Testing of a Small-scale Incinerator for Disposal of Slaughter Waste

Results of an Assessment of an *Inciner8* A2600(HF) Incinerator at Rodear Meats, Big Lake B.C. 2008-2009

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1. Introduction

Slaughterhouse operators in the Thompson/North Okanagan region of B.C. have been searching for disposal options for their solid wastes, both specified risk material (SRM) and non-SRM, to comply with new Canadian Food Inspection Agency (CFIA) rules for disposal of slaughter waste which came into force in July 2007. Historically, slaughter waste from this area has been trucked to a rendering plant located near Armstrong B.C., and when that plant closed in 2003, to West Coast Reduction (WCR) in Calgary for rendering. With the discovery of bovine spongiform encephalopathy (BSE) in the Canadian cattle herd, that option, which had provided a small revenue stream for slaughter plants, became a cost because the value of the products of rendering of cattle abattoir waste significantly declined so renderers were no longer willing to pay for the waste or the trucking. Disposal costs have continued to increase since the CFIA SRM regulations were imposed. With the increase in the cost of fuel, combined with a tipping fee for SRM at the WCR Calgary rendering plant, trucking of the waste to Alberta has become very expensive and is impacting the economic viability of area slaughter plants.

Specified risk material or SRM is that portion of the offal from the slaughter of bovine animals where the BSE prion would be expected to be found if present in the animal. This waste includes the distal ileum of cattle less than 30 months of age, and the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord, dorsal root ganglia and distal ileum of cattle aged 30 months or older. Approximately 10 % of the total volume of slaughter waste generated in an abattoir is SRM. The SRM is separated from the remainder of the waste in the abattoir under the supervision of a CFIA inspector, and is segregated and stained so that it can be kept separate from the non-SRM portion of the waste.

In 2008, a group of slaughter plant owners from the Thompson/North Okanagan area decided to explore the potential of small-scale incineration as a local management solution for their slaughter waste. Several of the plant owners within the area felt that incineration of all or part of their waste could be a viable disposal option for them. With funding from the Canada-BC Specified Risk Material Management Program (SRMMP), Mr. Bill Meikle, owner of Riverside Meats, purchased an incinerator from a United Kingdom (UK) company in July 2008. The incinerator was tested at Rodear Meats, Big Lake B.C. between November 2008 and July 2009.

2. Incinerator Description

The unit purchased for this project was a large capacity, top loading incinerator designed to accommodate carcasses as well as slaughter waste (see Appendix 1 for photos and Appendix 3 for unit specifications). The unit came with a full-width counterbalanced loading door for ease of loading, and a separate ash removal door on the side of the unit. The unit had a primary and secondary chamber to ensure complete combustion of gases. The primary chamber was designed to operate at over 1000° C, and gases are retained at 850° C or greater in the secondary chamber for the minimum requirement of two seconds. The unit had been tested in the European Union (EU) and met all EU emissions

standards, so it was anticipated that it would meet BC Ministry of Environment (BCMoE) emissions requirements for small-scale incinerators which are set out in the new *B.C. Code of Practice for the Slaughter and Poultry Processing Industries* (www.env.gov.bc.ca/epd/industrial/regs/codes/slaughter/index.htm), as well as CFIA time and temperature requirements for prion destruction.

The incinerator was designed and built by *Inciner8*, a company based in Southport, England with a second factory in Croatia. The incinerator was built in Croatia but shipped by boat from England. At the time of purchase, the company had its units in 85 countries around the world and their incinerators had been used in the UK and elsewhere for the destruction of SRM and mixed slaughter waste.

The selected incinerator (Model A2600 HF) was sized to accept a maximum load of 1200 kilograms of waste and designed to accommodate a medium-sized whole cow. Its top-loading opening had dimensions of 1m x 2m. The unit featured temperature monitoring with a digital display for both the primary and secondary chambers. It had a thermostat control device whereby burners shut down at a preset temperature to save fuel. It had a thick refractory lining rated to 1600° C in the main chamber.

3. Project Description

3.1 Phase I. Location of a Test Site

The first task of the incinerator testing project was identification of a suitable testing site for the incinerator. During May 2008, seven sites in the Thompson/North Okanagan area were identified as potential sites for testing. This list was reduced to two sites because of incorrect zoning, lack of utilities at the site and other issues. The final two proposed testing sites were the Rainer dairy farm at Darfield B.C. and the Robertson farm in Grindrod B.C. Appendix 2 contains the Siting Report prepared in May 2008 to assist the committee in selecting a test site.

The committee identified the Rainer farm as the preferred site of these two because it was more remote from neighbours. However, the site required a temporary change in zoning to allow siting of the incinerator on land in the Agricultural Land Reserve. The rezoning was anticipated to take up to 6 months and would have required a public process.

In order to expedite the project, the committee looked at alternative sites and identified Rodear Meats, a small abattoir owned by Dave and Sarah Fernie and located at Big Lake B.C., approximately 50 km east of 150 Mile House, as a suitable site. The owners agreed to have the incinerator sited at their property and to undertake the day-to-day operation of the incinerator during testing with assistance from BC Ministry of Agriculture and SRMMP staff as required. The site already had the required zoning, had the required utilities and good road access and had an on-site source of slaughter waste. This site had previously been used in the fall of 2005 to test another incinerator.

3.2 Phase II. Testing of the Incinerator

The incinerator was ordered from Inciner8 in the U.K. in July 2008. It was shipped from England in late August, 2008. It arrived at Rodear Meats in November 2008 and was tested between November 2008 and July 2009. During that time it was evaluated to determine if it could meet CFIA time and temperature requirements for prion destruction and provincial MoE emissions standards. As well, the incinerator was tested by introducing various different mixtures of slaughter waste including SRM, mixed slaughter waste and whole animals. It was tested at different load rates to its maximum capacity of 1200 kg. Fuel usage was calculated with the various mixes and load rates, and the cost of operating the incinerator was determined from these test burns.

