Government of Canada / Gouvernement du Canada

**MEMORANDUM** **NOTE DE SERVICE**

TO / À: Ann Wordsworth
Pollution Probe

FROM / DE: J.F. McDonald
Senior Project Engineer
Pollution Control Division
EPS - Ontario Region

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| SECURITY - CLASSIFICATION - DE SÉCURITÉ |
| OUR FILE/NOTRE RÉFÉRENCE |
| YOUR FILE/VOTRE RÉFÉRENCE |
| DATE: June 26, 1981 |

SUBJECT / OBJET: Notes on Hooker Incineration Evaluation

Essentially, there are three basic elements to effective incineration; temperature, residence time and turbulence. In simple terms, the temperature is a measure of the amount of heat available to promote thermal decomposition of the reactive waste material into simple gases; the residence time, a measurement of how long the materials are exposed to the elevated temperature; and the turbulence refers indirectly to the extent of mixing of the combustion air, waste material and, in some instances, fuel in the incinerating chambers.

In considering the incineration of any material, an essential initial quesiton is whether it supports combustion or "burn", and if so to what extent. The latter consideration is critical to the effective operation of the incinerator, since it is the combustion of the material which provides the heat necessary to raise the incinerator internal temperature to a level where thermal decomposition to simple gases can take place. In the destruction of wastes containing hazardous substances it is often necessary to use natural gas or fuel oil as a supplementary fuel to ensure that the heat supplied by combustion is adequate for decomposition.

Generally, as our survey indicated, substances such as those contained in the Hyde Park landfill site can be incinerated, but only under the most stringent controls. For example, recommendations for the incineration of PCB's include a temperature of 1200°C (2200°F), a retention time of greater than 2 seconds, and a level of excess oxygen of 3%.

The major criticism of the Hooker unit made by Ontario Ministry personnel was that the unit design was faulty and was not suited to such a demanding task. Both MOE personnel pointed out that the retention times quoted in the N.Y. State permit material were not an accurate reflection of the actual operating conditions of the reactor and thus waste material

could be exposed to the required elevated ( 1200°C) temperature for significantly less than the 1.6 seconds shown in the permit material. As one respondant pointed out, this lack of adequate retention time could cause only a partial decomposition of the waste material, which could in turn result in the presence of toxic substances in the scrubber effluent water. One author states that inclusion of the entire burner chamber volume as part of the retention time calculation is erroneous; a second points to the possibility of a wide variety of flow patterns, resulting an equivalent variety in path lengths for the gases travelling from entrance to exit and thus a variation in retention times.

Remedial measures referred to in the permit materials are not considered adequate. To continue to tinker with a seriously flawed design and expend valuable resources on retro fitting and performance testing, in addition to being a waste of resources, does not minimize the risks involved in incinerating such materials. In summary, the dimensions of the hazards involved in disposing of the Hyde Park material demands that best available incinerator technology be employed, and the Hooker unit does not meet this criterion.

John F McDonald

J.F. McDonald

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Ministry
of the
Environment

135 St. Clair Avenue West
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Toronto, Ontario
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Date: June 15, 1981

MEMORANDUM

TO: Mr. C.B. Martin
Supervisor
Air Resources Branch.

FROM: E. T. Barrow
Head, New Technology Development
and Appraisal Section.
Air Resources Branch.

SUBJECT: Hooker Chemical Co's Incinerator Specifications

Whilst incineration of organic wastes is a completely acceptable method of disposal, providing that by-products such as hydrochloric acid and ash are adequately dealt with, careful design of the incincerator is essential.

The design indicated only by rough sketches in the attached documentation does not appear to meet the requirements for the destruction of hazardous wastes. Without design details and specific information about the fuel and waste nozzles, the fuel and waste composition and feed rates no full evaluation of the design can be made, however the following points must be considered.

