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THE

ONTARIO WATER RESOURCES

COMMISSION

INDUSTRIAL WASTES SURVEY

of

DOW CHEMICAL OF CANADA, LIMITED

Sarnia, Ontario

1969

A report on an industrial wastes
survey of Dow Chemical of
Canada, limited, Sarnia Ontario.

A

Report On

AN INDUSTRIAL WASTES SURVEY

of

DOW CHEMICAL OF CANADA, LIMITED

Sarnia, Ontario

August and September, 1969

Division of Industrial Wastes

ONTARIO WATER RESOURCES COMMISSION

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SUMMARY

An intensive industrial waste survey was conducted at Dow Chemical of Canada, Limited, Sarnia, during August and September of 1969. Composite samples over 24-hour operating periods were collected at all outfalls to determine the waste loadings discharged to the St. Clair River. In-plant samples were also collected to determine the individual plant contributions to the final waste loading.

The discharge of mercury to the St. Clair River was the most serious pollution problem noted during this survey. For the purposes of this report, it was estimated that 50 lbs. to 100 lbs. of mercury were discharged daily to the watercourse at the time of the survey. It was recommended that the Company implement all the necessary corrective measures to eliminate all discharges of mercury to the St. Clair River. Since the time of the survey, this has been accomplished.

The Company was also found to discharge excessive quantities of BOD and COD-exerting materials, suspended solids, dissolved solids, chlorides and phenolic materials. In some cases, the waste discharges exhibited pH levels outside the OWRC objectives of 5.5 minimum to 10.6 maximum for discharge to a watercourse. A considerable portion of the St. Clair River was found to be discoloured by wastes discharged from Dow Chemical of Canada, Limited resulting in aesthetic pollution. It was recommended, therefore, that the Company separate all the contaminated waste streams and provide the necessary treatment to render the effluents acceptable for discharge to a watercourse.

It was further recommended that the Company undertake an extensive waste monitoring program to identify all sources of contaminated wastes and submit to

the OWRC a program for the control and/or treatment of the wastes, where necessary. Aside from day-to-day waste control, it was also recommended that the Company set up a contingency plan to cope with accidental losses of materials to the sewer systems.

INTRODUCTION

The Dow Chemical of Canada, Limited complex in Sarnia is made up of a series of separate plants arranged to operate in conjunction with one another to yield a wide range of chemical products. The raw materials are essentially brine from the deep wells and light hydrocarbon gases from the neighbouring refineries. These are processed by various chemical means to yield products including solvents, glycols, ammonia, polymers, chlorine and caustic.

During the week of August 11, 1969, a comprehensive industrial waste survey was carried out at Dow Chemical of Canada, Limited for the following purposes:

(a) to determine the sources and characteristics of the wastes within the complex by examining the individual production operations as they relate to the generation and subsequent disposal of the wastewaters;

(b) to determine the total industrial waste loadings for selected parameters discharged from this complex to the St. Clair River;

(c) to determine the contribution of the individual plants to these loadings; and

(d) to recommend remedial measures where needed based on data collected.

This report presents a compilation and interpretation of the data collected. First, the details of the survey are provided. Then, due to the complexity of the operations at the site, each production unit is dealt with as a separate entity with respect to products and raw materials, processes, sources and

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disposal of wastes, sampling and analysis, interpretation of analytical results, and conclusions and recommendations. Finally, a discussion on the overall complex with general conclusions and recommendations is provided.

DETAILS OF SURVEY

On August 11, 1969, staff from the Division of Industrial Wastes visited Dow Chemical of Canada, Limited to carry out an in-depth survey of the Sarnia works. This survey was conducted over a five-day period.

In addition to the main survey, the industry was revisited on September 3, 1969, to resample the Styrene Plant which reportedly was not operating normally at the time of the original survey. Following a number of interim discussions, a final meeting was held on January 28, 1970, to discuss the report in its preliminary stages. At this time, flow rates, process description, sampling points, etc., were reviewed with Company personnel to confirm their accuracy.

Personnel Participating

To obtain details on plant operations, it was necessary to involve key Company personnel to obtain information on process descriptions, operating techniques, unit operations, etc. During the course of the survey, the following personnel were contacted:

Mr. F. Sundberg - Superintendent of Electrochemical Division
Mr. W. J. McCagherty - Superintendent of Hydrocarbon Division
Mr. J. M. Gilber - Technical Manager - Chlorine Plants
Mr. P. Fink - Assistant Superintendent - Hydrocarbon Division
Mr. D. Cattran - Assistant Superintendent - Plastics Division

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Mr. C. R. Young - Assistant Superintendent - Manufacturing

Mr. D. T. Mullen - Stationary Engineer - Steam Plant

Mr. F. Bremner - Engineer

It was also necessary to interview supervisors, engineers and other personnel at the various plants to obtain more detailed information on sewer locations, flow rates, sampling points, etc.

The OWRC personnel involved in the survey were:

Mr. N. Borodczak - Chemical Engineer

Mr. R. W. Hussain - Chemical Engineer

Mr. M. V. Filey - Chemical Technologist

Mr. T. E. Wood - Chemical Technologist

Mr. R. A. Knapp - Student

Sampling and Analysis

During the course of the survey, 24-hour composite samples were taken of the outfalls at the St. Clair River, representing the total waste discharge from the works in Sarnia. The samples were collected in 8-hour shifts. Each sewer was sampled for at least three consecutive shifts to cover the 24-hour period. Because of the number of outfalls, the sewers were sampled in groups.

A simple code was established to identify the outfall samples taken. The code consists of the letter C, denoting a composite sample, a Roman numeral in the range I to VIII, which denotes which shift the sample was obtained, and an Arabic numeral in the range of 1 to 12, which indicates the sewer sampled.

A complete breakdown of the three component symbols follows:

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1. C : Indicates composite sample

2. I : Shift 1600 hours to 2400 hours — August 11, 1969
   II : Shift 0001 hours to 0800 hours — August 12, 1969
   III : Shift 0801 hours to 1600 hours — August 12, 1969
   IV : Shift 0001 hours to 0800 hours — August 13, 1969
   V : Shift 0801 hours to 1600 hours — August 13, 1969
   VI : Shift 1601 hours to 2400 hours — August 13, 1969
   VII : Shift 0001 hours to 0800 hours — August 14, 1969
   VIII : Shift 0801 hours to 1600 hours — August 14, 1969

3. 1 : 42" Sewer
   2 : 48" Sewer
   3 : 30" Sluice
   4 : 54" Sluice
   5 : Old Chlorine Caustic Sewer (North)
   6 : New Chlorine Caustic Sewer (South)
   7 : 2nd Street Sewer
   8 : 3rd Street Sewer
   9 : Dominion Alloy Sewer
   10 : 4th Street Sewer
   11 : Steam Plant 42" Sewer
   12 : Steam Plant 12" Sewer

The analytical results of the outfall samples were used to compile the total net waste loadings discharged to the St. Clair River from Dow Chemical of

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Canada, Limited.

During the day shifts, composite samples were collected within the complex to determine the characteristics of the wastes discharged from the individual plants or operations. These samples were labelled as to area, source, time of collection, etc.

Composite samples were made up by collecting equal aliquots approximately every one half-hour in a 40 oz. bottle, over a determined sampling period. In special cases, duplicate samples were obtained where ether solubles (non-volatile oil) and mercury analyses were required. Samples for mercury analyses were collected in plastic bottles to prevent metal losses on the walls of the container. All samples were shipped daily to the Ontario Water Resources Commission Laboratories in Toronto for analysis. The analytical results as obtained from the Laboratories are appended to this report.

Water Supply and Distribution

Water for industrial purposes is pumped from the St. Clair River and, at the time of the survey, it was reported that approximately 156 Imgd was used. The majority of this water is used for once-through cooling purposes. Other uses include product washing, equipment washing, product transportation medium and steam production. At the time of the survey, Dow personnel provided data which indicated water was distributed to the various plants in the complex as follows:

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Plant	Total Water Use Imgd (Approx.)
Brine Treatment	2.4
Chlorine I	3.4
Chlorine II	3.0
Chlorine III	6.5
Caustic	1.5
Glycol I	22.0
Glycol II	6.0
Ethanolamines	0.7
Vinyl Chloride	15.1
Solvents	1.9
Ammonia - Plant I	8.0
Ammonia - Plant II	28.0
Ethylene	20.0
Styrene	19.0
Styron	1.2
Latex	3.0
Polyethylene	9.0
Pelaspan	1.0
Steam	2.7
	154.4

Cooling water requirements vary depending on river water and ambient temperatures and hence, the rates presented above would approximate maximum use.

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It should also be noted that the figures above are only as reliable as the techniques used to obtain them and these are constantly being revised and improved according to Dow personnel.

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BRINE TREATMENT PLANTS

RAW MATERIALS AND PRODUCTS

Two types of treated brine for the electrolytic cell (i.e., Chlorine I, II and III) are produced from brine obtained from salt formations located in the Sarnia area.

PROCESS

Saturated brine (26% sodium chloride) is pumped from a network of underground caverns to a series of storage tanks. A major portion of the brine is acidified with hydrochloric and sulphuric acid to bring the pH level from approximately 10 to 2. This acidified solution is then pumped to Chlorine Plants I and III which utilize mercury cells for the electrolysis of brine.

The brine to be used in the diaphragm electrolytic cells in the Chlorine II Plant is treated with sodium carbonate to precipitate the calcium as calcium carbonate and thus, reduce the calcium concentration from approximately 700 ppm to less than 10 ppm. The treated brine is then acidified to a pH level of 1.8 to 2.2 and pumped to Chlorine II. The sludge from the settling operation is directed to a lime recovery system. (Since the time of the survey, this brine is also treated with sulphide to precipitate the mercury contained in the brine returned to the salt caverns from Chlorine I and III Plants.)

During the survey, brine was also received from another company which is forming storage caverns in the salt formation in the Sarnia area. The overall brine distribution was reported as follows:

Chlorine I	800 Igpm
Chlorine II	700 Igpm
Chlorine III	1,800 Igpm

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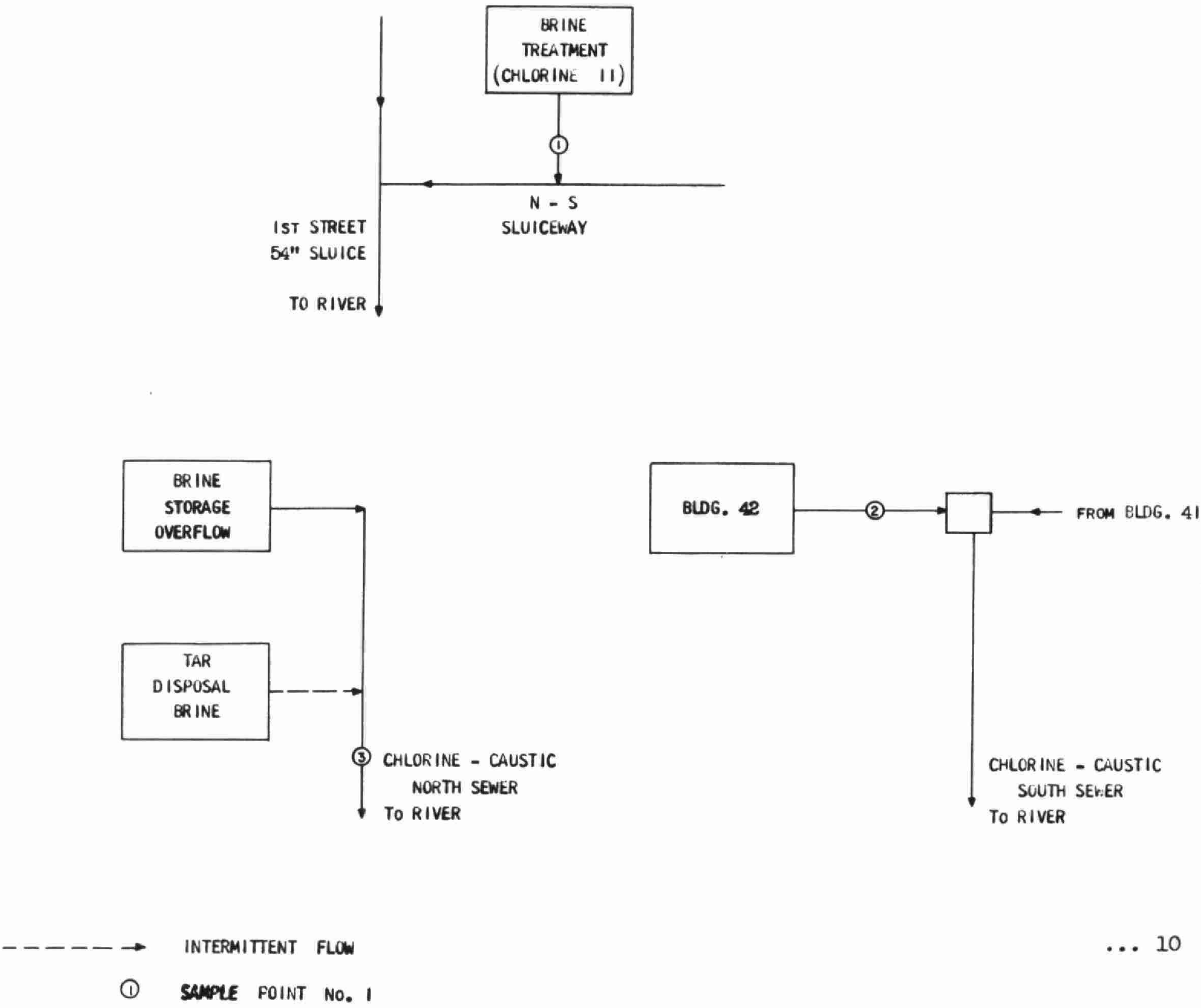
SOURCES OF WASTES AND DISPOSAL

Figure I indicates schematically the sources and disposal of wastes associated with brine treatment operations. Waste sampling locations are indicated on the diagram and are described below.

FIGURE I

BRINE TREATMENT



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(1) Brine treatment effluent to N-S Sluiceway (drainage from pump pads, leakage from pump seals, etc.).

(2) Building 42 effluent to South Chlorine-Caustic Sewer (comprised mainly of pump seal water).

(3) North Chlorine-Caustic Sewer to St. Clair River. Includes brine overflows due to imbalances and brine displaced from cavern used for tar disposal along with other minor unidentified flows.

SAMPLING AND ANALYTICAL RESULTS

During the course of the survey, composite samples were taken of waste waters arising from the brine treatment processes. The analytical results of the samples obtained are presented in Table I.

TABLE I

BRINE TREATMENT ANALYTICAL RESULTS AND FLOW DATA

Sample	Lab.	Flow		Solids		Chlorides	
Point*	No.	mgd	Total	Susp.	Diss.	as Cl^-	pH
1	T-1830	0.5	5,780	40	5,740	3,840	8.9
2	T-1925	1.9	4,930	100	4,830	2,006	12.3
3**	T-1909	0.9	34,240	70	34,170	20,440	9.1
	T-1884		80,860	150	8,710	41,680	12.1
	T-1905		123,160	450	122,710	64,440	11.0
Service Water (Estimate based on results of two samples)				20		40	

* Numbers correspond to sample locations indicated on Figure I.

** These 8-hour composite sample results are shown. The flow in this sewer could vary significantly from time to time and hence, data provided here cannot be used conclusively.

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

Based on the analytical results obtained and flow data provided by Company personnel, operations at the Brine Treatment Plants result in the net discharge of 3,500 lbs. per day of suspended solids and 435,800 lbs. of chlorides per day. These results indicate that the wastes produced in the brine treatment area contain excessive quantities of suspended solids and chlorides.

Principle sources of suspended solids included the discharge from Building 42 (approximately 1,500 lbs. per day) and brine overflows and/or brine displaced from the cavern used to dispose of tars (approximately 1,850 lbs. per day). A major portion of the latter occurred on one shift.

The high chloride levels indicated are no doubt almost solely attributable to the wasting of brine to the North Chlorine-Caustic Sewer due to imbalances. Additional losses would include spills, leakages, etc., in the Brine Treatment Plants. Since all of this brine would contain mercury, resulting from Chlorine Plants I and III which return brine to the sewer system, under no circumstances should any of this brine be allowed to reach the River.

The pH of wastes from Building 42 and in some cases in the brine overflows was high (9.1 to 12.3). This elevated pH condition must be due to loss

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of brine prior to acidification or the overflow of alkaline brine. Elimination of brine discharges would obviously correct this problem.

CONCLUSIONS AND RECOMMENDATIONS

The brine treatment effluent discharged to the 54" sluiceway appeared to be relatively uncontaminated. Contamination of the waste flows from the remaining operations in the brine treatment area, i.e., Building 42, resulted largely from spills, leakage, discharge of brine, etc., to the sewer system. The Company should, therefore, adopt good housekeeping practices to maintain such losses to a minimum by tight in-plant control. Spent brine should not be sewered to the watercourse under any circumstances because it will contain mercury.

During this survey, it was estimated that brine displaced from the tar disposal operation, and brine overflows brought about by imbalances in the brine system, resulted in the discharge of approximately 380,000 pounds of chlorides per day but accounted for a daily flow of less than one million gallons. The Company should, therefore, consider providing sufficient surge and storage capacity to retain these brine solutions for eventual return to the system.

Since the time of this survey, the Company has taken the action recommended above to eliminate the discharge of mercury. In addition to eliminating the discharge of mercury, the chloride losses would also be greatly reduced.

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CHLORINE I PLANT

RAW MATERIALS AND PRODUCTS

Hydrogen, chlorine and 50% sodium hydroxide solution are produced utilizing acidified brine and mercury and carbon electrodes.

PROCESS

Chlorine I utilizes mercury cells for the electrolysis of brine (800 Igpm). Treated saturated brine (26% sodium chloride) is fed into the cell and, as a current is passed through the cell, chlorine is liberated at the carbon anode while the sodium and mercury form an amalgam. The mercury-sodium amalgam is passed to another cell where it is contacted with deionized water to produce a 50% sodium hydroxide solution and hydrogen. In theory, since the brine is in a closed system, mercury is returned to the electrolytic cells.

The chlorine is chilled, scrubbed with sulphuric acid and compressed in preparation for distribution. The hydrogen is cooled directly with water, scrubbed with a weak caustic solution and then sent to the Ammonia Plants. The 50% sodium hydroxide solution is pumped to the Caustic Plant for further processing.

The spent brine (13% sodium chloride) is subjected to a vacuum to draw off the chlorine. The brine is then treated with spent sulphuric acid from the chlorine scrubbing operation and with sulphur dioxide to destroy the excess hypochlorite before it is returned to the well.

SOURCES OF WASTES AND DISPOSAL

Figure II schematically indicates sources and disposal of wastes associated with the Chlorine I Plant. The waste sampling location (1) is indica-

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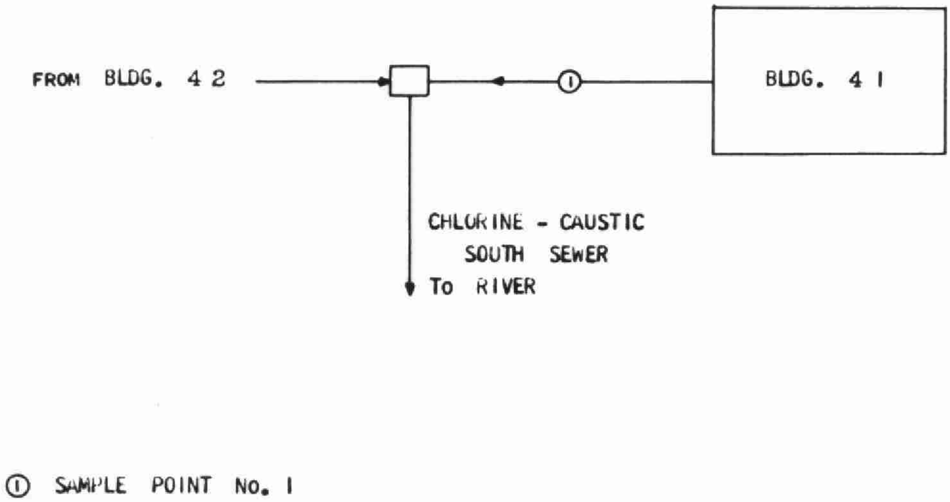
ted on the diagram and the sample would include cooling water, compressor waters, floor spills, cell floor drainage, hydrogen scrubber water, etc.

FIGURE II

CHLORINE I PLANT SOURCES AND DISPOSAL OF WASTES



(1) Cooling water, compressor waters, floor spills, cell floor drainage, hydrogen scrubber water, etc.

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SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, a composite sample was taken of the effluent from the Chlorine I Plant covering an operating period of 11:00 a.m. to 4:30 p.m. The analytical results are given in Table II.

TABLE II

CHLORINE I PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	Solids Total	Solids Susp.	Solids Diss.	Chlorides as Cl^-	pH	Mercury as Hg
1	T-1866 & T-1926	3.4	160	15	145	*	8.7	0.36

* Analysis not performed.

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

A mercury waste loading of approximately 12 lbs. per day was calculated on the basis of flow rates supplied by Company personnel and the analytical result of 0.36 ppm obtained on the sample of the Chlorine I Plant effluent.

It is anticipated that a major portion of the mercury found in the effluent from this Plant resulted from direct water cooling of the hydrogen stream which contains mercury. This cooling water and the condensates were discharged to the sewer. Other sources would include floor washings, spills and brine leakage which could contain mercury.

CONCLUSIONS AND RECOMMENDATIONS

The Company should take immediate steps to eliminate the discharge of any wastes which may contain mercury. Such measures may also reduce the amount

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of chlorides (the levels of which were not established) discharged to the River.

Since the time of this survey, the Company was advised to eliminate all mercury discharges and it was reported that this has been done. Recent investigations confirm this point.

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CHLORINE II PLANT

RAW MATERIALS AND PRODUCTS

Chlorine, hydrogen and 10% sodium hydroxide containing 16% sodium chloride (feed to Glycol Plant) are produced in this Plant using treated brine.

PROCESS

Treated brine (26% NaCl) is pumped (700 Igpm) to a series of 57 diaphragm cells comprised of steel cathodes, graphite anodes, and asbestos-in-steel diaphragms to separate the electrodes. As a current is passed through the cell, chlorine is liberated at the anode and hydrogen at the cathode. The spent electrolyte, made up of 16% sodium chloride and 10% sodium hydroxide, is pumped to the Glycol Plant.

Chlorine is passed through chillers, counter-current sulphuric acid drying towers and compressors to prepare the product for distribution. The spent acid is stored to be used in the brine treatment operation.

Hydrogen is scrubbed with water and 5% sodium hydroxide, and is used in the production of ammonia. The spent caustic solution is wasted to sewer.

SOURCES OF WASTES AND DISPOSAL

Figure III schematically indicates the sources and disposal of wastes. The waste sampling locations are indicated on the diagram and are described below.

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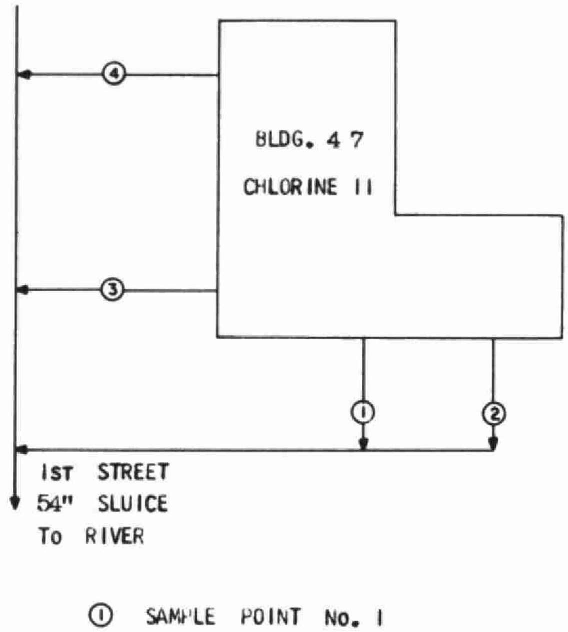
FIGURE III

CHLORINE II PLANT SOURCES AND DISPOSAL OF WASTES



(1) Compressor bay cooling water.

(2) Cascade cooler.

(3) Cell floor - H_2 scrubber, chlorine seal pots, etc.

(4) Graphite sewer - spray column, H_2 scrubber and wash waters.

SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, composite samples were collected of the waste flows from Chlorine II during the day shift at points noted in Figure III. The analyti-

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cal results of these samples are presented in Table III.

TABLE III

CHLORINE II PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	Total	Solids Susp.	Diss.	COD	pH	Chlorides as Cl^-
1	T-1824	1.0	500	30	470	12	12.4	313
2	T-1825	1.0	160	3	157	4	8.8	83
3	T-1823	0.5	43,910	60	43,850	40	13.2	43,600
4	T-1822	0.5	6,230	270	5,960	110	12.6	5,180
Service Water (Estimate)				20				40

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

Waste loadings based on the analytical results in Table III and the flow rates supplied by Company personnel were calculated and are provided below:

Sample Point	Flow (mgd)	Suspended Solids (lbs./day)	Chlorides as Cl^- (lbs./day)
1	1.0	300	3,100
2	1.0	-	800
3	0.5	300	218,000
4	0.5	1,400	25,900
Total Discharge From Chlorine II to 54" Sluice on 1st Street.	3.0	2,000	297,800
Net Loading	3.0	1,400	296,600

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From the analytical results, it is evident that a majority of the wastes discharged from Chlorine II are alkaline exhibiting high levels of pH. Three of the waste streams exhibited pH values in excess of 12.4, whereas the Commission's objective for maximum pH is 10.6, and accounted for a flow of approximately 2.5 mgd. These wastes are discharged to the 1st Street Sluice which also carries the effluents from Glycol I Plant and the lime slaking process. The basic wastes precipitate the carbonates creating a white coloured effluent from the 1st Street Sluice. The end result is an objectionable white plume in the St. Clair River.