Two technicians from *Inciner8* were on site for the first week of November 2008 to set up the incinerator and ensure that it was running optimally for the planned testing. Company technicians returned in July 2009 to install a replacement chamber and to be present during the final emissions tests.

An on-site field day was held in November 2008. During the field day, a 400 kg load of mixed slaughter waste was incinerated. Company technicians were on-site to answer questions. Speakers included Mark Raymond, BCSRMMP, Margaret Crowley, BC Ministry of Environment and Nikola Vujec from Inciner8. Approximately 40 slaughter plant owners, government personnel, neighbours and other interested persons attended the field day.

4. Project Chronology

2008

May and early June: A study of potential test sites for a small-scale incinerator in the Thompson-Okanagan region looked at seven sites and concluded that all of them had major impediments. The decision was made to test a unit at Rodear Meats at Big Lake, B.C. Dave Fernie, owner, agreed to operate the incinerator with assistance as required.

June and July: A decision was made to purchase an A2600 HF incinerator from *Inciner8,* a U.K company. Purchase contract details were worked out during July. Other background preparations for the trial were completed including permits and approvals from BCMoE and the CFIA, ALC consultation, determination of emissions testing details, securing of fuel metering equipment, etc.

End of September: The incinerator was shipped from the U.K. Shipping and on-site set-up details were arranged.

October 28-November 1: The *Inciner8* unit was delivered to Rodear Meats and set up on site.

November 3-7: *Inciner8* technicians were on site for incinerator optimization. A CFIA staff person was on-site to monitor a test burn of SRM. The incinerator appeared to meet CFIA time and temperature requirements for prion destruction. An ash sample was collected for protein and amino acid analysis. An on-site field day was held which attracted approximately 40 participants from around the province.

November 12: The first emissions testing was conducted. BC Ministry of Agriculture and Lands (BCMAL) staff provided on-site assistance to Dave Fernie. Total particulates exceeded MoE standards. Opacity was within *Code* allowable limits.

November 13- December 7: Dave Fernie burned various waste volumes and mixes to determine the fuel usage and burn capacity of the incinerator.

December 8-11: A second set of emissions tests was carried out. Emissions data included particulate matter and opacity only. Results were better, but at various times during the test both particulates and opacity exceeded allowable limits. BCMAL staff provided on-site assistance.

2009

January 2009: Dave Fernie continued with test burns. A tertiary burner was ordered for the incinerator in the hope that it would reduce particulates in emissions.

February: Serious cracks were discovered in the floor of the primary chamber. In addition, one of the primary chamber burners failed, likely due to a fault in the wiring. Testing was halted while *Inciner8* decided whether to repair the floor of the existing unit or replace the main chamber.

March 3: Inciner8 decided to replace the main chamber, to be shipped as soon as possible from Europe at *Inciner8*'s expense.

June 2: The replacement chamber arrived at Rodear Meats.

June 26 to July 4: *Inciner8* technicians (Nikola Vujec from Croatia and Paul Thorpe from the UK) were on site to prepare the incinerator for emissions testing and were present during testing.

July 2: The final emissions testing was conducted. The incinerator successfully met the emissions standards in the *Code of Practice*.

July: Dave Fernie conducted two additional burns of SRM waste to gain further information about fuel usage and burn times.

5. Description of Waste Materials Incinerated

The incinerator was tested with several different types and mixtures of slaughter waste. The various feedstocks are discussed below. It was found that the combustion rate of the incinerator changed depending on the composition of the waste put into it.

Slaughter or kill floor waste is a blend of all waste generated on the kill floor. It includes heads, backbones, other bones, stomach and intestines, rumen and rumen contents, feet and tails. It is the most difficult waste to incinerate. A large portion of it is waste that contains a significant amount of water and is poorly combustible. Because of this, it burns very slowly and requires a significant amount of fuel on an on-going basis to combust it.

SRM waste consists only of SRM which is separated and segregated in the plant. The SRM waste consists primarily of heads and backbones and the associated tissue as well as the distal ileum. The waste contains less moisture and is generally more combustible than mixed slaughter waste.

Butcher waste is generated from the cutting and wrapping of carcasses in the cutting room of the abattoir. The waste consists mainly of trimmings generated during meat cutting and is made up of fat and tissue with some bones. It is much higher in fat and is more readily combustible than mixed slaughter waste or SRM. It therefore burns much faster and hotter than the other two waste streams. It was found that a blend of slaughter and butcher waste combusted much more efficiently than either waste alone.

6. Economics of Operation of Incinerator

The Inciner8 A2600HF was selected for the project partly because of its reported excellent combustion rate and fuel efficiency (see Appendix 3 for incinerator specifications). An important aspect of the testing of the incinerator was to confirm the incinerator's burn capacity and fuel usage. To this end, fuel meters for each of the three burners were installed prior to arrival of the incinerator. This allowed measurement of exact fuel usage for each burner and total fuel usage per burn. A portable scale was set up on site which allowed accurate weighing of each load.

The incinerator was tested with many trial runs of varying weight and composition. For each of these, loading rate, fuel usage and burn duration were recorded in addition to other observations. A general conclusion was drawn that the specifications indicated in the company's brochures appear to be optimistic; the tests determined that the incinerator did not burn waste as quickly or with as little fuel as the promotional literature suggested.

