE	<u>50</u>	109 PCB-1232
54	ISOPHORONE	<u>40</u>	84	PYRENE	<u>10</u>	110 PCB-1248
55	NAPHTHALENE	<u>10</u>				111 PCB-1260
						112 PCB-1016
						113 TOXAPHENE

(A) MEASURED AS DIPHENYLAMINE

(B) MEASURED AS AZOBENZENE

<sup>c</sup> - limit - lower limit of detection for compounds is 1 liter of water

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## ORGANIC PRIORITY POLLUTANTS - DATA REPORT

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STATION	SEQUENCE	DATE	TIME	TAG #	DESCRIPTION	Lower Limit of Detection <sup>c, d</sup>
VOLATILES UNITS <u>ug/L</u>		VOLATILES UNITS <u>ug/L</u>		PHENOLS UNITS <u>ug/L</u>		
2	ACROLEIN	<u>10</u>	30	DICHLORODIFLUOROMETHANE	<u>10</u>	21 2,4,6-TRICHLOROPHENOL <u>20</u>
3	ACRYLONITRILE	<u>10</u>	31	CHLORODIBROMOMETHANE	<u>10</u>	22 PARACHLOROMETACRESOL <u>20</u>
4	BENZENE	<u>10</u>	35	TETRACHLOROETHYLENE	<u>10</u>	24 2-CHLOROPHENOL <u>20</u>
6	CARBONTETRACHLORIDE	<u>10</u>	36	TOLUENE	<u>10</u>	31 2,4-DICHLOROPHENOL <u>20</u>
7	CHLORO BENZENE	<u>10</u>	37	TRICHLOROETHYLENE	<u>10</u>	34 2,4-DIMETHYLPHENOL <u>20</u>
10	1,2-DICHLOROETHANE	<u>10</u>	38	VINYL CHLORIDE	<u>10</u>	57 2-NITROPHENOL <u>20</u>
11	1,1,1-TRICHLOROETHANE	<u>0</u>				58 4-NITROPHENOL <u>40</u>
13	1,1-DICHLOROETHANE	<u>0</u>		MISCELLANEOUS UNITS		59 2,4-DINITROPHENOL <u>40</u>
14	1,1,2-TRICHLOROETHANE	<u>10</u>	17	BIS(CHLOROMETHYL)ETHER	<u>NA</u>	60 4,6-DINITRO-O-CRESOL <u>20</u>
15	1,1,2,2-TETRACHLOROETHANE	<u>10</u>	61	N-NITROSODIMETHYLAMINE	<u>NA</u>	64 PENTACHLOROPHENOL <u>40</u>
16	CHLOROETHANE	<u>10</u>	129	2,3,7,8-TETRACHLORODIBENZO-DIOXAN	<u>NA</u>	65A PHENOL <u>20</u>
19	2-CHLOROETHYL VINYLETHER	<u>10</u>				
23	CHLOROFORM	<u>0</u>				
29	1,1-DICHLOROETHYLENE	<u>10</u>				
30	1,2-TRANS-DICHLOROETHYLENE	<u>0</u>				
32	1,2-DICHLOROPROPANE	<u>10</u>		PNG	PRESENT BUT NOT QUANTIFIED THE SUBJECT PARAMETER WAS PRESENT IN THE SAMPLE BUT NO QUANTIFIABLE RESULT COULD BE DETERMINED	
33A	1,3-TRANS-DICHLOROPROPYLENE	<u>10</u>				
33B	CIS-1,3-DICHLOROPROPYLENE	<u>10</u>		FQC	FAILED QUALITY CONTROL. THE ANALYSIS RESULT IS EITHER NOT PRESENT OR NOT RELIABLE BECAUSE THE QC LIMITS WERE EXCEEDED	
38	ETHYLBENZENE	<u>10</u>				
44	METHYLENE CHLORIDE	<u>10</u>		NAI	NOT ANALYZED DUE TO INTERFERENCE BECAUSE OF AN UNCONTROLLABLE INTERFERENCE, THE ANALYSIS FOR THIS PARAMETER WAS NOT CONDUCTED	
45	METHYL CHLORIDE	<u>10</u>				
46	METHYL BROMIDE	<u>10</u>		NA	NOT ANALYZED NOT ANALYZED IN THE SAMPLE	
47	BROMOFORM	<u>10</u>				
48	DICHLOROBROMOMETHANE	<u>10</u>		ND	NOT DETECTED NOT IDENTIFIED OR DETECTED IN THE SAMPLE	
49	TRICHLOROFLUOROMETHANE	<u>10</u>				

<sup>d</sup> Lower Limit of Detection for compounds in 5ml of water, p. 1031 for 12 minutes using Helium at 40ml/min (VGA).

STATION		SEQUENCE		DATE		TIME		TAG #		DESCRIPTION		Lower Limit of Detection <sup>E</sup>	
BASE/NEUTRALS		UNITS <u>ug/L</u>		BASE/NEUTRALS		UNITS <u>ug/L</u>		PESTICIDES		UNITS <u>ug/mL</u>			
1	ACENAPHTHENE		<u>25000</u>	56	NITROBENZENE		<u>50000</u>	89	ALDRIN		<u>0.02</u>		
2	BENZIDINE		<u>50000</u>	62	N-NITROSODIPHENYLAMINE (A)		<u>25000</u>	90	DIELDRIN		<u>0.05</u>		
3	1,2,4-TRICHLOROBENZENE		<u>25000</u>	63	N-NITROSODI-N-PROPYLAMINE		<u>50000</u>	91	CHLORDANE		<u>0.2</u>		
4	HEXACHLOROBENZENE		<u>25000</u>	66	BIS(2-ETHYLHEXYL)PHTHALATE		<u>25000</u>	92	4,4'-DDT		<u>0.1</u>		
12	HEXACHLORODETHANE		<u>25000</u>	67	BUTYLBENZYLPHTHALATE		<u>25000</u>	93	4,4'-DDE		<u>0.02</u>		
18	BIS(2-CHLOROETHYL)ETHER		<u>25000</u>	68	DI-N-BUTYLPHTHALATE		<u>25000</u>	94	4,4'-DDD		<u>0.1</u>		
20	2-CHLORONAPHTHALENE		<u>25000</u>	69	DI-N-OCTYLPHTHALATE		<u>50000</u>	95	A-ENDOSULFAN-ALPHA		<u>0.05</u>		
25	1,2-DICHLOROBENZENE		<u>25000</u>	70	DIETHYLPHTHALATE		<u>25000</u>	96	B-ENDOSULFAN-BETA		<u>0.05</u>		
26	1,3-DICHLOROBENZENE		<u>25000</u>	71	DIMETHYLPHTHALATE		<u>25000</u>	97	ENDOSULFAN SULFATE		<u>0.2</u>		
27	1,4-DICHLOROBENZENE		<u>25000</u>	72	BENZO(A)ANTHRACENE		<u>25000</u>	98	ENDRIN		<u>0.05</u>		
38	3,3'-DICHLOROBENZIDINE		<u>50000</u>	73	BENZO(A)PYRENE		<u>100000</u>	99	ENDRIN ALDEHYDE		<u>0.1</u>		
35	2,4-DINITROTOLUENE		<u>50000</u>	74	3,4-BENZOFLUORANTHENE		<u>100000</u>	100	HEPTACHLOR		<u>0.02</u>		
36	2,6-DINITROTOLUENE		<u>50000</u>	75	BENZO(K)FLUORANTHENE		<u>100000</u>	101	HEPTACHLOR EPOXIDE		<u>0.02</u>		
37	1,2-DIPHENYLHYDRAZINE (B)		<u>25000</u>	76	CHRYSENE		<u>25000</u>	102	A-BHC-ALPHA		<u>0.005</u>		
39	FLUORANTHENE		<u>25000</u>	77	ACENAPHTHYLENE		<u>50000</u>	103	B-BHC-BETA		<u>0.02</u>		
40	4-CHLOROPHENYLPHENYLETHER		<u>25000</u>	78	ANTHRACENE		<u>25000</u>	104	BHC-GAMMA (LINDANE)		<u>0.005</u>		
41	4-BROMOPHENYLPHENYLETHER		<u>25000</u>	79	BENZO(G,H,I)PERYLENE		<u>100000</u>	105	BHC-DELTA		<u>0.005</u>		
42	BIS(2-CHLOROISOPROPYL)ETHER		<u>50000</u>	80	FLUORENE		<u>25000</u>	106	PCB-1242		<u>0.2</u>		
43	BIS(2-CHLOROETHOXY)METHANE		<u>50000</u>	81	PHENANTHRENE		<u>25000</u>	107	PCB-1254		<u>0.2</u>		
52	HEXACHLOROBUTADIENE		<u>25000</u>	82	DIBENZO(A,H)ANTHRACENE		<u>100000</u>	108	PCB-1221		<u>0.2</u>		
53	HEXACHLOROCYCLOPENTADIENE		<u>50000</u>	83	INDENO(1,2,3-C,D)PYRENE		<u>100000</u>	109	PCB-1232		<u>0.2</u>		
54	ISOPHORONE		<u>50000</u>	84	PYRENE		<u>25000</u>	110	PCB-1248		<u>0.2</u>		
55	NAPHTHALENE		<u>25000</u>					111	PCB-1260		<u>0.5</u>		
								112	PCB-1016		<u>0.2</u>		
								113	TOXAPHENE		<u>1</u>		

