THE ONTARIO WATER RESOURCES COMMISSION

REPORT TO

THE
BOARD OF TECHNICAL
ADVISORS

TO THE

INTERNATIONAL JOINT
COMMISSION

ON

INDUSTRIAL WASTE SURVEY

OF THE

ALGOMA STEEL CORPORATION
SAULT STE. MARIE, ONTARIO

SEPTEMBER 1959

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ONTARIO WATER RESOURCES COMMISSION

Municipality Sault Ste. Marie Date of Inspection Sept. 11, 14, 15, 1959

Re: Algoma Steel Corporation Limited

Field Inspection By A. J. Harris Report by A. J. Harris, P. Eng.

INTRODUCTION

The Algoma Steel Works is located on six hundred acres of land along the banks of the St. Mary's River at the outfall of Davieaux Creek. The corporation produces industrial coke, coke oven gas, coal chemicals, such as, tar, light oil and its principal constituents - benzol, toluol and xylol; naphthalene, pyridine and solvent naphtha; and a variety of iron and steel products.

The production units consist of:

- four coke oven batteries with a total of 253 ovens,
- four blast furnaces for pig iron production,
- six open hearth furnaces and two basic oxygen vessels for steel production,
- a sintering plant which utilizes flue dust recovered by a Dorr thickener and the coke breeze recovered from the coke screening after quenching,
- pit furnaces,
- a number of mills for bloom, plate billet, slab, rail, structural, merchant, cold rolled and ball and bar and strip steel.

Provision for materials handling, raw materials storage, maintenance, auxiliary and utility services demand much of the plant area. Some of the

INTRODUCTION cont'd.

auxiliary services and utility departments are the docks which include a 765 foot coal dock, a 2056 foot ore dock, an 847 foot limestone dock and a 400 foot commercial dock with towers, buckets, and transfer cars for handling a yearly total of five million tons of material per year.

There is a railway system within the plant grounds, a water pumping station capable of supplying 94 million gallons per day, a steam generating plant, steel iron and brass foundries, electrical and mechanical repair departments, diesel repair; machine, maintenance, pattern, blacksmith boiler and forge shops. There is a gas engine house which utilizes blast furnace gas for the generation of power.

The services and maintenance departments occupy an area of about five acres and the rail transportation system consists of about sixty miles of track and 470 railway cars.

PURPOSE OF SURVEY

This report will define the nature and quantity of water borne wastes resulting from the operations of the Algoma Steel Corporation at Sault Ste.Marie, Ontario and will present the methods of treatment of these wastes prior to their discharge into the St. Mary's River. The report will also suggest remedial measures so that the effluent quality complies with the regulations of the Ontario Water Resources Commission.

PERSONNEL PARTICIPATING

For the Algoma Steel Corporation, Metallurgical Section:

Mr. W. C. Kimball, Ass't. Superintendent,
Mr. Fred N. Durham, In charge of Waste Disposal,
Mr. Gino Viselli, Technician.

For the Ontario Water Resources Commission:

Mr. A. J. Harris, Ass't. Supervisor of Industrial Wastes,
Mr. D. Caplice, Chemical Engineer,
Mr. I. Reiman, Student Engineer,
Mr. E. E. Jokipii, Student Engineer.

OPERATING SCHEDULE

All processes operate on a 24-hour basis. The total number of employees is approximately 7,400.

DESCRIPTION OF OPERATIONS

1. By-Product Coke Plant

The destructive distillation of coal yields four products known commercially as coal gas, ammoniacal liquor, coal tar and coke. The coke oven gas is used for the open hearth furnaces and gas engines. The light oil recovered from the gas produces a refined gas for use as a motor fuel and also its extraction products benzol, toluol and xylol. Tar is pumped to the neighboring Dominion Tar and Chemical Works and the coke is used as a raw material for the blast furnaces.

(a) By-Product Coke Ovens

This type of coke oven produces metallurgical coke for use in the manufacture of iron and steel. The oven is a rectangular chamber of silica

DESCRIPTION OF OPERATIONS cont'd.

brick, from 9-3/4 to 13 feet high, from 37 to 40-1/2 feet long and a width of 18-1/4 inches, being wider at the discharge end of the oven. There are four batteries of ovens in use with a total of 253 ovens producing an annual capacity of 1,458,000 tons. Waste heat is recovered and utilized in regenerators. The ovens are underfired with Blast Furnace or Coke Oven Gas which is introduced through regulated jets and meets the secondary air which has been preheated in passing up through the regenerators. About 5,000 tons of coal are used per day which produces 3,750 tons of coke and 61,000 M.C.F. per day of coke oven gas.

The ovens are charged at the top and the end openings closed. The gas produced is collected in hydraulic mains from which it is passed through large pipes to the condensing and purifying apparatus. The coke is removed by a mechanically operated ram which pushes the coke out of the retort into cars in which it is quenched by 5,500 gallons of water applied in 65 seconds in a quenching tower. There is a quenching tower at either end of the batteries of ovens. One over is pushed every seven minutes. After quenching the coke is screened and the coke breeze or fine dust removed. Coke breeze is collected in a settling basin 15 feet x 45 feet and the overflow discharged directly to the St. Mary's River at the east end of the coal dock. The flow is highly sporadic and discharges at water level. This outfall was classified as the "Coke Quench Water Outfall".