The following fuel and labour usage and burn cost information was derived from the various test burns undertaken. Table 3 contains a detailed list of economic data for each

test burn. Capital and maintenance costs of the incinerator are not included in the cost estimates.

- The cost to incinerate mixed slaughter waste ranged from $0.25 to $0.37 per kg ($0.115 to $0.165 per pound) (includes fuel and labour but not capital cost of incinerator).
- The cost to incinerate SRM waste was in the range of $0.28 per kg ($0.125 per pound) (includes fuel and labour but not capital cost of incinerator).
- The fuel cost to incinerate mixed slaughter waste (blended with butcher waste) ranged from $0.22 to $0.34 per kg ($0.10 to $0.15 per pound) (Table 3). The cost to incinerate declined as the percentage of butcher waste in the mix increased.
- The fuel cost to incinerate SRM waste was in the range of $0.25 per kg ($0.11 per pound) (Table 3).
- Fuel cost was assumed to be $1.00 per liter although it varied slightly over the period of incinerator testing.
- Labour cost to operate the incinerator was approximately $0.033 per kg of waste incinerated ($0.015 per pound) assuming labour at $20.00 per hour and 1.5 hours per day to load, run and clean out the incinerator for a full load of 900 kg of waste.
- The amount of fuel required to preheat the incinerator to operating temperatures in the primary and secondary chambers ranged from 64 litres in summer to 75 litres during the winter months.
- Fuel efficiency (weight of waste burned per unit of fuel) ranged from an average of 3.7 kg per litre of diesel for mixed slaughter waste to 4.0 kg per litre for SRM waste. This compares with Inciner8's stated fuel efficiency of 25 kg per litre of diesel fuel.
- Fuel usage ranged from 18 to 33 kg per hour compared to *Inciner8*'s claim of 12 kg of fuel per hour.

7. Operational information

Also based on the test burns undertaken, the following list contains information about optimizing combustion of waste in the A2600HF and other operational details.

- The average combustion rate of the incinerator was measured to be 93 kg per hour for mixed slaughter waste (blended with butcher waste) and 120 kg per hour for SRM. *Inciner8*'s literature suggests that the A2600HF model can burn between 200-300 kg per hour of mixed slaughter waste (Appendix 3).
- The maximum amount of waste the incinerator was able to completely burn in one day was 900-1000 kg. More than 12 hours of time was required to completely incinerate this amount. It was noted that if weights larger than 900-1000 kg are incinerated in one day, the primary chamber does not cool down sufficiently overnight after the burn is finished to allow ash removal the following morning prior to reloading.

- With loading rates higher than 900 kg per day, there is occasionally some unburned tissue on the floor of the primary chamber in the area between the two burners after the combustion cycle is complete. This appears to be dependent on the composition and moisture content of the waste, and on the structure of the load. Combustion was optimized when higher caloric materials were placed in the bottom of the load and wetter, less combustible materials were on top. Sheep hides burned optimally when placed on top of the load. If they are placed lower down in the load they can insulate the upper portion of the load and prevent it from combusting.
- Large volumes of waste (900 to 1100 kg) were more efficiently incinerated if put into the incinerator in two or three batches throughout the day, with each addition occurring after several hours of burning. It was determined that the first load of the day should be small – around 150 kg – and once this load was reduced to red-hot coals, the second load could be added. This optimized burn rate. Subsequent loads could be added every several hours onto a bed of hot coals. It was also found that, generally, opacity was reduced with this loading procedure.
- The rate of burn was optimized if a maximum of 60% of kill floor (slaughter) waste was incorporated in the load, with the remainder made up of cutting room (butcher) waste.
- The incinerator burned SRM waste more efficiently than mixed slaughter waste. SRM burns faster and hotter than mixed slaughter waste. The higher fat content and presence of paunch material and soft tissue in mixed slaughter waste slow down the rate of burn relative to SRM only. Fat also takes longer to ignite than other tissues.
- When tested using whole carcasses, the machine was barely able to handle a full-size cow; legs had to be severed and the animal repositioned in the primary chamber to effect efficient burning. It is marginally large enough for a beef cow and likely would not accommodate a mature dairy animal.
- Daily or near daily ash removal is required with this unit when large volumes of approximately 1000 kg are incinerated each day.
- Daily labour requirements for operation of the incinerator included 20 minutes for loading waste and program set-up, 5 minutes each hour to observe the progress of the burn and adjust controls as required and 15 minutes each morning for ash clean-out. For a 900 kg load of waste, the labour requirement would be approximately 1.5 hours per day.

8. Detailed Operating Procedures for Optimal Operation of Incinerator

The incinerator was determined to be fairly complicated to operate, contrary to what had been suggested by company promotional literature. For optimum operation, the incinerator required adjustments to the burner air supply which required knowledge of burner operation. It also requires a specific mix and loading order of waste to optimize performance and to ensure that it meets regulatory standards, particularly those associated with emissions standards. It arrived from the factory with several pre-programmed burn

cycles however use of these was not found to optimize incinerator performance. So while standard burn cycle programs were available, it was found that manual operation of the incinerator was able to produce better performance. It also was unable to meet emissions standards unless it was operated manually. Someone purchasing this incinerator would require a considerable amount of training to run it at optimum performance.

To address these challenges, a set of operating procedures was produced after the many trial burns conducted at Rodear Meats. BC Ministry of Agriculture and Lands Waste Management Engineer Gustav Rogstrand worked with *Inciner8* staff and Mr. Fernie to develop a set of standard settings and operating procedures to ensure optimal operation of the incinerator. The report containing these standard procedures is found in Appendix 4. It includes information on incinerator operation to optimize fuel consumption, and to ensure that emissions are within allowable limits and that temperatures are adequate to ensure prion destruction. These operating procedures could be used to develop Standard Operating Procedures if there is a need.