It was also reported that approximately 180 gallons per shift of spent weak caustic solution from the hydrogen scrubbing operation are wasted directly to the sewer. This waste discharge could have a marked effect on the pH of the final effluent discharged to the St. Clair River.

The graphite sewer contained the majority of the suspended solids discharged from the Chlorine II Plant contributing approximately 1,300 lbs. per day (net) to the total waste loading. The cell floor effluent exhibited an extremely high pH of 13.2 and contained high concentrations of chlorides as Cl^- contributing approximately 218,000 lbs. per day towards the total waste loading. The analyses of the cell floor effluent suggest high losses of brine to the sewer system.

Since the time of the survey, it has been realized that the brine used in this Plant contains mercury because it is common to the Chlorine I and III Plant recirculating systems. Hence, any losses of brine from this Plant could

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result in the discharge of mercury.

CONCLUSIONS AND RECOMMENDATIONS

All effluents from Chlorine II except for the cooling water from the cascade coolers were basic, exhibiting pH levels in the range from 12.4 to 13.2. It appears that contamination of the waste streams results from losses of alkaline brine or caustic solutions to the sewer system. Tighter in-plant control measures should be implemented to maintain such losses to a minimum.

The high pH levels are made more significant by the fact that these wastes are discharged to the 1st Street Sluice which also conveys the effluents from Glycol I. When these two streams are mixed, a milky-coloured precipitate is produced which discolours an appreciable stretch of the St. Clair River. Therefore, to eliminate at least a partial cause of this aesthetic pollution, the Company should, in addition to improving housekeeping practices, provide adequate pH control on a continuous basis.

It was also reported that spent weak caustic from the hydrogen scrubber is sewered following each shift. Waste of this type should be retained for alternate disposal.

The graphite sewer accounted for the discharge of approximately 1,300 pounds of suspended solids (net) to the St. Clair River. The Company should investigate the source of these solids with a view to eliminating them from the sewer system.

Since the time of the survey, it was learned that brine used at the Chlorine II Plant may contain mercury and hence, steps must be taken to prevent

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its discharge. When the Company was advised of this problem, it commenced treating the raw brine for mercury removal.

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CHLORINE III PLANT

RAW MATERIALS AND PRODUCTS

Chlorine, hydrogen and 50% caustic solution are produced utilizing acidified brine and mercury and carbon electrodes.

PROCESS

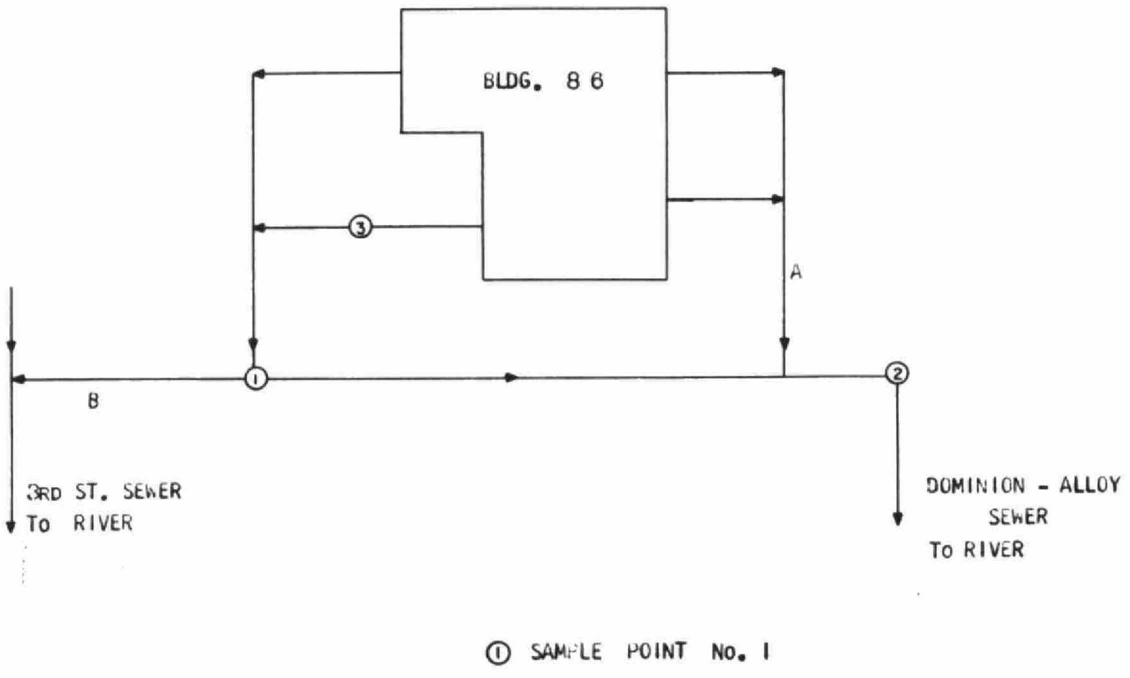
The process description for this Plant is essentially the same as for Chlorine I as both utilize mercury cells for the electrolysis of brine.

SOURCES OF WASTES AND DISPOSAL

Figure IV schematically indicates sources and disposal of wastes associated with the Chlorine III Plant. The waste sampling and other pertinent locations are indicated on the diagram and are described below.

FIGURE IV

CHLORINE III PLANT SOURCES AND DISPOSAL OF WASTES



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(1) H_2 scrubber and compressor water.

(2) Major portion of combined waste flow from Chlorine III.

(3) Hydrogen cooling water.

(A) Floor spills, floor drainage and compressor water. (not sampled)

(B) Intermittent overflow to 3rd Street sewer estimated at 1.0 Imgd. (not sampled)

SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, composite samples were collected from 11:00 a.m. to 4:30 p.m. of the waste flows from Chlorine III. The analytical results of the samples are presented in Table IV.

TABLE IV

CHLORINE III PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	Total	Solids Suspended	Dissolved	Chlorides as Cl^-	Mercury as Hg	COD	pH
1	T-1867 & T-1927	N.A.	950	20	930	470	0.77	20	8.8
2	T-1868 & T-1928	6.5	7,800	120	7,680	3,450	0.87	36	12.2
3	T-1869	0.3					12.7		

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSIONS OF RESULTS

The total net waste loadings from this Plant were calculated based on flow rates obtained from Company personnel and the analytical results of the above samples. To account for the loadings to the 3rd Street sewer brought about by an overflow (approximately 1 mgd), one would have to assume that the quality of wastewaters into this sewer is approximately the same as that of sample #1.

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This would give the net loadings to the Dominion Alloy sewer as approximately 6,500 lbs. per day suspended solids; 220,000 lbs. per day chlorides; 2,300 lbs. per day COD; 57 lbs. per day mercury; and to the 3rd Street sewer, approximately 8 lbs. per day of mercury.

By far the most significant contaminant discharged from the Chlorine III Plant is mercury. The mercury concentration in the hydrogen cooling water was found to be 12.7 ppm (grab sample) at the time of the survey in a flow of approximately 0.3 Imgd which accounts for about 36 lbs. of the mercury discharged daily from this Plant. The Company has reported mercury concentrations as high as 36 ppm in this cooling water which would constitute a mercury loss of over 100 lbs. per day to the St. Clair River from the hydrogen cooling operation alone. Other sources of mercury such as floor drains and brine losses account for the remainder of the loss from this Plant. The significance of mercury losses to a watercourse will be discussed later in the report.

The effluent from this Plant discharged to the Dominion Alloy sewer also exhibited a high pH of 12.2 and contained high concentrations of chlorides (as Cl^-) contributing approximately 220,000 lbs. per day to the waste loadings. This would suggest losses of caustic and/or spent brine in this Plant.

CONCLUSIONS AND RECOMMENDATIONS

The mercury losses from Chlorine III were estimated at 65 lbs. per day. The Company should take immediate steps to eliminate the discharge of any wastewater which may contain mercury. Such measures would also serve to reduce the amount of chlorides discharged to the River.

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The high pH level (12.2) indicates losses of caustic and/or alkaline brine to the sewer system. Tighter in-plant control measures should be adopted to significantly reduce these losses.

Since the time of this survey, the Company was advised to eliminate all mercury discharges and it was reported that this has been accomplished. Recent investigations confirm this point.

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CAUSTIC PLANT

RAW MATERIALS AND PRODUCTS

Solid sodium hydroxide and 73% caustic solution is produced from 50% caustic generated in the Chlorine I and III Plants.

PROCESS

The 50% caustic solution from the chlorine plants is concentrated to produce a 73% sodium hydroxide solution and/or solid sodium hydroxide. The 73% caustic solution is produced in two evaporator pots where the feed is steam heated to evaporate the water and thereby concentrate the solution.

To obtain solid sodium hydroxide, the 50% caustic solution is fed into a vessel having a dowtherm jacket. The temperature is maintained in the order of 375°C to evaporate the water. The slurried sodium hydroxide is cooled, passed through a flaker, screened, classified and drummed.

SOURCES OF WASTES AND DISPOSAL

Figure V indicates schematically the sources and disposal of wastes, and the location of sample point (1) which includes all wastes produced in the Plant such as evaporator condensate, cooling water, spills, etc.

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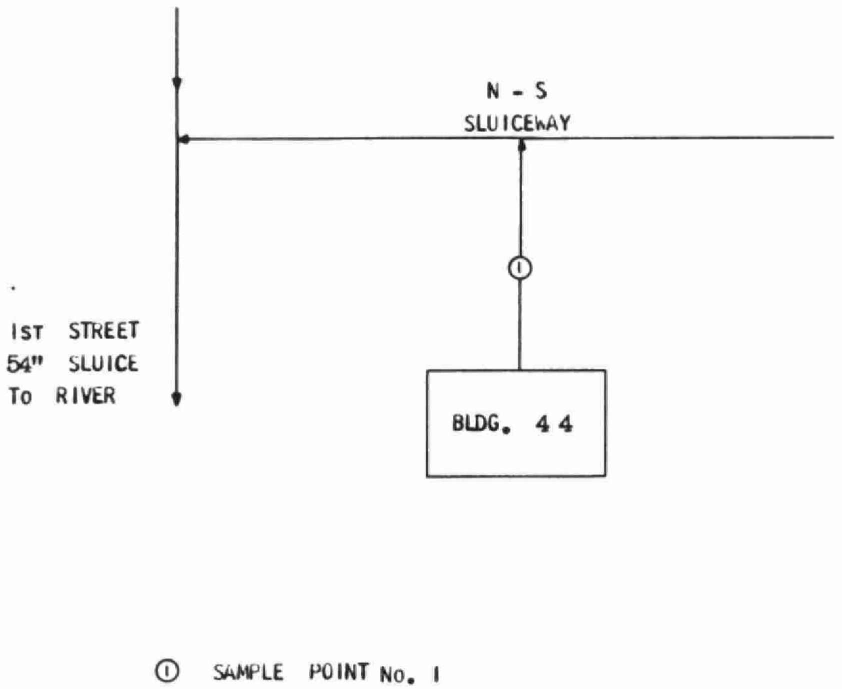
FIGURE V

CAUSTIC PLANT SOURCES AND DISPOSAL OF WASTES



SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, a composite sample over a period from 10:00 a.m. to 4:00 p.m. was obtained of the final effluent from the Caustic Plant discharging to the north-south sluiceway. The analytical results of the sample are provided in Table V.

TABLE V

CAUSTIC PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Total	Solids Susp.	Diss.	pH at Lab.	COD	Chlorides as Cl^-
1	T-1832	1.5	8.4	620	210	410	11.9	24	228
Service Water (Estimate)					20				40

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

Waste loadings were calculated based on flow rates supplied by the Company personnel and the analytical results in Table V, and were found to be as follows:

Flow (mgd)	BOD (lbs./day)	Suspended Solids (lbs./day)	COD (lbs./day)	Chlorides (lbs./day)
1.5	100	3,200	400	3,400
Net Loadings		2,800		2,800

The effluent from the Caustic Plant exhibited a high concentration of suspended solids (120 ppm), contributing approximately 2,800 lbs. per day (net) to the total industrial waste loading to the St. Clair River. As most of the wastes were reported to be made up of cooling water and condensates from the evaporators, it is difficult to relate this high suspended solids concentration with plant operations.

The pH was high at 11.9 suggesting entrainment of caustic in the eva-

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porator overhead and/or spillage and leakage of caustic.

CONCLUSIONS AND RECOMMENDATIONS

From the reported operations at the Caustic Plant, it was difficult to account for a suspended solids concentration of 210 ppm in the plant effluent. The Company should therefore carry out the necessary in-plant studies to determine the source of this contamination with a view to reducing the suspended solids concentrations to acceptable levels.

The Company should similarly take steps to reduce the pH to an acceptable level (5.5 to 10.6).

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GLYCOL I PLANT

RAW MATERIALS AND PRODUCTS

Mono-ethylene, di-ethylene and tri-ethylene glycol, ethylene oxide, ethylene dichloride, dichloroethylether, propylene oxide and propylene dichloride are produced using ethylene, chlorine, water, caustic and slaked lime.

PROCESS

The main process carried out in this Plant is the production of ethylene glycol via the chlorohydrin and ethylene oxide route. First, ethylene, liquified chlorine and pre-heated water are brought together in a chlorohydrin reactor to form ethylene chlorohydrin (ECH). Gases from this reactor go to an overhead condensor where by-products of the chlorohydrin reaction, ethylene dichloride and bis-2-chloro ethyl ether are recovered. The cooled gases are water scrubbed to remove any chlorine.

The dilute ECH is sent to a hydrolyzer where hydrolysis in a weak alkali medium (either with caustic or slaked lime) to ethylene oxide (EO) is accomplished. The resultant EO and water vapour mixture is compressed and condensed to remove some water. The rest of the water plus a portion of the by-products (ethylene dichloride and acetaldehyde) are removed in a finishing tower. The EO is cooled and stored for use in the Ethanolamine Plant or in the production of ethylene glycol.

The finished EO is then hydrolyzed in the liquid phase under pressure to form mono-ethylene glycol. Reaction with more EO forms the di-ethylene and tri-ethylene glycol plus the higher glycols in the form of tars. The crude glycol solution is concentrated by multiple effect evaporation to near the

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anhydrous state and then fractionated to separate the various glycol forms. The evaporator condensate is returned to the reactor.

Propylene oxide, a homologue of ethylene oxide, is produced in this Plant for use in the Glycol II Plant. As in the case of the ethylene oxide, propylene chlorohydrin is first produced by the reaction of propylene, liquified chlorine and water. The chlorohydrin is then reacted with a mixture of slaked lime (20%) and caustic (80%) to form the propylene oxide. The propylene oxide is finished and by-products collected in a similar fashion as the ethylene oxide.

The collected ethylene dichloride from the reactor and recovery areas is neutralized with 10% caustic (to get rid of any HCl) in the presence of water in a tank (D.3A). The water is used to improve mixing, to prevent inversion and to dilute the caustic. The supernatant from this tank is allowed to overflow to the sewer and the bottom layer or ethylene dichloride is further processed in a distillation tower.

SOURCES OF WASTES AND DISPOSAL

Figure VI shows an outline of the Glycol I Plant, the sources of wastewaters and the various means of transmitting the wastewaters to the sewers. The waste sampling locations and other pertinent points are indicated on the diagram and are described below.

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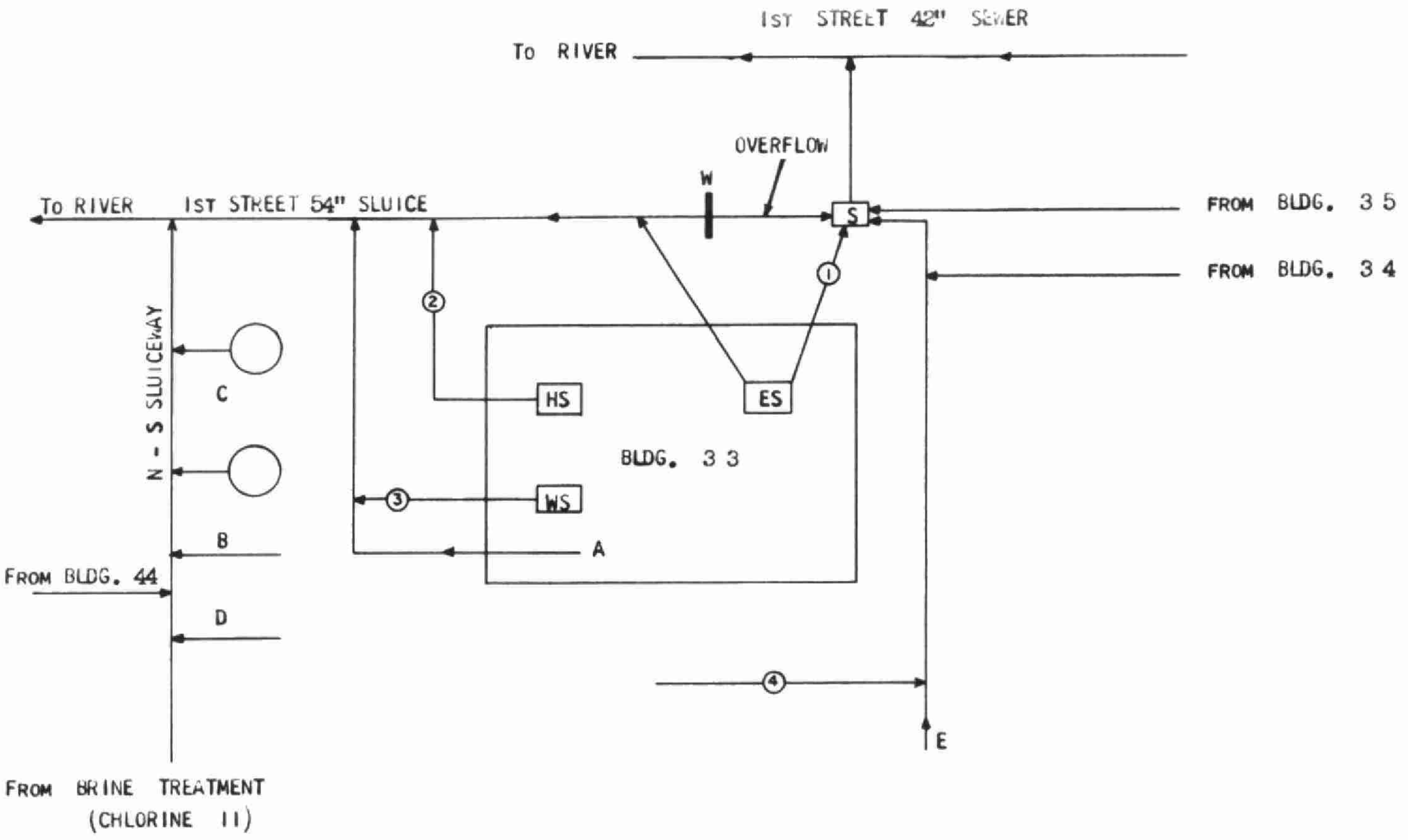
FIGURE VI

GLYCOL I PLANT SOURCES AND DISPOSAL OF WASTES



① SAMPLE POINT No. 1

E S - EAST SUMP

H S - HYDROLYZER SUMP

W S - WEST SUMP

S - SUMP

W - WEIR

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(1) Barometric leg **condenser** water from EO and glycol finishing from East Sump (ES).

(2) Scrub water of gases on chlorohydrin reactor and neutralized hydrolyzer bottoms from caustic side from Hydrolyzer Sump (HS).

(3) EO cooling water from West Sump (WS) (approx. 2 mgd)

(4) Overflow from D.3A tank.

(A) Compressor cooling water from the EO compression (approx. 2 mgd).

(B) EO storage cooling water to sluiceway.

(C) The overflow from lime recovery tanks.

(D) Clean-up wastes from lime building.

(E) **Pad** drains and storage scrubbing water.

SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, composite samples were taken at several points over a 6-hour period in the Plant. The analytical results of samples obtained are shown in Table VI.

TABLE VI

GLYCOL I PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	pH	COD	Chlorides as Cl^-	SO_4
1	T-1829	13	12	150	3	8.5	24	93	18
2	T-1827	2	112	20,700	290	11.0	800	12,680	342
3	T-1828	2	6.8	220	10	9.2	28	176	20
4	T-1818	.065*	5,700	24,960	220	12.4	16,000	19,180	772
Service Water (Estimate)					20		15	40	

* Volume estimated based on Cl^- balance.

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

There are two main contaminated waste streams emanating from this Plant. They are the D.3A overflow and the hydrolyzer sump flow.

The D.3A overflow originates from the neutralization of the ethylene dichloride in water before finishing by distillation. The volume of this flow was not measured during this survey but it can be approximated by carrying out a Cl^- balance on the waste flows leading into the south end of the collection sump (see Figure VI) and assuming that the chloride content of the flow originating from vent gas scrubbing and pad drainage (not sampled) is approximately 1,500 ppm. This gives the volume of the D.3A overflow to be approximately 65,000 gpd. Visual inspection of this flow tends to substantiate reliability of the estimated flow rate.

On the basis of this flow, the principle waste loadings from this one section in this unit to the 42" sewer are:

BOD_5	3,900 lbs./day
COD	11,000 lbs./day
Chlorides	13,000 lbs./day
pH	12.4

The contents of the hydrolyzer sump were also found to be highly contaminated. This wastewater is mainly comprised of the drainage from the bottom of the caustic hydrolyzer and thus, should contain high concentrations of salts

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(chlorides and sulphates), organics and a high pH - as borne out by the analytical results. The net waste loadings from this source to the 54" Sluice, based on a flow of 2 mgd, are:

BOD_5	2,250 lbs./day
Suspended Solids	5,400 lbs./day
COD	16,000 lbs./day
Sulphates	6,850 lbs./day
Chlorides	253,000 lbs./day
pH	11.0

In addition to these two highly contaminated waste flows, the wastewater resulting from any overflow from the lime recovery tanks would result in high solids loadings and a high pH to the N-S Sluiceway. The two recovery tanks receive the lime and **lime/caustic** hydrolyzers bottom wastes along with solids from the Brine Treatment Plants **for settling.** The settled solids are trucked away to retention lagoons at the Dow Brine Farm.

The other two main sources of wastes from this Plant, i.e., effluents from East and West Sumps, appear to be mainly uncontaminated once-through cooling water, even though chloride levels suggest some chemical losses due to leakage, spillage, etc. The net chloride loadings from these two sources are:

East Sump	7,000 lbs./day
West Sump	7,500 lbs./day

The total net loadings from the Glycol I unit are as follows:

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BOD_5	6,200 lbs./day
Suspended Solids	5,500 lbs./day
COD	27,000 lbs./day
Sulphates	7,400 lbs./day
Chlorides	275,000 lbs./day

CONCLUSIONS AND RECOMMENDATIONS

It was found that there are two highly contaminated waste streams from this Plant, namely, the D.3A overflow and the hydrolyzer sump overflow.

It is recommended that:

(1) The D.3A overflow should be segregated for alternate treatment and/or disposal.

(2) Hydrolyzer bottoms should not be discharged to the sewer system but should also be segregated for alternate treatment and/or disposal. While the exact volume of this waste is not known, it is not expected to be of such magnitude to make treatment and/or alternate disposal impractical.

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GLYCOL II PLANT

RAW MATERIALS AND PRODUCTS

Propylene glycols (mono-propylene, di-propylene and tri-propylene), propylene oxide and polyglycols are manufactured in this Plant from crude propylene oxide and propylene dichloride. Water, glycerine, caustic and potassium hydroxide catalyst are also used.

PROCESS

Crude propylene oxide from Glycol I is finished and converted to the propylene glycols in essentially the same manner as for the ethylene glycols.

Propylene dichloride (P.D.C.) in the oils from Glycol I and P.D.C. from the propylene oxide finishing are combined and distilled to remove any ethers from the P.D.C. The product is then batch-washed with an alkali and water prior to storage.

The finished propylene glycol is batch polymerized with a glycerine initiator and potassium hydroxide catalyst to produce polyglycols. Water is injected into the polymer mixture and the mixture centrifuged, vacuum flashed and filtered to separate potassium and sodium salts from the polyglycols.