(b) Recovery of By-Products

As the crude coal gas comes in contact with the liquid in the hydraulic mains, it deposits a portion of the higher boiling vapours as

DESCRIPTION OF OPERATIONS cont'd.

tar and some of the ammonia is absorbed. The gas is passed through primary gas condensers and coolers located at the suction side of the gaspumps to remove tar, naphthalene, water vapour and other constituents. The condensers are indirectly cooled with water at a rate of 2,000 gallons per minute, which is discharged uncontaminated to the St. Mary's River at the coal dock. The outfall was partially submerged and was inaccessible because of coal unloading operations being carried out at the time of sampling.

Exhausters, located after the primary coolers, maintain a uniform pressure on the retorts by removing and compressing the gas as fast as it is generated. Tar removed, in a final tar extractor that follows, and tar from the coolers is settled from ammonia liquor and sold to a neighbouring tar plant.

The process for production of ammonium sulphate has been discontinued because of poor market conditions. Weak ammoniacal liquor is discharged to the Trunk Sewer. The gas is taken to final coolers where it is scrubbed with water. During this cooling some naphthalene separates and is carried along with the waste water. The naphthalene is recovered as a yellow scum which is mechanically skimmed off the top of two chambers each 7 feet by 40 feet. Waste from this phase goes directly to the Trunk Sewer. This represents the bulk of the Coke Plant flow to the trunk sewer and since cooling is by direct contact the waste water contains the phenol and cyanide.

The light oils are recovered from the gas in oil scrubbers which extract the benzol, toluol and xylol. Separation is by distillation, where

DESCRIPTION OF OPERATIONS cont'd.

the wash oil after being stripped of benzol, toluol and xylol is recirculated for stripping more gas. The variety of wastes from these operations are discharged to the Trunk Sewer. Wash oil cooling water is pumped from the slip and returned to the slip without contact with the process. This outfall is designated as the Wash Oil cooling water outfall and sampling was not possible because of coal unloading operations. An emergency pond, for storage of benzol in case of rupture of the benzol storage tanks, is located to the north of the benzol recovery and storage area. At the present time, cooling water from the boosters, on the condensers in the booster and exhauster building, is discharged to this pond. The outfall of the pond is to Davieaux Creek and the cooling water is to be diverted to the pond outfall to Davieaux Creek.

2. Blast Furnace Department

Iron ore is smelted with coke and preheated air to produce pig iron. The body of the furnace is filled with coke from the bottom of the hearth to the top of the bosh, and above this, alternate layers of coke and iron ore together with appropriate quantities of limestone for a fluxing material. The preheated air, at a temperature of 1,300°F. and at a pressure of 15-30 psi., enters through Tuyere pipes at the top of the hearth, combines with the fuel and creates a volume of hot reducing gases which pass up through the charge melting, heating and reducing the ore before it passes out the throat of the furnace.

The iron collects in the bottom of the hearth and on top of it the liquid slag consisting of the impurities in the ore together with the ash of the coke and the lime. The slag is drawn off about fifteen times per

DESCRIPTION OF OPERATIONS cont'd.

24 hours and disposed of. The metal is tapped out of the bottom of the furnace every four or five hours and is cast in the form of pigs or transported to the steelmaking department.

The gas received at the throat has a calorific value. About one-third is used for combustion in the hot blast stoves which preheat the air used for smelting, and the remaining is consumed under boilers, in gas engines for air blowing, or the generation of power. The stoves are used alternatively for storing heat from the exhaust gases and then giving it out again to preheat the blast which is driven into the furnace.

There are four blast furnaces in use with a daily production capacity of 4,290 tons. About 4,000 gallons of water per minute flow through each furnace to keep them cool. The capacities of the blast furnaces are tabulated below:

Furnace No. 2	-	335 tons - not in use at present
3	-	700 tons daily
4	-	520 tons daily
5	-	1,380 tons daily
6	-	1,690 tons daily

3. Gas Cleaning Plant and Dorr Thickener

A central gas cleaning plant is provided to remove flue dust from the Blast Furnace gas to provide clean gas for use in heating the coke ovens, boilers and soaking pits. Approximately 267,000 cubic feet per minute of

DESCRIPTION OF OPERATIONS cont'd.

gas is cleaned in the gas washers. The gas is first passed through primary washers where it is washed with water. Secondary cleaning takes place in a submarine drier which is a further water spray, or in a Kottrell Electrostatic Precipitator. Numbers 3 and 6 furnaces use the water method and numbers 4 and 5 furnaces use the electrostatic precipitators.

The dirty water from the washers and driers is collected in a former settling basin now used as a pump sump. A pump then transfers the gas washer water to a Dorr Thickener for settling of the solids. Occasionally the sump becomes hydraulically overloaded and a by-pass allows dirty gas washer water to overflow directly to the St. Mary's River, in the vicinity of the ore dock, through the yard drain. There is a wide variation in the content of flue dust in the gas washer effluent. After a "slip" in the furnace, or when a gas washer or electrostatic precipitator is being cleaned, flushed or agitated, the momentary concentration of flue dust may increase many times.

In addition to the gas washer effluent, the Dorr Thickener receives the slurry from the gas cleaning plant for the two oxygen steelmaking furnaces, One primary and three secondary venturi scrubbers are used for cleaning of the gases from the vessels before discharge into the atmosphere.

The total flow to the Dorr Thickener is 10,000 U.S. gpm. or 15 million gallons per day. This unit is a circular gravity separator, equipped with revolving rakes for sludge collection, and operates on the upward vertical flow principle. Settled slude is removed and conveyed to filters and then

DESCRIPTION OF OPERATIONS cont'd.

to a Sintering machine with a grate area of 504 square feet. About 1,500 tons per day of sinter is produced for use in the blast furnaces.