(A) MEASURED AS DIPHENYLAMINE  
(B) MEASURED AS AZOBENZENE

Minimum lower limit of detection for compounds in 20mL liquid  
extracted into 50mL organic solvent

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## ORGANIC PRIORITY POLLUTANTS - DATA REPORT

PAGE 2 OF 2

HAZ Waste  
Lower Limit of Detection E, D

STATION	SEQUENCE	DATE	TIME	TAG #	DESCRIPTION	PHENOLS UNITS <u>ug/L</u>
VOLATILES UNITS <u>ug/L</u>		VOLATILES UNITS <u>ug/L</u>				
2	ACROLEIN	<u>15000</u>	50	DICHLORODIFLUOROMETHANE	<u>300</u>	21 2,4,6-TRICHLOROPHENOL <u>25000</u>
3	ACRYLONITRILE	<u>15000</u>	51	CHLORODIBROMOMETHANE	<u>300</u>	22 PARACHLOROMETACRESOL <u>25000</u>
4	BENZENE	<u>300</u>	85	TETRACHLOROETHYLENE	<u>300</u>	24 2-CHLOROPHENOL <u>25000</u>
6	CARBONTETRACHLORIDE	<u>300</u>	86	TOLUENE	<u>300</u>	31 2,4-DICHLOROPHENOL <u>25000</u>
7	CHLOROBENZENE	<u>300</u>	87	TRICHLOROETHYLENE	<u>300</u>	34 2,4-DIMETHYLPHENOL <u>25000</u>
10	1,2-DICHLOROETHANE	<u>300</u>	88	VINYL CHLORIDE	<u>300</u>	57 2-NITROPHENOL <u>25000</u>
11	1,1,1-TRICHLOROETHANE	<u>300</u>				58 4-NITROPHENOL <u>50000</u>
13	1,1-DICHLOROETHANE	<u>300</u>		MISCELLANEOUS UNITS		59 2,4-DINITROPHENOL <u>50000</u>
14	1,1,2-TRICHLOROETHANE	<u>300</u>	17	BIS(CHLOROMETHYL)ETHER	<u>NA</u>	60 4,6-DINITRO-O-CRESOL <u>25000</u>
15	1,1,2,2-TETRACHLOROETHANE	<u>300</u>	61	N-NITROSODIMETHYLAMINE	<u>NA</u>	64 PENTACHLOROPHENOL <u>50000</u>
16	CHLOROETHANE	<u>300</u>	129	2,3,7,8-TETRACHLORODIBENZO-DIOXAN	<u>NA</u>	65A PHENOL <u>25000</u>
19	2-CHLOROETHYL VINYLETHER	<u>300</u>				
23	CHLOROFORM	<u>300</u>				
29	1,1-DICHLOROETHYLENE	<u>300</u>				
30	1,2-TRANS-DICHLOROETHYLENE	<u>300</u>				
32	1,2-DICHLOROPROPANE	<u>300</u>				
33A	1,3-TRANS-DICHLOROPROPYLENE	<u>300</u>				
33B	CIS-1,3-DICHLOROPROPYLENE	<u>300</u>				
38	ETHYLBENZENE	<u>300</u>				
44	METHYLENE CHLORIDE	<u>300</u>				
45	METHYL CHLORIDE	<u>300</u>				
46	METHYL BROMIDE	<u>300</u>				
47	BROMOFORM	<u>300</u>				
48	DICHLOROBROMOMETHANE	<u>300</u>				
49	TRICHLOROFLUOROMETHANE	<u>300</u>				

## \*\*\*\*\* RESULTS QUALIFIERS \*\*\*\*\*

PNG	PRESENT BUT NOT QUANTIFIED THE SUBJECT PARAMETER WAS PRESENT IN THE SAMPLE BUT NO QUANTIFIABLE RESULT COULD BE DETERMINED
FGC	FAILED QUALITY CONTROL THE ANALYSIS RESULT IS EITHER NOT PRESENT OR NOT RELIABLE BECAUSE THE QC LIMITS WERE EXCEEDED
NAI	NOT ANALYZED DUE TO INTERFERENCE BECAUSE OF AN UNCONTROLLABLE INTERFERENCE, THE ANALYSIS FOR THIS PARAMETER WAS NOT CONDUCTED
NA	NOT ANALYZED NOT ANALYZED IN THE SAMPLE
ND	NOT DETECTED NOT IDENTIFIED OR DETECTED IN THE SAMPLE

D. Lower limit of detection for compounds in 5ml of water,  
purged for 12 minutes using 20ml/min (VCA).

## Hazardous Solids

## ORGANIC PRIORITY POLLUTANTS - DATA REPORT

PAGE 1 OF 2

 LOCATION: \_\_\_\_\_ SEQUENCE \_\_\_\_\_ DATE \_\_\_\_\_ TIME \_\_\_\_\_ TAG # \_\_\_\_\_ DESCRIPTION Lower Limit of Detection<sup>E1</sup>

BASE/NEUTRALS UNITS <u>mg/kg</u>			BASE/NEUTRALS UNITS <u>mg/kg</u>			PESTICIDES UNITS <u>ug/g</u>		
1	ACENAPHTHENE	<u>100</u>	56	NITROBENZENE	<u>250</u>	89	ALDRIN	<u>0.1</u>
2	BENZIDINE	<u>250</u>	62	N-NITROSODIPHENYLAMINE (A)	<u>100</u>	90	DIELDRIN	<u>0.2</u>
3	1,2,4-TRICHLOROBENZENE	<u>100</u>	63	N-NITROSODI-N-PROPYLAMINE	<u>250</u>	91	CHLORDANE	<u>1</u>
4	HEXACHLOROBENZENE	<u>100</u>	66	BIS(2-ETHYLHEXYL)PHTHALATE	<u>100</u>	92	4,4'-DDT	<u>0.5</u>
5	HEXACHLORODETHANE	<u>100</u>	67	BUTYLBENZYLPHTHALATE	<u>100</u>	93	4,4'-DDE	<u>0.1</u>
6	BIS(2-CHLOROETHYL)ETHER	<u>100</u>	68	DI-N-BUTYLPHTHALATE	<u>100</u>	94	4,4'-DDD	<u>0.4</u>
7	2-CHLORONAPHTHALENE	<u>100</u>	69	DI-N-OCTYLPHTHALATE	<u>250</u>	95	A-ENDOSULFAN-ALPHA	<u>0.2</u>
8	1,2-DICHLOROBENZENE	<u>100</u>	70	DIETHYLPHTHALATE	<u>100</u>	96	B-ENDOSULFAN-BETA	<u>0.2</u>
9	1,3-DICHLOROBENZENE	<u>100</u>	71	DIMETHYLPHTHALATE	<u>100</u>	97	ENDOSULFAN SULFATE	<u>1</u>
10	1,4-DICHLOROBENZENE	<u>100</u>	72	BENZO(A)ANTHRACENE	<u>100</u>	98	ENDRIN	<u>0.2</u>
11	3,3'-DICHLOROBENZIDINE	<u>400</u>	73	BENZO(A)PYRENE	<u>500</u>	99	ENDRIN ALDEHYDE	<u>0.4</u>
12	2,4-DINITROTOLUENE	<u>250</u>	74	3,4-BENZOFLUORANTHENE	<u>500</u>	100	HEPTACHLOR	<u>0.1</u>
13	2,6-DINITROTOLUENE	<u>250</u>	75	BENZO(K)FLUORANTHENE	<u>500</u>	101	HEPTACHLOR EPOXIDE	<u>0.1</u>
14	1,2-DIPHENYLHYDRAZINE (B)	<u>100</u>	76	CHRYSENE	<u>100</u>	102	A-BHC-ALPHA	<u>0.02</u>
15	FLUROANTHENE	<u>100</u>	77	ACENAPHTHYLENE	<u>250</u>	103	B-BHC-BETA	<u>0.1</u>
16	4-CHLOROPHENYLPHENYLETHER	<u>100</u>	78	ANTHRACENE	<u>100</u>	104	BHC-GAMMA (LINDANE)	<u>0.02</u>
17	4-BROMOPHENYLPHENYLETHER	<u>100</u>	79	BENZO(G, H, I)PERYLENE	<u>500</u>	105	BHC-DELTA	<u>0.02</u>
18	BIS(2-CHLOROISOPROPYL)ETHER	<u>250</u>	80	FLUORENE	<u>100</u>	106	PCB-1242	<u>1</u>
19	BIS(2-CHLOROETHOXY)METHANE	<u>250</u>	81	PHENANTHRENE	<u>100</u>	107	PCB-1254	<u>1</u>
20	HEXACHLOROBUTADIENE	<u>100</u>	82	DIBENZO(A, H)ANTHRACENE	<u>500</u>	108	PCB-1221	<u>1</u>
21	HEXACHLOROCYCLOPENTADIENE	<u>500</u>	83	INDENO(1, 2, 3-C, D)PYRENE	<u>500</u>	109	PCB-1232	<u>1</u>
22	ISOPHORONE	<u>400</u>	84	PYRENE	<u>100</u>	110	PCB-1248	<u>1</u>
23	NAPHTHALENE	<u>100</u>				111	PCB-1260	<u>2</u>
						112	PCB-1016	<u>1</u>
						113	TOXAPHENE	<u>5</u>