SOURCES OF WASTES AND DISPOSAL

Figure VII schematically indicates the sources of wastes, and the means of transmission of the wastewaters to the 2nd Street Sewer. The waste sampling points and other pertinent waste sources are indicated on the diagram and are described below:

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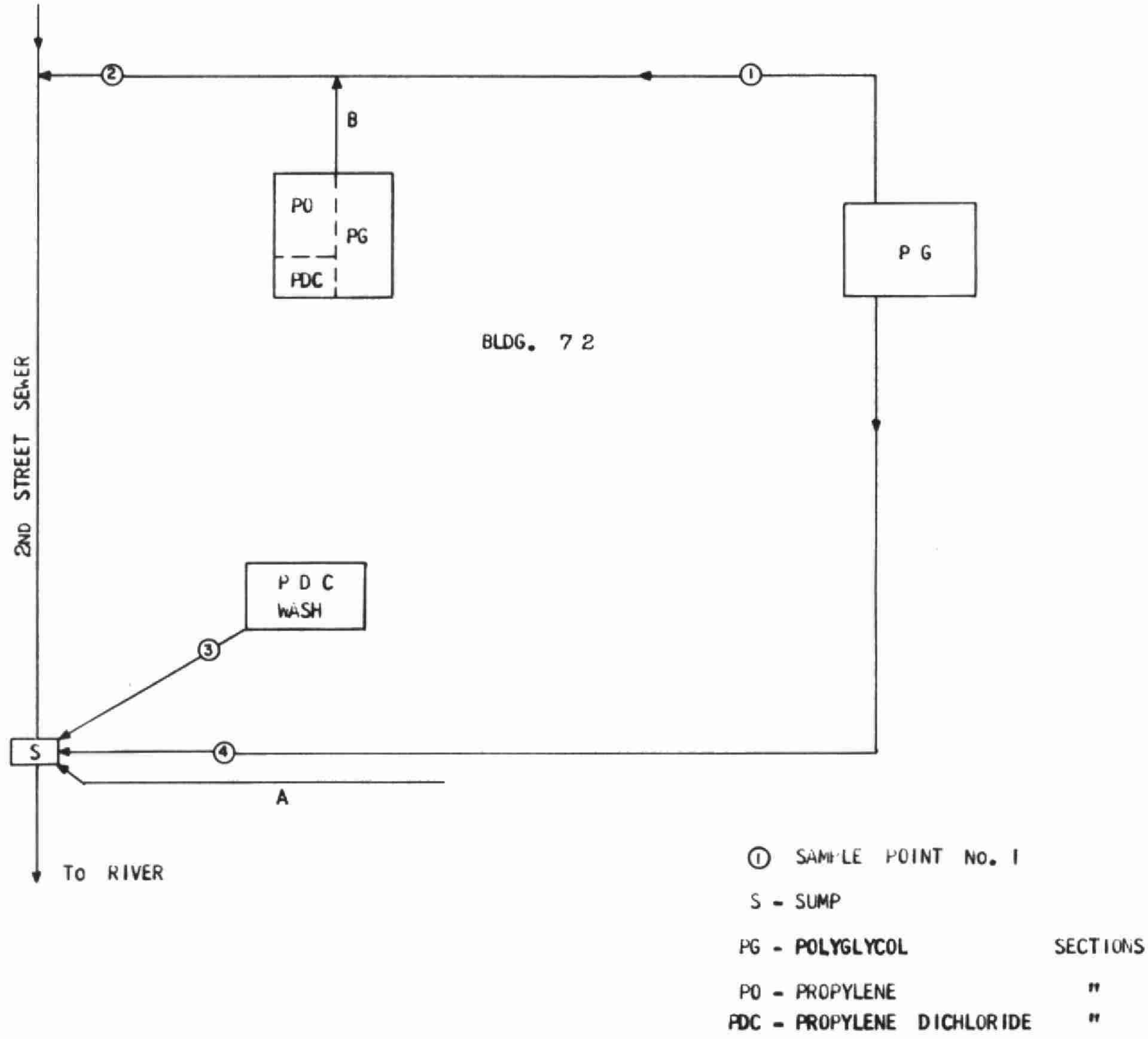
FIGURE VII

GLYCOL II PLANT SOURCES AND DISPOSAL OF WASTES



(1) Wastewater from 3 centrifuges, 2 pressure filters and backwashers, and 2 barometric leg condensers.

(2) (1) plus cooling waters (B).

(3) P.D.C. neutralizer water overflow from batch washing.

(4) Wastewater from one barometric leg condenser and one vacuum flash column.

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(A) Storage pad drainage (intermittent).

(B) Cooling waters from P.O., P.D.C. and P.G.

SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, composite samples were taken at four points in this Plant over a 5-hour period. The analytical results are provided in Table VII.

TABLE VII

GLYCOL II PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	pH	COD	Chlorides as Cl^-	Free NH_3
1	T-1900	N.A.	98	220	10	8.3	165	49	.3
2	T-1901	4.0	44	240	15	7.4	110	114	.2
3	T-1902	0.05*	450	380	5	7.2	5,200	105	2.1
4	T-1903	2.0	8	220	10	7.7	70	50	.1
Service Water (Estimate)					20		15	40	

* Visual observation or estimate.

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The net daily waste loadings from this Plant to the 2nd Street Sewer were calculated to be:

BOD_5	2,150 lbs.
COD	8,400 lbs.
Chlorides	3,200 lbs.

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During this survey, certain batch operations like washing down of polyglycol filters and centrifuging were not being carried on so it is conceivable that the BOD_5, suspended solids and COD loadings from the eastern section of the Plant could be higher than shown. It is also interesting to note that the P.D.C. wash contributes about one-third of the COD loading even though the volume of wastewater is relatively small. The western discharge of 2 mgd did not contain high concentrations of contaminants which would suggest that the flow was mainly comprised of cooling water wastes at the time of the survey.

From the analytical results, it was noted that the main contamination in the eastern stream (Sample Point 2) originated at the Polyglycol Section (condensor water and filtrates) rather than from the propylene oxide and P.D.C. Section. This would suggest that the wastewaters from the latter Section are largely cooling water. As was previously mentioned, contamination in this waste stream could be greater than determined during this survey.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the survey, the following conclusions were reached:

(1) The P.D.C. wash contributed approximately one-third of the total COD loading even though the volume was relatively small.

(2) There is reason to believe that contamination in the two main discharges (Sample Points 2 and 4) would be greater than recorded due to the fact that certain batch operations were not being carried out at the time of the survey.

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These conclusions lead to the recommendation that the Company carry out studies to determine the best method of reducing the organic waste loading as represented by BOD_5 and COD loadings.

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ETHANOLAMINES PLANT

RAW MATERIALS AND PRODUCTS

Mono-ethanolamines, di-ethanolamines and tri-ethanolamines, and mono-ethyl, di-ethyl and tri-ethyl glycolethers (dowanols) are formulated from ammonia gas, water, ethylene oxide and ethanol.

PROCESS

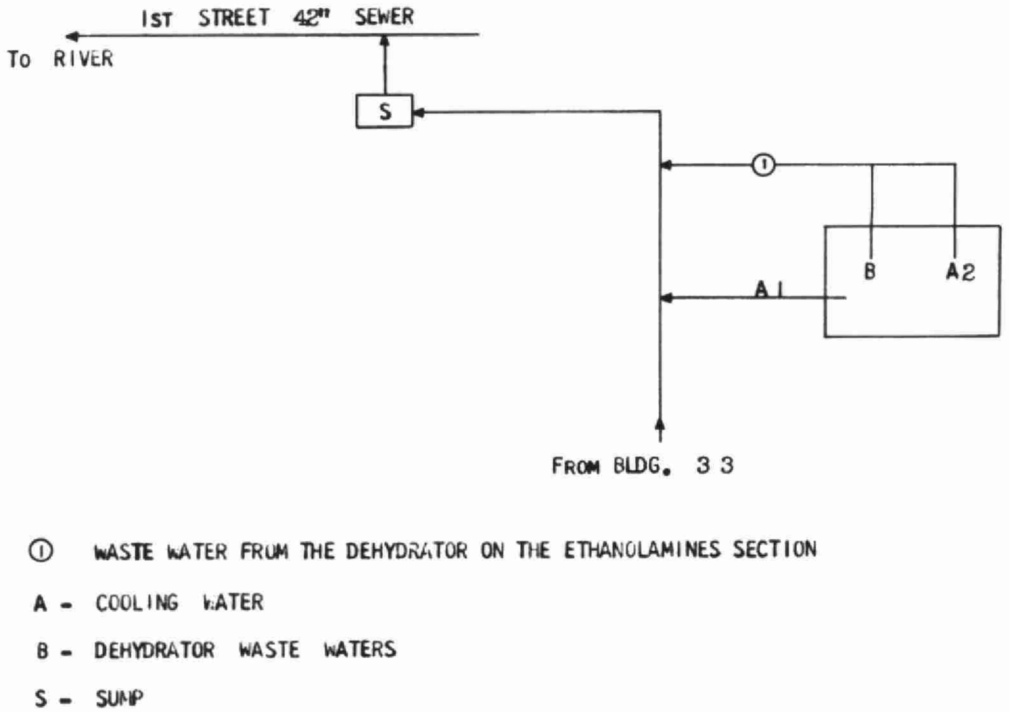
Ammonia gas produced in the NH_3 - II Plant is dissolved in water and piped to the Ethanolamines Plant where it is mixed, in excess, with liquid ethylene oxide under high pressures to produce ethanolamines. The reaction is exothermic therefore proper temperature controllers are necessary. The reaction mixture is ammonia stripped and then evaporated and dehydrated to remove water. This is followed by low pressure finishing in columns to produce the desired products, i.e., the three ethanolamines. The condensates from the evaporator are re-used in the absorber. In similar fashion, ethylene oxide is reacted with ethanol to form the three corresponding glycolethers. The ethanol is stripped off the reaction mixture but there are no dehydrator or water wastes from this process.

SOURCES OF WASTES AND DISPOSAL

Figure VIII gives an outline of the sources of wastes and the points of disposal of these wastes. The waste sampling location (1) is indicated on this diagram along with other pertinent sources of wastewater which are described below:

FIGURE VIII

ETHANOLAMINES PLANT SOURCES AND DISPOSAL OF WASTES



(1) Wastewater from the dehydrator on the ethanolamines section.

(A) Cooling water.

(B) Dehydrator wastewaters.

SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, a composite sample was taken at this Plant. The analytical results are tabulated in Table VIII.

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TABLE VIII

ETHANOLAMINES PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	pH	COD	Chlorides as Cl^-	SO_4
1	T-1821	N.A.	6.4	300	10	8.5	12	99	17
Service Water (Estimate)					20			40	

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

According to the analytical results, the quality of the waste generated in the Ethanolamines Plant is acceptable for discharge to a watercourse. This assumes the quality of the cooling water flow at Point A1 (not sampled) is approximately the same as that at Point A2. The total waste flow from this Plant is 0.7 mgd.

It should also be noted that tars from the finishing operations are trucked away by a waste haulage contractor for disposal at another site.

CONCLUSIONS

The wastewaters from this section were found to be virtually non-contaminated.

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SOLVENTS PLANT

RAW MATERIALS AND PRODUCTS

Tri-chloroethylene, per-chloroethylene, carbon tetrachloride, hydrochloric acid and methyl chloride are manufactured from "tetra heavy solvents", chlorine, propylene dichloride and propylene.

PROCESS

Chlorine is brought together with propylene dichloride and "tetra heavy solvents" from the Vinyl Chloride Plant in a reactor at low pressures and high temperatures to form carbon tetrachloride, per-chloroethylene and hydrogen chloride. The reaction products are recovered in a product recovery condenser and then undergo a distillation step for separation and finishing to the desired solvents. The non-condensable hydrogen chloride, excess chlorine and inerts are sent to an acid absorbtion system where HCl is absorbed in water to produce a saleable product and the wet chlorine is dried for recycle by scrubbing with 93% H_2SO_4. The spent sulphuric acid, 85% at this point, is neutralized with caustic before discharge to the sewers. The amount of H_2SO_4 involved is approximately 500 gpd. Additional propylene dichloride is produced in this Plant by the reaction of chlorine gas with propylene. Methyl chloride is also produced by the controlled chlorination of methane and the product finished by distillation in this Plant. The product recovery and finishing operations are quite similar to those used in the production of the solvents. Any contaminated (i.e., low pH) wastewaters from the methyl chloride and solvent trains are directed to a water-NaOH vent scrubber.

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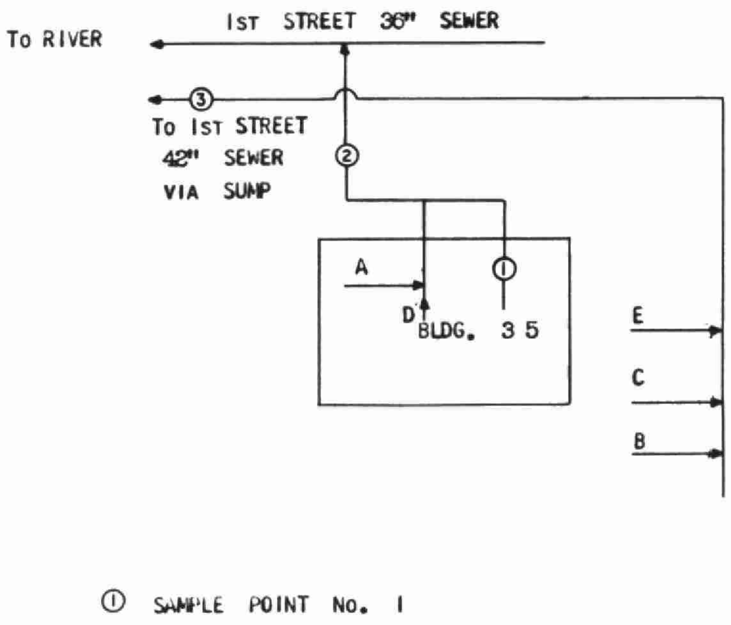
SOURCES OF WASTES AND DISPOSAL

Figure IX schematically indicates the sources and disposal of wastes. The waste sampling locations and other pertinent points are indicated on the diagram and are described below.

FIGURE IX

SOLVENTS PLANT SOURCES AND DISPOSAL OF WASTES



(1) Compressor cooling and floor drains.

(2) (1) plus pad drains (A) and cooling waters (D).

(3) Scrubber water on P.D.C. vent and on methyl chloride train (C), condenser waters (B) and H_2SO_4 - NaOH neutralized solution (E).

(A) Pad drains in storage area (in EDC area).

(B) Condenser cooling waters on methyl chloride.

(C) Scrubber on methyl chloride - solvents train and propylene dichloride vent.

(D) Cooling waters.

(E) H_2SO_4 - NaOH neutralized solution (approximately 500 gpd).

SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, composite samples were collected of the waste flows from the Solvents Plant over a 5-hour period at the sample points indicated on Figure IX. The analytical results are presented in Table IX.

TABLE IX

SOLVENTS PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	pH	COD	Chlorides as Cl^-	SO_4
1	T-1817	-	2.3	145	13	7.8	8	86	20
2	T-1816	.9	2.2	170	10	7.0	48	88	20
3	T-1820	1	17	2,900	120	12.1	140	2,380	121
Service Water (Estimate)					20			40	

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

Wastes discharged to the 36" sewer were relatively uncontaminated. Net waste loadings were calculated to be as follows:

COD	400 lbs./day
Chlorides	400 lbs./day

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Wastes discharged to the 42" sewer were found to be contaminated, having a pH value of 12.1 and chloride and suspended solids concentrations of 2,380 ppm and 120 ppm, respectively. Net daily waste loadings to this sewer were calculated to be:

BOD_5	170 lbs.
Suspended Solids	1,000 lbs.
COD	1,400 lbs.
Chlorides	23,500 lbs.

The source of the high pH and chloride concentration would be the wastes from the vent gas scrubber on the methyl chloride-solvents train and would be due to the incomplete control of the neutralization-scrubbing process. Another source would be the scrubber on the P.D.C.

CONCLUSIONS AND RECOMMENDATIONS

The wastewaters from this Plant discharged to the 42" sewer were found to contain high suspended solids and chlorides concentrations and to exhibit a high pH at 12.2. The exact origin of this high pH was not determined by the findings of this survey but it would most likely originate at the vent gas scrubber on the methyl chloride-solvents train. Survey work should therefore be conducted by the Company to determine the source and corrective measures. Some attention should also be directed to the high (2,380 ppm) chloride content in this waste stream. It is possible that it might be attributed to one or two small waste flows aside from the neutralization or gas scrubbing processes. The source of the suspended solids contribution should also be investigated.

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The wastewaters to the 36" sewer were found to be virtually uncontaminated.

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VINYL CHLORIDE PLANT

RAW MATERIALS AND PRODUCTS

Vinyl chloride monomer, anhydrous and aqua HCl and chlorothene (methyl chloroform) are manufactured from chlorine, ethylene and water. A ferric chloride catalyst is used.

PROCESS

Chlorine and ethylene are brought together in a high pressure reactor to form ethylene dichloride (EDC). Any unreacted inerts (mostly nitrogen) are purged from the system to a T-12 scrubber taking along some unreacted chlorine and chlorinated organics. The heavy ends formed in the reactor go to a vacuum tower and the "heavies" from this unit are recycled. Vents or condensables from this tower are water scrubbed before entering an acid sewer.

The crude EDC is sent to a stripping tower where the lighter components are stripped off to the T-12 scrubber and the EDC is then directed to a cracking furnace as feed. The heavy products from the furnace enter a heavy ends stripper ("heavies" recycled), and the light ends product goes first to an HCl removal unit and then to a vinyl chloride monomer finishing column to finish the vinyl chloride. Any EDC left at this stage is recycled.

The separated HCl is either collected and sold in its anhydrous state or directed to a karbate-type absorbtion column to produce hydrochloric acid. Vent gas scrubbers are located on tanks in the anhydrous HCl storage area and on the karbate column to scrub overheads with a mixture of sodium hydroxide, sodium chloride and water.

Vinyl chloride and hydrogen chloride are brought together with a ferric

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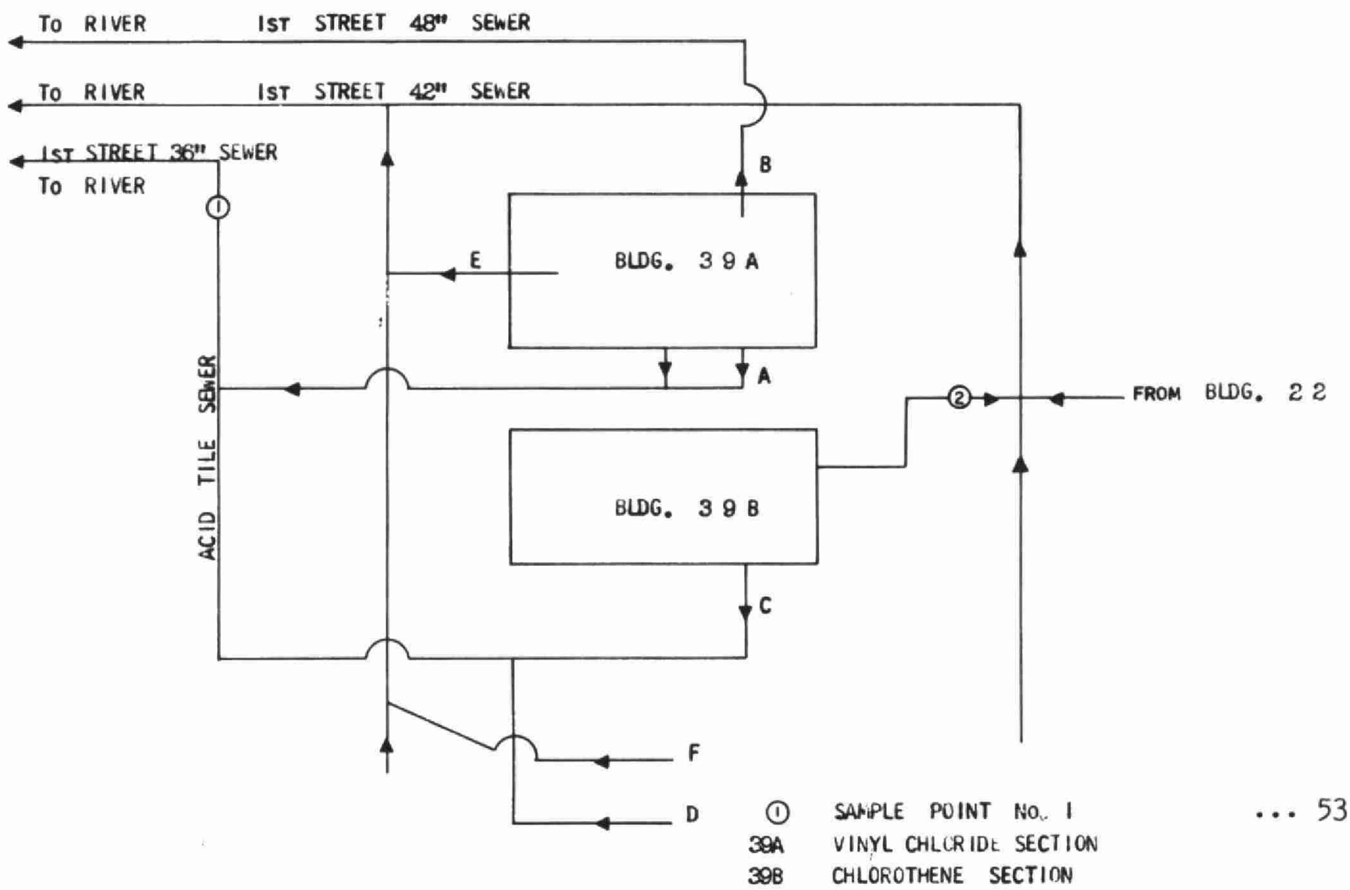
chloride catalyst in a reactor to form 1:1 di-chloroethane or "alpha-di". Any excess vinyl chloride is stripped off and the di-chloroethane is further chlorinated in a reactor to form methyl chloroform. The vents from this reactor are sent to the T-12 scrubber while any unreacted di-chloroethane is stripped from the reaction mixture and returned to the reactor. Vapourizable "heavies" from the stripping column are used as 'tetra heavy solvents' in another unit.

SOURCES OF WASTES AND DISPOSAL

Figure X schematically shows the outline of the Vinyl Chloride Plant and the sources and disposal of wastewaters. Waste sampling locations and other pertinent points are indicated on the diagram and are described below.

FIGURE X

VINYL CHLORIDE PLANT SOURCES AND DISPOSAL OF WASTES



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(1) Contents of Acid Tile Sewer (A + C + F + D).

(2) Cooling water from 39B to sewer on eastern section.

(A) T-12 vent gas scrubber to Acid Tile Sewer (ATS).

(B) Cooling water from columns to 48" Sewer.

(C) Sump leaks from HCl absorbtion process (very small). Scrubber on HCl absorption column to ATS. Condensates from chlorothene ejector and heavy ends stripping systems to ATS.

(D) Small vent gas scrubber on tank cars to ATS.

(E) Absorber cooling waters to 42" Sewer.

SAMPLING AND ANALYTICAL RESULTS

On August 12, 1969, composite samples were collected at two points within this Plant over a 5-hour period. The analyses of these samples are shown in Table X.

TABLE X

VINYL CHLORIDE PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	Solids Total	Solids Susp.	pH	COD	Chlorides as Cl^-	$SO_4^=$
1	T-1814	1.6	2,400	12	11.9	58	1,498	82
2	T-1811	N.A.	350	1	8	20	169	20
Service Water (Estimate)				20		15	40	

NOTE: All results reported in parts per million (ppm) except pH.

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DISCUSSION OF RESULTS

The major portion of the wastewater from this unit (7.5 mgd of cooling water) enters a 48" Sewer used exclusively for the Vinyl Chloride Plant and this waste should not be highly contaminated.

The main source of contamination from this Plant originates in the Acid Tile Sewer which receives wastes from the main vent gas scrubber (T-12), smaller scrubbers on the tank cars and the HCl absorbtion column, and condensates from two systems. The pH of these wastes was recorded at 11.9 and the chloride content at 1,498 ppm. The net waste loadings from the Acid Tile Sewer to the 36" Sewer were:

Chlorides	23,000 lbs./day
COD	900 lbs./day
pH	11.9

It should be noted that the Company has recently installed automatic pH adjustment equipment to control low pH discharges into the Acid Tile Sewer. According to the analytical results, the pH of the contents of this Sewer was 11.9 which would suggest that the neutralization processes were not too well controlled.

The total waste loadings from this Plant were not able to be calculated because certain strategic waste flows and samples were not obtained during this survey but one would suspect chloride loadings slightly above those recorded in the Acid Tile Sewer in view of the fact that some smaller scrubbers empty into the other sewers.

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CONCLUSIONS AND RECOMMENDATIONS

The main area of concern in this Plant is the relatively high pH of the wastewaters discharged to the 36" Sewer from the Acid Tile Sewer even though a new neutralization system has been installed on the Acid Tile Sewer. The cause of this problem should be determined by the Company and corrective action taken. In addition, a check on the chloride levels should be initiated with a view to reducing them to a minimum within this Plant.

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AMMONIA PLANTS I AND II

RAW MATERIALS AND PRODUCTS

Anhydrous and aqueous ammonia are produced from hydrogen, air, steam and natural gas (47% methane) in these two Plants.

PROCESS

Steam, natural gas (47% methane) and hydrogen are passed through a furnace to raise the temperature of the gases to approximately 800°C. Air is introduced and the gases are passed to a reformer where, in the presence of a nickel catalyst, carbon monoxide, carbon dioxide, and hydrogen are produced. The gases are then passed to a shift reactor where, in the presence of a chromium catalyst, the carbon monoxide is converted to carbon dioxide. The carbon dioxide is removed with MEA (methylethylamine) to produce the hydrogen and nitrogen reactants. Residual traces of carbon monoxide and carbon dioxide are removed by methanation over a nickel catalyst. The feed gases are then pumped over an iron loop where the ammonia is synthesized. The reaction gases are cooled and compressed and the ammonia separated.