The Dorr thickener is designed for a flow of 8,000 U.S. gallons per minute and a retention period of about one hour. The estimated dimensions are 85 feet diameter and 12 feet liquid depth. In order to compensate for the additional flow over the 8,000 gpm. design capacity, different coagulating agents have been employed. Coagulating agents properly applied can greatly speed up the deposition of the bulk of the flue dust load. At the time of sampling, a coagulant aid known as "separan" was being used in conjunction with waste sludge obtained from the neighbouring Linde Company who supply oxygen for the Linz and Donowitz Oxygen Steelmaking plant. This sludge from the production of oxygen is basically calcium hydroxide.

The clarified effluent, collected from an overflow weir along the circumference of the tank, is directed to two sewers. Normally about 10 million gallons per day of the effluent is directed to the "Dorr Thickener outfall" at the corner of the slip at the limestone dock. The remaining 5 million gallons per day is first discharged to the effluent trough of a former settling basin, where it is joined with cooling water from the blast furnace stoves, and then sent to the Trunk Sewer.

4. Steelmaking Department

(a) Open Hearth Shop

Number One Open Hearth Shop was closed down for dismantling. Number Two Open Hearth Shop consisted of four 165 tons capacity furnaces

DESCRIPTION OF OPERATIONS cont'd.

which are tapped every 8-9 hours and two 330 tons capacity furnaces which are tapped every 11-12 hours. Certain structural parts of the furnaces such as the doors require water cooling. This water was formerly discharged to the headrace of the Power Canal though the "Open Hearth Cooling Water Outfall". All open hearth cooling water is now being recirculated in a closed system with no effluent to the headrace.

(b) Basic Oxygen Steel Plant

There are two 60 metric ton Linz and Donowitz oxygen steelmaking vessels using 99.6% pure oxygen which started in production in November, 1958. Provision has been made for a future third vessel.

The disposal of the gas cleaning water from the venturi scrubbers in this department was discussed in the previous section.

The total annual capacity of the Open Hearths and Basic Oxygen Vessels is 1,600,000 tons of steel. Five hundred different kinds of steel are made.

5. Mill Sections

(a) Combination Bar and Strip Mill

The capacity of this mill is 400,000 tons annually and the products are bar and flat rolled sheet, strip, plate and skelp. Some of the units are a reheating furnace, roughing, intermediate and finishing stands, for both bar and flat rolled products, and a cooling bed. There is a continuous pickling line and one batch pickler.

The main constituents of the waste water discharged from the

DESCRIPTION OF OPERATIONS cont'd.

combination bar and strip mill is mill scale and oil. All hot rolling mills produce scale which consists mostly of iron oxides. The presence of oils with the mill scale arises from wash down of rolls, purging from tanks or sumps, and occasional spillage of lubricating and hydraulic oils.

There are two scale pits in series, located inside the bar and strip mill, for intercepting scale. The effluent from the scale pits flows to an outside settling basin with an oil skimming baffle. The overflow from the outside settling basin discharges to the headrace of the power canal. Oil collecting behind the baffle, in the basin, is removed regularly by hand.

This outfall was formerly called the Open Hearth Cooling Water Sewer but since the open hearth furnace now has a closed cooling water system, this outfall has been redesignated "The Bar and Strip Mill Outfall". The volume of flow in this outfall was recently estimated to be 10,000 gallons per minute or 15 million gallons per day.

(b) Other Mills

The various mills other than the Combination Bar and Strip Mill are tabulated below.

46 "Blooming and 114" Plate Mill
44" Blooming Mill
45" Continuous Billet Mill
Rail and Structural Mill
18" Merchant Mill
Ball Mill
Cold Mill

The mills discharge wastes normal to the operations carried out in rolling mills. Where present, scale pit effluents, oils, pickling liquor

DESCRIPTION OF OPERATIONS cont'd.

waste waters and cooling water from all these mills are directed to the Trunk Sewer which eventually discharges into the St. Mary's River below both the Power Canal and the Sault Ste. Marie Water Works intake. The flow in the Trunk Sewer is estimated by difference to be 45 to 50 million gallons per day.

WASTE FLOWS

By-Product Coke Plant

1. Wash Oil Cooling Water Outfall - 0.7 M. gpd.
2. Primary Gas Cooling Water Outfall - 1.15 M. gpd.
3. Coke Quench Water Outfall - 1.26 M. gpd.

Blast Furnace and Steelmaking

4. Yard Drain - (Intermittant primary gas cleaning sump overflow)
5. Dorr Thickener Outfall - 10 M. gpd.

Bar and Strip Mill

6. Bar and Strip Mill Outfall - 15 M. gpd.

Other Wastes

7. Trunk Sewer at A.S.C. Manhole - 45-50 M. gpd.

Total Waste Flow - 73 to 78 million gallons per day.

SAMPLING AND ANALYSES

Number one and two sampling points for the Wash Oil Cooling Water and Primary Gas Cooling Water were inaccessible because of docking

SAMPLING AND ANALYSES cont'd.

operations. Uniform hourly portions were composited for four consecutive eight hour periods beginning at 8:00 a.m., September 14th, 1959 from the following locations.

