YUKON ENERGY AND MINES BRANCH

DEPARTMENT OF ECONOMIC DEVELOPMENT:

MINES AND SMALL BUSINESS

WHITEHORSE, YUKON

YUKON USED OIL DISPOSAL ALTERNATIVES

by

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ABSTRACT

The Energy and Mines Branch of the Yukon Government's Department of Economic Development: Mines and Small Business is interested in deriving energy from used oil by burning it in used-oil burners, so as to conserve oil, reduce heating bills and reduce the used oil disposal problem in the Yukon. However, before the branch encourages people to burn used oil in used-oil burners, it wants to know what all the alternatives for utilizing used oil in the Yukon are and the benefits and costs of each alternative. This paper shows the results of a study of the alternatives for utilizing used oil which are most pertinent to the Yukon. The study was conducted by a University of Victoria Geography Co-op student, Catherine Cottrell-Tribes. The Energy and Mines Branch seconded Ms. Cottrell-Tribes from Energy, Mines and Resources Canada to do this study during her work term from June to August 1989. This paper will be used as background material for another study being conducted by professional consultants sometime in the fall of 1989.

This paper is based on a review of all the relevant literature on managing used oil and on many personal interviews conducted by Ms. Cottrell-Tribes. Due to limited resources the paper is largely qualitative in nature, but should be useful for directing the next study.

Three alternatives are examined in this paper: transporting used oil out of the Yukon to be re-refined, burning used oil in used-oil heaters or in cement kilns, and re-refining or reprocessing used oil in the Yukon. The author concludes that the best of these alternatives is transporting used oil out of the Yukon to be re-refined.

YUKON USED OIL DISPOSAL ALTERNATIVES

CONTENTS

LIST OF TABLES

LIST OF FIGURES

YUKON USED OIL DISPOSAL ALTERNATIVES

Introduction

Much of the Yukon Territory's used motor oil is being deposited in municipal dumps and landfills, stored in oil drums at industrial sites, or simply dumped in convenient areas, close to points where oil is changed. This undesirable situation will not change until Yukon residents are offered alternative methods of managing used oil. One alternative is to teach consumers to question their dependance on their non-renewable and environmentally harmful methods of heating and transportation. This is the key alternative, but it will not be pursued in this paper due to the terms of reference. This paper will examine the lesser but still very important alternatives for re-using oil.

The current methods of managing used oil are undesirable because of the health risk they pose to humans and other species sharing our environment. The detrimental effects of the used oil on the environment and its inhabitants may not be felt immediately after its disposal, but the accumulated effects of ingesting or absorbing small dosages of waste oil constituents (see Table 1) from leachates entering surface or groundwaters, over a long period of time, could have significant implications for health. For example, arsenic may cause cancer up to 50 years after exposure. Other effects of long-term exposure to the constituents of used oil include weakness, malaise, dermatitis, kidney damage, bone weakening, reproductive damage, nervous impairment, cardiovascular harm, digestive upsets, headaches, and various cancers(4).

Table 1. Concentration of Potentially Hazardous Constituents in Used Oils[a]

Parameter	Mean Concentration[b] (ppm)	Median concentration[c] (ppm)
Metals		
Arsenic	17	5
Barium	132	48
Cadmium	3.1	3
Chromium	28	6.5
Lead	665	240
Zinc	580	480
Chlorinated Solvents		
Dichlorodifluoromethane	373	20
Trichlorotrifluoroethane	62,9000	160
1,1,1-Trichloroethane	2,800	200
Trichloroethylene	1,3900	100
Tetrachloroethylene	1,420	106
Total Chlorine	5,000	1,600
Other Organics		
Benzene	961	20
Toluene	2,200	380
Xylenes	3,390	550
Benzo(a)anthracene	71	12
Benzo(a)pyrene	25	10
Napthalene	475	330
PCBs	109	5

Notes.
[a] results determined from the analyses of 1,071 used oil samples
[b] calculated for detected concentrations only
[c] for the purposes of determining median concentrations, undetected levels were assumed to be equal to the detection limit.
(Extracted from 10,p2-7,Table 2-4)

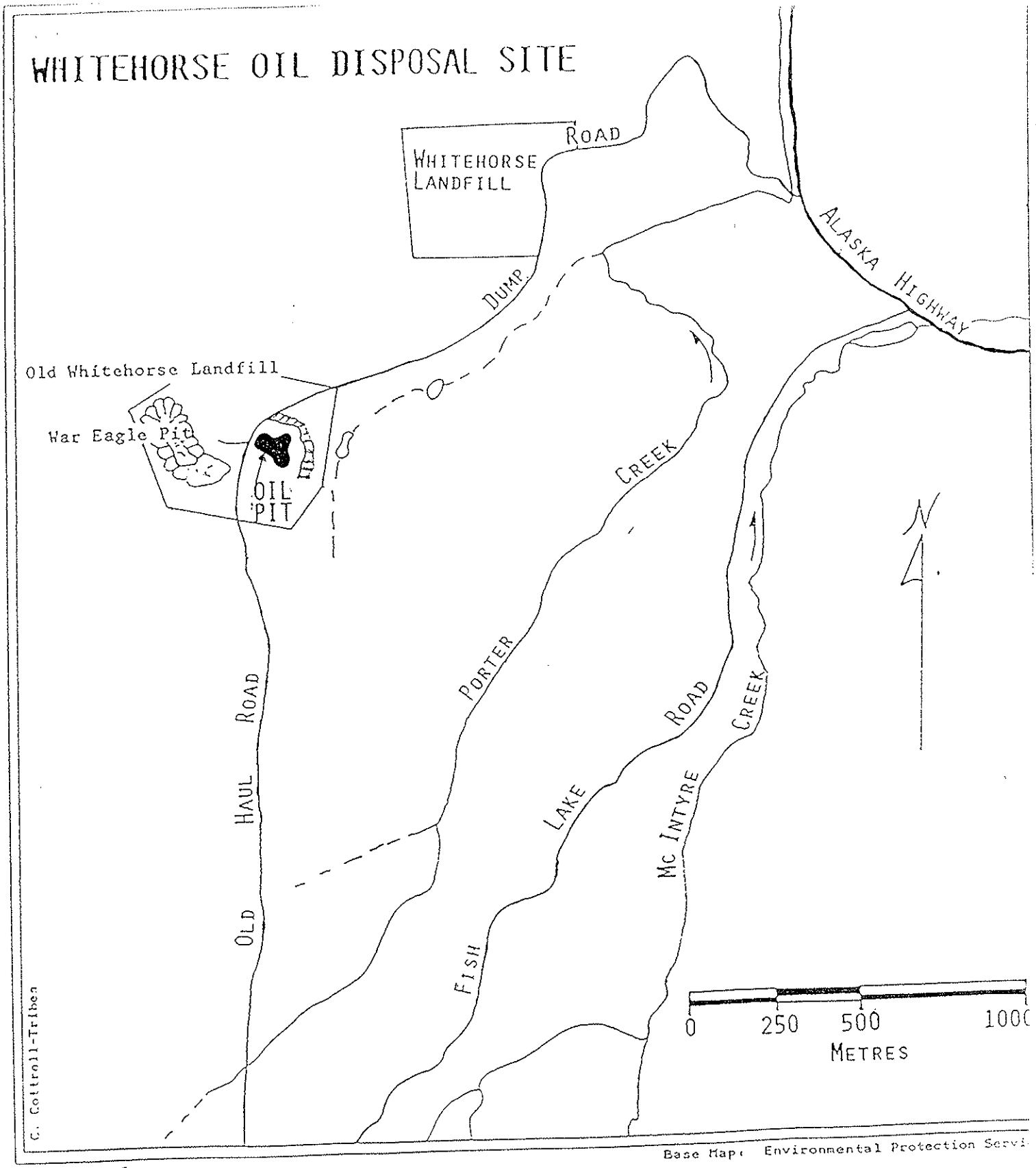
The hazardous substances, such as barium, zinc, and aromatic organics, are added to the oil during the refining process and "usually comprise 10 to 20 percent by volume of finished lube products"(9,p2-9). The hazardous substances are added "to improve the effectiveness of the

lubricant and to extend its life"(9,p2-9). Other substances, such as cadmium and chromium, enter used oil largely due to engine wear.