SOURCES OF WASTES AND DISPOSAL

Figure XI schematically shows the general plant layout, sources of wastes, and the means by which they are conveyed to the St. Clair River. The waste sampling points and other pertinent waste sources are indicated on the diagram and are described below.

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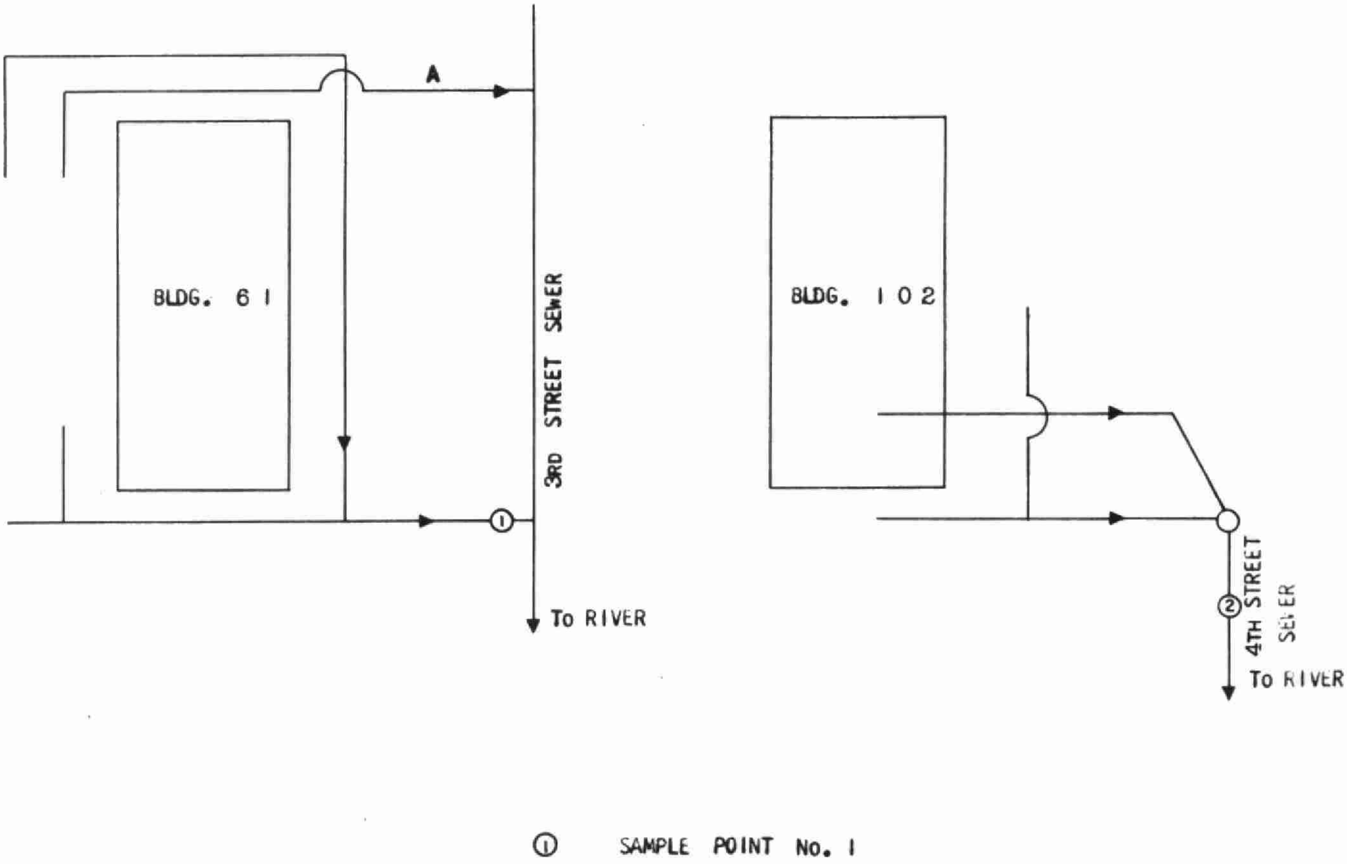
FIGURE XI

AMMONIA PLANTS I AND II SOURCES AND DISPOSAL OF WASTES



(1) Ammonia I west - aqua scrubber, etc.

(2) Total wastewaters from Ammonia II.

(A) Ammonia I east - compressor blow downs and compressor waters (5 mgd).

SAMPLING AND ANALYTICAL RESULTS

On August 14, 1969, composite samples were collected of the waste discharges from Ammonia Plants I and II over a period of 5 hours. The analyses of these samples are shown in Table XI.

TABLE XI

AMMONIA PLANTS I AND II ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	Solids Diss.	pH	Free Ammonia	Total Kjeldahl Nitrogen	COD
1	T-1871	3	14	260	80	180	9.5	20	25	24
2	T-1870	.28	15	380	10	370	8.6	3.2	5	28
Service Water (Estimate)					20		8.2			16

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The most significant waste loading was that calculated for free ammonia (NH_3) which was 600 lbs. per day representing a concentration of 20 ppm in a waste flow from one section of Ammonia I. Ammonia concentrations at this level at elevated pH's could prove toxic to aquatic life in the River and contribute to the nutrient load discharged to the River.

Although similarly high ammonia concentrations were not found in the Ammonia II Plant wastes to the 4th Street Sewer, there is reason to believe that these wastes would also contain high ammonia concentrations at times. For example, it was reported by Company personnel that high strength ammonia wastes (30% aqueous ammonia) are discharged to the sewers in Ammonia II from a tank (D-19). These wastes comprise a flow of 2 gpm discharged three times daily over 20 minute inter-

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vals. This ammonia is contained in the condensate from a compressor and such discharges could contribute to high ammonia concentrations.

CONCLUSIONS AND RECOMMENDATIONS

High ammonia concentrations in the wastes from one section of the Ammonia I Plant, and intermittent discharges of high strength ammonia wastes at the Ammonia II Plant, contribute to the nutrient loading discharged to the St. Clair River and, in conjunction with a high pH, could prove toxic to River organisms.

It is recommended that immediate action be taken to eliminate the discharge of compressor condensates and any other wastes bearing high concentrations of ammonia through in-plant control, process modification and/or waste treatment.

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ETHYLENE PLANT

RAW MATERIALS AND PRODUCTS

Ethylene and propylene are manufactured from light petroleum gases obtained from neighbouring refineries.

PROCESS

In the production of ethylene and propylene, the light petroleum gases used are obtained from the refineries in the Sarnia area. The process is essentially the steam cracking of methane and propane, and the subsequent refinement and distillation of the product mixture to separate the ethylene and propylene.

The starting products are steam fed into the thermal cracker where the methane and propane are converted into ethylene and propylene. The cracked gases are water quenched and compressed. Water is separated from the gases which are passed to a series of distillation columns to separate the ethylene and propylene.

The quench waters, after the cracking operation, are passed through gravity separators to recover hydrocarbons. Brine (15% sodium chloride - 10 gpm) is added to the effluent from the first separator and this mixture is fed to another separator where additional hydrocarbons are removed. The hydrocarbons are stored while the effluent from the second separator is discharged to the sewer (20 - 25 gpm).

Water condensate produced during the compression of the "enes" is directed to the same oil separator. The hydrocarbons are removed by gravity separation and the water is discharged to sewer.

SOURCES OF WASTES AND DISPOSAL

Figure XII schematically indicates the sources and disposal of wastes in

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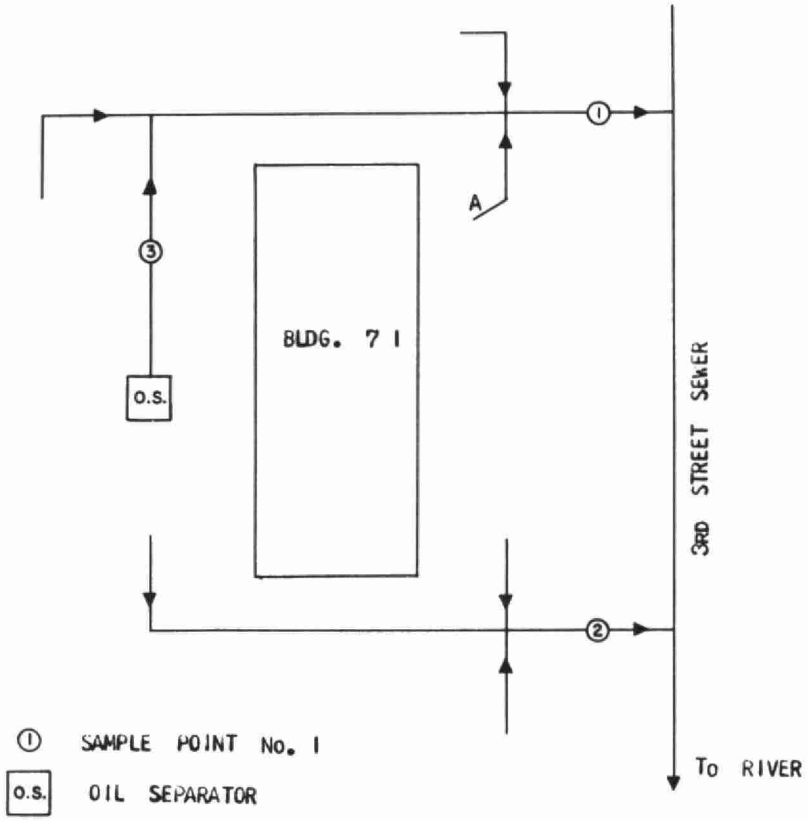
the Ethylene Plant. The waste sampling locations and other pertinent sources are indicated on this diagram and are described below.

FIGURE XII

ETHYLENE PLANT SOURCES AND DISPOSAL OF WASTES



(1) Ethylene East - oil separator effluent plus cooling water (A).

(2) Ethylene West - compressor cooling water.

(3) Brine-oil separator effluent.

(A) Cooling water.

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SAMPLING AND ANALYTICAL RESULTS

On August 14, 1969, composite samples were collected of the effluents from the Ethylene Plant over a 5-hour period. The analytical results of these samples are presented in Table XII.

TABLE XII

ETHYLENE PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample	Lab.	Flow		Solids			Chlorides	Phenols	Ether
Point	No.	mgd	Total	Susp.	Diss.	pH	as Cl^-	(ppb)	Solubles
1	T-1880	5	2,430	15	2,415	8.8	1,269	175	0
2	T-1881	15	340	30	310	8.3	-	100	0
3	T-1882	.03	123,310	70	123,240	11.1	71,600	8,000	7
Service Water (Estimate)				20		8.2	40	8	

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The net waste loadings were calculated based on flow rates submitted by Company personnel and the analytical results of samples collected during the course of the survey and were found to be:

Suspended Solids	1,300 lbs./day
Chlorides	55,000 lbs./day
Phenols	22 lbs./day

The effluents discharged from the Ethylene Plant exhibited high phenol concentrations. Based on the results of this survey, it is estimated that approximately 22 net lbs. per day of phenolic materials are discharged from the Plant.

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In addition to the contribution from the oil separator, which is minimal due to relatively low flow rates, phenols could originate from the cracking operations as condensates or in cooling water.

As the wastes discharged through the Ethylene - West Sewer were reported as being essentially cooling waters, it is difficult to account for the high phenol concentration noted during the survey, indicating that a further investigation is necessary to account for all phenolic sources.

A weak brine solution (10% sodium chloride) is added to the oil separator to effect better oil-water separation by producing a greater difference in the specific gravities. The effluent from this unit enters the eastern sewer from the Ethylene Plant and, undoubtedly, contributes significantly to the 55,000 lbs. (net) per day of chlorides found in this sewer.

CONCLUSIONS AND RECOMMENDATIONS

It is recommended that the Company investigate the possibility of using a more efficient type of oil separator or oil separation process that would eliminate the need for a brine solution and would, therefore, result in a significant reduction in the 55,000 lbs. of chlorides discharged from this Plant daily to the 3rd Street Sewer.

The sources of phenolic wastes should be established and appropriate action should be taken to reduce the loading significantly.

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STYRENE PLANT

RAW MATERIALS AND PRODUCTS

Styrene, ethyl benzene and toluene are manufactured from ethylene, steam, ethyl chloride and benzene. An aluminum chloride catalyst is used.

PROCESS

The production of styrene may be broken down into three distinct parts:

(a) alkylation of ethylene and benzene to ethyl benzene in the presence of ethyl chloride.

(b) dehydrogenation of ethyl benzene to crude styrene.

(c) recovering the styrene monomer from unreacted ethyl benzene and toluene by distillation.

Dried benzene, ethylene, and ethyl chloride are fed to reactors to produce ethyl benzene. Ethyl chloride supplies the hydrogen chloride necessary to activate the aluminum chloride catalyst. The vent gases are scrubbed with water and hydrochloric acid before being released to atmosphere. The scrubbing solution is sewered. The ethyl benzene, unreacted materials and the alkylation by-products are settled to recover the aluminum chloride. The catalyst-free products are then washed with caustic solution, settled to separate the water, and sent to the distillation columns.

The first column recovers the benzene which is returned to process while the second column recovers the ethyl benzene. The ethyl benzene is purified with caustic solution, settled to separate the water, and pumped to styrene production.

Ethyl benzene and superheated steam are fed to a furnace reactor where, in the presence of a catalyst, the ethyl benzene is converted to styrene. The

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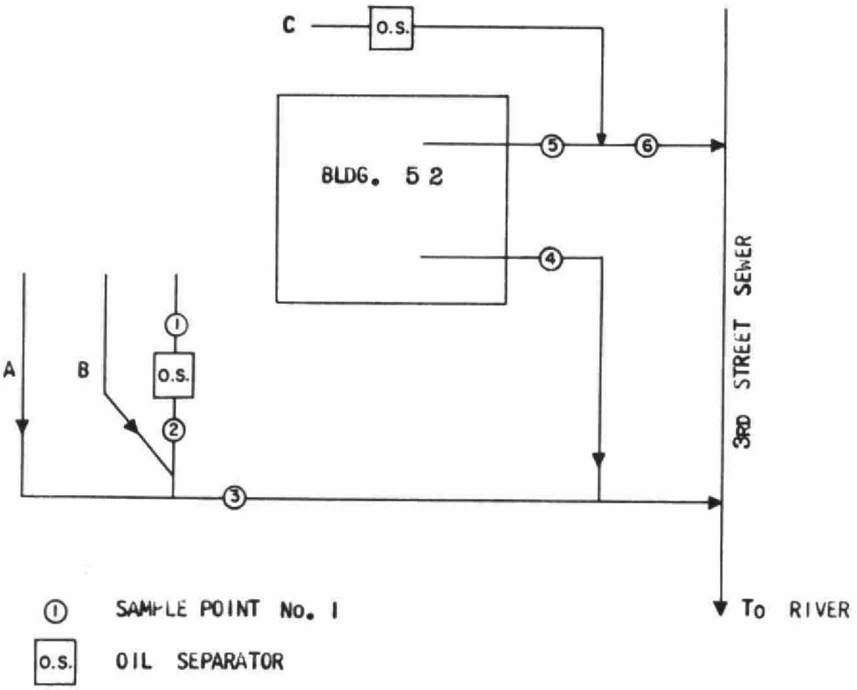
reactor products are condensed. The hydrocarbons are separated from the water and are directed to a fractionating column where the benzene and toluene are removed to be returned to process. The ethyl benzene and styrene mixture are passed through vacuum columns where the two products are separated. Ethyl benzene is returned to process while the styrene undergoes another purification step to remove styrene "tails". The pure styrene is sent to storage after a proper inhibitor has been added.

SOURCES OF WASTES AND DISPOSAL

Figure XIII schematically indicates the sources and disposal of wastes. The waste sampling locations and other pertinent sources of wastes are indicated on the diagram and are described below.

FIGURE XIII

STYRENE PLANT SOURCES AND DISPOSAL OF WASTES



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(1) Influent to above ground separator (some oily wastewaters and caustic dumps).

(2) Effluent from above ground separator.

(3) West Sump - (2) plus contaminated water sewer (A) plus acid sewer (B).

(4) Building 52 West discharge - mainly cooling water.

(5) Building 52 East discharge - mainly cooling water.

(6) Styrene Plant East Sewer - oil separator effluent (C) and cooling water.

(A) Contaminated water sewer - pump pads runoff, oil spills and drainage from general area.

(B) Acid Sewer - acid dumps from acid scrubbers.

(C) Small separator effluent mainly oily wastewaters from caustic washings.

SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, composite samples were collected of wastes originating at the Styrene Plant. The analytical results of samples obtained are presented in Table XIII. This Table also includes the samples of the Styrene Plant effluents collected on September 3, 1969.

TABLE XIII

STYRENE PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	COD	Chlorides as Cl^-	Ether Solubles	Copper
1	T-1892	N.A.	1,400	25,000	777	14.7%	.14
2	T-1893	N.A.	4,600	9,250	2,240	312	.56
3	T-1891	N.A.	2,400	4,800	1,528	11%	.14
4	T-1890	N.A.	136	--	531	0	.07
5	T-1889	N.A.	12	20	76	0	.01
6	T-1888	11.0	--	24	73	7	.01

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On September 3, 1969, the following results were obtained.

Sample Point	Lab. No.	Flow mgd	BOD	COD	Chlorides as Cl^-	Ether Solubles	Phenols (ppb)
2	T-2074	N.A.	400	1,350	--	3	140
3	T-2075	N.A.	120	8,600	--	3,318	1,000
3	T-2076 (Grab)	N.A.	--	--	--	42%	

NOTE: All results reported in parts per million (ppm) except phenols.

DISCUSSION OF RESULTS

It is difficult to estimate the waste loadings discharged from the Styrene Plant as flow rates could not be related to the sampled streams. However, based on analytical results alone, it is evident that the Styrene Plant contributes excessive quantities of BOD-exerting material, COD-exerting material and ether solubles. By virtue of the second set of samples collected on September 3, 1969, it is evident that the operations also result in notable discharges of phenolic materials.

The high ether soluble concentration (11%) noted in one of the samples was attributed to a failure in an acid line, resulting in a cross-connection of sewers and the subsequent overloading of an existing oil separator. However, when this same sewer was resampled on September 3, 1969, even higher ether soluble concentrations were obtained (42%), indicating a steady loss of ether soluble material to the sewer system.

During discussions held with plant personnel, it was learned that there were a number of batch discharges from the Styrene Plant that could have detrimental

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effects on the quality of the final effluent. The spent hydrochloric acid is discharged directly to the sewer under steady flow amounting to approximately 1,500 lbs. per day. There were also two separate dumps of caustic to the sewer. The first dump consisted of 3,500 lbs. of 2% caustic discharged every day over a one to two-hour period; the other dump of 3,500 lbs. of 2% caustic occurred every three days. It should be noted that the spent caustic would also contain appreciable concentrations of aluminum.

CONCLUSIONS AND RECOMMENDATIONS

The Company should examine the operations of the Styrene Plant to determine all sources of pollution. Of particular concern was the high phenol concentration of 1,000 ppb noted in the sample of the wastes taken at the West Sump (3) on September 3, 1969. Effective action should then be taken to reduce the contaminating components in the waste streams to render the effluents acceptable for discharge to a watercourse.

The Company should also investigate alternate methods of disposal of batch discharges. Spent caustic should not be discharged to an oil-bearing waste stream, as this would have a tendency to emulsify the oil making its removal more difficult.

Waste volumes should be established for principle waste flows to enable the Company to determine waste loadings sewered.

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POLYETHYLENE PLANT

RAW MATERIALS AND PRODUCTS

Linear polyethylene is manufactured from ethylene and butene. The catalyst used contains either titanium or aluminum.

PROCESS

Dow produces polyethylene by a low pressure process. The ethylene and butene monomers are brought into solution in a hydrocarbon medium (hexane). The monomers are polymerized over a catalyst, usually a Ziegler-type inorganic catalyst containing titanium or aluminum. The polymer forms around the particles of the catalyst and is removed for further processing while the hydrocarbon is recycled. The polymer/catalyst particles are separated by solvent extraction with alcohol and the alcohol is later recovered and the collected polymer is dried and finished.

SOURCES OF WASTES AND DISPOSAL

Figure XIV schematically represents the sources and disposal of wastes in this Plant. The waste sampling locations are indicated on the diagram and are described below.

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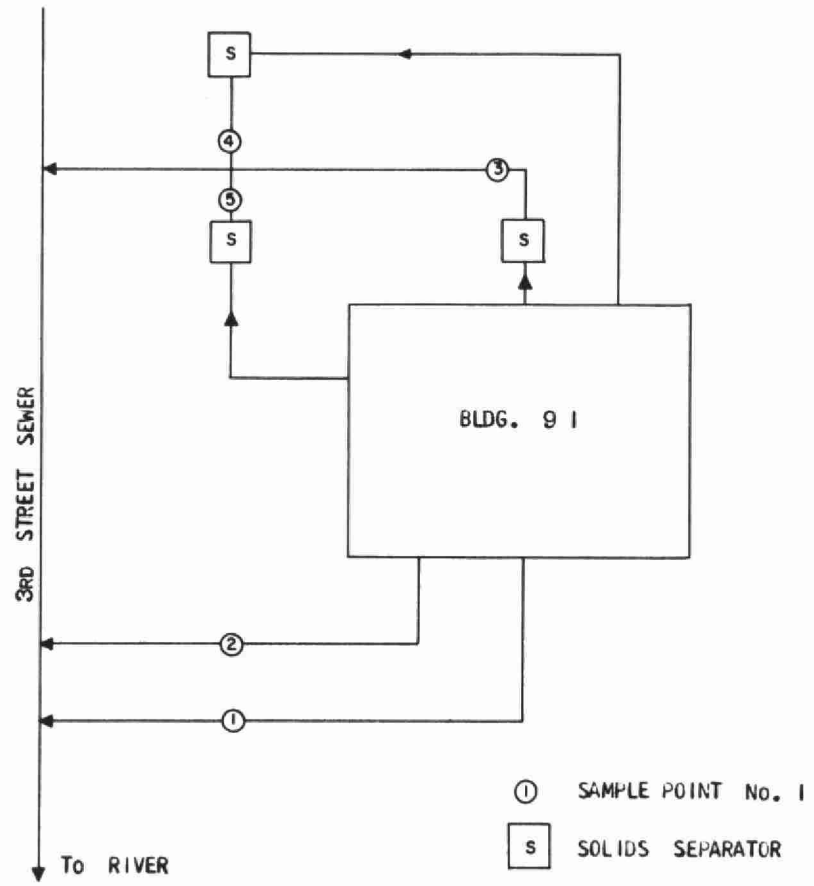
FIGURE XIV

POLYETHYLENE PLANT SOURCES AND DISPOSAL OF WASTES



(1) Effluent in polyethylene west sewer.

(2) Effluent in polyethylene middle sewer.

(3) Overflow from polyethylene sumps south.

(4) Overflow from polyethylene sumps east.

(5) Overflow from polyethylene sumps west.

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SAMPLING AND ANALYTICAL RESULTS

On August 14, 1969, composite samples were taken at various points in this Plant over about a 6-hour period. The analytical results of these samples are shown in Table XIV.

TABLE XIV

POLYETHYLENE PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	COD	pH	Ti	Al	Solids Total	Susp.	Diss.	NH_3
1	T-1873	4	240	9.1	.35	1.5	290	45	245	0.4
2	T-1874	3	58	7.5	-	-	290	10	280	0.1
3	T-1875	2	*	8.4	-	-	220	5	215	*
4	T-1876		*	8.6	-	-	220	10	210	*
5	T-1877		*	8.5	-	-	230	5	225	*
Service Water (Estimate)			15					20		

* Sample exhausted.

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The net waste loadings from this Plant to the 3rd Street Sewer were calculated to be:

Suspended Solids	400 lbs./day
BOD_5	900 lbs./day
COD	10,500 lbs./day

A relatively high concentration of COD at 240 ppm in the effluent in the west sewer would indicate some losses of raw materials or alcohols used in the finishing process.

Of some concern is the sewering of spent catalyst to the 3rd Street Sewer as this could contribute a significant metal loading to the watercourse.

CONCLUSIONS AND RECOMMENDATIONS

The Plant operation should be examined to determine low volume high strength waste streams in view of the relatively high COD concentrations noted in the effluent in the west sewer. These waste streams should be segregated for treatment or alternate disposal. In addition, the sewering of spent catalyst should be discontinued.

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STYRON PLANT

RAW MATERIALS AND PRODUCTS

High impact and general purpose styron or polystyrene are manufactured from styrene and butadiene. Ethyl benzene is used as a modifier.

PROCESS

(a) General Purpose Styron

The styrene monomer is converted to polystyrene (Styron) under the influence of heat and catalysts. Modifiers are added to produce desirable characteristics in the final product. In the manufacture of Styron, the principle modifier is ethyl benzene and its concentration in the material is usually kept at around 10%. The polymerization itself is a continuous process.

The viscous polystyrene is passed through a stripping tower where a combination of high temperatures and low pressures remove the unreacted styrene which is returned to the process.

The Styron is extruded, cooled and granulated.

(b) High Impact Styron

High impact Styron is produced in much the same way as general purpose Styron, with the exception that the product is a copolymer of styrene and butadiene. The copolymer is blended with rubber to achieve the desired characteristics in the final product.

SOURCES OF WASTES AND DISPOSAL

Figure XV schematically shows the sources and disposal of wastewater from the Styron Plant to the 2nd Street Sewer. The one sampling point is indicated on the diagram and is described below.