3. Coke Quench Water Outfall
4. Yard Drain Outfall
5. Dorr Thickener Outfall
6. Bar and Strip Mill Outfall
7. Trunk Sewer at Manhole

i Dorr Thickener (North side) to Dorr Thickener Outfall (5)

ii Dorr Thickener (south side) plus overflow from settling basin receiving cooling water from blast furnace stoves to Trunk Sewer (7)

A portion of each eight hour sample was preserved with copper sulphate for the phenol determination, and a separate bottle containing a composite of the first 24 hours of the 32 hour period was used to collect the sample for the oil determination. All the analyses were carried out at the Laboratory of the Ontario Water Resources Commission, 46 Wellesley Street West, Toronto.

The analytical results are listed in the appendix.

SANITARY SEWAGE AND STORM WATER

The sanitary sewage flows, from the various sanitary facilities located throughout the plant,were disposed to the Trunk Sewer. This Trunk Sewer was built by the Algoma Steel Corporation but in addition to the flow

SANITARY SEWAGE AND STORM WATER cont'd.

from the Algoma Steel Corporation it received the waste discharge from the Mannesmann Tube Company Limited and was joined by one of the large municipal combined sewers at a point several hundred feet before its outfall into the tailraces of the Great Lakes Power Company and the Abitibi Power and Paper Company.

Storm run off water from the plant area in most cases was discharged to the Trunk Sewer. During periods of heavy run off, the Trunk Sewer flows full and the part of the overflow from the Dorr Thickener directed to the Trunk Sewer must be reduced by being divered to the St. Mary's River through the Dorr Thickener outfall.

DISCUSSION OF RESULTS

An abbreviated table of the more significant analyses for the five outfalls sampled is presented below, which summarizes the results taken from the averages of the four eight hour composites tabulated in the appendix.

Outfall N°.	5-day B.O.D.	Susp. Solids	Iron	ppb. phenol	Cyanide	Ether Solubles	Total Kjeldahl
3	4.9	54	1.59	137	0	4.1	1.65
4	4.5	24	3.40	14	0	5.9	1.20
5	9.6	157	25	75	0	3.0	8.9
6	6.3	17	9.2	6.7	0	12.4	0.50
7	77	68	13	9,562	7.9	63.0	128.3

DISCUSSION OF RESULTS cont'd.

Outfall No. 3 - Coke Quench Water Outfall

Outfall No. 4 - Yard Drain Outfall

Outfall No. 5 - Dorr Thickener Outfall

Outfall No. 6 - Bar and Strip Mill Outfall

Outfall No. 7 - Trunk Sewer at Manhole.

As a guide for providing adequate control of pollution entering the watercourse, the following objectives for effluent quality are provided, and form the basis for the discussion. No distinction has been made for the quality of the effluent in the Trunk Sewer since this waste is eventually discharged untreated to the St. Mary's River.

(a) 5-Day Biochemical Oxygen Demand - 15 ppm

(b) Suspended solids - 20 ppm

(c) Iron - 17 ppm

(d) Phenol or its equivalent - 20 ppb

(e) Cyanide - 0

(f) Ether Solubles (oil or grease) - 15 ppm

(a) Five-Day Biochemical Oxygen Demand

The biochemical oxygen demand (B.O.D.) is the quantity of oxygen utilized in the biological oxidation of organic matter under standard laboratory procedures in five days at 20° C. expressed in parts per million.

DISCUSSION OF RESULTS cont'd.

The four process waste outfalls, numbers 3, 4, 5 and 6, to the St. Mary's River from the plant property, were below the recommended limit of 15 ppm B.O.D. The maximum figure for these outfalls was 16 ppm. for the Dorr Thickener Outfall (No. 5) between 12 midnight and 7 a.m. on September 15th, 1959.

The Trunk Sewer, at 77 ppm B.O.D., exceeded the recommended limit of 15 ppm and would represent the amount of B.O.D. in sanitary sewage contributed by 20,748 persons, based on 0.167 pounds of 5-day B.O.D. per capita per day and a flow estimate of 45 million gallons.

(b) Suspended Solids

Suspended solids are those which either float or are in suspension. The Trunk Sewer and all the Outfalls except the Bar and Strip Mill (No.6) exceeded the limit of 20 ppm for suspended solids. The greatest concentration of suspended solids was an average of 157 ppm for the Dorr Thickener Outfall (No. 5) and this figure varied from 50 to 292 ppm in the four composite samples, with the one grab sample showing 310 ppm. The high concentration of suspended solids in the grab samples, which was mostly iron (200 ppm), demonstrated the "slug" effect of the suspended solids discharged through this outfall.

Based on a flow of 10 million gallons per day and the average concentration of 157 ppm, the quantity of suspended solids discharged per

DISCUSSION OF RESULTS cont'd.

day from the Dorr Thickener Outfall at the limestone dock was 15,700 pounds.

The solids in the Trunk Sewer, at the manhole on company property, amounted to 30,600 pounds per day.

(c) Iron

The most prominent concentration of iron was indicated to be in the Dorr Thickener Outfall to the St. Mary's River at the limestone dock. This flow was estimated to be ten million gallons per day and the concentration was 25 ppm or equivalent to 2,500 pounds per day.

The origin of this iron was the blast furnace gas washer water used for removal of flue dust from the blast furnace gas. The flue dust in the gas washer effluent was settled, to a large extent, in the Dorr Thickener. One-third of the Dorr Thickener overflow was sent to the Trunk Sewer and the remaining two-thirds, or ten million gallons, to the St. Mary's River through the Dorr Thickener Outfall (No. 5), presumably undiluted with any other waste streams.

Although the average of the composites of the Dorr Thickener Outfall (No. 5) contained iron in only a slight excess of the recommended limit of 17 ppm, a grab sample, taken when the outfall appeared a more bright red than normal, showed iron of 200 ppm or a rate of 2,500 pounds in about two hours.