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(A) MEASURED AS DIPHENYLAMINE

(B) MEASURED AS AZOBENZENE

E1 Nominal lower limit of detection for compounds in 5g. solid, extracted,  
concentrated to 50ml organic solvent

## ORGANIC PRIORITY POLLUTANTS - DATA REPORT

PAGE 2 OF 2

STATION	SEQUENCE	DATE	TIME	TAG #	DESCRIPTION	Lower Limit of Detection E1
VOLATILES UNITS		VOLATILES UNITS		PHENOLS UNITS mg/kg		
2	ACROLEIN	<u>NA</u>	30	DICHLORODIFLUOROMETHANE	<u>NA</u>	21 2,4,6-TRICHLOROPHENOL <u>100</u>
3	ACRYLONITRILE	<u>NA</u>	31	CHLORODIBROMOMETHANE	<u>NA</u>	22 PARACHLOROMETACRESOL <u>100</u>
4	BENZENE	<u>NA</u>	85	TETRACHLOROETHYLENE	<u>NA</u>	24 2-CHLOROPHENOL <u>100</u>
6	CARBONTETRACHLORIDE	<u>NA</u>	86	TOLUENE	<u>NA</u>	31 2,4-DICHLOROPHENOL <u>100</u>
7	CHLOROBENZENE	<u>NA</u>	87	TRICHLOROETHYLENE	<u>NA</u>	34 2,4-DIMETHYLPHENOL <u>100</u>
10	1,2-DICHLOROETHANE	<u>NA</u>	88	VINYL CHLORIDE	<u>NA</u>	57 2-NITROPHENOL <u>100</u>
11	1,1,1-TRICHLOROETHANE	<u>NA</u>				58 4-NITROPHENOL <u>200</u>
13	1,1-DICHLOROETHANE	<u>NA</u>		MISCELLANEOUS UNITS		59 2,4-DINITROPHENOL <u>200</u>
14	1,1,2-TRICHLOROETHANE	<u>NA</u>	17	BIS(CHLOROMETHYL)ETHER	<u>NA</u>	60 4,6-DINITRO-O-CRESOL <u>100</u>
15	1,1,2,2-TETRACHLOROETHANE	<u>NA</u>	61	N-NITROSODIMETHYLAMINE	<u>NA</u>	64 PENTACHLOROPHENOL <u>250</u>
16	CHLOROETHANE	<u>NA</u>	129	2,3,7,8-TETRACHLORODIBENZO-DIOXAN	<u>NA</u>	65A PHENOL <u>100</u>
19	2-CHLOROETHYL VINYLETHER	<u>NA</u>				
23	CHLOROFORM	<u>NA</u>				
29	1,1-DICHLOROETHYLENE	<u>NA</u>				
30	1,2-TRANS-DICHLOROETHYLENE	<u>NA</u>				
32	1,2-DICHLOROPROPANE	<u>NA</u>				
33A	1,3-TRANS-DICHLOROPROPYLENE	<u>NA</u>				
33B	CIS-1,3-DICHLOROPROPYLENE	<u>NA</u>				
38	ETHYLBENZENE	<u>NA</u>				
44	METHYLENE CHLORIDE	<u>NA</u>				
45	METHYL CHLORIDE	<u>NA</u>				
46	METHYL BROMIDE	<u>NA</u>				
47	BROMOFORM	<u>NA</u>				
48	DICHLOROBROMOMETHANE	<u>NA</u>				
49	TRICHLOROFLUOROMETHANE	<u>NA</u>				

## \*\*\*\*\* RESULTS QUALIFIERS \*\*\*\*\*

PNG	PRESENT BUT NOT QUANTIFIED THE SUBJECT PARAMETER WAS PRESENT IN THE SAMPLE BUT NO QUANTIFIABLE RESULT COULD BE DETERMINED
FQC	FAILED QUALITY CONTROL THE ANALYSIS RESULT IS EITHER NOT PRESENT OR NOT RELIABLE BECAUSE THE QC LIMITS WERE EXCEEDED
NAI	NOT ANALYZED DUE TO INTERFERENCE BECAUSE OF AN UNCONTROLLABLE INTERFERENCE, THE ANALYSIS FOR THIS PARAMETER WAS NOT CONDUCTED
NA	NOT ANALYZED NOT ANALYZED IN THE SAMPLE
ND	NOT DETECTED NOT IDENTIFIED OR DETECTED IN THE SAMPLE

ENVIRONMENTAL PROTECTION AGENCY  
OFFICE OF ENFORCEMENT  
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER  
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

A-11

TO Steve Sisk, Project Coordinator

DATE January 24, 1980

Concurrence: Chief, Chemistry Branch *[Signature]*

FROM O. J. Logsdon

SUBJECT Results of Air Sample Analyses  
Hazardous Waste Investigation, Fike Chemical, Project 611

The analysis of the air samples collected at the Fike Chemical site have been completed. Seven samples, two blank traps and two spiked traps were received for analysis under chain-of-custody procedures. One blank trap and one spike trap were broken upon receipt. All other sample traps were acceptable for analysis. Attachment I summarizes the samples received. Because the analysis destroys the sample and the traps must be unpacked and cleaned for reuse, the tags were removed upon completion of each analysis.

Attachment II is a table of the chemicals detected. Twenty-seven chemicals were measured. Nine were priority pollutants (12 priority pollutants are shown in the table, 3 were analyzed but not detected in any of the samples) ~~were~~ detected. Also, 9 additional chemicals were detected but could not be verified. Some chemicals detected were aromatic and aliphatic hydrocarbons. These chemicals are often associated with internal combustion engine exhaust and fuels and could represent background levels. Large variations in the levels of these chemicals may indicate other sources however. Generally correlations may be seen between samples 14, 15 and 16, 17. The on-site samples 14 and 16 showing higher levels of chemicals than the off-sites 15 and 17.

The non-priority pollutants identified are listed in Attachment III with their Chemical Abstracts registry numbers (CAS#) for reference. Attachment IV summarizes the available quality control data corresponding to these samples.

Also attached are copies of the sample trap preparation, sampling, standardization and analysis procedures (Attachments V - VIII).