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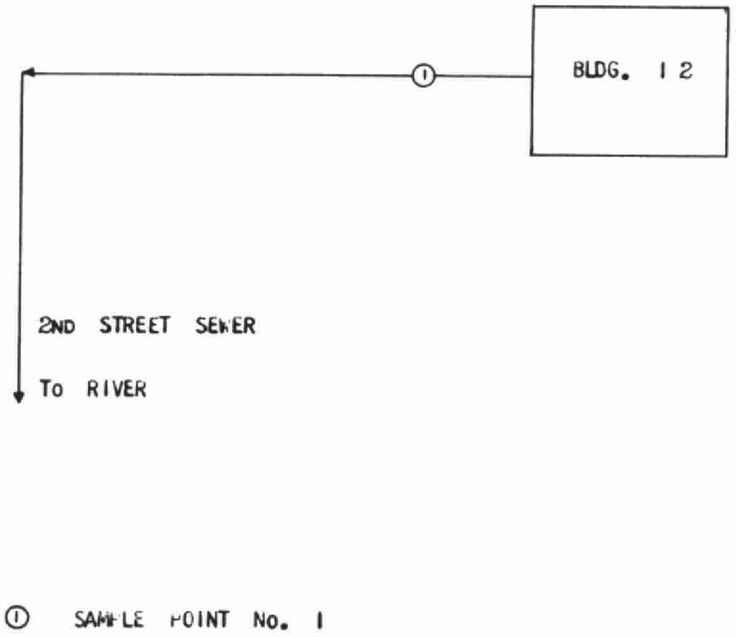
FIGURE XV

STYRON PLANT SOURCES AND DISPOSAL OF WASTES



1. (a) Barometric leg to maintain low pressure in styrene stripper.

   (b) Water baths used in product extrusion.

   (c) Emergency coolers to be used in event of failure in the Dowtherm coolers.

   (d) Spills from the styrene storage tanks.

SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, a 6½-hour composite sample was taken of the effluent from this Plant discharging to the 2nd Street Sewer. The analytical results are presented in Table XV.

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TABLE XV

STYRON PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Total	Solids Susp.	Diss.	pH	COD	Cl^-
1	T-1896	1.2	37	430	10	420	7.8	50	53

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The waste loadings from the Styron Plant discharged to the 2nd Street Sewer are not significant. The relatively high BOD, however, would suggest that there may be leaks, spills, etc., of styrene to the sewer.

During the course of the survey, it was discovered that Dowtherm was used in the production of Styron. This material, which can cause taste and odour problems, should not, under any circumstances, be permitted to discharge to a watercourse.

Other wastes arising in the production of Styron which were not sampled include:

(1) Tars which build up in the styrene to polystyrene conversion equipment and are collected and burned at the Steam Plant or returned to the Styrene Plant for reprocessing.

(2) Dowtherm tars which are hauled away by a local contractor for disposal. The Dowtherm does not have any contact with water at the Styron Plants.

(3) Miscellaneous solids which are removed from the various systems and are disposed of at the Plant solid waste disposal dump.

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CONCLUSIONS AND RECOMMENDATIONS

The waste from the Styron Plant does not constitute a significant source of pollution. The Plant should, however, be inspected for any low volume high strength streams. These streams should be diverted for suitable treatment. Care should be taken to ensure that, under no circumstances, Dowtherm is discharged to the River.

PELASPAN PLANT

RAW MATERIALS AND PRODUCTS

Two different forms of pelaspan (a polystyrene foam) are produced from polystyrene, blowing agents, water and a zinc suspending agent. In the Pelaspan Plant, an organic catalyst is also used.

PROCESS

(1) Pelaspan I

The Pelaspan I Plant is concerned with the extrusion of the formed polystyrene and the addition of a blowing agent. Water is used in the annealing baths which follow the extrusion but this does not constitute a waste source as the water is recycled.

(2) Pelaspan II

The Pelaspan II Plant formulates the polystyrene from monomeric styrene by means of a suspension polymerization process utilizing a zinc suspending agent and an organic catalyst. After polymerization, a hydrocarbon blowing agent is added to the mixture. The suspending agent is removed, after polymerization has occurred, by acidification with hydrochloric acid to zinc chloride. These wastewaters are directed to a zinc separation pond.

Capacity of the Pelaspan II Plant is at present slightly under one batch per day.

SOURCES OF WASTES AND DISPOSAL

Figure XVI schematically shows the sources and disposal of wastes from the Pelaspan Plant. The waste sampling locations and other pertinent sources of wastes are indicated on the diagram and are described below.

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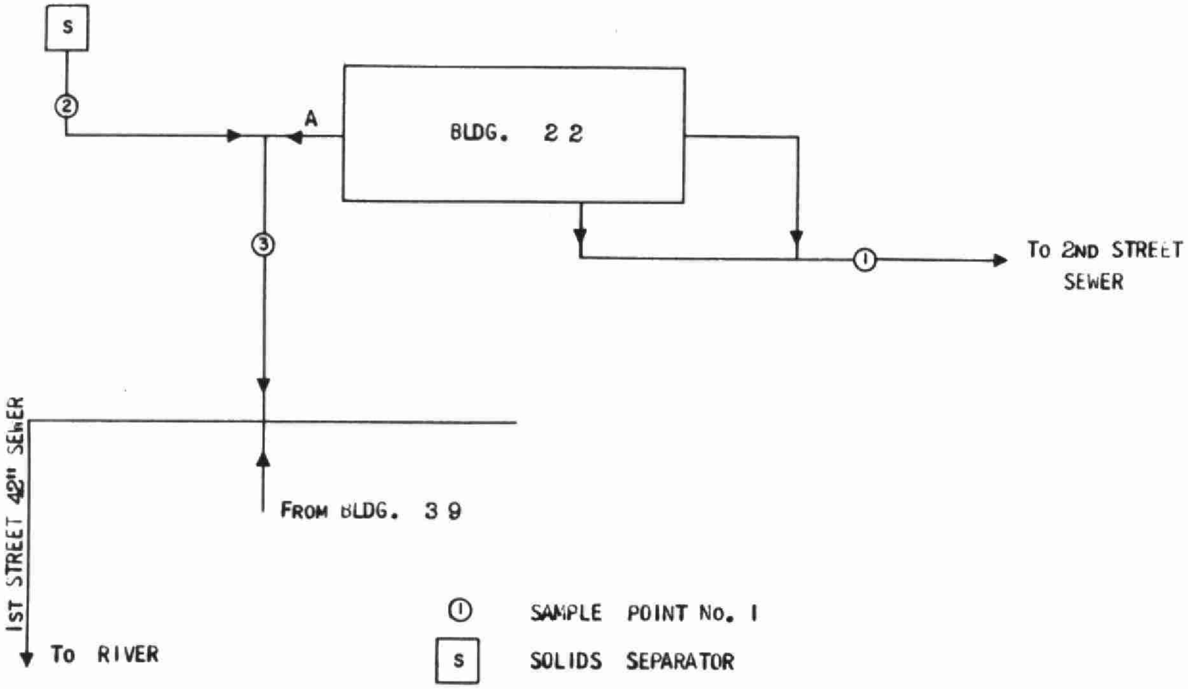
FIGURE XVI

PELASPAN PLANT SOURCES AND DISPOSAL OF WASTES



(1) Cooling waters from Pelaspan I section.

(2) Overflow from zinc separation pond.

(3) (2) plus cooling waters from Pelaspan II section (A).

(A) Cooling waters from Pelaspan II section.

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SAMPLING AND ANALYTICAL RESULTS

On August 13, 1969, composite samples were taken at three points in this Plant over a 5-hour period. The analytical results are provided in Table XVI.

TABLE XVI

PELASPAN PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample	Lab.	Flow		Solids							Nitrogen		
Point	No.	mgd	BOD	Total	Susp.	Diss.	pH	COD	Zn	Cl	NH_3	Total	SO_4
1	T-1897	.3	1.4	250	20	230	8.4	4		4.5	.40	.36	20
2	T-1815	N.A.	3.0	370	4	366	6.8	16	8.3	111	.1	.54	20
3	T-1810	.7	8.0	400	20	380	7.2	16		98	.02	.30	20
Service Water (Estimate)					20			15		40			

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

Except for the high zinc concentration noted in the overflow from the zinc separation pond, the wastes appear to be acceptable for discharge.

CONCLUSIONS AND RECOMMENDATIONS

The Company should attempt to effect better zinc separation and thereby reduce the metallic loading to the St. Clair River.

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LATEX PLANT

RAW MATERIALS AND PRODUCTS

Latex is manufactured from styrene and butadiene. Catalysts, oils, acids, soaps, and extruders and coagulating agents are used in this process.

PROCESS

Polymerization of the styrene and butadiene monomers into the styrene-butadiene copolymer occurs by a process of emulsion polymerization. The emulsion mixture contains the monomers in the ratio of 25% to 50% styrene and 50% to 75% butadiene. The reaction takes place at low temperature in the presence of catalysts.

The latex suspension (the particles of rubber in the suspension are generally in the range of 400 to 2,000 Å) is stored until needed. When required, the latex suspension is coagulated by the addition of acid and modified by the addition of oils and soaps to produce a product with the desired characteristics.

The coagulation of the latex suspension precipitates approximately 95% of the rubber particles. The supernatant from this coagulation which contains the remaining uncoagulated latex, extenders and coagulating agents, is directed to a sluiceway and a holding pond where the remaining latex is coagulated by calcium chloride and removed for land disposal. The effluent from the pond is discharged with the plant cooling water to the 3rd Street Sewer.

SOURCES OF WASTES AND DISPOSAL

Figure XVII schematically shows the outline of the Latex Plant and the sources and disposal of wastewaters. Waste sampling locations and other pertinent points are indicated on the diagram and are described below.

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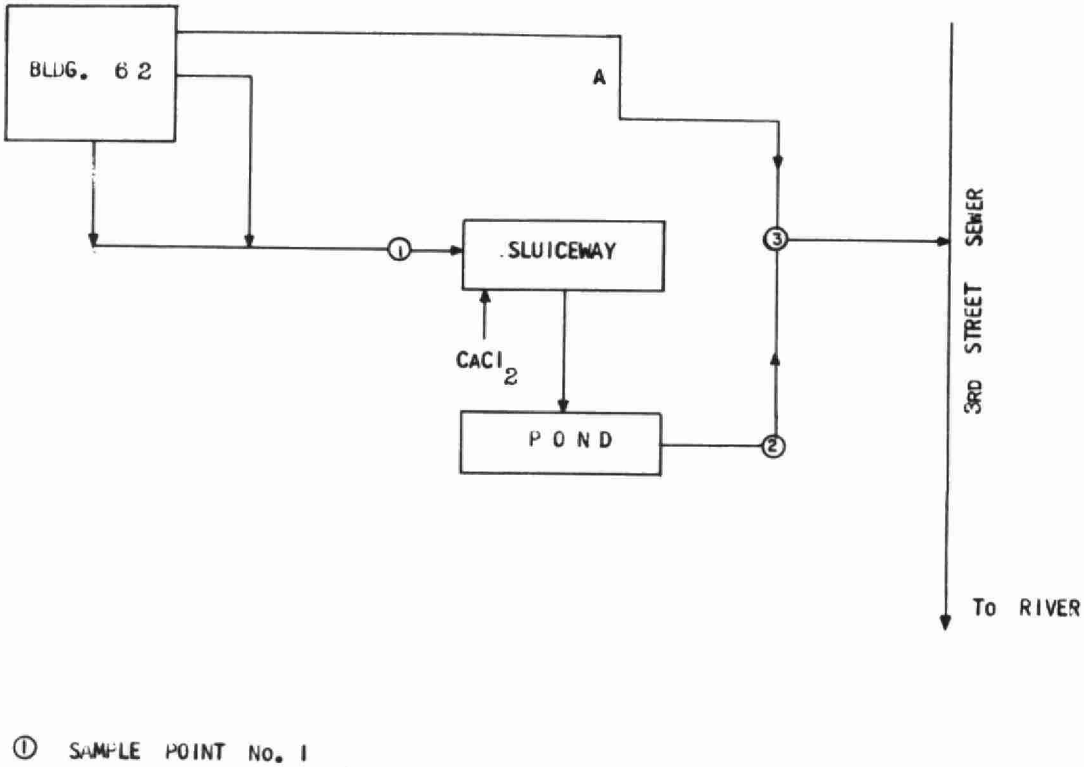
FIGURE XVII

LATEX PLANT SOURCES AND DISPOSAL OF WASTES



(1) Process wastes to latex treatment.

(2) Effluent from latex treatment.

(3) Effluent from treatment plus cooling waters.

(A) Cooling waters.

SAMPLING AND ANALYTICAL RESULTS

On August 14, 1969, composite samples were collected at three waste flows within this Plant over a 5-hour period. The analytical results are shown

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in Table XVII.

TABLE XVII

LATEX PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point	Lab. No.	Flow mgd	BOD	Solids Total	Solids Susp.	Solids Diss.	COD	pH	Chlorides as Cl^-
1	T-1894	N.A.	265	13,700	830	12,870	800	10.4	6,600
2	T-1895	N.A.	108	21,820	5	21,815	725	11.2	11,380
3	T-1904	3	11	1,450	60	1,390	48	7.5	488
Service Water (Estimate)					20		15		40

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The concentrations of waste constituents measured in the Latex Plant effluent are not high. However, the results suggest that the cooling waters contain suspended solids concentrations higher than normally expected.

The net daily waste loadings from this Plant to the 3rd Street Sewer were calculated from flow data provided by the Company and the analytical results, and were found to be:

COD	1,000 lbs.
Suspended Solids	1,200 lbs.
Chlorides	13,500 lbs.

It should be noted that the treated latex waste flow contained a high COD whereas the suspended solids levels would suggest that most of the organic material should have been removed. No explanation for this observation can be

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given at this time.

CONCLUSIONS AND RECOMMENDATIONS

With the exception of a high suspended solids concentration (60 ppm), the wastes were found to be acceptable for discharge to a watercourse. It is recommended that the Company examine this Plant with a view to eliminating or reducing the suspended solids discharge.

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STEAM PLANT

RAW MATERIALS AND PRODUCTS

Steam for the Dow Chemical of Canada, Limited complex in Sarnia is manufactured from treated river water. Coal, gas and oil are used as the energy source.

PROCESS

Dow Chemical of Canada, Limited operates a steam generating plant to provide the necessary steam for the processing complex. River water is pumped directly to the plant and is first treated with ferrous sulphate and lime for softening. The solids are permitted to settle out in a primary clarifier and the supernatant is pumped through sand filters. The filtered water is passed through a series of ion-exchangers to obtain the feed to the steam generators.

The solids, accumulated in the primary clarifier, are discharged intermittently to the sewer. The sand filters are back-washed on an average of once a day and the wastes from this operation are also discharged directly to the sewer. The ion-exchangers are regenerated about once every 32 hours. The cation exchangers are regenerated with hydrochloric acid; the anion exchangers with sodium hydroxide.

Oil and gas are the predominant fuels with coal used only on occasions. The fly ash from the cyclones is trucked away for disposal. The slag is ground and sluiced and also trucked away for disposal.

SOURCES OF WASTES AND DISPOSAL

Figure XVIII indicates the general plant outline, sources of wastes, and the means by which they are transmitted to the St. Clair River. Composite samples were taken over a 24-hour period of the two effluents from this Plant.

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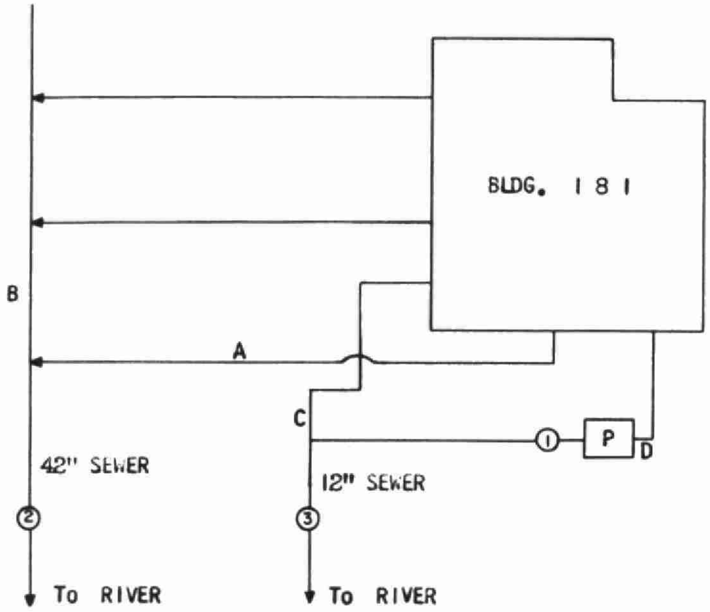
These sampling points are indicated on the following diagram and are described below.

FIGURE XVIII

STEAM PLANT SOURCES AND DISPOSAL OF WASTES



① SAMPLE POINT No. 1

P - SETTLING POND

(1) Overflow from settling pond.

(2) Total effluent in Steam Plant 42" Sewer to St. Clair River.

(3) Total effluent in Steam Plant 12" Sewer to St. Clair River.

(A) Clarifier bottoms.

(B) Sand filter back-wash, cooling water, etc.

(C) Acidic regenerant, ion-exchange back-wash, sluice pond, etc.

(D) Caustic regenerants, ion-exchange back-wash, runoff, etc.

SAMPLING AND ANALYTICAL RESULTS

The only in-plant sample taken during the survey was the supernatant from the caustic regenerant pond overflowing to the 12" Sewer. 24-hour composite samples were collected of the effluents in the 12" and 42" Sewers at the St. Clair River. The analytical results of the samples are shown in Table XVIII.

TABLE XVIII

STEAM PLANT ANALYTICAL RESULTS AND FLOW DATA

Sample Point		Lab. No.	Flow mgd	Suspended Solids	COD	pH	Chlorides as Cl^-	Iron
1		T-1929	N.A.	30	32	12.6	3,376	0.62
2	Shift I	T-1915	0.8	225	8	7.7	49	3.6
	Shift II	T-1919	0.8	55	4	7.9	53	1.0
	Shift III	T-1923	0.8	170	16	9.3	70	1.9
3	Shift I	T-1916	0.1	225	32	11.9	702	4.3
	Shift II	T-1920	0.1	100	32	11.3	473	1.5
	Shift III	T-1924	0.1	170	20	12.2	914	2.6
Service Water (Estimate)				20	--	8.2	40	--

NOTE: All results reported in parts per million (ppm) except pH.

DISCUSSION OF RESULTS

The net waste loadings were calculated based on flow rates supplied by

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Company personnel and the analytical results of samples collected during the survey. These were calculated to be:

Suspended Solids	2,600 lbs./day
Chlorides	2,500 lbs./day
Iron	60 lbs./day

There are a number of intermittent discharges which contribute to the waste flows and these include:

(a) primary clarifier bottoms.

(b) sand filter back-wash (an average of once per day).

(c) ion exchanger regenerants (an average of once every 32 hours).

The caustic and acid ion-exchanger regenerants are discharged to the sewer system without prior neutralization, thus, explaining the high pH levels in the 12" Sewer at the St. Clair River.

The suspended solids concentrations in both final effluents from the Steam Plant exceeded the 15 ppm concentration suggested by the OWRC for direct discharge to a watercourse. In the 42" Sewer, the concentration ranged from 55 ppm to 225 ppm and in the 12" Sewer from 100 ppm to 225 ppm. It is also very likely that these concentrations would be greatly exceeded for short intervals during the discharge of the clarifier sludges and sand filter back-wash.

The release of the primary clarifier sludges to the sewer accounts for the iron noted in the effluent at the St. Clair River. The objective for iron discharges to a watercourse is 17 ppm maximum. Although composite samples indicated iron concentrations in the order of 2 to 3 ppm, it is probable that these concen-

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trations would be considerably exceeded for short periods of time when the clarifier bottoms were being discharged.

During the course of the survey, it was noted that there was a marked periodic discolouration in the effluents discharged from the Steam Plant. This discolouration produced an objectionable yellow-orange plume in the St. Clair River that persisted for a considerable distance downstream of Dow's property limits.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this survey, it is evident that the Steam Plant discharges wastewater of objectionable quality caused mainly by batch or intermittent waste discharges. As a result, the Company should initiate a program to collect or retain these high strength waste discharges for alternate disposal or treatment.

The wastes produced during the ion-exchange regeneration cycle had a marked effect on the quality of the effluent discharged via the 12" Sewer to the St. Clair River. These wastewaters exhibited pH values ranging from 11.3 to 12.2. The Company should attempt to schedule this operation to permit the proper mixing of the caustic and acidic regenerants to effect neutralization. It may be necessary to provide storage facilities to retain wastes from one cycle until regenerants of another cycle are produced in order to provide for neutralization.

The Steam Plant was also found to discharge excessive quantities of suspended solids to the watercourse. The suspended solids concentrations in the final effluents in both sewers ranged from 55 ppm to 225 ppm. The net suspended solids

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loading contributed by the Steam Plant was in the order of 2,500 lbs./day in a total flow of 2.7 mgd.

It should be noted that the discharge of the primary clarifier bottoms and the back-wash from the sand filters would contribute a major portion of the suspended solids, yet would account for only a small percentage of the total flow. The Company should therefore consider segregating these contaminated waste streams for treatment.

The clarifier bottoms also accounted for the major portion of the iron noted in the final effluents discharged from the Steam Plant. (Iron was noted in both sewers as repair work was being done on the sewers at the time of the survey and wastes were permitted to flow from one sewer to the other.) Segregating the primary clarifier bottoms for treatment and separate disposal of the sludge would also eliminate this source of contamination. The iron in the wastes produces an intermittent objectionable coloured plume in the St. Clair River and the Company should make every effort to eliminate this situation.

In conclusion, it is recommended that the Company examine the operations of the Steam Plant to identify the sources of pollution, with a view to undertaking the necessary corrective action to render the final effluents suitable for discharge to a watercourse.

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DISCUSSION OF OVERALL COMPLEX

Introduction

During the course of this survey, two types of samples were collected. Outfall samples taken at the St. Clair River were composited over a 24-hour period to obtain an assessment of the waste loadings discharged directly to the watercourse. In-plant samples were composited for shorter periods and were used to determine the plant operations that contributed significantly towards the loadings noted in the outfall samples. The entire sampling program was carried out over a five-day period commencing August 11, 1969. It was necessary to re-sample the Styrene Plant on September 3, 1969, as the previous inspection was reported to have taken place during a plant upset and was therefore said to be non-representative of normal operations.

The concentration of contaminants, flow data and the net daily waste loading within the various sewers in the Dow complex, are shown in Table XIX.