1. Retention time: Retention times for the destruction of hazardous wastes are determined in specifically designed units. Transposition of the results to other designs must be carefully carried out. Generally laboratory results using small tubular plug flow reactors, heated to the desired degree by external means, are used to determine the times need to incinerate wastes. The waste and adequate air for combustion are usually premixed. For these reasons the degree of turbulence needed to maintain a well mixed gas is small, the variation in the retention times of molecules or small packets of gas is strictly limited. In the larger scale incineration units the variation (standard deviation) of retention times becomes much larger.

   In the unit under consideration the flow pattern will allow a wide variation since the reactor shape and waste injection point allow the wastes to take a very short path to the reactor outlet bypassing much of the volume of the reactor. The turbulent

back mixing possible in such a design, where flow is reversed in the reactor, also increases the variation in residence times. Much of the waste can therefore escape more rapidly than calculations based on the reactor dimensions will indicate, and therefore escape undestroyed. The degree to which this will occur will be very dependent on the unit's operating conditions at any given time.

Under the conditions specified in the permit, dated 6/30/81, numbered 2017, for the incineration of organic chlorine at 2,400 lb/hr and greater than 30% chlorine (say 40%) the retention time will be considerably shorter, even utilizing the duct volume for combustion, than 2 seconds. If fuel is needed then even shorter residence times than 1 second could ensue. The requirement in the letter of October 1st 1979 for 5% free excess oxygen (ca. 25% excess air) reduces the residence to a considerable degree and demands additional fuel in order to maintain adequate incineration temperatures.

2. Temperature: The use of steam, compressed air and water in the waste feed system will not only reduce residence times but lead to lower temperatures, and the need for excess fuel. Measurement of the chamber temperatures may be a problem unless the measuring thermo couples are shielded from flame and hot wall radiation effects.

The charts, included in the submission, indicating calculated temperature and residence times are based on unknown data but indicate that temperatures of less than 1200°C are achieved only within the reactor and the first section of the exit duct, about two thirds of the available volume. The basis for the requirement of 1200°C is not known, but generally this temperature and a residences time of 1-2 seconds is considered to be needed for the incineration of the more hazardous organic materials such as dioxins and PCB's, and the higher value of 2 seconds was chosen for this installation (page I.31 para 6(a)).

Summary:

Without further information it is not possible to be sure that this incinerator can meet the requirements of para 6 in the Stipulation and Judgement.

However, it appears unlikely that at high rates of incineration of wastes para 6 (a) will be met. It is also probable that paragraph 6(d) requiring 99.99% destruction efficiency, will not be met unless the "principal components of waste" are readily combustible, possible carrying other more difficulty combustible and unmonitored materials in lesser amounts. Destruction of these materials may then be questionable.

E.T. Barrow

ETB/mb/ER3-4

Copy: J. D. McDonald
W. B. Drowley

Ontario

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135 St. Clair Avenue West
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June 19, 1981

Environment Canada
Environmental Protection Service
Ontario Region
25 St. Clair Avenue East
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Toronto, Ontario
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Attn: Mr. J. F. McDonald, P. Eng.
Senior Project Engineer
Pollution Control Division

Dear Mr. McDonald:

Re: Hooker Chemical

The available information about the Hooker proposal has been reviewed.

There is insufficient data to execute a heat and material balance. The sketches of the incinerator, and the temperature profile are revealing, and lead to the following comments:

1. The assumption of retention time in Sections I and II is erroneous. This is the primary stirred reactor system, i.e. the burner per se, and the reaction is incomplete in this section.

2. The recorded steep drop in temperature at Section III, and subsequent sections indicates a quenching of propagation, and is likely to result in unburnt material being carried through the system. Smoke and odour would be emitted along with the highly toxic material in the aqueous phase injected at Section III. This prediction has been previously confirmed by observation of a similar system in Mississauga.

In summary the fundamental design is faulty. A flammable mix is not achieved within Sections I to III, thus normal stirred reactor propagation is not possible. The downstream Sections do not provide an adequately high temperature held for a defined period of time to achieve burnout.

The sewered discharge may contain more highly toxic residue than was initially introduced in the leachate, as the quenching of propagation will result in intermediate and recombinant products of combustion.