*[Signature]*  
O. J. Logsdon

Attachments

cc: C. Swibas (w/Attach. I, II, & III)

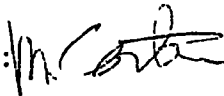
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ENVIRONMENTAL PROTECTION AGENCY  
OFFICE OF ENFORCEMENT  
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER  
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

TO John Logsdon

DATE February 25, 1980

Concurrence:



FROM Ed Bour

SUBJECT Trace Metals Data for Project 611, Hazardous Waste Investigation, Fike Chemical, Nitro, WV

One sample was received by the Chemistry Branch for metals analyses. Attached are the subject analyses requested, as well as detection limits and descriptions of analytical methods and quality control procedures.

Of particular note is the NA result obtained for the CST plant effluent.



Ed Bour

Attachments

cc: Carter  
Lowry

### Analytical Methods

The sample was digested in accordance with Method 4.1.3, EPA Methods Manual, page-metals 6 (EPA-600/4-79-020).

All elements were determined by "Inductively Coupled Argon Plasma - Atomic Emission Spectroscopy" (ICAP-AES). The methods used are referenced in ICAP-AES Methods for Trace Element Analysis of Water and Wastes, Interim Methods, U.S.E.P.A., EMSL, Cincinnati, Ohio, October 1979.

### Quality Control

A quality control reference standard and a calibration standard were analyzed and recoveries were found to be within 7% of the true values.

Because an insufficient quantity of sample was received, no precision and accuracy data are available for the digestion procedure.



Attachment IV. Quality Control Data for Air Samples. Hazardous Waste Investigation, Fike Chemical, Project 611.

<u>Name</u>	<u>% Difference</u> <sup>a</sup>	<u>% Recovery</u> <sup>b</sup>
methylenchloride	1.4	85
acetone	2.7	96
1,2-trans-dichloroethylene	1.6	88
chloroform	4.1	90
1,2-dichloroethane	4.1	88
trichloroethylene	3.3	98
benzene	2.7	94
n-hexane	20	114
toluene	5.2	92
chlorobenzene	3.2	98
ethylbenzene	12	87

<sup>a</sup> % difference =  $200 * (\text{second} - \text{first}) / (\text{second} + \text{first})$ . First and second are analyses of midrange standard.

<sup>b</sup> % recovery =  $100 * \text{recovered} / \text{level}$ . Spiked sample trap analysis after transport to and from field and 3 weeks holding time.

## 1.0 Introduction

- 1.1 Sampling for organics in air is performed by drawing air through a glass tube packed with the porous polymer resin Tenax GC. Air is drawn through each trap at 0.1 to 1 liter per minute using a calibrated personnel sampler. The sampler is calibrated before sampling using a mass flow meter.

## 2.0 Equipment

- 2.1 Sampler. MSA model S or equivalent personnel sampler. Capable of adjusting and monitoring the flow over the range of 0.1 to 1 liter per minute (lpm) with a trap in place.
- 2.2 Mass flow meter. Portable unit equipped with a teflon fitting to measure the flow through a sampling trap. It should have a range of 0 - 2 lpm and 0 - 10 lpm.
- 2.3 Sample traps. Glass sampling traps packed with Tenax GC.
- 2.4 Sampling line. 2 - 5 feet of 1/4" o.d. tygon tubing with a teflon fitting at one end to attach to the sampling traps.
- 2.5 Dummy Sampling Trap. One trap taken from the batch to be sampled.

## 3.0 Calibration Procedure

- 3.1 Attach the dummy sampling trap to the sample pump. Attach the mass flow meter over the inlet of the sample trap. Set the mass flow meter to the appropriate range and zero with no flow.
- 3.2 Start the sampling pump and adjust for a stable flow at the desired rate. Note the flow meter reading on the personnel sampler at the desired flow rate.
- 3.3 Record the mass flow meter reading and the sampler flow meter reading.
- 3.4 Detach the mass flow meter and the dummy trap.
- 3.5 Recalibrate the sample pump at the beginning of each sampling day, whenever the sample flow meter reading deviates from that at calibration or whenever necessary.
- 3.6 Flow rate variation between these traps is less than 5%.

## 4.0 Sample Collection

- 4.1 Using a clean tissue or wearing a nylon cloth glove, remove a sample trap from its culture tube being careful to reseal the culture tube.

- 4.2 Inspect the trap for damage such as broken glass, glass wool plugs loose or resin spilled. If the trap is in question, replace in culture tube and return to the laboratory unused.
- 4.3 Attach the trap to the calibrated sampler. See Figure 1.
- 4.4 Begin sampling noting the start time and sample pump flow meter reading. Collect sample volumes depending upon the suspected levels of contaminants. Generally:  
  
    Dumpsites: 1 lpm for 5-30 min.  
    Offsite: 1 lpm for 15-120 min.  
    Ambient: 1 lpm for 60-120 min.  
            or .1 lpm for 1-24 hr.
- 4.5 Stop sampling noting the end time and sample pump flow meter reading. Replace the trap into the culture tube being sure the glass wool cushions the trap. Reseal with the teflon lined septum cap and tag.
- 4.6 Replace sample traps in culture tubes into the tin can and reseal the can. Be sure to tag the "field blank" and "field spike" samples in each tin can.

## 5.0 Quality Control

- 5.1 Sample pumps are calibrated daily and any flow rate changes noted by monitoring the flow meter on the sampler.
- 5.2 Contamination in each sample transport container is monitored by a "field blank".
- 5.3 Deterioration of the samples is monitored by a "field spike".

## 6.0 Options

- 6.1 In the event of unknown atmospheres suspect of containing high levels of contaminants, two samples should be collected at flow rates of 1 and 1/10 or 1/100 rate (1 lpm and 10 ccpm for example).

## 7.0 Limitations

- 7.1 The sample traps are essentially short chromatographic columns. Retention of chemicals is dependant upon absorbtion characteristics of the chemical/resin system. Factors influencing retention include: temperature, flow rate, air volume and vapor pressure of the chemical. Volatile species like vinyl chloride are only moderately retained while other chemicals like chlorobenzene are retained very well. All chemicals will experience breakthrough under the correct conditions however. Table I lists breakthrough volumes for some relevant chemicals. The volumes represent the amount of air sampled where 50% of the collected chemical is lost through the trap. Data for chemicals where the sample volume exceeded the breakthrough volume represent at least that amount in the air.

- 8.1 "Development of Analytical Techniques for Measuring Ambient Atmospheric Carcinogenic Vapors", EPA-600/2-75-075, November 1975.
- 8.2 Env. Sci. Tech., 9, 556 (1975).
- 8.3 Pellizzari, E. D., Quarterly Report No. 1, EPA Contract No. 68-02-2262, February 1976.
- 8.4 Anal. Lett., 9, 45 (1976).

Prepared 1/24/78 C. J. Lopez, S.E.

Table I

Table A-2. TITAN GC BREAKTHROUGH VOLUMES FOR SEVERAL ATMOSPHERIC POLLUTANTS<sup>1</sup>

Chemical Class	Compound	b.p. (°C)	<i>liters of air pumped</i> Temperature (°F)					
			50	60	70	80	90	100
Halogenated hydrocarbon	methyl chloride	-24	8	6	5	4	3	2.5
	methyl bromide	3.5	3	2	2	1	1	0.9
	vinyl chloride	13	2	1.5	1.25	1.0	0.8	0.6
	methylene chloride	41	11	9	7	5	4	3
	chloroform	61	42	31	24	18	13	10
	carbon tetrachloride	77	34	27	21	16	13	10
	1,2-dichloroethane	83	53	41	31	23	18	14
	1,1,1-trichloroethane	75	23	18	15	12	9	7
	tetrachloroethylene	121	361	267	196	144	106	78
	trichloroethylene	87	90	67	50	38	28	21
	1-chloro-2-methylpropene	68	26	20	16	12	9	7
	3-chloro-2-methylpropene	72	29	22	17	13	10	8
	1,2-dichloropropane	95	229	162	115	81	58	41
	1,3-dichloropropane	121	348	253	184	134	97	70
	epichlorohydrin (1-chloro-2,3-epoxypropane)	116	200	144	104	74	54	39
	3-chloro-1-butene	64	19	15	12	9	7	6
	allyl chloride	45	21	16	12	9	6	5
	4-chloro-1-butene	75	47	36	27	20	15	12
	1-chloro-2-butene	84	146	106	77	56	40	29
	chlorobenzene	132	899	653	473	344	249	181
	o-dichlorobenzene	181	1,531	1,153	867	656	494	372
	m-dichlorobenzene	173	2,393	1,758	1,291	948	697	510

(continued)

Table A-2 (cont'd.)