The waste loadings from the individual plants were computed from the analytical results of the composite samples obtained at the outfalls of the plants and flow rates reported by the Company; while loadings to the St. Clair River were calculated from the analytical results for the effluent samples at the River for each 8-hour sampling period and one-third of the daily flow reported by the Company for each sewer. It should be noted that for calculated net loadings, the concentrations of contaminants in the raw water were taken as:

COD	15 ppm
Total Solids	200 ppm
Suspended Solids	20 ppm
Chlorides as Cl^-	40 ppm

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TABLE XIX

DOW CHEMICAL OF CANADA, LIMITED – SARNIA

SUMMARY OF FLOWS, CONTAMINANT CONCENTRATIONS AND WASTE LOADINGS

Sewer	Plant Effluents	Flow (MGD)	COD		Total Solids		Susp. Solids		Chlorides		Other
			PPM	LBS/DAY	PPM	LBS/DAY	PPM	LBS/DAY	PPM	LBS/DAY	
1st Street 42"	Pelaspan	0.7	4	NEG	250	NEG	20	NEG	4.5	NEG	Zinc 8.3 PPM – 58 LBS/DAY
	Vinyl Chloride	6.0	–	•	–	•	–	•	–	•	–
	Solvents	1.0	140	1,400	2,900	27,000	120	1,000	2,380	23,500	PH 12.1
	Ethanolamine	0.7	–	NEG	–	NEG	–	NEG	–	NEG	
	Glycol I	12.0	–	12,000	–	15,000	–	NEG	–	20,000	BOD$_5$ – 3,900
	Total	20.4	–	13,400	–	42,000	–	1,000	–	43,900	BOD$_5$ – 3,900 LBS/DAY
	Final Effluent I	6.8	125	8,000	510	20,000	190	12,000	413	27,000	BOD$_5$ – 6.6 PPM – 900
	Final Effluent II	6.8	140	9,000	460	17,000	110	7,000	373	21,000	43 PPM – 2,900
	Final Effluent III	6.8	130	8,500	450	16,000	90	6,000	348	20,000	48 " – 3,300
	Total	20.4	–	25,500	–	53,000	–	25,000	–	68,000	BOD$_5$ – 6,700 LBS/DAY
1st Street 48" (only serves Vinyl Chloride Plant)	Final Effluent I	2.5	4	NEG	140	NEG	3	NEG	94	1,300	
	Final Effluent II	2.5	16	NEG	140	NEG	7	NEG	88	1,200	
	Final Effluent III	2.5	8	NEG	140	NEG	6	NEG	106	1,650	
	Total	7.5	–	–	–	NEG	–	–	–	4,150	
1st Street 30" Tile	Vinyl Chloride	1.6	58	900	3,400	51,000	12	NEG	1,498	23,000	PH 11.9
	Solvents	0.9	48	400	170	NEG	10	NEG	88	400	
	Total	2.5	–	1,300	–	51,000	–	NEG	–	23,400	
	Final Effluent I	0.83	16	NEG	510	2,500	1	NEG	632	5,000	PH 7.6
	Final Effluent II	0.83	24	NEG	730	5,700	80	500	666	5,500	PH 11.0
	Final Effluent III	0.83	200	1,500	1,560	11,000	110	700	1,035	8,000	PH 12.0
	Total	2.5	–	1,500	–	19,200	–	1,200	–	18,500	
1st Street 54" Sluice	Glycol I	10.0	–	16,000*	–		–	5,400**		253,000**	BOD$_5$ – 2,250 LBS/DAY; PH 11.0
	Caustic Evaporator	1.5	24	100	620	6,000	210	3,000	228	NEG	PH 11.9
	Chlorine II	3.0	–	–	–	255,000	–	1,400	–	296,600	PH from 8.8 to 13.2
	Brine Treatment (for Chlorine II)	0.5	48	200	5,780	27,000	40	NEG	3,840	19,000	
	Total	15.0	–	16,300	–	288,000	–	9,800	–	568,600	BOD$_5$ – 2,250 LBS/DAY
	Final Effluent I	5.0	460	22,500	17,620	870,000	290	13,500	9,240	460,000	CaCO$_3$ – 1,915 PPM; BOD – 215 PPM – 11,500 LBS/DAY
	Final Effluent II	5.0	580	28,500	16,500	815,000	380	18,000	8,380	415,000	" – 2,130 " ; " – 500 " – 25,000 "
	Final Effluent III	5.0	420	20,000	15,900	785,000	250	11,500	7,840	390,000	" – 2,090 " ; " – 220 " – 11,500 "
	Total	15.0	–	71,000	–	2,470,000	–	43,000	–	1,265,000	-- BOD – 58,000 LBS/DAY

TABLE XIX (Continued)

Sewer	Plant Effluents	Flow (MGD)	COD		Total Solids		Susp. Solids		Chlorides		Other
			PPM	LBS/DAY	PPM	LBS/DAY	PPM	LBS/DAY	PPM	LBS/DAY	
Chlorine – Caustic North (only serves Brine Storage and Tar Disposal Area)	Final Effluent I	0.3	240	700	34,240	102,000	70	150	20,440	61,000	pH 9.1
	Final Effluent II	0.3	80	200	80,860	242,000	150	400	41,680	124,000	pH 12.1; BOD – 55 PPM
	Final Effluent III	0.3	200	600	123,160	370,000	450	1,300	64,440	193,000	pH 11.0
	Total	1.0	-	1,500	-	714,000	-	1,850	-	378,000	
Chlorine – Caustic South	Brine Treatment	1.9	24	200	4,930	89,000	100	1,500	2,006	38,000	pH 12.3
	Chlorine I	3.4	12	NEG	160	NEG	15	NEG	***	***	Mercury 0.36 PPM – 12 LBS/DAY
	Total	5.3	-	200	-	89,000	-	1,500	-	38,000	- - Mercury 12 LBS/DAY
	Final Effluent I	1.76	28	200	7,000	-	80	1,000	2,041	35,000	Mercury 0.29 PPM – 5.2 LBS/DAY; pH 11.5
	Final Effluent II	1.76	32	200	1,770	-	100	1,400	1,468	25,000	0.13 PPM – 2.3 LBS/DAY; pH 9.7
	Final Effluent III	1.76	8	NEG	1,320	-	115	1,500	288	4,000	0.09 PPM – 1.6 LBS/DAY; pH 10.2
	Total	5.3	-	400	-	-	-	3,900	-	64,000	Mercury 9.1 LBS/DAY
2nd Street	Pelaspan	0.3	4	NEG	250	NEG	20	NEG	4.5	NEG	
	Styron	1.2	50	NEG	430	2,400	10	NEG	53	NEG	
	Tank Car Wash	0.01	16	NEG	380	NEG	95	NEG	57	NEG	pH 11.0
	Laboratory	1.0	-	-	-	-	-	-	-	-	
	Glycol II	6.0	-	8,400	-	6,000	-	NEG	-	3,200	BOD_5 – 8 to 450 PPM – 2,150 LBS/DAY
	Total	8.5	-	8,400	-	8,400	-	NEG	-	3,200	BOD_5 – 2150 LBS/DAY
	Final Effluent I	2.83	125	3,000	230	NEG	5	NEG	49	300	BOD_5 115 PPM – 3,200 LBS/DAY
	Final Effluent II	2.83	150	3,800	230	NEG	5	NEG	126	2,300	45 PPM – 1,300 LBS/DAY
	Final Effluent III	2.83	68	1,600	230	NEG	10	NEG	66	700	25 PPM – 700 LBS/DAY
	Total	8.5	-	8,400	-	NEG	-	NEG	-	3,300	BOD_5 – 5,200 LBS/DAY
3rd Street	Styrene	19.0	-	**	-	**	-	**	-	**	
	Chlorine III	1.0	20	NEG	950	7,000	20	NEG	470	4,000	Mercury – 0.77 PPM – 7.7 LBS/DAY
	Latex	3.0	48	900	1,450	35,000	60	1,200	488	13,000	
	Polyethylene	9.0	-	10,500	-	NEG	-	400	***	***	Titanium – .35 PPM or 14 LBS/DAY; Aluminium 1.5 PPM or 60 LBS/DAY
	Ammonia I	8.0	-	NEG	-	NEG	-	NEG	-	NEG	Free NH_3 – 20 PPM or 600 LBS/DAY
	Ethylene	20.0	-	***	-	150,000	-	1,300	-	55,000	Phenols – 22 LBS/DAY
	Total	60.0	-	11,000	-	198,000	-	3,000	-	72,000	Phenols – 22 LBS/DAY; Mercury – 7.7 LBS/DAY; Free NH_3 – 600 LBS/DAY
	Final Effluent I	20.0	130	23,000	580	76,000	10	NEG	226	37,000	BOD_5 – 74 PPM – 15,000 LBS/DAY; Free NH_3 – 0.3 PPM – 60 LBS/DAY
	Final Effluent II	20.0	180	33,000	540	68,000	100	16,000	294	50,000	BOD_5 – 47 PPM – 9,500 LBS/DAY; Free NH_3 – 0.5 PPM – 100 LBS/DAY
	Final Effluent III	20.0	150	27,000	560	72,000	5	NEG	231	38,000	BOD_5 – 130 PPM – 26,000 LBS/DAY; Free NH_3 – 0.6 PPM – 120 LBS/DAY
	Total	60.0	-	83,000	-	216,000	-	16,000	-	125,000	BOD_5 – 50,000 LBS/DAY; Free NH_3 – 280 LBS/DAY

TABLE XIX (CONTINUED)

SEWER	PLANT EFFLUENTS	FLOW (MGD)	COD PPM	COD LBS/DAY	TOTAL SOLIDS PPM	TOTAL SOLIDS LBS/DAY	SUSP. SOLIDS PPM	SUSP. SOLIDS LBS/DAY	CHLORIDES PPM	CHLORIDES LBS/DAY	OTHER
DOMINION-ALLOY (ONLY SERVES CHLORINE III PLANT)	CHLORINE III	6.5	36	2,300	7,800	500,000	120	6,500	3,450	222,000	MERCURY - 0.87 PPM - 57 LBS/DAY
	TOTAL	6.5	-	2,300	-	500,000	-	6,500	-	222,000	- 57.0 LBS/DAY
	FINAL EFFLUENT I	2.16	50	750	5,830	124,000	100	2,000	2,796	60,000	MERCURY - 0.51 PPM - 11.2 LBS/DAY; PH - 12.0
	FINAL EFFLUENT II	2.16	28	300	5,180	110,000	70	1,000	1,940	42,000	MERCURY - 0.52 PPM - 11.4 LBS/DAY; PH - 12.2
	FINAL EFFLUENT III	2.16	36	500	3,190	65,000	5	NEG	1,722	37,000	MERCURY - 0.38 PPM - 8.4 LBS/DAY; PH - 7.1
	TOTAL	6.5	-	1,550	-	300,000	-	3,000	-	139,000	- 31.0 LBS/DAY
4TH STREET ALLEY (ONLY SERVES AMMONIA II PLANT)	AMMONIA II	28.0	28	4,200	380	55,000	10	NEG	-	-	FREE NH_3 - 3.2 PPM - 900 LBS/DAY
	TOTAL	28.0	-	4,200	-	55,000	-	NEG	-	-	- FREE NH_3 - 900 LBS/DAY
	FINAL EFFLUENT I	9.3	4	NEG	240	NEG	10	NEG	48	750	NO FREE AMMONIA ANALYSIS
	FINAL EFFLUENT II	9.3	4	NEG	270	NEG	5	NEG	63	2,250	FREE NH_3 - 0.2 PPM - 20 LBS/DAY; PH - 8.8
	FINAL EFFLUENT III	9.3	16	NEG	230	NEG	5	NEG	67	2,500	FREE NH_3 - 3.0 PPM - 280 LBS/DAY; PH - 8.7
	TOTAL	28.0	-	NEG	-	-	-	-	-	5,500	- FREE NH_3 - 300 LBS/DAY
STEAM PLANT 42" (ONLY SERVES STEAM PLANT)	FINAL EFFLUENT I	0.83	8	NEG	440	1,650	225	1,700	49	NEG	IRON - 3.6 PPM
	FINAL EFFLUENT II	0.83	4	NEG	290	NEG	55	350	53	NEG	1.0
	FINAL EFFLUENT III	0.83	16	NEG	410	1,600	170	1,250	70	NEG	1.9
	TOTAL	2.5	-	NEG	-	3,250	-	3,300	-	NEG	-
STEAM PLANT 12" (ONLY SERVES STEAM PLANT)	FINAL EFFLUENT	0.06	32	NEG	1,770	900	225	100	702	400	IRON - 4.3 PPM - 2 LBS/DAY; PH 11.9
	FINAL EFFLUENT	0.06	36	NEG	1,880	1,000	100	50	473	275	1.5 PPM - 1 LB/DAY; PH 11.3
	FINAL EFFLUENT	0.06	20	NEG	3,350	1,900	170	75	[illegible]	500	2.3 PPM - 1 LB/DAY; PH 12.2
	TOTAL	0.2	-	NEG	-	3,800	-	225	-	1,200	- IRON - 4 LBS/DAY

* COULD NOT BE ESTABLISHED CONCLUSIVELY

** REPRESENT ONLY PARTIAL LOADINGS

*** NO ANALYSES AVAILABLE

NOTE: SERVICE WATER CONCENTRATIONS ASSURED AS COD - 15 PPM; SS - 20 PPM; TS - 200 PPM; CHLORIDES - 40 PPM.

NEG - NEGLIGABLE

It should be borne in mind that the purpose of Table XIX was not to establish waste loading mass balances on individual sewer systems, but rather, to determine the total loadings from the Dow Chemical of Canada, Limited complex to the St. Clair River and also to indicate at a quick glance the major contributions of a waste parameter in any sewer system at this complex. Principle waste loadings, as determined by outfall samples, are also summarized in Table XXIII. Establishment of waste loadings mass balances were not possible in many cases because:

(a) flow rates were not established at certain sampling points;

(b) samples were not taken at strategic in-plant points;

(c) some analyses were not performed on samples because of interferences in analytical procedures, broken bottles, etc.; and

(d) the composited sampling periods at the individual plants were carried out over short periods (5 to 6 hours) on the day shifts only, which would indicate the wastewater conditions during that period and not necessarily the conditions over the full 24-hour period.

Based on the results of the survey, it is evident that there are a number of high-strength, low-volume waste discharges to the Company's sewer system that are masked and diluted by high flows of cooling water. These waste flows and their point of origin have been noted in the sections dealing with individual plants located within the complex and will be discussed more fully later in this report. Suffice to say at this time that the concentrations noted in the final effluent discharge at the St. Clair River, in many instances, could be attributed to a discharge upstream in the sewer of an extremely potent waste that contributed a small percentage towards the total flow but accounted for a high percentage of the waste

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loading.

It is the policy of the OWRC to request industries to undertake effective measures where practical to reduce the losses of polluting materials to sewer systems. If there are high-strength, low-volume waste streams discharged to a sewer, that have a significant effect on the quality of the final effluent, then the Company involved should be prepared to segregate these streams and provide the necessary treatment to render them acceptable for discharge to a watercourse. Diluting a strong waste with clean cooling water cannot be considered as an acceptable means of treatment, as the same amount of polluting materials is being discharged to the watercourse regardless of the final diluted effluent concentration.

In discussing the waste discharges from Dow Chemical of Canada, Limited, one cannot consider only existing impairment of water quality in the St. Clair River, but must also take into account the potential of the wastes to impair, in setting out the requirements for a pollution control program. In the past, many industries have adopted the attitude of placing the onus on the environment to show impairment before considering an effective pollution control program. This philosophy cannot be adhered to for a number of fundamental reasons.

The responsibility of any regulatory agency, given the task of managing a natural water resource, is to ensure that this particular resource is not impaired for other uses. To wait for pollution to occur before requesting appropriate corrective action would be defeating the purpose of the regulatory agency. In the case of Dow Chemical of Canada, Limited, situated on the shore of the St.

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Clair River, it is not always an easy task to demonstrate serious impairment of the watercourse because of its size.

The second basic reason for not adhering to the earlier-mentioned philosophy is that, in some cases, the impairment may turn out to be irreversible. A watercourse or the biological life in it may be permanently damaged rendering subsequent corrective action meaningless. In the case of mercury pollution, the effects may be felt for years even after all such discharges to the watercourse have been eliminated.

It has also been argued that one legitimate use of a watercourse is to carry away wastes. This, of course, cannot be disputed providing the waste loadings discharged do not exceed the assimilative and dilution capacities of the receiving watercourse. The OWRC has recognized this use of a watercourse only after the industry has implemented all the practical measures to control and/or treat the waste effluents prior to discharge. Only a small percentage of the total contaminated waste discharges of Dow Chemical of Canada, Limited are treated and hence, the industry should not be allowed to rely mainly on the assimilative and dilution capacities of the St. Clair River to handle its effluents.

Based on the recent applications for approval submitted by Dow Chemical of Canada, Limited, it appears that a number of revisions and alterations to existing facilities are being planned and many of these contribute towards an increase in the total waste loading to the St. Clair River. Although each individual contribution cannot in itself be considered appreciable, together they represent a significant increase in the total waste loading. The OWRC requires that

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this trend be reversed and the Company adopt a program where waste control and/or treatment becomes an inherent feature in any plant alteration whenever contaminated liquid wastes are encountered. Also, treatment of wastes must definitely be considered whenever a new source of waste is encountered.

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Mercury

TABLE XX

SUMMARY OF MERCURY WASTE LOADINGS

	Flow (mgd)	Mercury lbs./day
Chlorine I	3.5	9
Chlorine III	6.5	60
Total		69

During May, 1969, a biological survey was conducted by the OWRC Biology Branch of the St. Clair River on a stretch extending from approximately 1 mile below the Blue Water Bridge down to Ethyl Corporation of Canada Limited including that portion of the River adjacent to Dow Chemical of Canada, Limited. Although a complete and detailed report is to be published at a later date, some of the initial findings revealed high level concentrations of mercury in the bottom sediments in the vicinity of the outfall from Dow Chemical of Canada, Limited. Below the 5th most northern outfall, approximately 20 feet off shore, mercury concentrations of 1,470 ppm were noted in the bottom sediments. Other off-shore sediment samples exhibited high mercury concentrations of 100 ppm, 580 ppm and 760 ppm progressing downstream from the Company. As a result of the above findings, during the course of this industrial waste survey, particular emphasis was placed on determining all sources of mercury losses from Dow Chemical of Canada, Limited to the St. Clair River.

There were two separate electrolytic plants at Dow Chemical of Canada, Limited that utilized mercury cells for the electrolysis of brine to produce hydro-

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gen, chlorine, and sodium hydroxide. Chlorine I was reported to utilize 176 cells and maintain a total mercury inventory of approximately 294,000 lbs. Chlorine III, the larger of the two plants, utilized 100 cells and maintained a total mercury inventory of approximately 304,000 lbs. The total chlorine production at both plants was estimated at 24×10^6 lbs. per month with mercury losses averaging in the order of 0.7 lbs. of mercury per ton of chlorine produced. Based on the above Company figures, the daily mercury make-up for both plants was estimated at about 280 lbs. per day.

During the course of this survey, separate composite samples were collected in plastic containers of the final effluents discharged to the St. Clair River containing wastes from Chlorine I and Chlorine III. In-plant samples were also collected at each of the above plants to assess the mercury losses directly at the source.

The total waste discharge from Chlorine I was reported as 3.5 mgd. These wastes joined the effluent from Building 42 and the combined flow was discharged to the St. Clair River via the common Chlorine-Caustic South Sewer. The composite sample taken at the sump between Buildings 42 and 41, representing part of the flow from Chlorine I, indicated mercury concentrations in the order of 0.36 ppm. Three separate composite samples, representing a 24-hour operating period of the combined wastes at the St. Clair River, indicated mercury concentrations of 0.29 ppm, 0.13 ppm and 0.09 ppm. Based on the reported flows, and the above sample results, the mercury losses from Chlorine I to the St. Clair River were estimated to be about 9 lbs. per day at the time of the survey.

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The total effluent from Chlorine III was reported as 7.5 mgd of which 6.5 mgd were discharged to the Dominion Alloy Sewer and 1 mgd was allowed to overflow to the 3rd Street Sewer. A grab sample taken of the hydrogen scrubber water indicated a mercury concentration of 12.7 ppm in an approximate flow of 200 gpm. The total combined effluent from Chlorine III made up of cell floor wastes, H_2 scrubber water, compressor waters, etc., indicated a mercury concentration of 0.87 ppm. Based on the reported flow, and the analytical results of the samples, it was estimated that 60 lbs. of mercury per day were discharged to the sewer from Chlorine III. The figure included the 1 mgd of wastes discharged to the 3rd Street Sewer from the above plant.

The total mercury discharge to the St. Clair River varies considerably, depending upon the losses of brine to the sewers. The Company has reported mercury concentrations in the spent brine from the mercury cells ranging in the order of 4 ppm to 40 ppm with the average in the order of 10 ppm. Most of the spent brine is recycled back to the wells and sewering takes place only during hydraulic imbalances. For the purpose of this report, the mercury losses to the St. Clair River have been estimated at 50 to 100 lbs. per day.

During the course of this survey, Company personnel had indicated that they had only recently become aware of the high mercury losses to the St. Clair River. Although mercury losses were inherent in the operation of electrolytic cells, it was assumed that most of the metal was lost to the brine which was returned to the underground wells. Other minor losses incorporated with the products were assumed to account for the total mercury make-up required.

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With the awareness that mercury posed a water pollution problem, the Company began to investigate means of eliminating mercury losses to the watercourse. Immediate attention was focused on the H_2 scrubbing operation at Chlorine III with a view to eliminating the effluent entirely. Indirect coolers were to be installed at each mercury cell to eliminate the liquid effluent. The Company also began investigating methods of overcoming the hydraulic imbalances in the brine. Storage facilities were to be provided to collect surplus brine and brine spills and prevent their discharge to the watercourse. By the time this report is issued, many corrective measures will have been implemented resulting in a marked decrease in the amount of mercury discharged to the St. Clair River.

The Company should undertake every available measure to eliminate entirely all mercury losses to the St. Clair River. Mercury is an extremely toxic ingredient being lethal to fish in concentrations anywhere from 0.0004 to 0.02 ppm. The other significant aspect is that mercury accumulates in living tissue and can go through biological concentration up the food chain. The most serious mercury problems have been encountered in Japan and Sweden where ingestion of mercury-tainted fish flesh caused several health problems and even death.

Mercury poisoning produces numbness in the outer extremities and mental disorder but the minimum critical dosage at which symptoms of damage are observable is not well defined. Initial effects cannot be determined as healthy cells have the ability of replacing and carrying on the job of mercury damaged cells. The effects of mercury poisoning can only be discerned if too many cells are destroyed to a point where the replacement power of the healthy cells is non-existent. Mer-

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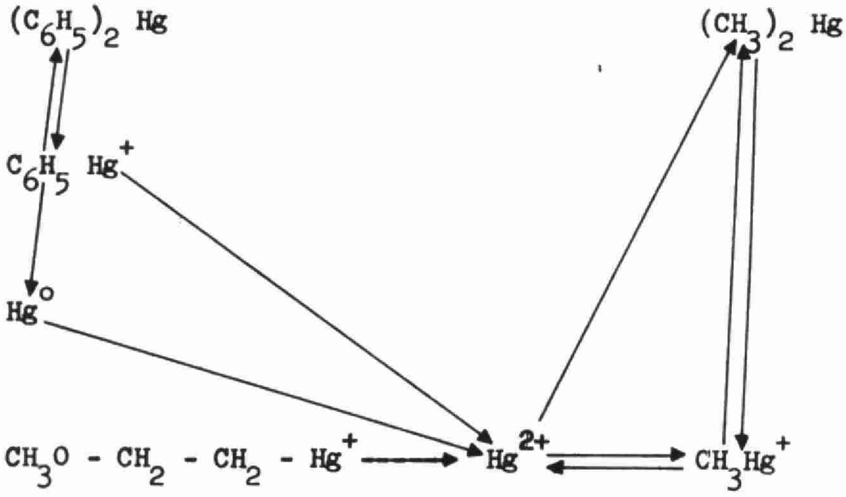
cury also effects the fetus and cases have been recorded where newly-born children have exhibited higher mercury concentrations than the mother.

Studies on mercury indicate that fish containing more than 0.02 mg Hg/Kg (wet tissue) should be regarded as unfit for human consumption under steady diet conditions. Higher concentrations may be tolerated providing the number of ingestions is limited. The half-life of mercury in man has been estimated from 70 days to 200 days and hence, minor ingestions at long intervals should not have serious detrimental consequences.

Studies have shown that some unidentified microorganisms can methylate inorganic mercury. Generally, the conversion rate to methyl mercury is much higher when the bottom sediment contains organic substances and is influenced by oxygen deficiency and temperature. Some steps by which inorganic mercury and mercury-containing compounds are converted in nature to methyl mercury (1) are as follows:



Mercury-tainted fish can still be found in a watercourse long after all the mercury discharges to the receiving stream have been eliminated or reduced.

It has been reported that the effects of pollution may last 10 to 100 years unless the mercury is made inactive by physical removal or by the elimination of its biological availability. In the case of mercury, one definitely cannot adhere to a philosophy that the environment must show an impairment before a pollution abatement program is embarked upon.

(1) A. Jernelov, Chemical Fallout, Charles C. Thomas, Springfield, Illinois, 1969.

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Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD)

TABLE XXI

SUMMARY OF PRINCIPLE CONTRIBUTIONS OF BOD AND COD WASTE LOADINGS

	Flow mgd	Waste Loadings (lbs./day) BOD	Waste Loadings (lbs./day) COD	Point of Discharge
Glycol I (D.3A Overflow)	.065	3,700	10,000	42" 1st Street Sewer
Solvents	1.0	--	1,400	42" 1st Street Sewer
Vinyl Chloride	6.0	--	900	42" 1st Street Sewer
Glycol I	10.0	2,300	16,000	54" Sluice
N-S Sluice to 54" Sluice	2.0	18,000	22,000	54" Sluice
Glycol II	6.0	3,200	8,400	2nd Street Sewer
Latex	3.0	--	1,000	3rd Street Sewer
Polyethylene	9.0	900	10,500	3rd Street Sewer

The measures of COD and BOD do not reveal concentrations of a specific substance but rather the effects of a combination of materials. The total COD discharge to the St. Clair River from the entire Dow Chemical of Canada, Limited operating complex in Sarnia was estimated to be in excess of 192,000 lbs./day. Most of the COD-bearing wastes were found in the 1st Street 42" Sewer (26,000 lbs./ day), the 54" 1st Street Sluice (71,000 lbs./day), the 2nd Street Sewer (8,400 lbs. day) and the 3rd Street Sewer (79,000 lbs./day). The above waste discharges totalled approximately 184,400 lbs. of COD per day and accounted for approximately 96% of the total COD loading from the entire complex.

In reviewing the results of the in-plant samples, it was noted that the

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COD-bearing wastes found in the 1st Street 42" Sewer originated essentially at three points. The D.3A overflow at Glycol I contributed approximately 10,400 lbs. of COD per day. Similarly, the waste discharge from the Solvents Plant and the effluent from Vinyl Chloride Plant accounted for 1,400 lbs. COD per day and 900 lbs. COD per day, respectively. The above sources contributed approximately 55% of the total loading found in the sewer even though all the COD contributions from Glycol I were not accounted for.

The total waste flow in the 54" Sluice on 1st Street contributed approximately 71,000 lbs. of COD per day to the St. Clair River. It was found that the Glycol I Plant contributed approximately 16,000 lbs. of COD per day while the wastes in the N-S Sluice accounted for an additional 22,000 lbs. of COD per day. The above two discharges account for most of the COD noted in the 54" Sluice on 1st Street.

The waste flow that could possibly account for the high COD loading in the N-S Sluice was the effluent from the lime recovery system. The bottoms from the lime and lime-caustic hydrolyzers, along with solids from the brine treatment system for Chlorine II, are discharged in the form of a slurry to the lime recovery tanks. The overflow from these tanks is discharged to the N-S Sluice and could account for the high COD loadings noted.

The total COD loading from the 2nd Street Sewer was estimated at 8,400 lbs./day. The main contributors were found to be the wastes discharged from Glycol II.