9. CFIA Time-Temperature Testing Results

Incinerators to be used for destroying the BSE prion must have a primary combustion chamber capable of operating at a minimum of 850° C continuously during the burn. Smoke and emissions from this chamber must pass through a secondary chamber with a temperature of 850° C and a residence time of 2 seconds. The ash must be free of proteins and amino acids to ensure complete destruction of protein materials. All incinerators used to destroy SRM slaughter waste must meet these CFIA requirements before permits or approvals are granted.

The required time-temperature testing of the incinerator was conducted on November 5, 2008. CFIA veterinarian Dr. Margaret Fisher of Edmonton was on site to observe a burn of SRM-only waste. Approximately 1200 kg of SRM waste were trucked in from Riverside Meats, near Salmon Arm B.C., under a CFIA permit. The incinerator appeared to easily satisfy the time-temperature requirements for prion destruction; the temperatures in both chambers are computer-controlled and can be set to meet the 850° C requirement in the primary and secondary chambers. A visual readout and chart recorder on the control panel confirmed the temperature in the chambers during the burn. A copy of the temperature chart is found in Appendix 5.

A sample of the ash was collected following the burn and submitted to Cantest Laboratories in Burnaby B.C. for protein and amino acid determination as per CFIA requirements. Test results are found in Appendix 6. The results of both tests were negative; no protein or amino acids were detected in the ash sample indicating that combustion of the tissue in the waste was complete. A final CFIA approval for the Rodear unit cannot be issued until it is located at a permanent site and a set of Standard Operating Procedures is prepared. At that time, time-temperature determinations and ash

analyses will need to be conducted again, as is the case for each additional incinerator at each specific site.

10. Results of BC Ministry of Environment Emissions Testing

Three sets of emissions tests were conducted on the incinerator. The first two tests failed due to either excessive total particulates or high opacity. During the third set of tests, the incinerator was satisfactory with respect to both of these criteria. Table 1 contains the total particulates and opacity data from the three sets of tests.

The initial intent of emissions testing was to ensure that the incinerator met the opacity and particulate matter limits set out in the *B.C. Code of Practice for the Slaughter and Poultry Processing Industries*. Under this regulation, small-scale incinerators with maximum loading rates of 400 kg per hour or per load can be used to incinerate slaughter waste provided that they meet siting restrictions and emissions standards. The emissions standards under the regulation stipulate a maximum total particulate concentration of 50 mg per cubic meter and an opacity of less than 10%.

The siting requirements for incineration under the *Code* are quite restrictive and many small-scale slaughter plants will not be able to meet the requirements due to their proximity to neighbours, schools, hospitals or businesses. Thus, BC Ministry of Agriculture staff requested that, for the emissions testing conducted at Rodear Meats, the list of parameters tested be expanded to include other parameters that might be required if an incinerator were to be sited under a permit from the BC Ministry of Environment or by substitution under the *Code of Practice*. The substitution option allows a slaughter plant operator to request an alternate, less restrictive, set of siting requirements from the Ministry of Environment if the ones found in the *Code of Practice* are too restrictive for a particular site. Additional emissions data could be used to demonstrate that the siting restrictions could safely be relaxed on a case-by-case basis.

The first set of emissions tests was conducted on November 12, 2008. This set of tests included the additional analyses as per the Ministry of Agriculture's request. It included total opacity, particulate matter and stack gaseous emissions (nitrogen oxides, sulphur dioxide, total hydrocarbons, hydrochloric acid and carbon monoxide). Duplicate one-hour tests were conducted on a total of 785 kg of mixed slaughter waste (loaded into the incinerator in two batches). The results from these tests are found in Tables 1 and 2 below. Average total particulates were 136 mg per cubic meter, and opacity was less than 5%. The particulates exceeded the *Code of Practice* limits substantially although the opacity was within the stipulated limit.

Following the initial emissions test, discussions between Dave Fernie of Rodear Meats, the emissions testing company, Ministry of Agriculture, the SRM Program staff and *Inciner8* were held to determine what caused the elevated particulates in the emissions. *Inciner8*'s own research and development results from Europe showed that the incinerator was capable of meeting the B.C. standards. Following these discussions, it

was decided to conduct a modified series of tests for particulates and opacity only, and to test the incinerator without any waste to determine if the diesel fuel was contributing to particulates. This testing was conducted from December 8-11, 2008 (see Table 1). Test results without waste in the incinerator were within Code limits. It was concluded that the diesel fuel was not contributing significantly to particulate emissions. Throughout all the conducted tests, total opacity was routinely within *Code of Practice* limits for a variety of slaughter waste loading rates with the exception of two samples collected very early in a burn when opacity was typically higher. Particulates improved as testing evolved and came close to meeting the *Code* standard.

It was decided after the second set of emissions tests that several changes should be made to the incinerator. The high particulate reading appeared to result from the automatic on-and-off cycling of the burner in the secondary chamber. While it was off, particulates were not being fully combusted in the secondary chamber. It was determined that it would be uneconomical to run the original secondary burner continuously but that a small tertiary chamber could be attached to the top of the secondary chamber and fitted with a small burner that would 'polish' the emissions as they passed through. Strategic loading of the waste into the primary chamber was also required to ensure that materials with higher calorific properties were placed near the bottom of the load to encourage early load ignition; slower-burning wastes placed on top of the load help to ensure complete burning.

As noted above, severe cracking of the refractory lining on the bottom of the primary chamber was observed after the test period in January 2009 upon which *Inciner8* decided to replace the primary chamber. The new chamber and the tertiary chamber were installed in June by *Inciner8* staff just prior to the final emissions tests.