The residue burner improvement plans will not correct the fundamental error in design.

Yours very truly,

R. F. Cairns, P. Eng.
Senior Spprovals Engineer
Industrial Approvals Section

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 15 1981

OFFICE OF ENFORCEMENT

Mr. John McDonald
Environmental Protection Service
Ontario Section
M4T 1M2
7th Floor
25 St. Claire Avenue East
Toronto, Ontario Canada

Dear John,

Enclosed is copy of the EPA Incinerator Research Branch's evaluation of Hooker Chemical & Plastics incinerator in Niagara Falls, New York. Although this evaluation is based on limited data, the conclusion, i.e. that the data available to date does not indicate that the incinerator can meet the requirements of EPA regulations, is in agreement with EPA's previously stated view. Letter from Deputy Director of Enforcement Division, EPA Region II (March 12, 1981) and Response to Public Comments on the Hyde Park Proposed Cosent Judgment at pp. 34-35 (Copies attached). In 1979 EPA's Office of Enforcement inspected Hooker's incinerator. Our technical team's judgment was that the data did not indicate that the incinerator met EPA requirements. This view was based on a review of the data obtained during an inspection of the incinerator and a comprehensive audit of the Hooker Niagara Falls plant. Since that report also covers matters which are still the subject of investigation and litigation, I cannot give you a copy at this time.

The proposed Hyde Park Agreement (a copy of the incinerator related portions of the proposed Agreement is enclosed) does not endorse or approve of Hooker's incinerator and Hooker has repeatedly been so informed. The proposed Agreement requires Hooker to incinerate the relatively viscous insoluble chemicals (non-aqueous phase) collected by the tile drain and purge well collection systems required under the Agreement, unless Hooker demonstrates that some other technology is at least the performance equivalent of incineration (See p. I-30 Paragraph E (5) of the proposed Agreement). Contaminated materials, spent media, or solid residues may also be incinerated (See p. I-25 Paragraph E (3)).

The specific incinerator requirements in the proposed Agreement (at F-I-31-2 Paragraph E (6)), are based on the proposed EPA regulations pending at the time the proposed Agreement was negotiated and lodged with the Court. In order to ensure that the latest regulatory requirements would apply to Hooker, the proposed Agreement also specifically requires Hooker to operate the incinerator "in a manner to meet applicable federal and state

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statutes and regulations." (p. I - 3 B (6)(f)) (See a copy of the two applicable EPA incinerator regulations which are enclosed). Hooker therefore must comply with EPA and the State hazardous waste incinerator regulations, EPA and the State PCB incineration requirements, and EPA's dioxin disposal regulations (see copy enclosed). In sum, Hooker will not be able to incinerate any wastes unless and until it has demonstrated through submission of data and carefully supervised test burns that incineration of such waste would have no adverse environmental impact.

If you have any further questions on this matter, please feel free to call me.

Enclosures

Yours truly,

William Walsh

William Walsh
Attorney-Advisor
Office of Hazardous Waste
Enforcement

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY

Mr. J. F. McDonald
Environment Canada
25 St. Clair Avenue East
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Dear Mr. McDonald:

Your letter of June 5, 1981 specifically asked for IERL's comments on two questions:

(1) The adequacy of the Hooker Chemical Company incinerator for destruction of the Hyde Park residues,

(2) The suitability of incineration in general as a destruction method for the wastes in question,

With regard to the latter question, we believe controlled high-temperature incineration to be the most effective existing means for destroying organic hazardous waste to a high degree (99.99 percent and greater). Considerable design and operating experience is available on incineration relative to other hazardous waste control technologies. It has the ability to destroy a wide variety of hazardous materials. Perhaps the disposal of as much as 50 percent of the current United States annual hazardous waste generation is manageable by incineration. While incineration hardware is state of the art, there is a great need for more waste-specific performance data for a wide variety of hazardous waste streams for the numerous variants of incineration systems in order to determine the specific operating requirements for meeting RCRA and other performance standards.