Oil most commonly enters and spreads through the environment by forming a leachate with water. Water cannot be cleaned once oil leachate contaminates it. In groundwater, microbial activity is slow due to low temperatures, so the used oil does not degrade as fast as it would above ground. Thus, the only practical action for humans, using contaminated groundwater, is to use carbon filters, or in severe cases abandon the contaminated water; other species may not have the same choice.

One used oil site with a potential for leaching into an important water source is the used oil "pit" at the Whitehorse landfill. The volume of oil in the pit is approximately 2 million litres(43). The oil pit is situated atop a pile of rocks left by the mining company which leases the area to the city. As can be seen in Figure 1, the area adjacent to the oil pit drains into some small ponds, an intermittent stream, and eventually into Porter Creek, a tributary of the Yukon River. While the Ministry of Environment has not, as yet, discovered any contamination caused by the used oil, members of the ministry feel that it is only a matter of time before leachate from the oil contaminates the nearby water(22,43). (See Appendix A for photographs of the used oil pit).

Given the possible harmful effects of used oil discussed earlier, the implications of oil possibly leaching into the water are serious for the plant and animal species which rely on the Yukon River, and Porter Creek. From a purely anthropocentric viewpoint, there are several


WHITEHORSE OIL DISPOSAL SITE
WHITEHORSE LANDFILL
ROAD
DUMP
ALASKA HIGHWAY
Old Whitehorse Landfill
War Eagle Pit
OIL PIT
CREEK
PORTER
HAUL ROAD
OLD
LAKE
ROAD
MC INTYRE
CREEK
FISH
N
0
250
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1000
METRES
C. Coltroll-Tribes
Base Map: Environmental Protection Servi

FIGURE 1

communities downstream of Whitehorse in the Yukon and in Alaska which rely on the Yukon River for drinking water and fish.

While the used oil pit at the Whitehorse landfill may be one of the largest used oil disposal sites in the Yukon, it is by no means atypical. Other municipalities and mining companies(19) have similarly risky disposal practices. However, no matter how safe and efficient the disposal method we choose, simply treating used oil as a waste should not be the final solution for the problems caused by these unacceptable practices. We know that our reserves of "virgin" oil will eventually run out, so it seems foolish to simply dispose of such a valuable, recyclable resource as used oil. With this in mind, only alternatives to the current practices which may be feasible for re-using used oil in the Yukon will be examined in this paper. (See Appendix G for information on how some northern communities outside the Yukon are managing used oil.)

Inventory

A first step in determining the feasibility of various recycling alternatives, is to establish the volumes of oil generated in the Yukon and what is available for recycling. A preliminary inventory (a systematic inventory has not yet been done) reveals that over 400,000 litres of used oil are generated in the Yukon each year and that over 330,000 litres of that used oil is available for recycling. (See Appendix B for a breakdown of used oil sources in the Yukon.)

Alternative 1: Energy From "Waste"

When used oil is burned in used-oil heaters, it is most often a substitute heat source for establishments that would otherwise burn virgin oil in conventional oil heaters. Thus, even though burning used oil only allows it to be reused one time, it still reduces the amount of virgin oil which is consumed, as well as the amount of used oil which must be disposed of.

One section of the Yukon government and at least four businesses in the Yukon, utilize used oil to heat some of their buildings. They cite lower heating costs, combined with a desire to conserve oil and reduce the amount of waste, as reasons for installing the used-oil heaters. Of the utilizers of used oil, all but Whitehorse Motors and Northern Kat Ltd. burn used oil generated by their own operations. Whitehorse

Motors and Northern Kat Ltd. also burn oil from other sources(35,38). (See Appendix C for a summary of each organization's used oil system.)

Whitehorse Motors, Yukon Highways Central Workshop, Yukon Alaska Transport, and Mic Mac Motors, all in Whitehorse, use atomizing used-oil burners, while Northern Kat Ltd., in Dawson, uses a vapourizing burner. The atomizing burners are preferred by many, even though they require more capital initially, and not all models are CSA approved(26). The reason for this is that atomizing burners do not require the daily cleaning that the vapourizing burners require. Atomizing burners also have higher operating efficiencies than vapourizing burners because they have a more complete mixing of air and fuel. The mixing occurs when compressed air forces the used oil, and contaminants, into a mist, which is then burned(25). This leads to the negative aspect of an atomizing burner: all the contaminants in the used oil are also atomized and thus escape out the stack and into the atmosphere. The hazardous substances can then be inhaled directly or ingested through drinking water or crops, to which the wind has carried the contaminants.

Vapourizing burners release fewer contaminants into the air than do atomizing burners because in a vapourizing burner oil is injected onto a preheated vapourization pan which causes the oil to evaporate but leaves much of the hazardous constituents in a solid form on the pan. The vapour is then burned in a combustion chamber and so only the contaminants able to stay in the oil vapour are emitted out the

stack(6,7). This is positive from an environmental perspective because the hazardous substances in the oil are easier to contain in a solid form inside the burner than if they were in a gas form and spread about by wind outside the burner. Having the contaminants contained inside the burner is negative from a maintenance perspective, however, because the residue must be removed from the burner daily.

Other positive qualities of vapourizing burners are that they are more reliable than atomizing burners because they have fewer parts to break down and are far less affected by suspended solids that can plug filters. Also, the capital cost of vapourizing burners is lower than that of atomizing burners(1).

Since very little pre-treatment (i.e. settling and filtering) is given to the used oil before it is burned in the used-oil burners, there is reason to be concerned about the toxicity of the emissions from these burners. A comparison of emissions from vapourizing and air atomizing used-oil burners is presented in Table 2.

Table 2. Comparison of discharge concentrations of some elements determined by ICAP[a] and the American Conference of Governmental Industrial Hygienists Threshold Limit Values (all values are reported in $\mu g/m^3$).

Threshold Limit Values (Time Weighted Averages)	Pb 150	P 1000	Cr 500	Ni 1000	Cu 1000	Zn 5000	Cd 50	Fe 1000	Co 50
SASS TRAINS[b]									
Vaporizing burner-truck[c]	200	210	1500	1100	16	450		5600	21
Vaporizing burner-automotive[d]	1600	200	4200	21	16	200	1	1500	54
Air atomizing burner-automotive	144000	19000	5000	3500	2400	66000	110	22000	72
Air atomizing burner-truck	58000	69000	310	1600	2400	120000	160	16000	23
Dilution Filters									
Vaporizing burner-truck	120	520	0.9		11	340	0.3	48	2
Vaporizing burner-automotive	550	170	0.6		6	89	0.4	37	1
Air atomizing burner-automotive	86000	40000	300	54	1800	46000	86	9000	220
Air atomizing burner-truck	24000	51000	79	32	1000	45000	86	4400	9

Notes:

[a] Inductively Coupled Argon Plasma - used to "determine fuel elemental mass values"(4,p684).