The final emissions tests were conducted on July 2, 2009. *Inciner8* staff was on site for the tests. These tests were successful; average total particulates were measured at 44.1 mg per cubic metre and average opacity was less than 5%. Tables 1 and 2 contain this data and the additional data on stack gaseous emissions. Appendix 7 contains the complete emissions testing reports from A. Lanfranco and Associates Inc., the company that was engaged to undertake the emissions testing.

11. Incinerator Purchase and Set-up Costs and Details

In addition to the purchase cost of the incinerator, there were a number of costs associated with set-up which would also be incurred by future purchasers.

The purchase cost of the A2600HF incinerator was $64,550.00 which included the incinerator with primary and secondary chambers, 3 diesel-fired burners, control box, temperature probes and controls, data logger and printer. It also included a spare parts package with a spare burner, extra temperature probes and materials to repair the refractory lining. The purchase cost included shipping of $3,500.00.

There were several additional costs for installation of the incinerator. A concrete pad approximately 3.5 m by 5 m in size was required to hold the incinerator. The incinerator required some assembly including bolting the secondary chamber onto the main chamber, installing the burners and burner covers, installing the lid and filling the counterbalance with sand, installing fuel lines and mounting the control box on the secondary chamber. An electrician was required to wire the incinerator into the power source.

On-site set-up costs were approximately $4,500.00. This included the following items:

Crane rental for off-lifting incinerator from truck to concrete pad	$800.00
Concrete pad	$775.00
Electrical hookup	$1850.00
Supplies for fuel line and electrical hookups	$1000.00

Additional costs that should be expected include a fuel tank of a suitable size (1000 gallon minimum recommended), and materials and labour to build a shed or lean-to shelter to house the incinerator. This is required to protect the electrical and computer components from inclement weather. The incinerator was not enclosed during the tests at Rodear Meats because the test period was relatively short. However, for permanent installations, some sort of roofed structure is required.

The incinerator arrived with 220 V, 50/60 Hz, 10 Amp wiring which was thought by the purchaser and Inciner8 to be compatible with North American wiring, however, it was not. Apparently, European 220 V wiring is incompatible with 220 V North American wiring. Either 220V or 110V wiring is acceptable but it must be compatible with North American wiring; it may be necessary to have an electrician work with the supplier to ensure that the wiring meets North American standards.

If emissions testing is required, this should be expected to cost between $8,000.00 and $13,000.00 depending on whether the basic analyses required under the *Code* are tested (particulates and opacity) or whether additional parameters are determined. The emissions testing crew will require a solid platform approximately 4 m tall in order to collect samples from the stack at the required height above the incinerator. A sampling port which can be added on to the existing chimney and which is built to the specifications of the testing company is also required. This could cost up to $500.00.

Testing of the ash for the presence of protein and amino acids will be required by the CFIA in addition to the required time-temperature testing. This laboratory analysis will cost in the range of $240.00.

12. Summary

A group of slaughter plant owners from the Thompson/North Okanagan area of B.C. were interested in the potential of small-scale incineration as a local management solution for their slaughter waste. Several of the plant owners within the area felt that incineration of all or part of their waste could be a viable disposal option for them. With funding

from the Canada-BC Specified Risk Material Management Program, Mr. Bill Meikle, owner of Riverside Meats, purchased and imported an incinerator from a United Kingdom company to test for the destruction of slaughter plant waste. The incinerator was tested at Rodear Meats, located at Big Lake B.C. during late 2008 and 2009.

The *Inciner8* A2600HF incinerator was tested for regulatory compliance and to determine the economics of using this disposal option for slaughter waste in B.C. The incinerator met the Canadian Food Inspection Agency time and temperature requirements for prion destruction and the resulting ash was found to be protein and amino acid-free. The incinerator met the provincial emissions standards for small-scale incinerators as outlined in the *B.C. Code of Practice for the Slaughter and Poultry Processing Industries.*

Extensive economic testing of the incinerator found that the fuel and labour cost to incinerate slaughter waste using this equipment ranged from $0.28 per kg of waste ($0.125 per pound) for SRM waste to $0.25 to $0.37 per kg ($0.115 to $0.165 per pound) for mixed slaughter waste. The optimal daily loading rate of the incinerator was determined to be approximately 900 kilograms; attempts to load significantly larger volumes resulted in incomplete combustion and required a subsequent clean-up burn. The incinerator combusted most efficiently with SRM waste only, and, if mixed slaughter waste was incinerated, it was found that an optimum mix was 60% 'kill floor' or slaughter waste and 40% cutting floor or butcher waste.

The incinerator was found to be complicated to operate optimally. Extensive testing with loads of varying size and composition was required before the operator felt comfortable in his ability to run it optimally and to avoid having to deal with 'run-away' burns or incomplete burns. Because of this, a set of optimal operating conditions was prepared to assist purchasers of this machine in operating the equipment optimally.

At the date of writing (December 2009), the cost for pick-up of slaughter waste by a contractor who hauls the waste to Calgary, Alberta for rendering was $0.19 per kg ($0.085 per pound) for non-SRM waste and $0.30 per kg ($0.135 per pound) for SRM. The cost to incinerate slaughter waste using the purchased unit was found to be similar or more expensive than this cost, making this option less economical at this time than pick-up for rendering, particularly for disposal of non-SRM waste. The disposal costs are similar for SRM waste alone suggesting that the unit may be suitable for SRM disposal or for those producers who do not have a pick-up service in their area.