The 3rd Street Sewer discharges 83,000 lbs. of COD per day in a total

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flow of 60 mgd. The Latex and Polyethylene Plants contributed 1,000 lbs. COD per day and 10,500 lbs. COD per day, respectively. The Company should examine all the plants serviced by the 3rd Street Sewer to locate other possible sources of COD discharges that were not accounted for by this survey.

The total discharge of BOD-exerting materials to the St. Clair River from the entire Dow Chemical of Canada, Limited operating complex was estimated at approximately 111,200 lbs./day. The main contributing sewers were the 42" 1st Street Sewer (6,700 lbs./day), the 54" Sluice (48,000 lbs./day), the 2nd Street Sewer (5,200 lbs./day) and the 3rd Street Sewer (50,000 lbs./day). These four sewers contributed a total of 107,000 lbs. of BOD per day and accounted for nearly all the BOD loading discharged to the St. Clair River.

The sources of BOD discharges followed the same pattern as the COD discharges in as much as the same plants contributed to both loadings. The N-S Sluice flowing into the 54" Sluice along 1st Street also exhibited high BOD concentrations and accounted for approximately 18,000 lbs./day discharged to the watercourse. In general, the total BOD loading was in the order of one-half of the total COD loading; it indicated that the organic materials were readily biodegradable and could exert localized oxygen demands in the St. Clair River.

The discharge of wastes to a natural watercourse containing appreciable quantities of BOD and COD-exerting materials constitutes a potential source of water pollution. Large quantities of this material may enhance bacterial growth in localized areas upsetting the ecology of that portion of the stream. Oxygen demands in localized areas may also have sub-lethal effects on other biological

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forms of life by interfering with the mechanism of normal oxygen transfer. The measure of COD represents the oxygen demand of a number of organic compounds. As these organic compounds are not identified by the above test, they could have other adverse effects by imparting tastes and odours to waters and aquatic organisms or have sub-lethal effects on biota, interfering with reproduction, metabolism, etc.

The in-plant studies indicated that most of the BOD and COD loadings were the result of relatively low-volume discharges containing such high concentrations of the components as to have a marked effect on the quality of the final effluent. The D.3A tank overflow at Glycol I, for instance, estimated at 0.065 mgd, exhibited BOD and COD concentrations of 5,700 ppm and 16,000 ppm, respectively, accounting for a waste loading of 3,700 lbs. BOD/day and 10,400 lbs. COD/day.

Diluting concentrated waste streams with clean cooling water is not an acceptable means of waste disposal. Because the discharge of significant quantities of BOD and COD-exerting materials is in itself a potential source of water pollution, Dow Chemical of Canada, Limited should be prepared to segregate the relevant waste streams for treatment to render them acceptable for discharge to the St. Clair River.

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Chlorides and Suspended and Dissolved Solids

TABLE XXII

SUMMARY OF SOLIDS WASTE LOADINGS

Plant	Flow mgd	Dissolved Solids (lbs./day)	Suspended Solids (lbs./day)	Chlorides as Cl^- (lbs./day)	Point of Discharge
Solvents	1.0	26,000	1,000	23,500	1st Street 42" Sewer
Glycol I	12.0	15,000	*	20,000	1st Street 42" Sewer
Glycol I	10.0	**	5,400	253,000	54" Sluice
Caustic Evaporator	1.5	3,000	3,000	*	54" Sluice
Chlorine II	3.0	253,600	1,400	296,000	54" Sluice
Brine Treatment	0.5	27,000	*	19,000	54" Sluice
Brine Storage, etc.	1.0	912,000	2,000	378,000	Chlorine-Caustic North
Brine Treatment	1.9	87,500	1,500	38,000	Chlorine-Caustic South
Latex	3.0	33,800	1,200	13,000	3rd Street Sewer
Ethylene	20.0	148,700	1,300	55,000	3rd Street Sewer
Chlorine III	6.5	493,500	6,500	222,000	Dominion Alloy Sewer
Steam Plant	2.5	3,300	3,300	*	42" Steam Plant Sewer

* Negligible

** Insufficient sample for analyses

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Dissolved solids in a watercourse have the ability of altering osmotic pressure which can create stresses in microscopic aquatic organisms resulting, for instance, in the rupture of cell membranes. Dissolved solids may also impart objectionable tastes to waters and may create corrosion problems. In general, it has been suggested that the dissolved solids in a watercourse should not be increased by more than one-third of that which is characteristic of the natural condition.

Suspended solids produce detrimental effects by covering the bottoms of receiving streams. The bottom sediments destroy the environment for the benthal organisms and may also upset fish spawning beds. Suspended solids in colloidal form may have direct lethal effects by coating the gills of fish causing serious respiration problems. If the suspended solids impart a turbidity to the water, then the penetration of light may be impaired upsetting the normal growth of algae and other aquatic plants in the watercourse. Suspended solids are not assimilated in a receiving stream and hence, their discharge should be minimized.

Based on the findings of this survey, it was estimated that 3.9 million pounds of dissolved solids were discharged to the St. Clair River per day from the Dow Chemical of Canada, Limited complex in Sarnia. Of the above total, approximately one-half consisted of chlorides which accounted for a loading of approximately 2.1 million pounds per day. In reviewing the outfall samples, the following sewers were found to contribute significantly towards the total chloride loading: 1st Street 42" Sewer (68,000 lbs./day), 1st Street 54" Sluice (1,265,000 lbs./day), Chlorine-Caustic North Sewer (378,000 lbs./day), Chlorine-Caustic South Sewer

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(64,000 lbs./day), 3rd Street Sewer (125,000 lbs./day) and the Dominion Alloy Sewer (139,000 lbs./day). The individual plants served by the above sewers which discharge excessive quantities of chlorides are listed in Table XXII.

Based on in-plant samples, Glycol I and the three Chlorine Plants were found to be the major chloride contributors. In Glycol I, sodium chloride is produced as a waste by-product in one of the processes and is disposed directly to the sewer. Because of the high chloride concentration of this by-product stream, the Company should consider process modification and/or alternate methods of disposal.

In the Chlorine Plants, it appears that excessive amounts of spent brine are lost to the sewer. In the two plants utilizing mercury cells, it is necessary to flush the individual cells periodically which results in high brine discharges. The Company should adopt good housekeeping practices and should attempt to eliminate brine losses through tight in-plant control. At no time should spent brine be discharged to the St. Clair River, especially since reports have been received indicating that mercury is present in brine pumped up from the underground wells. (It should be noted that since the time of the survey, the Company has reported that no mercury-contaminated brine will be discharged to the River. Recent OWRC sampling confirms this point.)

The suspended solids discharge to the watercourse from Dow Chemical of Canada, Limited has been estimated to approach 100,000 lbs./day. The sewers found to contribute significant loadings were as follows: 1st Street 54" Sluice (43,000 lbs./day), 3rd Street Sewer (16,000 lbs./day) and the Steam Plant 42" Sewer (3,300

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lbs./day). The individual plants contributing to the above loadings are summarized in Table XXII.

The methods for the removal of suspended solids have been well documented in the literature and hence, adequate waste treatment facilities can be designed without much difficulty. The Company should be prepared to segregate the waste streams containing high concentrations of suspended solids for treatment to render the wastes acceptable for discharge to a watercourse.

In the "Summary Report on Pollution of the St. Marys River, St. Clair River, Detroit River", prepared by the International Joint Commission Advisory Board, it states that the chloride concentration in the St. Clair River varied from 6 to 7 mg/l near the Blue Water Bridge to 25 mg/l downstream of Polymer Corporation Limited and then to 51 mg/l downstream of Dow Chemical of Canada, Limited 50 feet away from the Canadian shore. The chloride ion is considered to be a conservative pollutant (one for which the concentration is directly related to the extent of dilution and one which is not altered, removed or subjected to biological purification) and hence, its effects may be far reaching.

In the report to the International Joint Commission entitled "Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River, Volume I - Summary, 1969", it is pointed out that the dissolved solids and chloride concentrations in Lake Erie have increased from 140 mg/l in 1910 to 180 mg/l in 1967 and 8 mg/l in 1910 to 27 mg/l in 1967, respectively. As Dow Chemical of Canada, Limited discharges approximately 3.9 million pounds per day of dissolved solids and 2.1 million pounds per day of chlorides, these contributions would have

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a significant effect on the trends noted. The Company should therefore make every possible effort to reduce these loadings to more acceptable levels.

During the biological survey conducted of the St. Clair River in May 1969, samples of bottom sediments indicated extremely high calcium concentrations in the vicinity of the 1st Street 54" Sluice some 30 feet off-shore. The concentrations ranged from 56,000 ppm below the Polymer dock to 451,000 ppm below the 54" Sluice. Other concentrations adjacent to Dow Chemical of Canada, Limited were in the order of 390,000 ppm, 104,000 ppm and 140,000 ppm and were reduced to 49,000 ppm downstream of the Company.

It would therefore appear that the excessively high carbonate discharge from Dow Chemical of Canada, Limited formed a heavy deposit on the bottom of the River. As this would have serious adverse local effects on the benthal organisms, the Company should treat these particular high carbonate waste streams. Treatment would likely consist of precipitation of the carbonate with a base followed by clarification to remove the particulate matter.

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Miscellaneous Waste Components

Phenolic Materials

The effects of phenolic compounds, namely, the hydroxy derivatives of benzene or its condensed nuclei, are well documented in the literature relating to water quality criteria. Depending on the concentration, the presence of these materials may be toxic to fish or may impart a taste to the flesh of fish. Phenols in very minute concentrations will combine with chlorine to produce intense taste and odours which are objectionable in water supplies, in many of the food and beverage products and which are variously described as medicinal and chemical in nature.

In the Dow complex, phenolic compounds were found to originate mainly in one sewer system - the 3rd Street Sewer with the Ethylene and Styrene Plants considered to be the main contributors. Unfortunately, no phenol analyses were performed on the Styrene effluents and the final effluent composite samples obtained during the August 1969 sampling program so that the total loading to the River could not be established. However, on the basis of the samples at the Ethylene Plant, it would appear that at least 22 pounds of phenolic compounds were discharged daily from this sewer system to the St. Clair River.

On September 3, 1969, additional samples were taken on this sewer system. The analytical results of these samples showed a phenol concentration of 2,400 ppb in the final effluent at the St. Clair River or a waste loading during the sampling period (4½ hours) of approximately 270 pounds. While this may not be a true indication of the phenolic loading in the day-to-day waste flow in this

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sewer, it nevertheless serves to demonstrate that certain high phenolic waste flows, originating from upsets, spills or abnormal operating conditions at the Ethylene or Styrene Plants, could be discharged into this sewer system leading to the River. The Company should therefore make every effort to pinpoint the sources and nature of the phenolic discharges reaching this sewer system and initiate remedial measures to reduce concentrations and loadings to the minimum.

Ether Solubles

Ether solubles concentrations are shown on the OWRC analytical result sheets and indicate the presence of non-volatile oils and/or greases in the wastewaters. In the Dow complex, the levels of ether soluble concentrations in the final effluent samples obtained during the survey do not seem to pose any serious pollution threat to the St. Clair River. The highest concentration recorded during the survey was 7 ppm in the 2nd Street Sewer. It is evident, however, that these low concentrations are brought about by dilution with the tremendous volume of relatively oil-free wastewaters in the sewer system, especially in the 2nd and 3rd Street Sewers where one would normally expect some oil contamination. For example, oil concentrations of 3,318 ppm and 42% by volume were found in the wastewaters from one section of the Styrene Plant discharging to the 3rd Street Sewer on September 3, 1969, but the corresponding concentration at the outfall was no higher than 3 ppm. In keeping with the philosophy that dilution should not be used to bring about an acceptable concentration at the outfall and that all wastes prior to discharge should receive the best practicable treatment, the Company should improve or modify the present oil separation equipment to achieve

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optimum oil removal at these facilities and to ensure that there are no slug discharges of oil, caused by upsets or abnormal operating conditions at the various plants. Recent upset conditions (April 1970) at the Ethylene and Styrene Plants serve to demonstrate the inadequacy of the present facilities.

Free Ammonia

The test used to determine the free ammonia content measures all the nitrogen in the form of NH_3, NH_4OH and NH_4^+. According to many literature references, the toxicity of ammonia to aquatic life is directly related to the amount of undissociated ammonium hydroxide present in solution which in turn is a factor of the pH value of the wastewater. Concentrations of 2.5 ppm are considered to be harmful in the pH range of 7.4 to 8.5.

The two main areas of free ammonia contamination in the Dow complex are obviously the Ammonia I and Ammonia II Plants. The ammonia concentrations in the 3rd Street Sewer which receives wastewaters from Ammonia I Plant were well below acceptable levels for the three sampling shifts on August 14, 1969. The same holds true for the contents of the 4th Street Sewer with the exception of a concentration of 3 ppm and a pH of 8.7 found during the first sampling shift. This sewer exclusively carries wastewaters from the Ammonia II Plant.

In spite of the low outfall concentrations, there were indications that strong ammonia wastes were sewered periodically. Hence, the Company should determine the sources of ammonia-contaminated wastewaters at the Ammonia Plants with a view to reducing concentrations to a minimum before the wastes are discharged to the various sewer systems.

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pH

The OWRC objective on pH states that the pH of a discharge to a watercourse should not be less than 5.5 or greater than 10.6. In several instances, this objective is found to be exceeded by wastewater flows in several sewer systems discharging to the St. Clair River. The analytical results showed that the acceptable pH range was exceeded in the 1st Street 42" Sewer, the 1st Street 54" Sewer, the 1st Street Sluice and the 12" Steam Plant Sewer during all three of the 8-hour sampling shifts on these sewers thus indicating that the contributing sources to these unacceptable conditions were continuous. On the other hand, the pH in the 1st Street 48" Sewer, the Chlorine-Caustic North Sewer and Dominion Alloy Sewer was high on either one or two of the three 8-hour sampling shifts thus suggesting the presence of intermittent high pH discharges from one or several of the plants entering the particular sewer system. The Company should investigate all of the above-mentioned instances of high pH conditions with a view to reducing these to a more acceptable level.

Dowtherm

Dowtherm is a mixture of biphenyl and biphenyloxide used for heating or cooling in various operations in the Dow complex. Dowtherm was not mentioned as a significant source of waste in the individual reports of the plants which use Dowtherm (that is, the Solvents, Caustic and Styron Plants) because Dowtherm is maintained in closed systems in these Plants. However, based on past experiences with the release of this compound to watercourses, it is imperative that the Company make every effort to ensure that there is no escape of this potentially harm-

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ful material from the various plants to the St. Clair River. The 1969 biological survey of the St. Clair River did reveal the presence of some Dowtherm in bottom sediments.

Metals

Apart from the mercury situation at this complex, which has been discussed in detail earlier in this report, several other metals (mostly in the form of salts) are used as extenders or catalysts in various operations at this complex. While in most cases, no analyses were performed on the final effluent samples for these metals (copper, zinc, aluminum, iron and titanium), judging from the samples obtained within the plant, the concentrations of these metals are not expected to be significant in the River. However, it is felt that simple modifications of processes could bring about a sharp reduction in the metal loadings discharged to the River. For example, cessation of the sewering of the spent catalyst at the Polystyrene Plant could help eliminate all traces of aluminum and titanium in the wastewaters discharged to the St. Clair River. The Company should also investigate all plants using metal catalysts with a view to reducing metal losses to the sewer system.

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Aesthetic Pollution

During the course of this survey, it was evident that a number of the waste discharges from Dow Chemical of Canada, Limited were a source of aesthetic pollution. Sewers in the vicinity of 1st Street discharged a white material that discoloured a considerable shore-line portion of the St. Clair River. The sewers serving the Steam Plant discharged intermittently discoloured wastes that formed plumes out into the River alternating from dark grey to deep orange-brown. The discolouration was most pronounced when the plumes combined just downstream of the Company property and proceeded past the Sun Oil Company Limited.

The discolouration noted in the sewers in the vicinity of 1st Street was attributed by Company personnel to the presence of carbonates which precipitated to form a white particulate solid when contacted with alkali wastes in the sewer and with the alkaline water in the St. Clair River. This discolouration was especially pronounced whenever caustic wastes were sewered to the 54" Sluice on 1st Street from Chlorine II.

As part of the water treatment operation, ferrous chloride is added to the incoming river water in a primary clarifier. The bottom sludges from the clarifier are discharged intermittently to the sewer producing an orange plume in the River. The supernatant from the clarifier is passed through sand filters which are back-washed periodically. The back-wash waters are also sewered and this results in a dirty grey plume in the River.

The "Objectives For Industrial Wastes Control in Ontario", as set out by the OWRC, regarding aesthetic pollution reads as follows:

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> "Treatment or control shall be effected to ensure that waste discharges do not impair the aesthetic qualities of the receiving water by imparting colour, by giving rise to accumulation of solids, oils or grease, by inducing foaming, or by other adverse effects".

Dow Chemical of Canada, Limited should, therefore, adopt an effective program to eliminate the sources of aesthetic pollution.

As most of the discolouration produced is the result of particulate matter, it appears that the wastes would lend themselves to treatment by clarification. The high carbonate effluents could be treated with caustic (perhaps that which has previously been used in scrubbing operations) to precipitate the carbonate and then passed to clarifiers or settling lagoons to remove the solids. Also, the high solid wastes from the clarifier and sand filter back-wash from the Steam Plant could be segregated and subjected to similar treatment to remove the suspended materials. Methods for suspended solids removal have been well documented in the literature and hence, the Company should have no difficulty in designing a suitable treatment system.

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Pollution From Accidental Losses of Materials

The major sampling program carried out at Dow Chemical of Canada, Limited was conducted during the week of August 11, 1969. As 24-hour composite samples were required, sampling was carried out over 8-hour shifts and hence, at least two OWRC staff members remained on the plant property at all times. During the week, a number of plant upsets had occurred that had an effect on the quality of the final effluent discharged to the St. Clair River. These upsets were as follows:

(1) On the morning of August 13, 1969, a marked discolouration was noted in the St. Clair River extending from the 1st Street Sewers down past the Sun Oil Company Limited. The white discolouration was further enhanced by a blue sky and the natural blue-green colour of the water.

Upon investigation, it was learned from plant personnel that an upset had occurred in the lime slaking operation resulting in unusually large losses of chemical to the 54" Sluice on 1st Street flowing to the St. Clair River. This chemical discharge resulted in the precipitation of a white carbonate solid in the sewer and in the River producing the white plume noted. Although the problem was corrected by 4:00 p.m. that same day, a considerable portion of the River had been discoloured and aesthetically impaired.

(2) While collecting outfall samples of the 3rd Street Sewer at the St. Clair River, it was noted that a considerable amount of hydrocarbon was being discharged to the watercourse. Dark oil-like scum formed on the surface of the water near the outfall and proceeded to flow downstream. There was also a strong smell of

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hydrocarbon that persisted for about two days.

The plant upset accounting for the hydrocarbon discharge was reported to have occurred at the Ethyl Benzene Plant, in the vent gas scrubbing system. A malfunction in the condenser permitted ethyl benzene to enter the water phase of the scrubber. This water, along with the entrained ethyl benzene, was discharged to the 3rd Street Sewer and hence, to the St. Clair River.

(3) During one of the night shifts, an overflow of brine to the sewer from one of the storage tanks had taken place. It was reported that this accident occurred as a result of a pump failure. It was further reported that the brine was being lost at an approximate rate of 30 gpm for about one hour.

(4) While in-plant samples were collected at the Styrene Plant, excessively high discharges of oily material were noted in the sewers servicing the extreme western portion of the Plant. A sample of this particular waste flow indicated an ether soluble concentration of 11%.

It was reported that an acid sewer had corroded resulting in a cross-connection of sewer lines and subsequent overloading of an existing oil separator. The oil was therefore permitted to overflow from the separator and escape to the watercourse.

For a complex plant, the size of Dow Chemical of Canada, Limited, plant upsets are inevitable. The above incidents have been cited simply to point out that aside from a need for day to day effluent control, some form of contingency planning is necessary to handle unusual losses of material arising from accidents, upsets, etc., to prevent an impairment of water quality in the St. Clair River.

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Dow Chemical of Canada, Limited should therefore examine its operations at Sarnia to pin-point potential areas where pollution could occur through spills and accidents. Effective measures should then be implemented to minimize operational errors and contain accidental spills should they occur. It is recognized that plant upsets are inevitable, however, water pollution need not necessarily become the end result.

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GENERAL CONCLUSIONS AND RECOMMENDATIONS

Conclusions

(1) Based on the findings of this survey, it was estimated that the net daily BOD and COD loadings discharged to the St. Clair River from Dow Chemical of Canada, Limited were in the order of 109,000 lbs. and 188,800 lbs., respectively. The organic compounds exerting the oxygen demand were not identified. Aside from depleting oxygen in the watercourse, these materials may impart a taste and odour to the water and may have sub-lethal effects on the biota of the receiving stream.

(2) The total net chloride loading discharged to the St. Clair River was estimated at 2.1 million pounds per day. Results contained in IJC reports indicate appreciable increases in the chloride concentrations in the St. Clair River adjacent to Dow Chemical of Canada, Limited. These chlorides may cause corrosion problems to downstream water users and may increase water treatment costs especially for industrial purposes. The exceptionally high chloride loading could contribute significantly to the chloride build-up in Lake Erie which is noted in other IJC reports.

(3) The net suspended solids loading discharged to the St. Clair River was estimated to be in the order of 97,000 lbs. per day. A biological survey carried out in May 1969 of the St. Clair River opposite Dow Chemical of Canada, Limited revealed high concentrations of calcium (as precipitated calcium carbonate) in the bottom sediment samples. This covering of the River bottom was considered to have adverse local effects on benthal organisms.

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(4) Based on the findings of this investigation, it was estimated that 50 lbs. to 100 lbs. per day of mercury were discharged to the St. Clair River in August of 1969. A biological survey of the St. Clair River conducted in May also revealed high mercury concentrations in the bottom sediment samples collected adjacent to Dow Chemical of Canada, Limited. Since the survey, fish caught in Lake St. Clair and the St. Clair River have exhibited significant quantities of mercury in their muscle tissue.

(5) Based on the analytical results of samples collected at the Ethylene Plant in August 1969, it was concluded that about 22 lbs. of phenolic material were discharged to the St. Clair River daily. During a 4½-hour period of sampling at the 3rd Street Sewer outfall on September 3, 1969, it was found that 270 lbs. of phenolic material was discharged thus indicating that there are significant phenolic discharges from plants upstream serviced by the 3rd Street Sewer.

(6) It was estimated, based on outfall samples, that approximately 580 lbs. of free ammonia were discharged to the watercourse per day. Based on in-plant investigations, it was concluded that the ammonia, noted in the outfall samples, was largely the result of sewering small volumes of concentrated ammonia solution.

(7) During the course of the survey, it was learned that some spent metallic catalyst was disposed directly to the sewer system which would increase the metallic loading discharged to the watercourse.

(8) A number of waste discharges were found to discolour significant portions of

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the St. Clair River and were therefore a definite source of aesthetic pollution.

(9) During the course of the survey, a number of plant upsets were reported to have occurred at Dow Chemical of Canada, Limited. These were found to have detrimental effects on the quality of the wastes discharged to the St. Clair River.

(10) A number of the waste discharges were found to exhibit unacceptable levels of pH outside the 5.5 to 10.6 range which is the objective of the OWRC for direct discharge to a watercourse.

(11) The survey indicated that a number of high-strength wastes were being diluted by excessive amounts of cooling water prior to discharge to the watercourse. In many instances, the loadings noted in the final effluent could be attributed to discharges of extremely potent wastes from individual upstream plants that accounted for a fraction of the total flow yet contributed a high percentage towards the total waste loading.

(12) Waste loadings from a number of individual plants could not be calculated as flow rates for the various internal sewers were not available and/or appropriate sampling locations were inaccessible. It was therefore not possible to obtain mass balances, relating the waste loading contributions of the various individual plants on a sewer with the total waste loadings found in the sewer based on outfall samples.

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Recommendations

Based on the findings of this survey, the following recommendations are put forward:

(1) Dow Chemical of Canada, Limited should be prepared to segregate all wastes exhibiting high BOD, COD, phenol and oil concentrations for treatment to reduce the organic loading discharged to the St. Clair River. Some form of biological treatment may be necessary to accomplish this aim. It may also be possible to reduce organic loadings through process changes and through in-plant control.

(2) The wastes containing high concentrations of suspended solids should also be segregated and treated, possibly by some form of clarification. Removing the particulate matter from the waste discharges may also reduce the aesthetic impairment of the St. Clair River and lower metal loadings significantly.

(3) Because mercury is such a toxic waste component, Dow Chemical of Canada, Limited should implement all the necessary corrective measures to eliminate all mercury losses to the St. Clair River. (Since the time of this survey, this has been accomplished.)

(4) All batch discharges of spent solutions to the sewer system should be eliminated. The company should consider alternate methods of disposal as this may correct many of the pH problems noted.

(5) Dow Chemical of Canada, Limited should adopt good housekeeping practices and attempt to reduce chemical losses to the sewer system through tighter in-plant control. Adopting such measures may reduce the chloride and dissolved

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solids loadings to the St. Clair River.

(6) Plant upsets and inadvertent losses of materials to the sewer system in a complex the size of Dow Chemical of Canada, Limited, are inevitable and hence, the Company should adopt some form of contingency planning to ensure that no impairment of water quality in the St. Clair River takes place. Operations at the Sarnia complex should be carefully examined to detect areas where spills and plant upsets are liable to occur. Facilities to cope with such upsets should be provided so that water pollution does not become the end result.