[b] SASS (Source Assessment Sampling System) Trains and Dilution Filters are two different methods of sampling stack emissions. "For most elements, the SASS train collected a significantly higher amount of the element of interest than the dilution tunnel, indicating that metallic species may be passing through the dilution tunnel sampler uncollected"(11,p686). The anomalously high value for chromium and nickel in the SASS sample "appeared to be a sampling artifact caused by the stainless steel sampling system"(11,p686).
(5,p686,Table IV)

[c] truck oil

[d] automotive oil

Table 2 shows that both vapourizing and atomizing burners exceed the "Threshold Limit Values" for 50% of the values. Also, the atomizing burner exceeds the threshold limits for 86% of the values while the vapourizing burner exceeds the threshold limits for 46% of the values (only the SASS Train samples are included in this comparison, with the nickel and chromium values being omitted-see notes with Table 2). Omitting the SASS TRAIN values for nickel and chromium, the atomizing burner's emissions are over 100 times as great as the vapourizing burner's emissions for 80% of the values and exceed 1000 times the vapourizing burner's emissions for 13% of the values.

While the results of Table 2 are too general to draw specific conclusions about health impacts, they do show that the atomizing burner used in this test had far greater emissions of metals than the vapourizing burner. Given the way the two different types of burners operate, it seems likely that atomizing burners would generally have higher emissions of heavy metals than vapourizing burners, burning the same used oil stock.

The results of another test, shown in Table 3, give similar results.

Table 3. Gaseous and particulate data from waste oil heaters.

	Oxygen %	Excess Air %	Carbon Monoxide ppm @ $3\%O_2$	Carbon Monoxide g/kg	Unburned Hydrocarbons ppm @ $3\%O_2$	Unburned Hydrocarbons g/kg	Nitric Oxide ppm @ $3\%O_2$	Nitric Oxide g/kg	Sulfur Dioxide ppm @ $3\%O_2$	Sulfur Dioxide g/kg	Steady-State Smoke No. Bacharach	Particulate Loading mg/m^3
Vaporizing burner												
No. 2 oil	9.45	76.9	31.2	0.48	2.5	0.06	51.2	0.84	20.1	0.7	4.1	24.15
Automotive waste oil	9.98	84.6	14.7	0.23	3.3	0.08	104.4	1.72	195.6	6.9	1	18.2
Truck waste oil	10.08	86.7	16.5	0.25	1.8	0.04	90.3	1.47	318.6	11.1	1	26.72
Air atomizing burner												
No. 2 oil	4.2	23.5	12.9	0.2	1.7	0.04	59.4	0.97	55.9	1.9	0	10.28
Automotive waste oil	4.83	27.9	25	0.38	3.1	0.08	158.1	2.61	214	7.5	2.2	224.45
Truck waste oil	4.83	28	16.7	0.25	2.1	0.05	109.6	1.79	333	11.6	1.1	223.4

(5,p687, Table III)

Even with the lower excess air level and thus higher temperature at which the atomizing burner was able to operate, its value for particulate loading was an order of magnitude higher than the corresponding vapourizing burner value. The relatively high smoke number for the vapourizing burner using No. 2 oil may be due to the No. 2 oil being less volatile than the used oil, resulting in a sootier sample.

Tables 2 and 3 may lead us to conclude that the lower quantities of metals, gaseous and particulate matter emitted by vapourizing burners make vapourizing burners more acceptable from an air quality perspective than atomizing burners for burning used oil. However, the study also showed "that total organic emissions from the two burner designs are similar....[but] higher levels of PAH [polynuclear aromatic hydrocarbons] were found in discharges of the vaporizing burner"(5,p687). Therefore, when comparing the two burner types, we must weigh the greater amount of metals, gaseous and particulate matter emitted from atomizing burners against the greater amount of organic substances,including PAHs, emitted from vapourizing burners.

Another important point to consider when comparing the two designs of burners is that of the residues left in the burners. It is advisable to dispose of the residues from both types of burners in impermeable containers. Vapourizing burners leave more solid wastes to be disposed of than atomizing burners. While the original waste volume is greatly reduced, the hazardous substances are in a much more concentrated form and PAHs have also been "observed in the vaporizing pot residue after combusting truck crankcase oil"(5,p685).

To minimize the hazards caused by burning used oil, large burners (greater than 25 million kJ/h) can be used. Larger burners are more likely to have pollution control devices than smaller boilers(9). As well, boilers with a larger capacity are considered more environmentally acceptable because they provide more complete combustion due to their higher temperatures and longer fire box residence times. However even

large burners may not be able to reach the 1000°C temperature with a fire box residence time of 1 second, recommended by the Canadian Council of Resource and Environment Ministers (CCREM) to "ensure the destruction of organics"(2,p4-4).

Further actions to minimize the hazards associated with burning used oil in used-oil burners are addressed by government guidelines.

Government Guidelines For Used-Oil Burners:

There is no legislation specific to burning used oil in used-oil burners in the Yukon, but some provinces have specific legislation. The Government of Manitoba requires used-oil burners to be licensed according to the guidelines of the Clean Environment Act(9). The government of British Columbia does not encourage burning used oil in used-oil burners(30). The Government of Quebec has quality standards for used oil burned in greenhouses and industries. Burners must be approved and flue gas emissions "must not compromise ambient air quality standards"(9,p5-24). Appendix D contains the Quebec quality standards for used oil.

The Ontario Ministry of Environment requires used-oil burners to obtain a certificate which specifies the maintenance program to be

followed, "operating constraints and site specific requirements for oil quality, burner location and storage facilities"(9,p5-4). Only vapourizing burners may be approved without requiring "individual testing and assessment since [atomizing burners] do not have a source test history"(11,p3). Only transmission oil, hydraulic oil and diesel crankcase oils may be burned and these oils may not contain lead or chlorinated organic compounds. "Chlorinated organic compounds in fuel of any kind may result in the emission of highly toxic complex products such as dibenzofurans or chlorinated dioxins"(11,p2). As well, only used oil "generated on the premises of the owner can be burned"(11,p2).

The Canadian Council of Resource and Environment Ministers (CCREM) has produced emission guidelines for Municipal Solid Waste Incinerators (MSW). These guidelines may also be useful for setting emission standards for used-oil burners as they establish limits on some of the hazardous substances which are found in used-oil burner emissions as well as MSW incinerator emissions. The relevant CCREM MSW emission guidelines may be found in Appendix E.

Burning used oil in cement kilns:

Energy Mines and Resources Canada endorses the "combustion of waste oil in industrial minerals kilns (e.g. cement or lime) as contaminants of concern are either destroyed or bound in the cement"(15,p1) Also, Skip Hayden of the Canadian Combustion Research Laboratory recommends using cement kilns over used oil burners for recycling used oil, but only if re-refining the oil is not feasible(27). Burning used oil

in cement kilns provides extra energy for the cement making process(20), as well as reducing the amount of used oil which must be disposed of. When used oil is burned in cement kilns, the temperatures are great enough and the retention times long enough to destroy organic contaminants. Most of the heavy metals within the used oil become trapped "within the insoluble structure of the hydrated compounds in the concrete produced from the cement"(15,p5-16). The quality of the cement is not decreased and the kilns only need slight modification to burn used oil(9). The bottom sediment and water in the used oil should be removed prior to it being burned in a kiln(9).

There are no cement kilns in the Yukon Territory, so used oil would have to be transported out of the territory to the kilns. Canadian LaFarge, the largest cement manufacturer in Canada, does not seem too interested in using used oil in their kilns, although the company's Vancouver plant burns other waste, such as methane from a landfill, sawdust, woodchips, and rubber tires, as an energy source to heat its kilns(23,29).

Alternative 2: Transporting Used Oil Out of the Yukon to be Re-refined

Re-refining oil allows for its reuse indefinitely, and so has the potential to greatly reduce the amount of virgin oil consumed, and the amount of used oil which must be disposed of. There are no re-refineries located in the Yukon, so an infrastructure for collecting and transporting the used oil out of the territory needs to be created if used oil is to be re-refined in an established re-refinery. The infrastructure should include an overseeing authority, a territorial collection system, and a transportation system to move the oil from the Yukon to a re-refinery.