Table 1. Total Particulate Matter and Total Opacity from Emissions Testing of Inciner8 A2600HF Incinerator at Rodear Meats – November 12, 2008, December 8-11, 2008 and July 2, 2009

Date/Time	Waste Incinerated (kg)	Total Particulate Matter @ 11% O_2 (mg/m^3)	Total opacity (%)
		BC Slaughter and Poultry Processing Waste Code of Practice Standard <50	BC Slaughter and Poultry Processing Waste Code of Practice Standard <10
November 12, 2008	**500 kg initial load + 285 kg reload (4 hours later)**		
Test 1		135	<5
Test 2		137	<5
Average		**136**	**<5**
December 10, 2008	**200 kg**		
Test 1 (9:53 - 11:00 AM)		36.9	>50
December 10, 2008	**400 kg**		
Test 1 (11:32 AM -12:39 PM)		104.8	<5
Test 2 (12:58 -14:17 PM)		71.3	<5
Test 3 (14:34-15:40 PM)		27.9	<5
Average		**68**	**<5**
December 11, 2008	**400 kg**		
Test 1 (10:31-11:48 AM)		102.8	20
Test 2 (12:04-13:08 PM)		33.2	<5
Average		**68**	**10**
December 11, 2008	**400 kg**		
Test 1 (14:01-15:07 PM)		64.7	<5
Test 2 (15:34-16:40 PM)		15.4	<5
Average		**40**	**<5**
July 2, 2009	**400 kg initial load + 400 kg reload (4 hours later)**		
Test 1 (10:51-11:56 AM)	Beginning of burn	74.3	7.5
Test 2 (13:11-14:17 PM)	End of burn	38.4	<5
Test 3 (15:36-16:42 PM)	Middle of burn	19.5	<5
Average		**44.1**	**<5**

Table 2. Stack Gaseous Emissions – Inciner8 A2600HF

Parameter	Nitrogen Oxides as NO_2	Total Hydrocarbons as CH_4	Carbon Monoxide (CO)	Sulphur Dioxide (SO_2)	Hydrochloric Acid (HCl)
	Units: mg/Sm^3 @ 11% O_2				
November 12, 2008					
Test 1 (10:30-11:30)	284	89.7*	646*	145	3.5
Test 2 (14:20-15:20)	119	0.7	43.4	44.5	0.7
Average	**202**	**45.2**	**345**	**95**	**2.1**
July 2, 2009					
Test 1 (10:36-11:36)	164.7	81.8	442.6	ND**	ND
Test 2 (13:15-14:15)	232.3	0.5	13.6	ND	ND
Test 3 (15:46-16:46)	245.1	0.5	11.7	ND	ND
Average	**214.1**	**27.6**	**156.0**	ND	ND

*Reading may not be accurate as value periodically went off scale during test
**Not Determined

Table 3. Incinerator Economic Information (fuel cost only; fuel cost averaged $1.00 per liter)

Waste Type and Burn Date	Weight of Waste	Burn Time	Fuel Usage	Fuel Efficiency	Unit Cost to Incinerate	Notes
	kg	hrs	litres	kg/litre	$/kg	
December 10, 2008 – Mixed slaughter waste						
Load 1	210	2.2	54.5	3.9	$0.26	
Load 2	403	4.5	90.4	4.5	$0.22	
December 11, 2008 – Mixed slaughter waste						
Load 1	397	3.5	117	3.4	$0.29	Secondary burner running continuously for emissions testing causing fuel efficiency to be lower than normal
Load 2	420	3.5	116.5	3.6	$0.28	
January 12 + 13, 2009 – Mixed slaughter waste						
Load 1 (January 12)	1465	13	-	-	-	Incomplete burn – 1.5 hours clean up burn required to finish combustion
Load 2 (January 13)	800	12.5	-	-	-	
Total	*2265*	*25.5*	*772.9*	*2.9*	*$0.34*	
February 3, 2009 – Mixed slaughter waste						
Load 1	913	11	196.4	4.6	$0.22	50:50 blend of slaughter to butcher waste
February 4, 2009 – Mixed slaughter waste						
Load 1	926	12	252	3.7	$0.27	66:34 blend of slaughter to butcher waste

Table 3 continued. Incinerator Economic Information

Waste Type and Burn Date	Weight of Waste	Burn Time	Fuel Usage	Fuel Efficiency	Unit Cost to Incinerate	Notes
	kg	hrs	litres	kg/litre	$/kg	
July 2, 2009 – Mixed slaughter waste						
Load 1 (start of burn)	152	-	-	-	-	Final emissions testing Incomplete burn – some unburnt material remaining in primary chamber after burn
Load 2 (1 hour later)	400	-	-	-	-	
Load 3 (5 hours later)	405	-	-	-	-	
Total	*957*	*12*	*270.3*	*3.5*	*$0.28*	
July 27, 2009 – SRM						
Load 1 (start of burn)	700	-	-	-	-	
Load 2 (4 hours later)	300	-	-	-	-	
Total	*1000*	*8*	*248*	*4.0*	*$0.25*	
August 4, 2009 - SRM						
Load 1 (start of burn)	560	-	-	-	-	
Load 2 (5 hours later)	560	-	-	-	-	
Total	*1125*	*10*	*278.9*	*4.0*	*$0.25*	

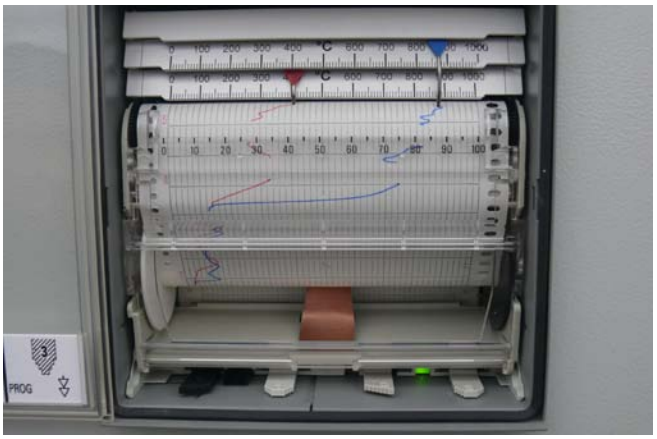
Appendix 1. Photos

	Photo 1. A2600HF incinerator side view.
	Photo 2. Side view of incinerator showing two primary chamber burners.