(7) Dow Chemical of Canada, Limited should initiate an extensive and effective waste monitoring program. Every individual plant operation should be carefully examined to pinpoint all possible sources of pollution. In-plant and outfall samples should be collected and waste flows accurately measured to determine the contribution of each plant towards the final waste loading discharged to the St. Clair River.

Based on the findings of this survey, Dow Chemical of Canada, Limited should submit to the OWRC an effective waste control and/or treatment program aimed at reducing the waste loadings to more acceptable levels in line with the recommendations outlined in this report.

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TABLE XXIII

DOW CHEMICAL OF CANADA, LIMITED

SUMMARY OF TOTAL NET WASTE LOADINGS DISCHARGED TO THE ST. CLAIR RIVER BASED ON OUTFALL SAMPLES

Sewer	Flow mgd	COD (lbs./day)	Suspended Solids (lbs./day)	Chlorides as Cl^- (lbs./day)	Others (lbs./day)
1st Street 42" Sewer	20.4	25,500	25,000	68,000	BOD - 6,700
1st Street 48" Sewer	7.5	neg	neg	4,200	
1st Street 30" Tile	2.5	1,500	1,200	18,500	
1st Street 54" Sluice	15.0	71,000	43,000	1,265,000	BOD - 48,000
Chlorine-Caustic North	1.0	1,500	1,850	378,000	
Chlorine-Caustic South	5.3	400	3,900	64,000	Mercury - 9.1
2nd Street Sewer	8.5	8,400	neg	3,300	BOD - 5,200
3rd Street Sewer	60.0	83,000	16,000	125,000	BOD - 50,000; Free NH_3 - 280; Phenol - 270*; Mercury - 7.7
Dominion Alloy	6.5	1,500	3,000	139,000	Mercury - 31
4th Street Sewer	28.0	neg	neg	5,500	Free NH_3 - 300
Steam Plant 42" Sewer	2.5	neg	3,300	neg	
Steam Plant 12" Sewer	0.2	neg	neg	1,200	
Total	157.4	192,800	97,250	2,071,700	BOD - 109,900; Mercury - 47.1; Free NH_3 - 580

* Based on samples collected on September 3, 1969.
neg - negligible

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

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1 p.p.m. = 1 mgm. / litre = 1 lb./100,000 Imp. Gals.

Municipality: Sarnia
Report to: N. Borodczak
c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 12/69 by: T.W. & N.B.

Lab. No.	5-Day B.O.D.	Solids Total	Solids Susp.	Solids Diss.	pH at Lab.	COD	Chloride as Cl	Sulphate as SO_4	Iron as Fe	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl		Zinc as Zn
T-1810	8.0	400	20	380	7.2	16	98	20	0.12	0.02	0.30		--
T-1811	4.8	350	1	349	8.5	20	159	20	0.20	0.3	0.54		--
T-1812	**	1,220	2	1,218	8.7	44	603	35	0.80	0.1	0.10		--
T-1813	0.4	480	2	478	8.3	16	198	23	0.36	0.1	0.36		--
T-1814	4.0	3,400	12	3,388	11.9	58	1,498	82	--	0.1	0.32		0.06
T-1815	3.0	370	4	366	6.8	16	111	20	--	0.1	0.54		8.3
T-1816	2.2	170	10	160	7.0	48	88	30	--	0.1	0.72		0.09
T-1817	2.3	145	13	132	7.7	8	86	20	--	0.1	0.56		0.06

** Interference - High Chlorine

T-1810	1	Vinyl Chloride Plant and Area - Pelaspan Plant - Composite 11:00 a.m. to 4:30 p.m.
T-1811	2	Vinyl Chloride Plant and Area - 39B Effluent - Composite 11:00 a.m. to 4:30 p.m.
T-1812	3	Vinyl Chloride Plant and Area - 1 + 2 Combined - Composite 11:00 a.m. to 4:30 p.m.
T-1813	4	Vinyl Chloride Plant and Area - Furnace, Quench + 3 - Composite 11:00 a.m. to 4:30 p.m.
T-1814	5	Vinyl Chloride Plant and Area - Acid Tile - Composite 11:00 a.m. to 4:30 p.m.
T-1815	6	Vinyl Chloride Plant and Area - Zinc Oxide - Composite 11:00 a.m. to 4:30 p.m.
T-1816	7	Vinyl Chloride Plant and Area - Floor Drain + T3 - Composite 11:00 a.m. to 4:30 p.m.
T-1817	8	Vinyl Chloride Plant and Area - Floor Drains - Composite 11:00 a.m. to 4:30 p.m.

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CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

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Municipality: Sarnia Report to: N. Borodczak c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 11/69 by: T.W.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Chloride as Cl	Sulphate as SO_4	Hardness as $CaCO_3$	NITROGEN AS N		
		Total	Susp.	Diss.						Free Ammonia	Total Kjeldahl	
T-1818	5,700	24,960	220	24,740	16,000	12.4	19,180	772	92*	0.1	3.0	
T-1819	840	1,900	25	1,875	1,300	11.7	1,697	72	23	0.2	2.7	
T-1820	17	2,900	120	2,780	140	12.1	2,380	121	32	2.1	12	
T-1821	6.4	300	10	290	12	8.5	99	17	100	0.3	1.4	

* Filtered

T-1818	9 Glycol Plant I - D.3A Overflow - Composite 10:00 a.m. to 4:00 p.m.
T-1819	10 Glycol Plant I - South into sump - Composite 10:00 a.m. to 4:00 p.m.
T-1820	11 Glycol Plant I - North into sump - Composite 10:00 a.m. to 4:00 p.m.
T-1821	12 Glycol Plant I - Amine Plant - Composite 10:00 a.m. to 4:00 p.m.

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Municipality: Sarnia

Report to: N. Borodczak

c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 12/69 by: M.F.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Chloride as Cl						
		Total	Susp.	Diss.									
T-1822		6,230	270	5,960	110	12.6	5,180						
T-1823		43,910	60	43,850	40	13.2	43,600						
T-1824		500	30	470	12	12.4	313						
T-1825		160	3	157	4	8.8	83						

T-1822	1	Chlorine II Plant - Graphite Sewer - Composite 9:00 a.m. to 4:00 p.m.
T-1823	2	Chlorine II Plant - Cell Floor - Composite 9:00 a.m. to 4:00 p.m.
T-1824	3	Chlorine II Plant - Compressor Bay - Composite 9:00 a.m. to 4:00 p.m.
T-1825	4	Chlorine II Plant - Cascade Cooler - Composite 9:00 a.m. to 4:00 p.m.

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Municipality: Sarnia　　Report to: N. Borodczak　　c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 12/69 by: T.W.

Lab. No.	5-Day B.O.D.	Solids			pH at Lab.	COD	Chloride as Cl	Sulphate as SO_4	Hardness as $CaCO_3$				
		Total	Susp.	Diss.									
T-1826	37	10,430	180	10,250	10.4	490	5,680	186	261*				
T-1827	112	20,700	290	20,410	11.0	800	12,680	342	625*				
T-1828	6.8	220	10	210	9.0	28	176	20	103				
T-1829	12	150	3	147	8.5	24	94	18	110				
T-1830	30	5,780	40	5,740	8.9	48	3,840	111	116				
T-1831	4.4	4,000	200	3,800	11.3	36	2,027	79	275*				
T-1832	8.4	620	210	410	11.9	24	228	18	22				
T-1833	900	25,500	270	25,230	11.9	1,140	13,760	206	9,230*				
						* Filtered							

T-1826	5	Glycol Plant I - E-W Sluice - Composite 10:00 a.m. to 4:00 p.m.
T-1827	6	Glycol Plant I - Hydrolyzer Sump - Composite 10:00 a.m. to 4:00 p.m.
T-1828	7	Glycol Plant I - West Sump - Composite 10:00 a.m. to 4:00 p.m.
T-1829	8	Glycol Plant I - East Sump - Composite 10:00 a.m. to 4:00 p.m.
T-1830	1	Glycol Plant I - Brine Treatment - Composite 10:00 a.m. to 4:00 p.m.
T-1831	2	Glycol Plant I - Lime Building - Composite 10:00 a.m. to 4:00 p.m.
T-1832	3	Glycol Plant I - Caustic Plant
T-1833	4	Glycol Plant I - N-S Sluice

ONTARIO WATER RESOURCES COMMISSION
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INDUSTRIAL WASTE ANALYSIS

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Municipality: **Sarnia** Report to: **N. Borodczak** c.c.

Source: **Dow Chemical of Canada, Limited**

Date Sampled: **Aug. 11/69** by: **M.F. & T.W.**

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sul- phate as SO_4	Hardness as $CaCO_3$	
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia				
T-1834	6.6	510	190	320	125	10.6	1.2	0.10	413	27	60*	
T-1835	3.0	140	3	137	4	8.4	0.44	0.10	94	17	88*	
T-1836	**	610	1	609	16	7.1	0.20	0.20	632	83	110*	
T-1837	215	17,600	290	17,310	460	11.6	1.0	0.20	9,240	240	1,915*	
T-1838	43	460	110	350	140	11.0	1.6	0.30	373	28	52*	
T-1839	1.4	140	7	133	16	7.6	1.5	0.30	88	17	90*	
T-1840	**	730	80	650	24	11.0	0.60	0.10	666	55	42*	
T-1841	500	16,500	380	16,120	580	11.9	1.8	0.20	8,380	209	2,130*	

** Interference, High Chlorine

* Filtered

T-1834	1	C/I/1
T-1835	2	C/I/2
T-1836	3	C/I/3
T-1837	4	C/I/4
T-1838	5	C/II/1
T-1839	6	C/II/2
T-1840	7	C/II/3
T-1841	8	C/II/4

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ONTARIO WATER RESOURCES COMMISSION
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INDUSTRIAL WASTE ANALYSIS

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1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 12/69   by: M.F. & T.W.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sul- phate as SO_4	Hardness as $CaCO_3$		
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia					
T-1842	48	450	90	360	130	10.8	1.3	0.40	348	23	63*		
T-1843	3.2	140	6	134	8	8.6	0.58	0.10	106	17	74*		
T-1844	0.4	1,560	110	1,450	200	12.0	0.40	0.40	1,035	113	7*		
T-1845	220	15,900	250	15,650	420	11.7	0.95	0.30	7,840	118	2,090*		

* Filtered

T-1842	9 C/III/1
T-1843	10 C/III/2
T-1844	11 C/III/3
T-1845	12 C/III/4

ONTARIO WATER RESOURCES COMMISSION
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Municipality: Sarnia
Report to: N. Borodczak
c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: T.W. & R.K.

Lab. No.	5-Day B.O.D.	Solids			Mercury as Hg								
		Total	Susp.	Diss.									
T-1857					0.05								
T-1858					0.04								
T-1859					0.01								
T-1860					0.29								
T-1861					0.13								
T-1862					0.09								

T-1857	1	C/1V/5
T-1858	2	C/V/5
T-1859	3	C/V1/5
T-1860	4	C/1V/6
T-1861	5	C/V/6
T-1862	6	C/V1/6

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= 1 lb./100,000 Imp. Gals.

Municipality: Sarnia

Report to: N. Borodczak

c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: R.K.

Lab. No.	5-Day B.O.D.	Solids			Mercury as Hg								
		Total	Susp.	Diss.									
T-1863					0.51								
T-1864					0.52								
T-1865					0.38								

T-1863	7	C/1V/9
T-1864	8	C/V/9
T-1865	9	C/V1/9

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Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: R.H., T.W. and N.B.

Lab. No.	5-Day B.O.D.	Solids			Mercury as Hg									
		Total	Susp.	Diss.										
T-1866					0.36									
T-1867					0.77									
T-1868					0.87									
T-1869					12.7									

T-1866	10	Chlorine I - H_2 Scrubber
T-1867	11	Chlorine III - North
T-1868	12	Chlorine III - Combined
T-1869	13	Chlorine III - H_2 Scrubber E - 101 - Grab Sample

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Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Titanium as Ti	Aluminum as Al			
		Total	Susp.	Diss.			~~Free~~ Ammonia	Total Kjeldahl					
T-1870	15	380	10	370	28	8.6	3.2	5.0	--	--			
T-1871	14	260	80	180	24	9.5	20	25	--	--			
T-1872	142	500	20	480	260	8.2	4.7	5.0	--	--			
T-1873	7.6	290	45	245	240	9.1	0.4	0.40	0.35	1.5			
T-1874	19	290	10	280	58	7.5	0.1	0.50	--	--		** Sample Exhausted	
T-1875	2.3	220	5	215	**	8.4	**	0.36	--	--			
T-1876	**	220	10	210	**	8.6	**	0.26	--	--			
T-1877	2.1	230	5	225	**	8.5	**	0.32	--	--			

T-1870	1	Ammonia II
T-1871	2	NH_3 (I) W at 3rd Street
T-1872	3	3rd Street Downstream of NH_3 (I)
T-1873	4	Polyethylene
T-1874	5	Polyethylene Middle
T-1875	6	Polyethylene Sump South
T-1876	7	Polyethylene Sump East
T-1877	8	Polyethylene Sump West

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= 1 lb./100,000 Imp. Gals.

Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F.

Lab. No.	5-Day B.O.D.	Solids Total	Solids Susp.	Solids Diss.	COD	pH at Lab.	NITROGEN AS N Total Kjeldahl	NITROGEN AS N Free Ammonia	Chloride as Cl	Sulphates as SO_4	Phenols in ppb (distilled)	Ether Solubles
T-1878	135	420	30	390	150	7.8	1.4	0.50	245	27	+++	trace ***
T-1879	2.1	280	5	275	4	8.6	0.48	0.27	78	17	0	0
T-1880	13	2,430	15	2,415	**	8.8	--	--	1,269	--	175	0
T-1881	7.2	340	30	310	**	8.3	--	--	**	--	100	0
T-1882	**	123,310	70	123,240	**	11.1	--	--	71,600	--	8,000	7
T-1883	--	670	30	640	**	8.6	--	--	41	--	8	--

** Sample Exhausted

+++ 1 preserved - Broken in transit

* Preserved

T-1878 1 C/V11/8
T-1879 2 C/V111/10
T-1880 3 Ethylene A
T-1881 4 Ethylene B
T-1882 5 Brine Oil Separator
T-1883 6 Service Water - Aug. 14/69

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Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F.

Lab. No.	5-Day B.O.D.	Solids			Zinc as Zn	Copper as Cu							
		Total	Susp.	Diss.									
T-1880					0.0	0.0							
T-1881					**	**							

** Sample Exhausted

T-1880

T-1881

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Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69   by: T.W. & R.K.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sulphates as SO_4	Ether Solubles		
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia					
T-1884	55	80,860	150	80,710	80	12.1	3.0	0.70	41,680	1,280	--		
T-1885	1.0	1,770	100	1,670	32	9.7	0.25	0.09	1,468	44	0		
T-1886	45	230	5	225	150	7.3	0.40	0.10	126	17	--		
T-1887	47	540	100	440	180	9.1	1.5	0.50	294	23	trace		

* less than 2 ppm

T-1884	1 C/V/5
T-1885	2 C/V/6
T-1886	3 C/V/7
T-1887	4 C/V/8

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= 1 lb./100,000 Imp. Gals.

Municipality: Sarnia Report to: N. Borodczak c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: T.W., R.H. and N.B.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Chloride as Cl	Ether Solubles	Copper as Cu	Zinc as Zn
		Total	Susp.	Diss.						
T-1888	**	280	**	**	24	8.6	73	7	0.01	0.0
T-1889	12	320	**	**	20	8.6	76	0	0.01	0.0
T-1890	136	**	**	**	**	7.6	531	0	0.07	0.04
T-1891	2,400	*	*	*	4,800	5.8	1,528	11% w/v	0.14	0.66
T-1892	1,400	*	*	*	25,000	4.5	777	14.7% w/v	0.14	1.0
T-1893	4,600	*	*	*	9,250	4.1	2,240	312	0.56	3.1
T-1894	265	13,700	830	12,870	800	10.4	6,600	4	*	*
T-1895	108	21,820	5	21,815	725	11.2	11,380	3	*	*

* Oily samples will not dry

** Sample Exhausted

T-1888	1	Styrene Sewer A & B - Composite
T-1889	2	Styrene Sewer B - Composite
T-1890	3	Styrene Sewer C - Composite
T-1891	4	Styrene Sewer D - Composite
T-1892	5	Influent to Oil Separator - Composite
T-1893	6	Effluent from Oil Separator
T-1894	7	Inlet to Latex Treatment
T-1895	8	Effluent from Latex Treatment

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Municipality: Sarnia   Report to: N. Borodczak   c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: T.W., R.H. and N.B.

Lab. No.	5-Day B.O.D.	Solids Total	Solids Susp.	Solids Diss.	pH at Lab.	COD	Chloride as Cl	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl	Total Hardness as $CaCO_3$
T-1896	37	430	10	420	7.8	50	53	0.60	1.5	54*
T-1897	1.4	250	20	230	8.4	4	45	0.40	0.36	56*
T-1898	8.0	380	95	285	11.0	16	57	0.30	1.0	32*
T-1899	18	330	75	255	10.2	28	51	0.30	0.50	32*
T-1900	98	220	10	210	8.3	165	49	0.30	0.50	62*
T-1901	44	240	15	225	7.4	110	114	0.20	0.60	100*
T-1902	450	380	5	375	7.2	5,200	105	2.1	3.0	61*
T-1903	8.0	220	10	210	7.7	70	50	0.10	1.7	64*

* Test performed on filtered sample

T-1896	1	Styron Plant - Composite 10:00 a.m. to 4:30 p.m.
T-1897	2	Pelaspan Plant South - Composite 10:00 a.m. to 4:30 p.m.
T-1898	3	Tank Wash Area - Composite 10:00 a.m. to 4:30 p.m.
T-1899	4	2nd Street Sewer at Tank Wash Area - Composite - 10:00 a.m. to 4:30 p.m.
T-1900	5	Glycol II Plant - 72 Glycol Sump - Composite - 11:00 a.m. to 4:30 p.m.
T-1901	6	Glycol II Plant - E. Glycol at 2nd Street - Composite 11:00 a.m. to 4:30 p.m.
T-1902	7	Glycol II Plant - P.D.C. Wash Water - Composite 11:00 a.m. to 4:30 p.m.
T1903	8	Glycol II Plant - W. Glycol at 2nd Street - Composite 11:00 a.m. to 4:30 p.m.

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

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1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Sarnia

Report to: N. Borodczak

c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F. & N.B.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Alkalinity as $CaCO_3$					
		Total	Susp.	Diss.								
T-1904	11	1,450	60	1,390	48	7.5	488					
T-1904	9 Latex Final											

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Municipality: Sarnia

Report to: N. Borodczak

c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F. & N.B.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sulphate as SO_4	Ether Solubles		
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia					
T-1905	15	123,160	450	122,710	200	11.8	1.5	0.70	64,440	1,140	--		
T-1906	2.6	1,320	115	1,205	8	10.2	1.1	0.40	288	31	0		
T-1907	25	230	10	220	68	8.7	1.3	0.10	66	16	--		
T-1908	130	560	5	555	130	7.8	0.85	0.60	231	27	0		

T-1905	1	C/V1/5
T-1906	2	C/V1/6
T-1907	3	C/V1/7
T-1908	4	C/V1/8

10M-60-22690

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

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Municipality: Sarnia

Report to: N. Borodczak

c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: R.K.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Phenols in ppb	NITROGEN AS N		Chloride as Cl	Ether Solubles		
		Total	Susp.	Diss.				Free Ammonia	Total Kjeldahl				
T-1909	--	34,240	70	34,170	240	9.1	--	--	0.90	20,440	--		
T-1910	--	7,000	80	6,920	28	11.5	--	0.20	0.40	2,041	--		
T-1911	115	230	5	225	125	8.6	0	0.30	0.90	49	7		
T-1912	74	580	10	570	130	7.6	--	0.50	0.8	226	4		

T-1909	1	C/1V/5
T-1910	2	C/1V/6
T-1911	3	C/1V/7
T-1912	4	C/1V/8

ONTARIO WATER RESOURCES COMMISSION
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Municipality: Sarnia
Report to: N. Borodczak
c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: R.K.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Chlorides as Cl	Sulphates as SO_4	Hardness as $CaCO_3$	Ether Solubles	Iron as Fe		
		Total	Susp.	Diss.									
T-1913	4.8	5,830	100	5,730	50	12	2,796	132	20*	--	0.60		
T-1914	2.0	240	10	230	4	8.5	48	15	93*	--	0.12		
T-1915	6.8	440	225	215	8	7.7	49	18	107*	--	3.6		
T-1916	8.0	1,770	225	1,545	32	11.9	702	55	8*	3	4.3		

* Test performed on filtered sample

T-1913	5	C/1V/9
T-1914	6	C/1V/10
T-1915	7	C/1V/11
T-1916	8	C/1V/12

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ONTARIO WATER RESOURCES COMMISSION
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Municipality: Sarnia Report to: N. Borodczak c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: T.W. & R.K.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sulphate as SO_4	Iron as Fe		
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia					
T-1917	2.4	5,180	70	5,110	28	12.2	0.25	0.20	1,940	88	0.32		
T-1918	1.2	270	5	265	4	8.8	0.95	0.70	63	17	0.12		
T-1919	1.7	290	55	235	4	7.9	0.55	0.20	53	22	1.0		
T-1920	22	1,880	100	1,780	36	11.3	1.4	0.30	473	97	1.5		

T-1917	5 C/V/9
T-1918	6 C/V/10
T-1919	7 C/V/11
T-1920	8 C/V/12

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ONTARIO WATER RESOURCES COMMISSION
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Municipality: Sarnia
Report to: N. Borodczak
c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 14/69 by: M.F. & N.B.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	NITROGEN AS N		Chloride as Cl	Sulphate as SO_4	Iron as Fe		
		Total	Susp.	Diss.			Total Kjeldahl	Free Ammonia					
T-1921	**	3,190	5	3,185	36	7.1	0.24	0.10	1,722	106	0.30		
T-1922	4.0	230	5	225	16	8.7	4.3	3	67	17	0.08		
T-1923	4.4	410	170	240	16	9.3	0.50	0.5	70	23	1.86		
T-1924	8.4	3,350	170	3,180	20	12.2	1.5	1	914	99	2.3		

** Interference from residual chlorine

T-1921	5	C/V1/9
T-1922	6	C/V1/10
T-1923	7	C/V1/11
T-1924	8	C/V1/12

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ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

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Municipality: Sarnia Report to: N. Borodczak c.c.

Source: Dow Chemical of Canada, Limited

Date Sampled: Aug. 13/69 by: R.H., T.W. and N.B.

Lab. No.	5-Day B.O.D.	Solids			COD	pH at Lab.	Chlorides as Cl	Total Hardness as $CaCO_3$	Iron as Fe	Phenols in ppb			
		Total	Susp.	Diss.									
T-1925	8.0	4,930	100	4,830	24	12.3	2,006	7*	--	--			
T-1926	1.0	160	15	145	12	8.7	**	79*	--	--			
T-1927	2.2	950	20	930	20	8.8	470	83*	--	--			
T-1928	7.2	7,800	120	7,680	36	12.2	3,450	10*	--	--			
T-1929	8.4	7,640	30	7,610	32	12.6	3,376	16*	0.62	--			
T-1930	16	3,140	890	2,250	20	12.4	1,728	2,175*	--	--			
T-1931	--	190	5	185	16	7.9	43	65*	--	20			

* Filtered

T-1925	9	Brine Treatment Composite 11:00 a.m. to 4:30 p.m.
T-1926	10	H_2 Scrubber plus other cell room wastes at Chlorine I Plant - Composite 11:00 a.m. to 4:30 p.m.
T-1927	11	Chlorine III North
T-1928	12	Chlorine III Combined - Composite 11:00 a.m. to 4:30 p.m.
T-1929	13	Steam Plant Pond - Grab Sample 2:00 p.m.
T-1930	14	Lime Building - Grab Sample 2:45 p.m.
T-1931	15	Service Water Shift III - Grab Sample

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

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Municipality: **Sarnia**   Report to: **N. Borodczak**   c.c.

Source: **Dow Chemical of Canada, Limited**

Date Sampled: **Sept. 3/69**   by: **N.B.**

Lab. No.	5-Day B.O.D.	Solids			pH at Lab.	COD	Phenols in ppb	Ether Solubles	Aluminum as Cl	Zinc as Zn	Ether Solubles % by volume	
		Total	Susp.	Diss.								
T-2074	400	570	40	530	7.6	1,350	140	3	7.25	--	--	
T-2075	120	**	**	**	7.5	8,600	1,000*	3,318	0.13	0.0	--	
T-2076	--	--	--	--	--	--	--	--	--	--	42%	
T-2077	20	660	5	655	7.7	73	2,400	3	--	0.02	--	

* Analysis done on the aqueous layer

** Oily - No test done

T-2074	1	Styrene Plant - Oil recovery separator effluent - Composite 2:30 p.m. - 6:30 p.m.
T-2075	2	Styrene Plant - Combined Effluent - West Sump - Composite 2:30 p.m. - 6:30 p.m.
T-2076	3	Styrene Plant - Combined Effluent - Grab Sample 5:35 p.m.
T-2077	4	3rd Street Sewer - Composite 2:00 p.m. - 6:30 p.m.

DOW CHEMICAL OF CANADA LTD. SARNIA

SCHEMATIC SEWER DIAGRAM