The overseeing authority should be a government body because of the broad coordinating, enforcing, and educating scope that would be needed to have a successful collection program. The Territorial Government's Department of Renewable Resources or its Department of Community and Transportation Services are structured for managing such a program(21). Along with coordinating the collection and transportation of the used oil, the overseeing authority should be responsible for legislation to enforce bringing oil to collection centres and having collection centres in the communities. If a tax on oil sold in the Yukon was applied to overcome collection costs, the overseeing authority should also be responsible for legislating the tax. An additional role of the overseeing authority should be to promote the collection program to the public and to educate the public on the purpose, value and proper usage of the collection system.

Finally, the overseeing authority would monitor all aspects of the system, such as transportation safety, storage facilities, and oil quality.

The collection system could have local collection centres in communities throughout the Yukon and a central collection depot at the Whitehorse Landfill. If communities with populations greater than 400 were chosen as collection centres then all the main used oil generators would be included in the program (21). The collection centres could be at service stations, landfills/dumps, or whatever location suits the individual communities best. The Yukon's central depot could be located at the Whitehorse landfill as people are accustomed to depositing used oil at the Whitehorse landfill, and there is enough space there.

At all of the collection centres the following guidelines should apply to ensure an oil quality suitable for re-refining:

> "1. Used oils should be segregated at source to minimize contamination. Degreasing solvents, gasoline, anti-freeze, paint strippers and/or pesticides should not be mixed with used oil.
>
> 2. Lubricating oil containers should provide information to encourage consumers to return used oils to collection facilities.
>
> 3. Quantities of used oil greater than 20 litres should be stored in clearly identified and approved containers.
>
> 4. Used oil storage areas and containers for used oil should be clearly marked and posted with signs describing the need to avoid contamination"(9,p3-11).

To encourage the public to use the collection centres and to encourage the system's operators to maintain the collection centres well, the following should apply:

"-the site[s] must be accessible but located away from drainageways and environmentally sensitive areas;

-the area should be posted with signs advising [used oil] generators to avoid contamination of used oil. The sign should list restricted used oils which are not accepted at the centre (antifreeze, brake and steering fluids, paints, solvents and gasolines);

-secure waste repositories for empty used oil containers should be provided;

-the area around the tank inlet and waste repository should be inspected regularly to ensure adequate collection frequencies;

-the centre should be equipped with a telephone and a list of emergency phone numbers to call in case of a spill, vandalism or a full tank;

-a reasonable level of cleanliness should be maintained to avoid a messy appearance which would discourage small volume generators from using the facilities"(9,pp3-15,3-16) and;

and the sites should be equipped with "underground storage tanks, liners below and around storage tanks..., loading/unloading facilities, and perimeter fencing"(9,p3-16).

The transportation system would need to facilitate oil being hauled from the local collection centres to the main depot at the Whitehorse landfill, and oil being hauled from the Whitehorse depot to the chosen re-refinery. Vehicles operating within the Yukon would need no special licensing, as the Federal Transportation of Dangerous Goods Act does not classify used oil as a dangerous good and there is no territorial regulations for transporting used oil(41). The used oil could be transported by Yukon Territorial Vehicles returning to Whitehorse and/or private haulers. Large used oil generators could be required to haul their own used oil to Whitehorse.

Contracted haulers, hired either by the overseeing authority or the re-refinery, could transport the used oil to the re-refinery and would have to conform to the regulations of the province they were traveling through. If one of the re-refineries closest to Whitehorse, the Mohawk

Re-refinery in Vancouver, was the end market for the Yukon's used oil, that company would contract tanker trucks to transport the used oil from Whitehorse to the re-refinery. Mohawk would charge 14.3 cents per litre for this service. Mohawk requires that at least 38.6 thousand litres per haul, of used oil be available and that the used oil meet Mohawk's quality standards. A test of the top, middle, and bottom of the first haul would need to be analyzed and the results reported to Mohawk(34).

The closest re-refinery, the Turbo Re-refinery in Edmonton, would also hire a contractor to transport the Yukon's used oil. The cost would reflect the contractor's rate. The first time the used oil was to be collected Turbo would require that the oil be analyzed to ensure it meets the company's standards. Turbo's standards do not appear to be as stringent as Mohawk's standards. For example, Turbo will take a customer's word that the oil is not contaminated with PCBs(42).

If the overseeing authority for the collection system hired a contractor to haul the used oil out of the Yukon, costs could be reduced by hiring transporters who are equipped to haul oil and who are presently leaving the Yukon with empty vehicles. The White Pass and Yukon Corporation ships the most oil into the Yukon (65%(8,p42)) and so is the most likely company to have the back-hauling capability needed for transporting used oil out of the Yukon.

Finally, an awareness program should be undertaken by the overseeing authority to acquaint the public with the collection system. The

awareness program should have a promotional aspect and an educational aspect. The promotional aspect could include

-signs at oil purchasing points encouraging consumers to return their used oil to collection centres;

-newspaper advertising of the collection system;

-signs on buses, transport trucks, etc. advertising the collection system;

-radio or local cable t.v. advertisements;

-a deposit refund on oil;

-and information on the used oil program presented in recycling packages targeted at schools and the general public.

The educational aspect of the awareness program could inform the public and the operators of the collection system, of desirable practices designed to maintain the integrity of the system. Educational activities could include

-posting signs at collection centres "stating the used oil products by brand or generic names, which are accepted for collection;

-erect[ing] an information board or provid[ing] information regarding disposal options for used oil products which are not acceptable (i.e. names, addresses and phone numbers of local collectors or government agencies involved in special waste collection);

-introduc[ing] a receipt system requiring the customer to complete and sign a simple "tick-off" form regarding the nature of the used oil (i.e. crankcase oil, power steering or brake fluid, transmission fluid, and other, "specify";

-and erect[ing] a fence with a locked gate around the oil drop-off facility or us[ing] drums with locked caps (as used for automotive gas tanks).... each customer [could] fill out a receipt before the key for access is released"(9,p3-14).

Alternative 3: Re-refining or Reprocessing Used Oil in the Yukon

Energy Mines and Resources Canada encourages re-refining as the most desirable mode of waste oil disposal as it preserves virgin oil stocks(15). Re-refining and reprocessing "restore the original usefulness of the oil or clean the contaminated oil to a point suitable for subsequent reuse"(9,p4-1). In addition, the by-products of re-refining can be useful, depending on the re-refining process. For example, the Mohawk re-refinery in Vancouver has two by-products: asphalt and a road bed base(34). At the Turbo Re-refinery, in Edmonton, the "light ends cut" of the used oil is sent to a gasoline re-refinery. The only other by-product is a neutralized sludge which is solidified and then landfilled(42).

Re-refining and reprocessing differ in that reprocessing uses lower technology than re-refining, is less expensive and removes less contaminants from the oil, therefore producing an oil inferior to re-refined oil. Reprocessing includes such methods of contaminant removal as "settling, dehydrating, flashing, filtration, coagulation and centrifugation"(10,p5-2). Re-refining has two types of processes for removing contaminants: the Acid/Clay process and the Distillation processes. The Distillation processes require higher technology, but produce a better product than the Acid/Clay processes and generate less waste, as well as costing less than the Acid Clay processes. For more detail on the re-refining processes, the wastes they generate, and their costs see Appendix F.

When considering whether or not to build a re-refinery in the Yukon, we should consider the results of a 1987 study conducted in the Northwest Territories. The study concluded that there was not enough used oil generated in the Northwest Territories to justify building a re-refinery in the Northwest Territories. The study said that the amount of used oil would have to be an order of magnitude higher than the 834,000 litres per year generated in the Northwest Territory. From the results of the preliminary inventory, it appears unlikely that the Yukon Territory generates more used oil than the Northwest Territories.