	Photo 3. Manually loading incinerator through top-loading door.
	Photo 4. Primary chamber pre-heating prior to loading.

	Photo 5. Loaded incinerator at start of burn cycle.
	Photo 6. Load mid-way through burn cycle.

	Photo 7. Ash remaining after burn cycle.
	Photo 8. Loading deadstock into incinerator.

	Photo 9. Incinerator control panel showing chart recorder, temperature readout and controls.
	Photo 10. Chart recorder.
	Photo 11. Temperature readout in primary and secondary chambers.

Appendix 2. Review of Proposed Sites for Testing of Incinerator

Interior Slaughter Plant SRM Incinerator Proposal

Phase I. Review of proposed sites

May 23, 2008

A group of slaughter plant owners in the Thompson, Shuswap and North Okanagan is developing a proposal to purchase an incinerator under the BCSRM (Specified Risk Material) Program and to test the incinerator to ensure that it meets B.C. Ministry of Environment emissions standards and CFIA SRM destruction time and temperature requirements. The proposed incinerator is built by Inciner8, a U.K company, and is designed to accommodate 1200 kg per load (model A2600). Company-provided emissions and temperature data suggest that the incinerator will meet the required standards. The group is proposing to incinerate both SRM and deadstock on a trial basis for several months after which the incinerator will be moved to a permanent site.

The first step of this project was to identify a site to test the incinerator. Four possible sites were put forward by the group. These sites were further investigated to determine which site best met the requirement to site the incinerator and start testing as quickly as possible. This report contains the results of the investigation into the suitability of each site.

The four proposed sites were as follows:

1. B.C. Livestock Cooperative – Kamloops site (E. Trans Canada Highway, Kamloops)
2. Trinity Valley Road gravel pit – north of Lumby
3. Rainer Custom Cutting – north of Darfield
4. Robertson Property – east of Grindrod

Discussion of suitability of sites

1. B.C. Livestock Cooperative, Kamloops auction site: Following a management meeting on May 14, the B.C. Livestock Cooperative was removed as a potential site unless there were no other viable options. The committee felt that setbacks to other businesses were insufficient and that there may be issues with incinerating SRM waste at a public auction yard.

2. Trinity Valley Road gravel pit: this site is owned by the Regional District of North Okanagan and operated as a gravel pit by a private operator. In order for this site to be considered as a possible test site, permission must be obtained from the Okanagan Regional Board. A letter has been submitted to the Board requesting permission to have this site considered as a potential test site; the request will be discussed at their next board meeting on June 4, 2008.

If the Regional Board grants permission for the group to use the site to test the incinerator, the only other approval required will be from the Ministry of Environment. The land is not in the ALR and is zoned industrial so no additional approvals will be required from the ALC or the RDNO. The site has power and good road access but does not have a concrete slab for the incinerator. It is less central to the production of SRM than the other sites. There is no labour available on site to run the incinerator as there would be at either the Rainer or Robertson site.

3. Rainer site: this proposed site would be located on the site of Karl and Debbie Rainer's dairy farm north of Darfield in a rural area. It is also the site of their slaughter plant and new slaughter waste composting facility. The proposed test site for the incinerator is approximately 300 m from the dairy and slaughter plant, near the composting facility. The site has power and a concrete slab, and has good access for truck traffic.

Permits and approvals
Some sort of permit will be required from the Ministry of Environment, the Agricultural Land Commission and Thompson Nicola Regional District (TNRD) to undertake the testing at this site.

Ministry of Environment: This site is under the jurisdiction of the Kamloops MoE office. Barb John of the Kamloops office has indicated that they will work closely with the group to ensure that the required approval is produced in a timely fashion so that the testing can begin as soon as possible (within 4-6 weeks). No particular environmental issues were identified with this site (air quality, water quality).

Regional District requirements: The TNRD will require temporary rezoning of the site to allow testing of an incinerator on the site. The site is currently zoned for agricultural use only. Staff from the TNRD planning department suggested that it may take up to 3 months to get the temporary zoning in place however as the TNRD is familiar with the SRM issue it is hoped that the temporary permit could be expedited.

Agricultural Land Commission requirements: The Rainer site is located on land within the agricultural land reserve; incineration is not a permitted use on agricultural land so some sort of approval may be required from the ALC to test the incinerator. Discussions with Trevor Murrie of the ALC suggest that the ALC understands the importance of being flexible with non-permitted land uses to support agriculture.

Location issues: The Rainers have met with their nearest neighbours to explain the plans to test the incinerator. None have expressed serious concerns at the time of writing.

4. Robertson site: this site is located on the Robertson property east of Grindrod in a rural area. Dave Robertson is proposing to site the incinerator at the same site currently used to transfer meat waste and deadstock for his Greenwave trucking business. The site is well away from neighbours and is flat. There is no power at the site; to site the incinerator at this site would require either putting in a power line (approx. 300') or running a generator.

Permits and approvals

Approvals will be required from the Ministry of Environment and possibly the Agricultural Land Commission to test the incinerator at this site. The site is zoned agri-industrial to allow for the meat waste transfer station currently on site.