Another source of iron in the form of a "slug" was the Yard Drain Outfall (No. 4) which had an overflow connection from the sump for

DISCUSSION OF RESULTS cont'd.

the Blast Furnace gas washer water. This outfall averaged 3.4 ppm on the composite samples but increased to 30 ppm in a grab sample taken at 7:30 p.m. on September 14th, 1959.

(d) Phenol

The term "phenol" is used in a collective sense and includes those hydroxy derivatives of benzene which can be determined under specified conditions by either Gibbs Reagent (2, 6-dibromoquinonechlorimide) or 4-aminoantipyrine. Gibbs Reagent, which was used for these analyses, has a sensitivity of about two parts per billion.

These compounds, even when highly diluted, may give a taste and odour to the water which is variously described as medicinal, chemical or iodoform. They taint fish and are toxic to fish depending upon their concentration. Normal water contains no phenolic compounds.

Two of the outfalls, the Coke Quench (No. 3) and the Dorr Thickener (No. 5), from the plant property, and the Trunk Sewer at the manhole showed phenol in excess of the recommended 20 parts per billion.

Most of the phenolic type compounds originate from the By-product Coke Plant operations and these wastes have been purposely diverted to the Trunk Sewer to ensure that they do not reach the St. Mary's River above the City of Sault Ste. Marie water works intake.

The phenol in the Coke Quench Outfall results from the direct contact of the cooling water with the hot coke, and the phenol in the Dorr

DISCUSSION OF RESULTS cont'd.

Thickener Outfall is probably derived from traces washed from the Blast Furnace gas.

The Trunk Sewer was extremely high in phenol concentration, carrying an average of 9,562 ppb. and the two outfalls from the plant property, although low in comparison, still carried sufficient phenol to possibly result in objectionable taste in the water supply. The threat of phenol contamination upstream from the water works intake has already necessitated installation of special chemical feeding equipment for chloramine generation at the water works to prevent the formation of the taste producing substance chlorophenol, and ensure a potable water supply at all times.

(e) Cyanide

The toxicity of cyanide requires the complete elimination of this chemical from an industrial discharge either to a watercourse or to a municipal sewer of any kind. Cyanide is highly toxic to human, aquatic or other wild life and has been found to be fatal to fish in concentrations less than 0.1 ppm.

The discharge of cyanide, to the St. Mary's River through the Trunk Sewer, which averages 7.9 ppm or in quantities estimated to be between 3,555 and 3,950 pounds per day, is a practice which should be discontinued. Traces of cyanide (0.6 and 0.8 ppm) were indicated at the Dorr Thickener overflow but none was measurable by the time this flow reached the Dorr Thickener Outfall to the St. Mary's River.

DISCUSSION OF RESULTS cont'd.

(f) Ether Solubles

The maximum concentration of grease or oil of mineral origin determined as ether solubles, recommended in industrial effluents is 15 ppm, or in amounts which does not create more than a faint iridescence on the surface of a watercourse.

The Trunk Sewer exceeded this limit and carried 63 ppm in a 24-hour composite sample.

The Bar and Strip Mill Outfall was controlled for discharge of oil but required constant supervision and hand skimming of the surface oil collected behind the baffle. The measures taken were effective in reducing the concentration of oil in the effluent to 12.4 ppm in a 24-hour composite sample, although evidence of shoreline oil pollution was noticed below the outfall.

OTHER ANALYSES

The nitrogen tests were carried out as an aid to comparison with sanitary sewage for purposes of evaluating the most effective methods of waste treatment. The results show low nitrogens in the outfalls to the St. Mary's River from the plant property, and nitrogens in excess of amounts found in strong sanitary sewage for the Trunk Sewer. This indicates that conventional methods for the treatment of sanitary sewage, such as activated sludge, would probably be effective for the treatment of the waste in the Trunk Sewer.

OTHER ANALYSES cont'd.

The turbidity test corresponds to the suspended solids in that it indicates the effect of the suspended solids on the transmission of light through the sample and in this respect, along with the chloride and alkalinity, is used for water quality criteria. The concentrations of chlorides and alkalinity in any of the samples were not significant.

RECOMMENDATIONS

General

Large expenditures have already been made by the Algoma Steel Corporation for the recovery and utilization of waste materials. For example, some of the equipment installed is gas washers, settling basins or pits, a dephenolizer, a Dorr thickener and sludge filter. Certain clean water streams have been segregated for discharge directly to the river. The expenditures involved and steeply increasing costs of removing a greater proportion of waste material remaining in the effluent, in flows which total over eighty million gallons per day, makes it imperative that recommendations, for disposal of the wastes, be ones that get rid of the waste in the simplest and least expensive manner with the main consideration being the effect on downstream users of the water into which the waste discharges. Large volumes of dirty water have already been diverted to the Trunk Sewer which has its outfall below the Sault Ste. Marie water works intake, but this sewer has reached hydraulic

RECOMMENDATIONS cont'd.

capacity and during storm periods becomes overloaded with dirty yard drainage so that some process waste must be diverted to the stream, usually from the Dorr Thickener.

Specific recommendations cannot be given because of the complicated plant processes, equipment or operations which are concerned. Recommendations can only be made by qualified plant personnel who understand the limitations and capabilities of the processes before making changes for reduction in waste concentrations or diversion of certain streams. Recommendations, in general, are therefore that responsible persons at the plant become fully informed of the waste disposal situation and the necessity for immediate steps to rectify certain situations.