Reprocessing requires less oil and costs less than re-refining, so reprocessing may be more feasible in the Yukon. Although reprocessed oil may not be of good enough quality to use as a lubricating oil it would be of a much better quality to burn in used oil heaters than untreated used oil. Currently, a re-processor, the "Shurtleff Refiner", is being developed in New Brunswick by Utopia Fabricating Ltd. The re-processor can process 1800 litres of used oil per day. The re-processor's distillation process is fueled by its own end product. The by-products of the Shurtleff Refiner are sludge containing heavy metals, and energy (greater than 210 000 kJ/h). Emissions from the reprocessor are claimed to be similar to those produced from a residentially-sized heater equipped with an atomizing burner and burning No. 2 fuel oil(3,14).

A territorial collection system as discussed in Alternative 2 combined with using a reprocessor near the central collection depot and then burning the reprocessed oil in the best available used-oil burner may be

a useful compromise between the three alternatives. When considering such a compromise it would be necessary to compare the cost of the reprocessor to the cost of transporting used oil out of the Yukon to a re-refinery, as well as comparing the emissions of reprocessed used oil burnt in used-oil heaters to that of used oil which has not been reprocessed. Also, the emissions and waste from the reprocessor must be considered.

DISCUSSION

Due to limited resources, this study has not been able to include indepth quantitative data, however, the information that has been presented is sufficient to make the qualitative analysis that follows.

Alternative 1: Energy From "Waste".

Both Energy, Mines and Resources Canada and the Canadian Combustion Research Laboratory(15,27) suggest that burning used oil in used-oil burners be the last alternative considered for disposing of used oil if re-refining or burning used oil in cement kilns is not possible. As well, some provinces discourage the use of used-oil heaters or require special testing and certification in order for them to be used(11,30). When we consider the harmful emissions created by used-oil heaters, the reluctance of governments to encourage their use is not surprising. Although using these heaters has the positive effects of reducing virgin oil consumption, lowering heating costs and reducing waste, the air pollution they create makes them environmentally undesirable. Even if the effects of the heavy metals and toxic organics in the emissions are not felt close to the point of emission (i.e. if a tall stack was employed and the gases were carried some distance away), or if the effects are not felt in the short term, we know that in the long term these substances do not readily break down, do bioaccumulate, and do have negative, even deadly effects on living organisms. We do not know if spreading the hazardous substances, which can be harmful in trace amounts, through the air is more or less harmful than allowing them to

spread through the water; thus, we cannot know if burning used oil in used-oil heaters is more environmentally acceptable than disposing of the used oil in landfills. Therefore, we should look more seriously at the other alternatives, even though they may entail more short term monetary costs than utilizing used-oil heaters.

Burning used oil in cement kilns appears to greatly reduce the problem of hazardous substances being emitted into the air. However, the hazardous substances are retained in the cement, and while they can be controlled much more readily in this form, it is questionable if all the hazardous substances will stay locked in the cement, especially before it is hydrated. There is the possibility that users of such cement could contact the hazardous substances that are in the cement. Even with the this possibility, burning used oil in cement kilns appears to be an environmentally more acceptable way of deriving energy from used oil than burning it in used-oil heaters.

Alternative 2: Transporting Used Oil Out of the Yukon to be Re-refined.

The Yukon public could see the initial costs of setting up the infrastructure for transporting used oil out of the Yukon to be re-refined as an investment in health by the Yukon Government. The concern shown by the government would not only be seen as a favourable short term project, but as a very positive and responsible long term action taken for the future of the Yukon. Given the public's current strong interest in managing the environment well, such an action

should be well received, even if it means requiring a deposit on oil sold in the territory, to cover the program's costs.

Transporting the oil out of the territory to be re-refined is not simply giving the Yukon's problem away. The re-refineries in the south are capable of re-refining the amount of used oil generated in the Yukon in addition to their regular loads. Both the Mohawk re-refinery in Vancouver and the Turbo re-refinery in Edmonton, which are the closest re-refineries to the Yukon, have indicated their interest in the Yukon's used oil(34,42). Their re-refining systems are already in place, including methods for disposing or using the by-products of their re-refining processes. Transporting the Yukon's used oil out of the territory to be re-refined appears to be the best of the alternatives discussed in this report and it is recommended that the concerned divisions of the Yukon Government concentrate their efforts in this area.

Alternative 3: Re-refining or Reprocessing Used Oil in the Yukon.

Building a re-refiner in the Yukon would be redundant, as the southern re-refineries have the capacity to take the Yukon's used oil. Also, from a report conducted in the Northwest Territories, it appears that a re-refinery operating with just the Yukon's volume of used oil would have a large excess capacity(13). If a reprocessor was used in the Yukon, the territorial infrastructure needed for collecting used oil would still need to be implemented and the sludge containing the heavy metals disposed of in an acceptable manner. The costs saved by using the reprocessed oil may slightly offset the costs of setting up the

infrastructure, however, if the emissions from the reprocessor and/or the heaters in which the reprocessed oil is burned prove to be a hazard, then the benefits of such a system would not outweigh the costs. In order to satisfy the public on the unknown information associated with this alternative, it is recommended that this alternative be studied in greater detail, but that further study of it not be allowed to impede efforts to initiate Alternative 2 (Transporting Used Oil Out of the Yukon to be Re-refined). Studying Alternative 3 while initiating Alternative 2 should not cause conflicts as the territorial infrastructure would need to be created for either alternative.

CONCLUSION

We can conclude from the discussion that the best solution to the Yukon's used oil disposal problem, is to transport the Yukon's used oil out of the Yukon to be re-refined. Even if the costs of this solution appear too high for any short term gains, in the long term, this alternative is the best for preserving the environment and conserving energy.

In illustration: A report written on the Northwest Territories' used oil disposal problem stated that "re-refining the waste oil in Southern Canada may become economically feasible if the costs of getting the waste oil to the re-refinery are substantially reduced and the price paid for the waste oil rises considerably. This is not expected to happen in twenty years"(12,p61). This report reflects the view of those who believe that the short term costs of transporting the used oil south to a re-refinery are too high. However, can we afford to wait twenty years to see if our neglect or ideas of practicality have irreversible harmful effects? What if we find, in twenty years time, that the amount of contaminants we have let escape from burners and dumps into our environment has done irreparable damage? Can we afford the price (in 2009 dollars) of relocating people, subsidizing fishermen and trappers, and paying for health bills and law suits because of the effects of the bioaccumulated contaminants? As well as the pollution we are adding to our environment, we are also using up a valuable resource, when we could be re-using it many times. Will we look back in 2009 on the foolishness of simply using oil once instead of many times?

Finally, as was noted in the introduction, the key to solving the waste oil disposal problem is to teach consumers to question their dependance on oil. As in many waste related problems, we focus too much on what to do with refuse, instead of on how to create less refuse in the first place. But before people will create less, they must be given a reason to do so; they must recognize that a problem is created by their current practices and that they are able to lessen this problem substantially. This means that an educational system must be established which researches the problems, shows people how they can conserve, and makes and enforces regulations to ensure that people do conserve. In most parts of Canada this is a provincial responsibility and is taken care of by some branch of the provincial governments, for example the Waste Management Branch of the British Columbia Ministry of Environment. However, in the territories this responsibility falls between the cracks of territorial and federal jurisdiction, leaving various departments of both governments to react to waste related problems as they occur. Therefore, for the long term health of the Yukon, and to manage all waste related problems in the Yukon, a territorial waste management body needs to be formed and given all the authority and power of similar bodies across Canada.

RECOMMENDATIONS

1. The Yukon Territorial Government Departments of Renewable Resources and Community and Transportation Services should concentrate their efforts in transporting the Yukon's used oil out of the territory to be re-refined. The divisions within these departments that are most concerned with the used oil problem should form the overseeing authority and determine exactly who will undertake the steps listed in Alternative 2(Transporting Used Oil Out of the Yukon to be Re-refined).