Table I cont

Chemical Class	Compound	b.p. (°C)	Temperature (°F)					
			50	60	70	80	90	100
Halogenated hydrocarbons (cont'd)	benzyl chloride	179	2,792	2,061	1,520	1,125	830	612
	bromoform	149	507	386	294	224	171	131
	ethylene dibromide	131	348	255	188	138	101	74
	bromobenzene	155	2,144	1,521	1,079	764	542	384
Halogenated Ethers	2-chloroethyl ethyl ether	108	468	336	241	234	124	89
	Bis-(chloromethyl) ether	-	995	674	456	309	209	142
Nitrosamines	N-nitrosodimethylamine	151	385	280	204	163	148	107
	N-nitrosodiethylamine	177	2,529	1,836	1,330	966	700	508
Oxygenated hydrocarbons	acrolein	53	19	14	10	8	6	4
	glycidaldehyde	-	364	247	168	114	77	52
	propylene oxide	34	35	24	17	11	8	5
	butadiene diepoxide	-	1,426	1,009	714	506	358	253
	cyclohexene oxide	132	2,339	1,644	1,153	811	570	400
	styrene oxide	194	5,370	3,926	2,870	2,094	1,531	1,119
	phenol	183	2,071	1,490	1,072	769	554	398
	acetophenone	202	3,191	2,382	1,778	1,327	991	740
	β-propiolactone	57	721	514	366	261	186	132
Nitrogenous hydrocarbons	nitromethane	101	45	34	25	19	14	11
	aniline	184	3,864	2,831	2,075	1,520	1,114	817
Sulfur Compounds	diethyl sulfate	208	40	29	21	15	11	8
	ethyl methane sulfate	86	5,093	3,681	2,564	1,914	1,384	998

(continued)

Table I cont

Table A-2 (cont'd.)

Chemical Class	Compound	b.p. (°C)	Temperature (°F)					
			50	60	70	80	90	100
Amines	dimethylamine	7.4	9	6	4	3	2	1
	isobutylamine	69	71	47	34	23	16	11
	t-butylamine	89	6	5	4	3	2	1
	di-(n-butyl)amine	159	9,506	7,096	4,775	3,105	2,168	1,462
	pyridine	115	378	267	189	134	95	67
	aniline	184	8,128	5,559	3,793	2,588	1,766	1,205
Ethers	diethyl ether	34.6	29	21	15	11	8	5
	propylene oxide	35	13	9	7	5	4	3
Esters	ethyl acetate	77	162	108	72	48	32	22
	methyl acrylate	80	164	111	75	50	34	23
	methyl methacrylate	100	736	484	318	209	137	90
Ketones	acetone	56	25	17	12	8	6	4
	methyl ethyl ketone	80-2	82	57	39	27	19	13
	methyl vinyl ketone	81	84	58	40	28	19	14
	acetophenone	202	5,346	3,855	2,767	2,000	1,439	1,037
Aldehydes	acetaldehyde	20	3	2	2	1	0.9	0.7
	benzaldehyde	179	7,586	5,152	3,507	2,382	1,622	1,101
Alcohols	methanol	64.7	1	1	0.8	0.6	0.4	0.3
	n-propanol	97.4	27	20	14	10	7	5
	allyl alcohol	97	32	23	16	11	8	6

(continued)

Table A-2 (cont'd.)

Table I cont.

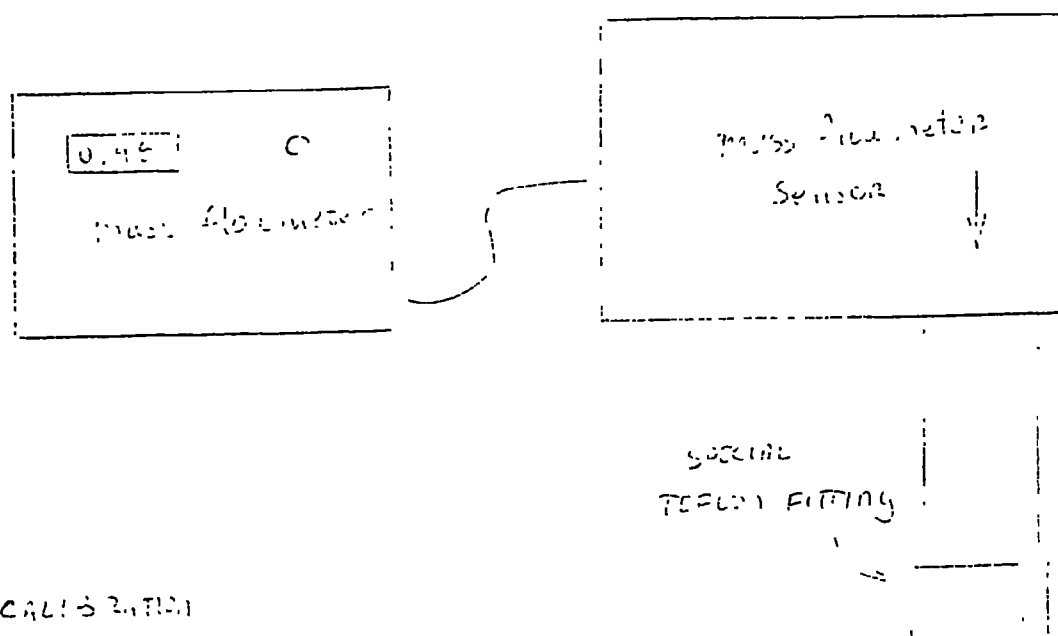
Chemical Class	Compound	b.p. (°C)	Temperature (°F)					
			50	60	70	80	90	100
Aromatics	benzene	80.1	108	77	54	38	27	19
	toluene	110.6	494	348	245	173	122	86
	ethylbenzene	136.2	1,393	984	693	487	344	243
	cumene	152.4	3,076	2,163	1,525	1,067	750	527
Hydrocarbons	n-hexane	68.7	32	23	17	12	9	6
	n-heptane	98.4	143	104	75	55	39	29
	1-hexene	63.5	28	20	15	11	8	6
	1-heptene	93.6	286	196	135	93	64	44
	2,2-dimethylbutane	49.7	0.5	0.4	0.3	0.2	0.2	0.1
	2,4-dimethylpentane	80.5	435	252	146	84	49	28
	4-methyl-1-pentene	53.8	14	10	8	6	4	3
	cyclohexane	80.7	49	36	26	19	14	10
Inorganic gases	nitric oxide	-	0	0	0	0	0	0
	nitrogen dioxide	-	0	0	0	0	0	0
	chlorine	-	0	0	0	0	0	0
	sulfur dioxide	-	0.06	0.05	0.03	0.02	0.02	0.01
	water	100	0.06	0.05	0.04	0.03	0.01	0

<sup>a</sup> Breakthrough volume is given in 2/2.2 g Tenax GC used in sampling cartridges.

from: EPA-560/13-79-010, September 1979  
 "Analytical Protocols for Making a Preliminary Assessment  
 of Halogenated Organic Compounds in Man and  
 Environmental Media".