On the first question, based upon the information you provided on the Hooker incinerator and the waste material of concern, it is not possible to provide a definitive engineering assessment of the adequacy of the incinerator. Also, the time available for evaluation is quite short. The following comments, however, represent our initial best engineering judgement on this matter and outline the data an steps which are necessary to eventually determine the adequacy of the unit.

(1) The design of the incinerator proposed is apparently some 20 years old, and the drawings or sketches we supplied are insufficient to permit our understanding of its operation in a complete manner.

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(2) The waste to be incinerated is not well defined in terms of concentrations of principal organic hazardous components (POHC's), the heating value, halogen content, moisture, percent solids, viscosity, and other properties.

(3) The mechanical design of the combustion chambers, apparently two units of similar size, is not well defined. More information on construction details, materials used, flow patterns, burner configurations, sizes, locations, auxiliary fuel inputs, temperature information, and other data would be essential for a complete definition.

(4) EPA's knowledge of the incinerability of certain of the waste components in the liquids and residues is limited, but some data is available on many of the compounds you listed in the form of laboratory and pilot scale investigation results. For example, hexachlorocyclopentadiene was examined at laboratory scale and in a pilot incinerator, but further tests would be necessary at full scale. Benzene is believed to be easily incinerated, as is the case with trichloroethylene. Mirex was tested in a pilot scale incinerator, and although these brief tests showed somewhat less than 99.99 percent destruction, we believe that proper feed and atomization conditions would show satisfactory results at full scale. Lindane pilot scale data is available and shows better than 99.999 percent destructibility. A host of PCB destruction data is also available including full scale information. Whether existing data can be applied to other incinerators of different sizes and designs is, of course, another matter. The EPA recommends that trial burns be implemented in most cases involving verification of one set of operating data which may be applied to a different incinerator of significantly different design.

Although time did not permit a search for more data on all of the compounds you mentioned from our sources of information available, our judgement is that most if not all of the compounds you noted including the dioxins can be safely incinerated under proper conditions and in state of the art incinerators. However, dioxins may require the most stringent control and operating parameters as well as presenting the biggest problem in terms of conducting test burns. In 1977, for instance, when dioxin contaminated herbicide orange inventories were incinerated, Federal authorities determined that for this particular action, incineration at sea using the incineration ship, Vulcanus, provided the optimal solution by removing the incineration site far away from populated areas. Due to the nature of dioxins, little data is available at laboratory or pilot scale, unfortunately.

(5) We would be very interested in any past performance data from the Tooker incinerator on known compounds in terms of destruction efficiency and temperatures, etc. These data may provide some insight into the incinerator's capacity for the compounds of current interest.

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(6) We feel that the Hooker incineration system does have the apparent capability for operating temperatures up to 1300° to 1420°C, which, along with sufficient residence time and mixing, could most likely destroy all of the compounds mentioned. However, we would require additional verification information on these claimed performance parameters as well as the past performance information noted above.

(7) Possibly our newly formed Permit Assistance Panel consisting of some 20 incineration experts may be appropriate to consider this matter further. This would have to be determined by offices other than at our R&D level.

In conclusion, we believe that any operational permit for the Hooker incinerator could not be granted without conducting an EPA approved series of trial burns on the unit. Such trial burns may need to begin with performance tests of the unit on selected waste streams of lesser toxicity levels first, proceeding towards the testing of gradually increasing concentrations of more toxic POHC's and then actual Hyde Park landfill residues of interest. Incineration regulations appropriate for consideration would include all of the Federal requirements now available (but not yet promulgated) under RCRA. For adequate control of dioxin compounds, it is conceivable that the current EPA task force on dioxins may also add additional requirements for incineration of the Hyde Park landfill residues in the near future. PCB regulations may also be appropriate.

Please review the comments contained in this letter and do not hesitate to contact us further through Mr. Walsh's office. Mr. Oberacker and I would appreciate hearing from you as to whether this reply has satisfied your letter of request at this point.

Sincerely yours,

E. Timothy Oppelt
Chief
Incineration Research Branch
Industrial Pollution Control Division

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