2. If burning used oil is still to be considered, then burning used oil in cement kilns should be considered seriously, as it appears to be a more environmentally acceptable way of deriving energy from used oil than burning it in used oil heaters.

3. Reprocessing used oil in the Yukon should be studied in greater detail to answer some of the questions associated with it, but further study of this alternative should not be allowed to impede efforts to initiate transporting the Yukon's used oil out of the Yukon to be re-refined.

ABBREVIATIONS

ASME	American Society of Mechanical Engineers
bbl/day	barrel per day - 158.97 litres per day
CCREM	Canadian Council of Resources and Environment Ministers
DIAND	Department of Indian Affairs and Northern Development
EMRC	Energy, Mines and Resources Canada
HVI	High Viscosity Index
ICAP	Inductively Coupled Argon Plasma - used to "determine fuel elemental mass values"(4,p684)
LVI	Low Viscosity Index
MSW	Municipal Solid Waste Incinerators
MVI	Middle Viscosity Index
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PNA	Polynuclear Aromatic
PROP	a distillation re-refining process
ppm	parts per million
ppmdv	parts per million dry volume
RDF	Refuse Derived Fuel
SASS TRAIN	Source Assessment Sampling System Train - method of sampling stack emissions to determine the concentration of substances in flue gases
µg	micro gram - 10^{-6} grams
YT	Yukon Territory
YTG	Yukon Territorial Government

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PERSONAL COMMUNICATIONS

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35. Nielson, Rick. General Manager, Whitehorse Motors, Whitehorse, Yukon.

36. Rafferty, Terry. Yukon Electrical Company.

37. Robinson, Marvin and Donny. Robinson Trucking, Yellowknife, Northwest Territories.

38. Schmidt, John. Owner, Northern Kat Ltd., Dawson, Yukon.

39. Senyk, Krystal. Utilities Technologist, City Of Whitehorse.

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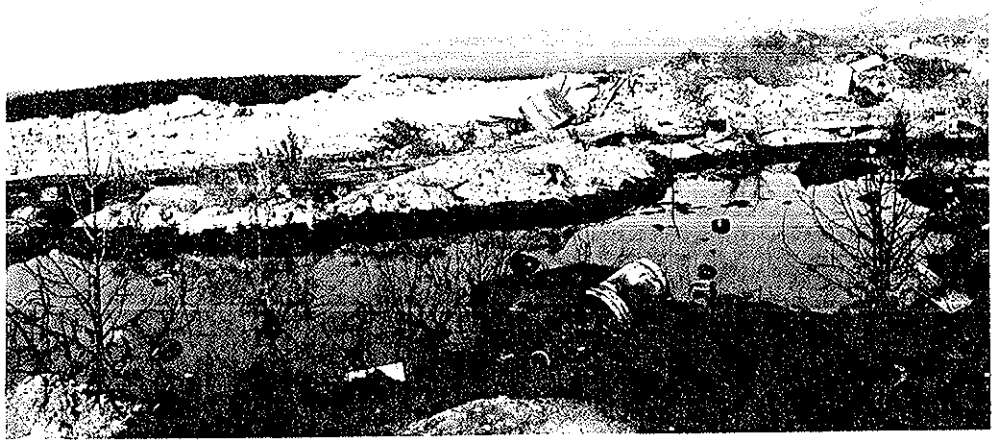
42. Wargacki, Marion. Plant Manager, Turbo Re-refinery, Edmonton, Alberta.

43. Wile, Ken. Ex-Manager, Industrial Programs, Environmental Protection, Yukon Branch, Environment Canada.

APPENDIX A

WHITEHORSE USED OIL DISPOSAL PIT
AT
WHITEHORSE LANDFILL

APPENDIX A
(CONTINUED)



APPENDIX B - YUKON TERRITORY USED OIL INVENTORY

Generator	Generated (L/yr)	Available for a New Recycling Program (L/yr)
City of Whitehorse(39)	7,886.00	7097.40
Yukon Territorial Government(16)	85,417.00	76,875.00
Yukon-Alaska Transport(24)	42,000.00	21,000.00
Yukon Electric Company(36)	31,822.00	19,093.20
Curragh Resources Ltd.(18)	236,392.00	212,752.80
DIAND(28)	1,363.80	1,227.42
Total	404,880.80	338,045.82

APPENDIX C

YUKON TERRITORY'S USED-OIL BURNERS

Whitehorse Motors, Whitehorse, Yukon:

Whitehorse Motors uses a Sunfire Model CBWO-11-AC atomizing burner to heat the company workshop. The sources of the used oil burned, are Whitehorse Motors' own operations and NorthwesTel. All types of oil are stored in an underground tank which has a 13,638 litre capacity. The oil is pretreated for burning by allowing water and sludge to settle out in a 1,137 litre day tank equipped with a drain. The oil is also filtered through two inline filters. Installation of the used oil system cost Whitehorse Motors approximately 30 thousand dollars. The company burns 30 thousand litres of used oil each year. Whitehorse Motors' simple payback period is approximately 2.75 years. Whitehorse Motors has had a great deal of maintenance problems with the burner and has had to put considerable effort and money into improving the burner system. The problems include the atomizing nozzle becoming restricted by "baked" on carbon deposits, the pump being inadequate (a Lanair model pump is now in use), and the first type of filters being inadequate(1,25,35).

Yukon Highways Central Workshop, Whitehorse, Yukon:

Yukon Highways Central Workshop uses a Sunfire Model CBWO-11-AC atomizing burner to heat the Central Workshop's main building. The source of the used oil is from Yukon Highways' own operations. The oil is segregated and the sludge and water is removed. As with Whitehorse Motors, the oil is filtered through two inline filters. Installation of the used oil system cost approximately 25 thousand dollars. The simple pay back period is 5 years. Yukon Highways Central Workshop has also had a great deal of problems with its burner. Most of the problems are due to pump malfunctions because of the system's physical layout: the pumps and furnace are located above the tank. Also, the filters are difficult to change due to their inconvenient location on the ceiling(1,31,33).

Yukon-Alaska Transport, Whitehorse,Yukon:

Yukon-Alaska Transport also uses a Sunfire Model CBWO-11-AC atomizing burner. The source of the used oil is Yukon-Alaska's own operations. To pre-treat the used oil, Yukon-Alaska removes sludge and water from the oil and filters it through two inline truck filters. The used oil system cost 25 thousand dollars. The company bought the system in 1987 when they started operating in Whitehorse. They had a great deal of trouble with smoke and with the atomizing nozzle fouling. In 1988 they had new parts put in and it works much better. Now the maintenance is low and there is no smoke problem(1,24).

Mic Mac Motors, Whitehorse, Yukon:

The first used-oil burner Mic Mac Motors installed was a Lanair Model L-220-E vapourizing burner. However, when the company moved into a new building, a Sunfire Model CBWO-11-AC atomizing burner was installed. Mic Mac Motors switched to the atomizing burner because the vapourizing burner had to be cleaned every 24 hours. Although the actual cleaning only took 15 minutes, the heater had to be shut down for one hour to facilitate the cleaning. The atomizing burner does not need to be cleaned every 24 hours, but it does require cleaner fuel than the vapourizing burner. The source of Mic Mac Motors' used oil is its own operations. The oil is stored in a 4,546 litre tank(1,17).

Northern Kat Ltd., Dawson, Yukon:

Northern Kat Ltd. uses a Lanair Model L-220-E used-oil burner. The sources of the used oil are Northern Kat's own operations, Yukon Energy Corporation (Dawson), local placer miners, and various others. No special segregation of the oil is done. Solvents appear to be "no problem". The only oil quality problems occur when gasoline is mixed with the oil(1,38). The used oil system cost 7 thousand dollars. The company burns 13,638-18,18184 litres of used oil per year. The simple pay back period is less than two years. The left over pot residue from the burner is put in drums and taken to the Dawson dump.