## Sample Collection



CALIBRATION

## SAMPLING

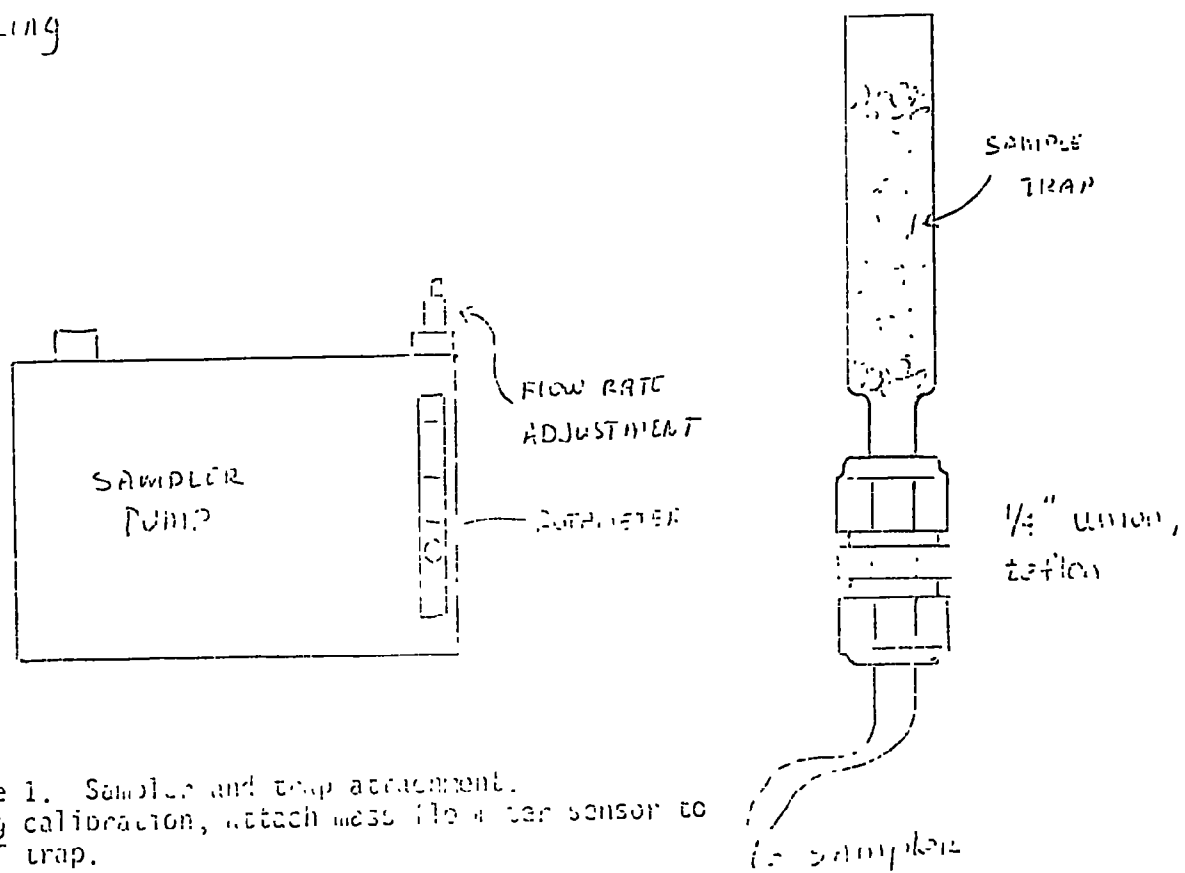


figure 1. Sampler and trap attachment.  
During calibration, attach mass flow meter sensor to top of trap.

**APPENDIX B**  
**MUTAGEN ASSAY METHODS AND RESULTS**

## FIKE CHEMICAL COMPANY

Summary and ConclusionsMutagen Testing

The Ames Test for mutagenesis did not demonstrate mutagenic activity in any of the three composite samples collected from 1) the CST final effluent (Station 01), 2) the CST storm sewer overflow (Station 02), and 3) the monitoring well adjacent to the south end of Lagoon #1 (Station 11) at Fike Chemical Company.

### Survey Findings

The standard bacterial assay for mutagenicity was performed on liquid sample concentrates using the plate incorporation method as described by Ames, et al<sup>1</sup>. This test consists of specially developed strains of Salmonella typhimurium that are auxotrophic for the amino acid, histidine (i.e., unable to grow without histidine supplemented to the media). The organisms have been genetically altered so when they are subjected to certain mutagenic and carcinogenic substances they will mutate and regain the natural ability to synthesize histidine. Thus, only mutant colonies can grow on media which does not contain histidine and their growth indicates presence of a mutagenic substance. Mutagenic activity based upon use of bacteria as indicator organisms correlates closely ( $\geq 90\%$  probability) with inducement of cancer in laboratory animals by organic compounds<sup>2,3,4,5,6,7</sup>.

Acidic and basic sample extracts were pre-screened for mutagenic activity using five standard Salmonella test strains: TA 98, TA 100, TA 1535, TA 1537, and TA 1538. Samples were first tested individually. If they showed negative mutagenicity, they were then subjected to metabolic activation by adding rat liver homogenate (S-9 mix) [Appendix       ].

The mutagenicity test did not demonstrate mutagenic activity in any of the three samples. All of the concentrated sample extracts exhibited toxicity to one or another of the five Salmonella test strains. However, mutagenicity was not apparent in any of the test strains at low concentrations. Therefore, mutagenicity could not be definitively determined for this material.

The inability to detect mutagenic activity in the samples does not necessarily mean that these substances are absent, but that the mutagenic effect may be below the detection limit of the test system used. The Salmonella test does not detect some of the important chlorinated carcinogens such as chloroform, carbon tetrachloride and hexachlorobenzene. The concentration techniques employed eliminates the volatile alkyl halides. Data for test results that did not exhibit elevated reversion rates (negative mutagenic activity or toxicity) are not presented in this report.

## MUTAGEN ASSAY METHODS

### Sample Extraction\*

For base-neutral extractions, four 1250 ml portions of sample were adjusted above pH 12 with NaOH. Each sample aliquot was extracted for 2 minutes with 125 ml, 70 ml and 70 ml of dichloromethane, respectively. Emulsions were removed by centrifugation (2-5 min at 10,000 rpm). The combined solvent fractions were poured through a drying column containing 3-4 inches of anhydrous sodium sulfate (pre-rinsed with 20-30 ml dichloromethane). The organic extract was collected into a Kuderna-Danish (K-D) flask equipped with a 10 ml concentrator tube. The aqueous sample fraction was retained for acidic extraction.

Approximately 500 ml of the dichloromethane in the combined extract was evaporated off at 65° C. One hundred fifty ml acetone was added to the K-D flask; the volume was reduced to less than 5 ml. Acetone was added to a final volume of 10 ml. A portion (2 ml) of the acetone extract was removed for trace organic analyses. Ten ml dimethylsulfoxide (DMSO) was added to the remaining acetone extract. The acetone was rotoevaporated at 65° C; DMSO was added to the residue to a total volume of 35 ml. The extract was collected in a small amber bottle (pre-rinsed in DMSO), labeled and refrigerated at 4°C until assayed by the Ames procedure. Aqueous fractions were adjusted below pH 2 and the above procedure repeated.

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\* *Using this method, the estimate of mutagenic activity from complex mixtures is low, because: 1) the volatile alkyl halides are lost in the dichloromethane/DMSO exchange, and 2) the Salmonella test detects only about 90% of carcinogens as mutagens. Some of the important chlorinated hydrocarbons are not detected, i.e., chloroform, hexachlorobenzene, etc.*

### Bacterial Mutagenicity Assay

The Standard Ames Salmonella/mammalian microsome mutagenicity assay was performed using the agar-plate incorporation procedure as described by Ames, et al<sup>1</sup>. Sample extracts were screened with Salmonella typhimurium test strains TA 98, TA 100, TA 1535, TA 1537, and TA 1538, first individually and then in the presence of rat liver homogenates (S-9 mix).

### Alternate Mutagenesis Assay

To test for interferences caused by trace metal chelation of S-9 mix, concentrated liver homogenate was first boiled to destroy enzyme activity. Aliquots of boiled liver extract (1 ml) were added to 3.8 ml of each sample extract. This dilution corresponds to the total volume of S-9 used in a normal test run. The modified sample was then analyzed by the Standard Ames procedure. Test results of the sample extract did not indicate that trace metal chelation and consequent enzyme toxification had occurred.

### Quality Control

A four-liter volume of tap water was added to a clean, one-gallon amber, glass-bottle and treated as a sample. This served as a quality reference for the sample bottles, extracting solvents, emulsion removal, and the concentration process. A DMSO sample was tested to ensure that this material did not interfere with test results.

The test strains TA 1535, TA 1537, TA 1538, TA 98, and TA 100 were exposed to diagnostic mutagens to confirm their natural reversion characteristics. The strains were tested for ampicillin resistance, crystal violet sensitivity, ultra-violet light sensitivity, and histidine requirement. Spontaneous reversion rates were tested with each sample series.

Rat liver homogenate was tested with 2-aminofluorene with strains TA 1538, TA 98, and TA 100 to confirm the metabolic activation process.

Sterility checks were performed on solvents, extracts, liver preparation, and all culture media.

## REFERENCES

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7. Sugimura, T., et. al., Overlapping of Carcinogens and Mutagens, In Magee P.N., S. Takayama, T. Sugimura, and T. Matsushima, eds., Fundamentals in Cancer Prevention, Univ. Park Press, Baltimore, Md., pp. 191-215, 1976.