A programme should be carried out to obtain the maximum possible efficiency of each unit, directed toward improving present facilities, recirculation of certain streams, diverting streams containing no contaminants after confirmation by quality analyses, elimination of water by dry processes or land disposal such as dust control with waste water. Individual departments should be requested to provide a contribution, no matter how small, for improving or reducing the volume or concentration by some means and also carry out good housekeeping practices at all times.

Primary consideration should be directed toward elimination of cyanide, reduction of iron, oil and phenol and replacing clean water

RECOMMENDATIONS cont'd.

now discharged to the Trunk Sewer by some of the contaminated water now going to the slip. Thought should also be given to eventually sharing treatment facilities with the municipality (for certain industrial wastes which lend themselves to this type of treatment and the sanitary sewage from the plant) in any proposed municipal system. The operations at the docks should not be overlooked as a source of iron pollution since large quantities of ore are spilled during unloading operations and some of this is easily washed or blown into the slip.

A few more specific recommendations or suggestions for each outfall are outlined below:

Number Three Outfall

For the Coke Quench operation, instead of water, the use of an inert gas such as carbon dioxide or nitrogen should be investigated. Dry quenching has been claimed to recover 70 to 75 per cent of the heat of the coke and also produce a more efficient fuel. Elimination of quench water would remove one source of phenol above the water works intake and conserve over one million gallons of water per day.

Number Four Outfall

The overflow from the old settling basin, now used as a pump sump, which is thought to reach the slip through the yard drain should be investigated. If settled sludge has reduced the capacity of the

RECOMMENDATIONS cont'd.

basin (38,585 c.f.), the settled material should be removed and the basin cleaned at regular intervals. In any case, this overflow should not be discharged to the slip.

Number Five Outfall

Because of the potential contamination at the water works intake by slugs of iron, the flow from the Dorr Thickener to this outfall should be reduced as much as possible. Apparently clean blast furnace stove water is discharged to the Trunk Sewer, which if uncontaminated and redirected to the slip would provide more capacity for Dorr Thickener overflow in the Trunk Sewer.

Installation of more of the new venturi type gas washers to replace the conventional gas washers would reduce the wash water requirements.

Continued effort should be placed on achieving better results from the Dorr Thickener by the use of coagulant aids. The aids used at the time of the survey were acting efficiently but at earlier times had not achieved as good results. The Ontario Water Resources Commission operates a Purification Processes Branch which specializes in this type of work and on request would render all assistance possible to determine the optimum conditions for good coagulation.

Number Six Outfall

This outfall lies in a direct line upstream from the water works

RECOMMENDATIONS cont'd.

intake for the City of Sault Ste. Marie and its proximity requires constant supervision. The scale pits, which overflow to this outfall, should be dredged with the least possible interference with the quality of the scale pit effluent and if necessary, improvements or redesigning of the scale pits to provide continuous mechanical scale removal should be done to ensure a clean effluent. As with flue dust, coagulation can speed up separation of mill scale.

For oil collection at the source, a baffle and oil skimmer should be provided at the outlet of each scale pit to intercept oil before it reaches the lagoon. Hand skimming of oil from the lagoon surface is not a reliable procedure if "slugs" of oil enter the lagoon.

Number Seven - Trunk Sewer

It is recommended that cyanide in the Trunk Sewer be eliminated at the source and such contaminants as phenol, oil and iron be kept to a minimum by processing the waste before discharge to the plant sewers. Any clean, uncontaminated cooling or process water should be eliminated and storm sewers which carry off surface waters not heavily loaded with material such as iron ore should be sent direct to the river. Any capacity in the Trunk Sewer made available in this manner should be taken up with Dorr Thickener overflow water to reduce the volume of iron-bearing waste to the slip.

Prepared and Supervised by:

A. J. Harris ..... Fred A. Voege .....
Assistant Director of Labs. & Research.

Approved by:

A. E. Berry .....
General Manager.

AJH:imu

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Municipality: Sault Ste Marie — Report to: A.J.Harris. — c.c

Source: Algoma Steel Corp. Ltd.
Coke Quench Water Outfall.

Date Sampled: Sept. 14-15/59 — By: A.J.Harris.

Lab. No.	5-Day B.O.D.	SOLIDS Total	Susp.	Diss.	Turbidity	Chloride	pH	Alkalinity as $CaCO_3$	Iron as Fe	Phenol in ppb	Cyanide as HCN	Ether Solubles
3a	7.0	150	24	126	16	12	7.5	44	1.36	150	0	4.1
3b	6.5	200	100	100	22	11	9.1	52	2.20	180	0	-
3c	2.6	122	50	72	15	10	9.0	60	1.52	150	0	-
3d	3.4	120	44	76	22	7	9.2	56	1.28	70	0	-
AVERAGE	4.9	148	54	94	19	10	8.7	53	1.59	137	0	4.1

3a	Sept.14.1959	8a.m. to 3p.m. Composite. Coke Quench Outfall - to St. Mary's River.
3b	Sept.14.1959	4p.m. to 11p.m. " " " " - " " " "
3c	Sept.15.1959	12 Mid. to 7a.m. " " " " - " " " "
3d	Sept.15.1959	8a.m. to 3p.m. " " " " - " " " "

Note: The Ether soluble (oil or grease) sample represents a composite of the first three eight hour periods.

ONTARIO WATER RESOURCES COMMISSION

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

Municipality:

Report to:

c.c

Source: Coke Quench Water Outfall-Continued.