APPENDIX D

QUEBEC USED OIL REUSE/RECYCLING STANDARDS

Element	Maximum Concentration[a] (mg/l)		
	Spec.I[b]	Spec.II[b]	Spec.III[d]
Arsenic (As)	5	5	5
Cadmium (Ca)	2	2	5
Chromium (Cr)	10	10	10
Lead (Pb)	100	100	100
PCB	3	50	0.15
Total halogens	1500	100	1500
Flash point (minimum value)	38°	38°C	38°C

[a] Dilution to meet these standards is prohibited.

[b] Standards for used oil burned for energy requirements by any industry or greenhouse.

[c] Standards for greenhouse or industrial burners with 10 MW or more heating capacity.

[d] Standards for end-use other than burning for energy recovery.

(9,pl-12, Table 1-2)

APPENDIX E

CCREM MSW EMISSION AND OPERATING GUIDELINES FOR MSW INCINERATORS

Table E-1 Stack Discharge Limits @ 11% O_2

Contaminant	Limit	Monitoring Method/ Averaging Time
Particulate Matter	20mg/R[a] m^3	EPS Method with adequate sampling time
Hydrogen Chloride (HCl)	57mg/Rm[3b] (50 ppmdv)or 90% Removal	Continuous Emission Monitor - 24 hour Rolling Average
Carbon Monoxide (CO)	57 mg/Rm[3c] (50 ppmdv)	Continuous Emission Monitor - 4 hour Rolling Average
Total polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-furans as well.	0.5 ng/Rm[3d] (Toxic Equivalence Factor new International Method)	ASME Modified Method 5 (3 Run Average)

Notes.

[a] R=dry cubic metres of flue gas at 25°C and 101.3kPa

[b] the less restrictive of these requirements shall apply

[c] RDF systems shall maintain a limit of 114mg/Rm^3(100 ppmd)

[d] based upon isomer specific basis for calculation but if only homologue analytical test data are available, then the most conservative (largest) equivalency factor should be applied.

(2,p4-11, Table 4-3)

Table E-2. Anticipated Emission Concentrations from MSW Incinerators Operating Under Good Combustion Conditions and Equipped with Dry Scrubber Fabric Filter Systems (Concentrations at 11% O_2)

Contaminant	Typical Concentrations	Monitoring Method/Averaging Time
Sulphur Dioxide	260 mg/Rm^3 100 ppmdv	Continuous Emission Monitor (24 hour)
Oxides of Nitrogen (NO_x as NO_2)	400 mg/Rm^3 210 ppmdv	Continuous Emission Monitor (24hour)
Lead	50 ug/Rm^3	EPS Method (July 1985)
Cadmium	100 ug/Rm^3	EPS Method (July 1985)
Mercury	200 ug/Rm^3	EPS Method (July 1985)
Arsenic	1 ug/Rm^3	EPS Method (July 1985)
Chromium	10 ug/Rm^3	EPS Method (July 1985)
Polyaromatic Hydrocarbons	5 ug/Rm^3	Modified Method 5 (ASME)
Polychlorinated Biphenyls	1ug/Rm^3	Modified Method 5 (ASME)
Chlorophenol	1 ug/Rm^3	Modified Method 5 (ASME)
Chlorobenzene	1ug/Rm^3	Modified Method 5 (ASME)

Note.
R=dry cubic metres of flue gas at 25°C and 101.3kPa
(2,p4-12, Table 4-4).

APPENDIX F

SUMMARY OF RE-REFINING PROCESSES

Re-refiners try to produce oil that is as high a quality as possible so that the re-refined oil can be used in the same way as virgin oil. Therefore, not all oils are considered re-refinable. Table F-1 illustrates those oils that are and are not re-refinable.

Table F-1. Classification of Used Oils for Re-Refining Purpose

Re-Refinables (Complete List)	Non-Re-Refinables (Partial List)
High Viscosity Index (HVI) Oils Only	Polychlorinated Biphenyls (PCBs) & Polynuclear Aromatics (PNAs) (unacceptable at any detectable concentration)
All diesel & gasoline crankcase oils	LVI and MVI oils
Transmission oils	Halides
Hydraulic oils (non-synthetic)	Synthetic oils
Gear oils (non-fatty)	Brake Fluids
Transformer oils (if non-PCB)	Fatty oils
Dryer Bearing oils	Asphaltic oils
Compressor oils	Black oils
Turbine oils	Bunker oils
Machine oils (non-fatty)	Metal working oils containing fatty acids
Grinding oils (non-fatty)	Form oils
Quenching oils (non-fatty)	Rolling oils
	Solvents of any type

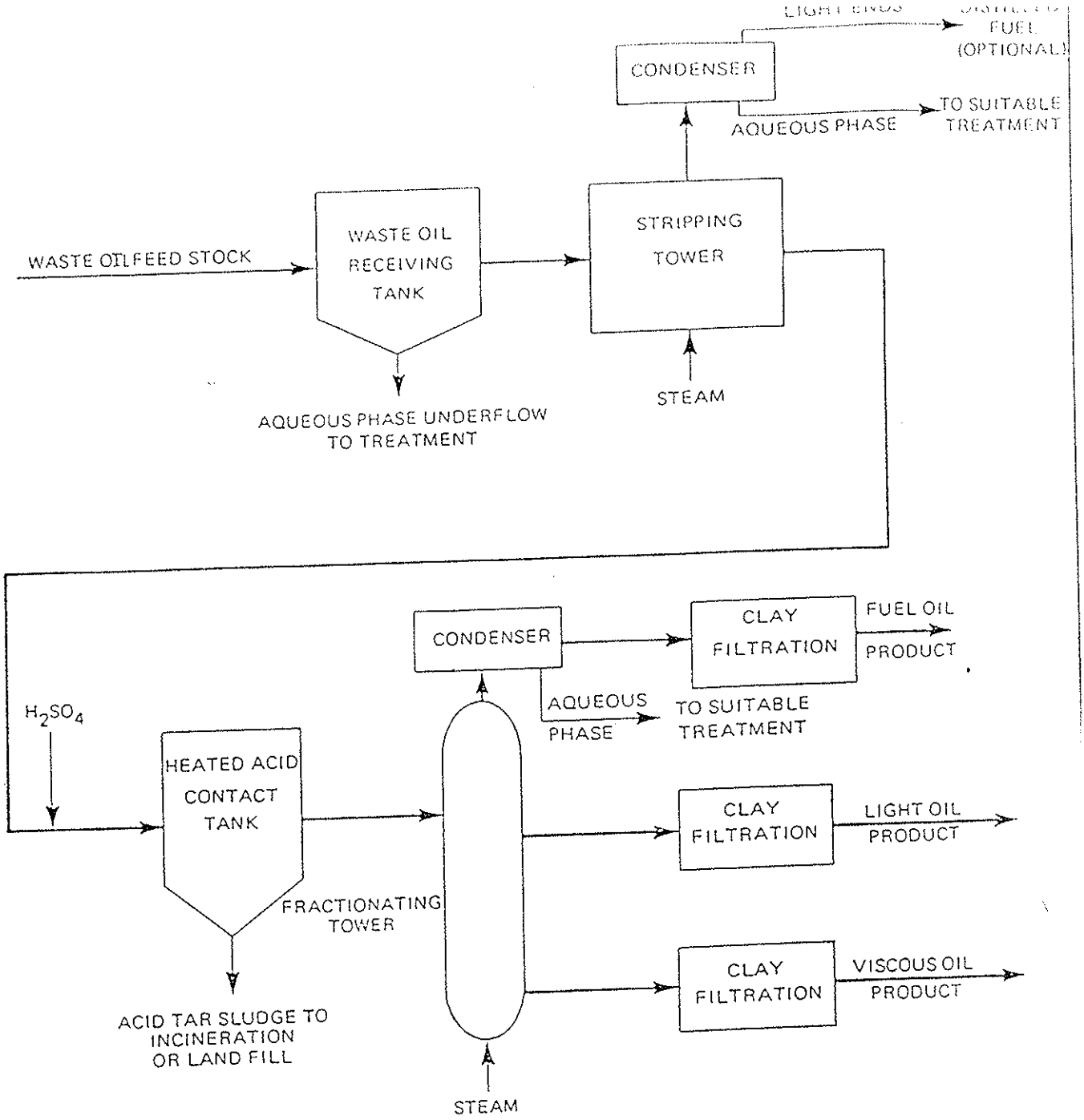
(9,p4-2, Table 4-1)