## APPENDIX C

### TOXICITY AND HEALTH EFFECTS

## DATA COMPILATION METHODS

Sixty-two organic compounds and four priority pollutant metals were identified in the Fike Chemical Company survey. Thirteen organic compounds were identified in both air samples and the soil and/or liquid samples (cyclohexane, cyclohexanone, carbon disulfide, hexane, dichloromethane, chloroform, benzene, toluene, ethylbenzene, tetrachloroethylene, bis (2-chloroethyl) ether, trichloroethylene, and anisole).

To obtain toxicity and health effects data for the 62 organic compounds and four priority pollutant metals, the Registry of Toxic Effects of Chemical Substances (RTECS), an annual compilation prepared by the National Institute for Occupational Safety and Health, was searched.

RTECS contains toxicity data for about 37,000 substances, but does not presently include all chemicals for which toxic effects have been found. Chemical substances in RTECS have been selected primarily for the toxic effect produced by single doses, some lethal and some non-lethal. Substances whose principal toxic effect is from chronic exposure are not presently included. Toxic information on each chemical substance was compiled from published medical, biological, engineering, chemical, and trade information.

The Toxline data base, a computerized bibliographic retrieval system for toxicology, containing 692,394 records taken from material published in primary journals, was also searched. It is part of the MEDLARS system from the National Library of Medicine and is composed of 11 subfiles:

1. Chemical-Biological Activities, 1965 - (Taken from Chemical Abstracts, Sections 1-5, Sections 62-64, Section 8 - Radiation Biochemistry, Section 59 - Air Pollution and Industrial Hygiene, and Section 60 - Sewage Wastes.)

2. Toxicity Bibliography, 1968 - (A subset of Medline)
3. Pesticides Abstracts, 1966 - (Compiled by the Environmental Protection Agency and formerly known as Health Aspects of Pesticides Abstracts Bulletin)
4. International Pharmaceutical Abstracts, 1970 - (Product of the American Society of Hospital Pharmacists)
5. Abstracts on Health Effects of Environmental Pollutants, 1972 - (Comprised of profiles from BIOSIS data bases only)
6. Hayes File on Pesticides, 1940-1966 - (A collection of more than 10,000 citations to published articles on the health aspects of pesticides)
7. Environmental Mutagen Information Center File, 1960 - (Prepared at the Environmental Mutagen Information Center, Oak Ridge National Laboratory, Tennessee)
8. Toxic Materials Information Center File, 1971-1975 - (Prepared at the Oak Ridge National Laboratory, Oak Ridge, Tennessee)
9. Teratology File, 1960-1974 - (Closed subfile of citation on teratology)
10. Environmental Teratology Information Center File, 1950 - (From the Oak Ridge National Laboratory, Oak Ridge, Tennessee)
11. Toxicology/Epidemiology Research Projects, October 1978 - (Projects selected from the Smithsonian Science Information Exchange - SSIE data base)

The RTECS search yielded information on 49 of the 66 organic compounds and metals. The TOXLINE search yielded 14,000 citations from the 40 compounds, providing support to the toxic data from RTECS. Sixteen of the 45 organic compounds are listed as priority pollutants.

Additional sources searched to locate toxic information on those compounds having no toxic data were: (1) Merck Index; (2) Toxicology Data Bank (TDB), from the National Library of Medicine, which currently contains information on 2,514 substances; (3) Oil and Hazardous Materials Technical Assistance Data System (OHMTADS), and EPA file, containing toxic data for about 1,000 compounds; and (4) Chemical Abstracts.

Toxic data were not located on the following compounds detected in the soil and/or liquid samples:

bis (2-chloroisopropyl) ether  
 bis (1-chloroisopropyl) ether  
 9 H-xanthen-9-one, Hydroxy isomer  
 N,N'-Bis(1-methylethyl) urea  
 1-methylethylphenyl carbamate  
 3-(butyl thio) propionic acid  
 dimethylphenol isomer  
 methylethylphenol isomer  
 chlorophenol isomer  
 2-propenylbenzeneacetate  
 1-methylethyl (3-chlorophenyl) carbamate  
 tetrahydrothiophene  
 benzeneacetic acid  
 1-ethyl-3-piperidone

Toxic data were not located on the following compounds detected in the air samples:

3-methylhexane  
 2-methylhexane  
 2-chloropropane

ENVIRONMENTAL PROTECTION AGENCY  
OFFICE OF ENFORCEMENT  
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER  
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TO Steven W. Sisk, Coordinator, Hazardous Site Inspection, Fike Chemicals, Inc., Nitro, West Virginia DATE June 19, 1980

FROM John E. Preston, Ph.D. *JEP*

SUBJECT Health Hazard Evaluation, Fike Chemicals, Inc.

### Background

The National Enforcement Investigations Center conducted investigations (with samplings) of Fike Chemical Inc. in October 1977, August and December 1979 and February 1980.

The chemicals in the water, soil and air samples were identified and quantified to the extent possible.

Based on the toxic properties of the 62 organic chemicals, plus four priority pollutant metals, a hazard evaluation has been conducted.

### Conclusions

The data on the magnitude of the exposure to the toxic chemicals found and the toxicity data on these chemicals are not sufficient to completely assess the associated hazard to human health and the environment. The presence of eight priority pollutants in three media, air, liquid, and soil, increases the hazard since exposure may occur by three routes, inhalation (air), orally (water and contaminated food), and through the skin (soil, water, air). Also, the presence of these toxic chemicals plus the priority pollutant metallic compounds and the additional non-priority pollutant organics in the soil, increases the off-site pollutant hazard due to leaching action by rain and runoff water and contamination of the subterranean water.

Also of importance for off-site hazard evaluation are the priority pollutants found in the air: benzene, ethyl benzene, chloroform, trichloroethylene, dichloromethane (methylene chloride) and toluene. Three of these pollutants are carcinogens (underlined) for which the ambient concentration in air for maximum protection of human health would be zero. However, in the case of certain chemicals, it is

difficult or impossible to reduce ambient levels to zero. For example, benzene, which is a component of American gasolines (average of 0.8% w/w), occurs in the ambient air of gas stations to the level of 0.3 to 2.4 ppm and the rural level has been reported as 0.017 ppb. Further, NIOSH has a recommended worker protection standard (air) ceiling value of 1 ppm for benzene. Although the risk of adverse effects, including cancer, may be considered reasonable at the level of 1 ppm for 8 hours per day, 5 days per week a much lower level, 1 ppb, when inhaled continuously for years may represent an unacceptable risk.

Generally, the data on the effects of low level long-term exposure to chemicals are not available. Also the data to make an extrapolation from exposure to a chemical during the workweek to continuous exposure for many years are not available. Finally, the basic toxicity data on many chemicals, as well as the effects of mixtures of chemicals, are not known. Therefore, a prudent course of action is to reduce exposure to a pollutant to a minimum, or whenever possible, to eliminate the pollutant(s).

#### Toxicity and Health Effects of Identified Pollutants

Sixty-two organic compounds including 15 priority pollutants plus 4 priority pollutant metals (metallic compounds) were identified in the survey of the Fike Chemical Company and Cooperative Sewage Treatment (CST). Twelve organic compounds including 8 priority pollutants were detected in both soil/liquid and air samples, namely anisole, benzene,\* ethylbenzene,\* chloroform,\* cyclohexane, cyclohexanone, bis(2-chloro-ethyl)ether,\* tetrachloroethylene,\* trichloroethylene,\* hexane, dichloromethane,\* and toluene.\* The presence of these chemicals, especially the 8 priority pollutants in three media, air, water and soil, increases the probability of exposure and therefore the hazard to humans and the environment.

Toxicity data was not found on 17 of the 62 chemicals. However, these chemicals do have adverse effects on humans, animals and the environment at a sufficient dose level; so their hazardous effects, although unknown, must be recognized as contributing to the magnitude of the hazard to human health and the environment.

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\*Priority pollutants are chemicals or compounds generally requiring priority consideration due to their inherent toxicity and as a result of legislative mandates and various suits. A list of 65 toxic pollutants was published by the Administrator of EPA on January 31, 1978 and is judicially recognized in the Natural Resources Defense Counsel v. Russel E. Train (June 1976) and referred to in the Clean Water Act as Table I of Committee Print 95-30. The list currently includes about 130 chemicals.