Date Sampled: By:

Lab. No.	NITROGEN AS N			
	Free Ammonia	Nitrate	Nitrite	Kjeldahl
3a	2.60	0.22	0.010	2.7
3b	0	0.08	0.005	1.0
3c	2.00	0.05	0.005	2.3
3d	0.20	0.06	0.004	0.6
AVERAGE	1.20	0.10	0.006	1.65

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Municipality: Sault Ste. Marie. Report to: A.J.Harris c.c.

Source: Algoma Steel Corp. Ltd.
Yard Drain Outfall.

Date Sampled: Sept. 14-15/59 By: A.J.Harris.

Lab. No.	5-Day B.O.D.	SOLIDS Total	Susp.	Diss.	Turbidity	Chloride	pH	Alkalinity as $CaCO_3$	Iron as Fe	Phenol in ppb	Cyanide as HCN	Ether Solubles
4a	5.0	166	32	134	20	16	9.1	60	3.2	0	0	5.9
4b	2.7	174	26	148	19	13	8.3	56	2.8	20	0	-
4c	7.0	148	20	128	19	16	9.3	60	3.0	12	0	-
4d	3.4	162	20	142	22	17	9.4	56	4.8	25	0	-
AVERAGE	4.5	162	24	138	20	15	9.0	58	3.4	14	0	5.9
Grab	13	176	64	112	517	16	8.5	32	30	0	0	-

4a Sept 14 1959 8a.m. to 3p.m. Composite. Yard Drain Outfall - St. Mary's River.
4b Sept 14 1959 4p.m. to 11p.m. " " " " - " " "
4c Sept 15 1959 12 Mid to 7a.m. " " " " - " " "
4d Sept 15 1959 8a.m. to 3p.m. " " " " - " " "
Grab Sept 14 1959 7.30p.m. Yard drain outfall at time of heavy red discharge.

Note. The ether soluble (oil or grease) sample represents a composite of the first three eight hour periods.

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Municipality: Report to: c.c

Source: Yard Drain Outfall - Continued.

Date Sampled: By:

Lab. No.	NITROGEN AS N			
	Free Ammonia	Nitrate	Nitrite	Kjeldahl
4a	0	0.08	0.016	0.8
4b	0	0.06	0.016	1.1
4c	0.20	0.06	0.015	0.3
4d	2.50	0.06	0.015	2.8
AVERAGE	0.67	0.06	0.015	1.2
GRAB	1.30	0	0.038	1.4

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Lab. No.	5-Day B.O.D.	SOLIDS TOTAL	SUSP.	DISS.	Turbidity	Chloride	pH	Alkalinity as $CaCO_3$	Iron as Fe	Phenol in ppb	Cyanide as HCN	Ether Solubles
5a	10	300	150	150	54	31	9.7	86	30	35	0	3.0
5b	2.4	226	50	176	35	20	8.5	120	26	70	0	-
5c	16	462	292	170	429	23	7.7	116	12	130	0	-
5d	10	286	138	148	45	21	8.6	112	34	65	0	-
AVERAGE	9.6	318	157	161	140	24	8.6	108	25	75	0	3.0
Grab	6.0	810	310	500	616	26	8.8	166	200	0	0	-

5a Sept. 14 1959 8a.m. to 3p.m. Composite. Dorr Thickener Outfall - to St. Mary's River.

5b Sept. 14 1959 4p.m. to 11p.m. " " " " - " " " "

5c Sept. 15 1959 12 Mid to 7a.m. " " " " - " " " "

5d Sept. 15 1959 8a.m. to 3p.m. " " " " - " " " "

GRAB Sept. 15 1959 4a.m. Dorr Thickener Outfall at time of heavy red discharge.

NOTE. The ether soluble (oil or grease) sample represents a composite of the first three eight hour periods.

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Lab. No.	NITROGEN AS N			
	Free Ammonia	Nitrate	Nitrite	Kjeldahl
7a	165	0	0	171.0
7b	102	0	Interf.	115.0
7c	156	0.05	0	160.0
7d	57.4	0.10	Interf.	67.3
AVERAGE	120	0.04	0	128.3

ONTARIO WATER RESOURCES COMMISSION.
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Municipality: Sault Ste. Marie. Report to: A.J.Harris. c.c.

Source: Algoma Steel Corp. Ltd.
Dorr Thickener Overflows.

Date Sampled: Sept. 14-15/59 By: A.J.Harris.

Lab. No.	5-Day B.C.D.	SOLIDS * Total	Susp.	Diss.	Turbidity	Chloride	pH	Alkalinity as $CaCO_3$	Iron as Fe	Phenol in ppb	Cyanide as HCN
ia	5.0	232	66	166	44	18	9.5	56	7.0	95	0
ib	8.0	268	38	230	26	28	8.2	140	28	75	1.3
ic	11.0	232	34	198	26	22	7.4	136	22	95	0
id	4.0	298	118	180	45	30	7.5	128	30	65	1.1
AVERAGE	7.0	257	64	193	35	22	8.1	115	22	82	0.6
iia	8.2	216	48	168	44	20	9.4	52	11.0	100	0.8
iib	5.8	230	46	184	32	20	8.3	128	12.8	75	1.3
iic	4.0	190	22	168	22	26	7.3	128	8.8	90	0
iid	5.0	240	64	176	39	23	9.1	120	23.	5.	1.0
AVERAGE	5.7	219	45	174	34	22	8.5	107	14.1	67	0.8

ia	Sept 14 1959	8a.m. to 3p.m.	North Overflow from Dorr Thickener to Outfall No. 5.
ib	Sept 14 1959	4p.m. to 11p.m.	" " " " " " " "
ic	Sept 15 1959	12 Mid to 7a.m.	" " " " " " " "
id	Sept 15 1959	8a.m. to 3p.m.	" " " " " " " "
iia	Sept 14 1959	8a.m. to 3p.m.	South Overflow from Dorr Thickener plus I.F. Stove Cooling Water.
iib	Sept 14 1959	4p.m. to 11p.m.	" " " " " " " " " "
iic	Sept 15 1959	12 Mid to 7a.m.	" " " " " " " " " "
iid	Sept 15 1959	8a.m. to 3p.m.	" " " " " " " " " "