THE ACID/CLAY RE-REFINING PROCESS

The Acid/Clay process filters used oil and separates the water from it(13). Then sulfuric acid is added to the oil to dissolve "metal salts, particles, aromatics, organic acids, polar compounds and dirt"(9,p4-7). The dissolved substances settle and form a sludge which is separated from the oil. Next, clay is added to the oil to remove "light fuel fractions, mercaptans and colour"(13,p21) and the oil is filtered once more(9). A variation of the Acid/Clay process is the Solvent Extraction/Acid/Clay process which uses propane as a solvent instead of sulfuric acid(9). The Turbo re-refinery in Edmonton uses the Acid/Clay process. (See Figure F-1 for a schematic diagram of a "Conventional Acid/Clay Process.")

THE DISTILLATION PROCESSES

The Distillation processes dehydrate the used oil and then mix it with "caustic and naphtha to break up oil-water emulsions, and precipitate solids"(13,p22). This treatment is followed by distillation. Then, in the Vacuum Distillation/Clay Polishing process the Acid/Clay process is used. In the Vacuum Distillation/Hydrotreating process hydrogen is used instead of clay, so there is no clay to dispose of. The Chemical Demetalization/Vacuum Distillation/Hydrotreating process incorporates a preliminary step of demetalization into the Vacuum Distillation/Hydrotreating process. The used oil is "demetalized by chemical precipitation and then hydrotreated to produce about 90% yields of base oil"(9,p4-6). This process can produce a great variety of



PROCESS SCHEMATIC FOR CONVENTIONAL ACID - CLAY
WASTE OIL REREFINING PROCESS

FIGURE F-1 (12, P3.7)

re-refined lubricating oils(9). The Mohawk re-refinery in Vancouver uses a Vacuum Distillation process to re-refine used oils.

The wastes from the re-refining processes are "distillation bottoms (used as an asphalt extender or in fuel oil blending) and demetalized filter cake (used as a road base material). The remaining materials are wastes such as "acid sludge, spent clay, centrifuge sludge and process water directed to treatment and/or disposal"(9,p4-9). Table F-2 lists the various wastes produced from re-refining.

Table F-2 Used Oil Re-refining Wastes and Their Sources

Waste	Source
Aqueous Wastes	Dehydration Unit Receiving Tank Bottoms
Sludges Containing Lead and Other Metals	Acid Tar Sludges in Acid-Clay Process, Spent DAP Solution in PROP Process
Still Bottoms	Distillation Columns
Non-Condensed Vapour Air Emissions	Distillation Columns
Spent Catalyst	Hydrotreating Steps of the PROP and KTI Processes

(12,p3.10)

The costs of re-refining vary depending on the process and the amount of used oil to be re-refined. For example, the Acid/Clay process is more expensive than the Vacuum Distillation/Hydrotreating process,

which is more expensive than the Vacuum Distillation Re-refining process, and the unit production costs decrease for each process as the re-refineries' capacity to re-refine larger volumes increases(9).

APPENDIX G

USED OIL MANAGEMENT IN THREE NORTHERN COMMUNITIES

ANCHORAGE:

In Anchorage, Alaska the municipal government collects used oil at the city's landfill, a transfer station in the metropolitan area, and in an outlying community. A limit of 23 litres per deposit is permitted at the collection stations. The used oil is analyzed once a storage tank is full, and if the oil is suitable for re-use, water and some solids are drained from it. Higher quality used oil is blended with lower quality used oil to produce a more uniform stock. Two firms use the oil collected at the stations in their boilers. Neither of the firms' boilers have used-oil burners and no emission or waste tests have been done on the boilers' by-products. The larger of the boilers is located about 129 km from Anchorage, while the smaller boiler is in the metropolitan area(37).

There are other firms in Anchorage which burn their own used oil in used-oil burners(40).

YELLOWKNIFE:

There is one firm in Yellowknife, Robinson's Trucking, which burns some of its own, untreated, used oil as fuel (20,000-25,000L/yr) and transports the rest(27,000L) to a re-refinery in Edmonton. Robinson's has two home-built burners which have to be cleaned out every week. The residue from the burner pots is a waxy substance which is sent to the city's landfill. The

smoke from the burner is light grey in colour and there is no creosote ash associated with it. No emission tests have been done on the burners. Robinson's does not receive payment for the used oil it takes to Edmonton and the transportation costs for shipping it are $3000/yr(37).

FORT NELSON:

Most of the used oil in Fort Nelson is generated by the electrical generating station's motors and the transportation sector. In the past, the municipality collected used oil and used it as a dust suppressant on gravel roads, but stopped six months ago with the advent of the new special waste legislation in British Columbia. Now, the municipal government will only accept used oil if it has been tested by service stations to determine if it meets the new requirements for re-use. However, the service stations will not test the used oil, so a private contractor is collecting the oil and deep well injecting it, illegally. When the collection program was operating, approximately 4,500-6,800 L/yr were being collected. At one time trucks were back-hauling used oil to a re-refinery free of charge, but since the price of virgin oil went down, this too has stopped(32).

Contacts For Used Oil Study

Contact	Phone #	Information
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Davis, Donna	667-5324	YTG Central Wkshp-Invoices-Inventory
Gardener, Scotty	633-4143	Yukon-Alaska Transport-Inventory
Gran, John	(604)299-7244	Mohawk, Vancouver-Re-refining
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Lanair	1-800-665-0048	Used Oil Heater Manufacturer
Locher, John	(604)774-2541	Ft. Nelson Municipal Director of Engineering-Ft.Nlsn Used Oil Mngmt
McCullum, John	873-6019	Ecology North, Yellowknife-Recycling
Magnuson, Robert	667-5415	Mechanical Sup., YTG-Inventory- YTG's Used Oil Heater
McGovern, Frank	(604)929-1284	Mohawk Re-refinery, Vancouver
Mitchell, Paul	667-7860	Mohawk, WHSE
Ng, Wilfred	(416)323-5155	Mngr, Special Wastes & Info Support Ont. Waste Mngmt
Nielson, Rick	667-7866	Gen. Mngr, WHSE Motors WHSE Motor's Used Oil Heater
Rafferty, Terry	667-2494	Yukon Electric Co.-Inventory
Robinson, Donny	873-6271	Robinson's Trucking, Yellowknife-
Robinson, Marvin	873-6271	Home Built Used Oil Heater
Schmidt, John	933-5710	Owner, Northern Kat. Ltd., Dawson Used Oil Heater
Senyk, Krystal	667-6401	Utilities Technologist, City of WHSE-Contacts
Sunfire	(519)669-5252	Used Oil Heater Manufacturer

*All numbers are of (403) area code unless otherwise indicated.

Contacts For Used Oil Study

Sweeney, Jim	(907)561-1906	Anchorage Municipal Gov't. Anchorage Used Oil Mngmt
Thompson, Robert	667-3032	YTG Dangerous Goods Inspector Transport Regulations
Turner, Tom	(907)562-2267	Mngr, Anchorage Recycling Centre
Wargacki, Marion	465-1633	Plant Mngr, Turbo Re-refinery, Edmonton, Alberta-Re-refining

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