Fourteen of these 17 chemicals were found in soil and/or liquid samples, namely:

bis(2-chloroisopropyl)ether	dimethylphenol isomer
bis(1-chloroisopropyl)ether	methylethylphenol isomer
9 H-xanthen-9-one, hydroxy isomer	chlorophenol isomer
N,N'-Bis(1-methylethyl) urea	2-propenylbenzeneacetate
1-methylethylphenyl carbamate	tetrahydrothiophene
3-(butyl thio) propionic acid	benzeneacetic acid
1-methylethyl (3-chlorophenyl) carbamate	1-ethyl-3-piperidone

Similarly, there were three compounds in air samples for which toxic data was not located:

3-methylhexane	2-chloropropane
2-methylhexane	

To aid in the evaluation of the toxicity of these chemicals, established data bases and the scientific literature were searched and these data are summarized in Tables 10 and 11. It should be recognized that most of the toxicity data reflects short term (acute) high dose testing in animals rather than the more useful and appropriate low dose coupled with long term (chronic) exposure to hazardous chemicals. Finally, the effects of combinations of long term exposure to two or more toxic chemicals is generally not known; but such combinations could result in more severe toxic effects than would be expected from the additive effects of each chemical in the mixture. For example, one chemical could promote the carcinogenic effect of another chemical, i.e., it could act as a co-carcinogen.

#### Liquid and Soil Sample Pollutants

Twenty-one of the 39 organic chemicals and 4 priority pollutant metals detected in liquid/soil samples have known or demonstrated adverse human health effects. Involved are adverse effects on many organs and tissues as shown in Table 10, including the liver, kidneys, blood, gastrointestinal tract, lungs, central nervous system, skin, mucous membranes, and the eye. In addition, certain of the chemicals found show carcinogenic, ceratogenic and mutagenic effects. Fourteen of the 21 organics were priority pollutants: benzene, ethylbenzene, chloroform, 1,2-dichloroethane, bis(2-chloroethyl)ether, 1,2-dichloroethylene, tetrachloroethylene, trichloroethylene, dichloromethane, phenol, 2,4,6-trichlorophenol, bis(2-ethylhexyl)phthalate, benzylbutyl phthalate, and toluene. Of these, the six underlined above have been classified

as carcinogenic by one or more of the following groups: the Cancer Assessment Group (CAG) of the EPA, the International Agency for Research on Cancer (IARC) or the National Cancer Institute (NCI). Also, two chemicals have been reported in the literature as carcinogenic in animals, namely, bis(2-chloroethyl)ether and phenol. Benzene is considered a human carcinogen as well as a teratogen and mutagen (adversely affects reproduction and heritable genetic material). Also tri-methyl thiourea was found which is an animal carcinogen and teratogen. Three other compounds found are teratogenic or are mutagenic: carbon disulfide, ethylene oxide, and bis(2-ethylhexyl)phthalate.

For maximum protection of human health from the potential carcinogenic effects of a chemical, such as benzene, due to ingestion of contaminated water, food (aquatic organisms, etc.) or inhalation of contaminated air, the acceptable intake is zero. At present, there is no agreement as to the acceptable concentration of a carcinogen in the environment. The concentrations of priority pollutant organics found, together with the presence or absence of the other organics according to sampling site, are shown in Table 5. Taking, for example, the highest level of benzene found in a monitoring well, namely 790 ppb (shown in Table 5), it can be shown that this value exceeds an EPA proposed water criteria (1.5  $\mu\text{g/l}$ ) by a factor of about 500. The presence of five other known carcinogens, chloroform, 1,2-dichloroethane, tetrachloroethylene, trichloroethylene and bis(2-chloroethyl)ether and other hazardous compounds (such as methylene chloride - see Table 5) renders the groundwater polluted and unfit for human consumption. For example, the proposed EPA water standard for chloroform is 0.21 ppb or 0.21  $\mu\text{g/l}$  and this level corresponds to an added risk of cancer of 1 in 1 million. The concentration of chloroform in the sample from well No. 2 was greater than 2100 ppb or 10 thousand times higher than the proposed standard. When the risk of cancer from the other five carcinogens is added to that due to chloroform, a prudent evaluation would be that the risk is unacceptable and that steps must be taken to reduce the carcinogenic, teratogenic and mutagenic hazard due to the presence of these and the many other chemicals present in the groundwater.

#### Air Samples

Twenty-four organic compounds including 9 priority pollutants were detected in the air samples. Toxicity data were not available for 3 of these compounds. Of the 9 priority pollutants which were detected, all were also found in the liquid/soil samples except for 1,1,1-trichloroethane. This chloroethane has been shown to be negative as a carcinogen by the NCI carcinogen bioassay but it does exhibit adverse effects on the central nervous system; it is a moderate skin irritant and a severe



eye irritant. As shown in Table 8, detectable amounts of 8 organic chemicals including 6 priority pollutants were found in the air. Three of the 6 priority pollutants are carcinogenic, namely benzene, chloroform and trichloroethylene.

In the case of benzene, a human carcinogen, the levels found at all sampling stations exceeded the rural background level of 0.017 ppb\* with values ranging from 0.7 to 1.3 ppb. Therefore, Fike Chemical is adding to the hazardous load of benzene from other sources (mainly automotive) to which people in the Nitro area are exposed.

Since no agreement exists as to safe concentrations in the air, every effort should be made to reduce their levels to a minimum.

#### Metallic Compounds

As shown in Table 6, compounds of four metals (copper, lead, nickel and zinc) which are priority pollutants were found in the Coast Tank Lines effluent together with compounds of less toxic metals (aluminum, calcium, iron, magnesium, manganese, sodium and vanadium. Of particular interest are the compounds of lead since they have been designated as carcinogenic (by IARC in the animal) and teratogenic (causes birth defects).

Lead compounds were detected at 0.052 mg/l. This is between 5 and 50 times the background level in groundwater and is essentially the same as the proposed water criterion of 50  $\mu\text{g/l}$ . However, as stressed earlier, at present agreement is lacking as to the safe level of any carcinogen including lead and nickel compounds.

As indicated above, nickel compounds have been designated as carcinogenic (in humans and animals by CAG and IARC). Nickel was found in the CST effluent at a concentration of 0.79 mg/l. This exceeds the proposed ambient water criterion of 133  $\mu\text{g/l}$  by a factor of about 6. Nickel levels in drinking water in the U.S. based on two studies and including levels in the ten largest U.S. cities averaged between 4.8 and 5  $\mu\text{g/l}$ . Also, there is evidence that most of the nickel intake of people in the general population comes from foods. For adults, estimates of nickel intake vary from 300 to 600  $\mu\text{g/day}$ .

Carcinogenic response to various nickel compounds by injection has been observed in a number of animal studies. Also, an excess of risk of nasal and lung cancers has been demonstrated in nickel refinery workers. However, since at present there is no evidence that nickel is tumorigenic by the oral route, there does not appear to be an imminent hazard due to the presence of nickel in the CST effluent. Nickel does possess a type of toxicity which can lead to great discomfort and distress, namely it can cause skin allergies and asthma. For this reason, people allergic to nickel would be at added risk as workers at Fike or if they came in contact with nickel polluted soil/water from CST.

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\*Cleveland, J.G., and G. L. Kingsbury. 1977. Multimedia environmental goals for environmental assessment. EPA-600/7-77-136.

Zinc compounds were also detected on the CST effluent at 0.14 mg/l. This is lower than the proposed ambient standard for water of 5 mg/l by a factor of about 350. The principal hazard due to zinc compounds appears to be to freshwater organisms since zinc concentrations as low as 90 µg/l reportedly are acutely toxic to such organisms.

Zinc is an essential metal for plant and animal life. The recommended daily intake (dietary allowance) for adults is 15 mg/d. However, as is true for all chemicals, zinc will exert toxic effects at the appropriate dose. For example, zinc oxide fumes have caused acute poisoning (metal fume fever). Also, poisoning by zinc has also occurred due to ingestion of acidic food kept in galvanized containers (1000 ppm of zinc) with an estimated intake of 325-650 mg of zinc. The adverse effects were reversible and without sequelae.

#### Mutagen Testing

The Ames standard bacterial assay for mutagenicity was performed on liquid sample concentrates from Stations 01, 02, and 11. The mutagenicity test did not demonstrate mutagenic activity in any of the three samples. However, all of the concentrated sample extracts exhibited toxicity to one or another of the five Salmonella test strains. The inability to detect mutagenic activity in samples containing a mixture of toxic chemicals does not necessarily mean that these substances are not mutagenic, rather it may mean that the mutagenic effect is below the detection limit of the test system used.