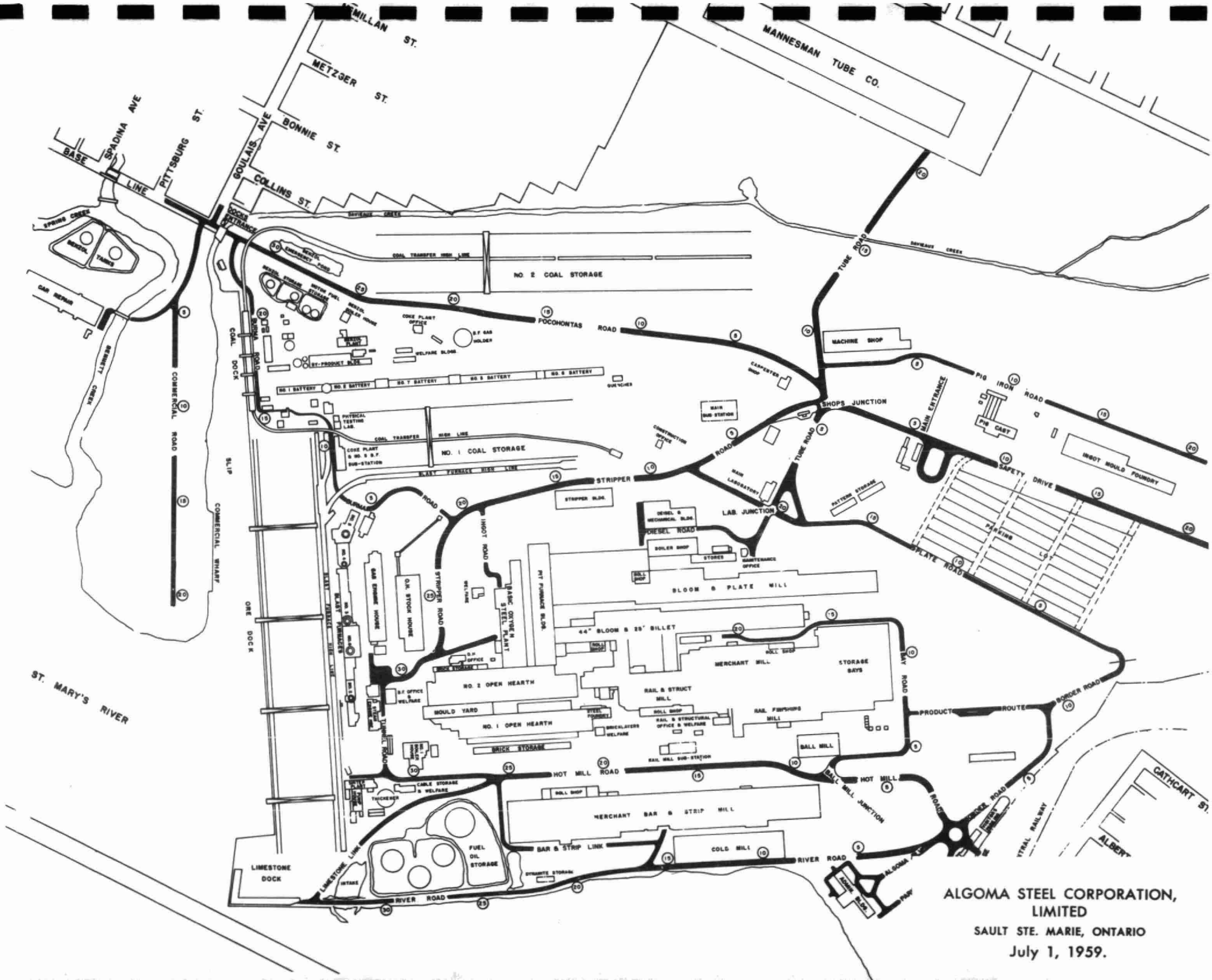
ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES
INDUSTRIAL WASTE ANALYSIS

Municipality: Report to: c.c.

Source: Dorr Thickener Overflows - Continued.

Date Sampled:

Lab. No.	NITROGEN AS N			
	Free Ammonia	Nitrate	Nitrite	Kjeldahl
ia	7.90	0	0.016	10.8
ib	14.00	0	0.023	16.5
ic	9.60	0	0.018	11.8
id	15.00	0	0.014	16.3
AVERAGE	11.62	0	0.017	13.8
iia	7.20	0	0.017	8.2
iib	15.00	0	0.023	15.1
iic	5.90	0	0.020	6.2
iid	12.30	0	0.014	14.6
AVERAGE	10.10	0	0.018	11.0



ALGOMA STEEL CORPORATION, LIMITED

SAULT STE. MARIE, ONTARIO

July 1, 1959.