Ministry of Environment: This site is under the jurisdiction of the Pencticton MoE office. Mike Reiner of the Penticton office has indicated that an approval from their office would take approximately 8 weeks and that they would not have any concerns about the planned testing provided that the incinerator is designed to meet UK or EU emissions standards and required prion destruction conditions. No particular environmental issues were identified with this site in the discussion with MoE (air quality, water quality)

Agricultural Land Commission requirements: the Robertson site is on land zoned agri-industrial. The ALC would still have to be notified of the non-permitted use but as with the Rainer site, the ALC appears to be supportive of on-farm incineration if it enhances agriculture in the area.

Location issues: Mr. Robertson has met with some of his neighbours, in particular the dairy farmers in the area. They are in support of siting the incinerator at his site as there is currently a serious deadstock disposal problem in the area. Dave has one neighbour who was very concerned at the time he put in the meat transfer station; that neighbour appears now to be on side. At this time there do not appear to be any serious neighbour issues however Mr. Robertson has not met individually with all of his neighbours.

Recommendations

1. As per the request of the B.C. Livestock Cooperative management committee, due to concerns about the location of the site in the public eye, the Kamloops auction yard should not be considered as a possible test site for the incinerator except as a last resort.
2. Because the goal of this project is to install and test the incinerator as quickly as possible, it is recommended that the Trinity Valley gravel pit site not be considered at this time but be considered as an alternate site if the other two sites become unavailable for some reason. Approval for the use of this site must come from the Okanagan Regional Board at their next meeting on June 4, 2008 which will delay the start of the project.

Both the Rainer and Robertson sites appear to be acceptable as test sites for the incinerator. Site facilities, regulatory issues and location issues all appear to be similar. The following is a discussion of the differences between the two sites.
Location: the Robertson site is somewhat more central to the supply of SRM in the region. Neither site owner has identified serious concerns from the neighbours at this preliminary stage.
Site facilities: the Rainer site has power at the proposed testing site; the Robertson site does not and would require power to be brought in approximately 300' or the use of a generator which would be sufficient for the testing phase. Both sites have good access and a concrete slab in place already.
Permits and approvals: the Kamloops MoE office is more familiar with the SRM issue and the urgency to get the incinerator testing underway – an approval for the use of the Rainer site may be issued more quickly out of that office than one for the Robertson site out of the Penticton MoE office.
The Rainer site will require temporary re-zoning for industrial use while the Robertson site is already zoned for industrial use – re-zoning at the Rainer site may take up to 3

months although the TNRD is also familiar with the SRM issue so it is hoped that permitting could be expedited.

Appendix 3. Inciner8 A2600HF Operational Specifications

INCINER8

Waste Incineration Model A2600(HF)

Animal & Waste Incinerators

We can now offer our range of incinerators exclusively throughout Europe and the rest of the world through our dealer network. Our range of units are fully CE certified, ensuring that we meet the highest standards in safety and construction.

Model A2600(HF)

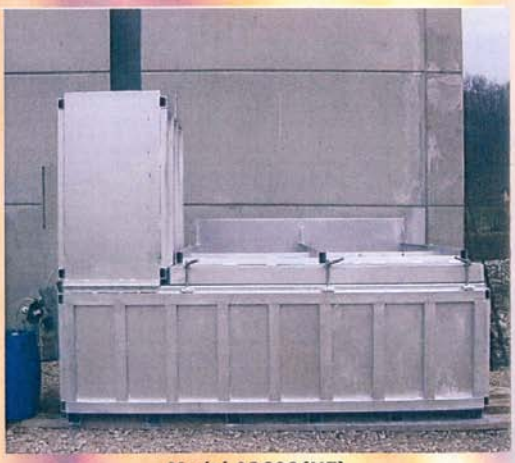
Large Capacity Unit Model A2600(HF)

Our latest range of units lend themselves in particular to large animal carcasses such as pigs or calves. One of the unique features of this range is the full width counterbalance loading door allowing easy to the main chamber for loading and removing ash.
The design of this model ensures extra air is drawn into the main chamber aiding primary combustion to ensure the efficient disposal of carcasses at minimum cost.

Ease of Use
Auto ignition. No pilots to light. Set the timer and walk away.
Built-in skid facilitates placement

Fuel Efficiency
Rapid incineration means low fuel consumption.
Higher burn rate than other models. Up to 300kgs per hour.
Thick refractory lining rated to 1600 deg C in main chamber retains heat, increasing efficiency.

Quality Built to Last
Heat resistant 5mm steel.



Model A2600(HF)

INCINER8 House, Balmoral Drive,
Southport PR9 8PZ, United Kingdom
Tel: +44 (0) 1704506506 Fax: +44 (0) 1704506666

Testing / Specifications for the Model A2600(HF)

The model A2600(HF) is well suited for slaughterhouse / processing plants. Recent testing showed an average fuel consumption of 10 litres per hour with a combustion rate of 250kgs per hour average.
Bones and fatty content will burn at up to 300kgs per hour, whilst guts (lower calorific value waste) would burn at 200kgs per hour. The most sensible and effective way to run this machine is by having a good mix of bone, off-cuts and offal.
The Model A2600(HF) is the most cost effective incinerator available anywhere as it will incinerate 25kgs of slaughterhouse waste with only 1 litre of diesel oil.
Further to this we also can provide a hot water system which will provide up to 5000 litres of water every hour. This system has proved extremely popular with many slaughterhouses as they significantly reduce their energy costs with plentiful FREE hot water. In many EU countries this has also allowed our customers to achieve up to 50% EU grant funding for energy recycling.

Directors : V.P. Ferguson : Registered Number : 04866401 Vat No. 855 9995 44

ISO9001 WCS UKAS
Certificate No. 6596

TECHNICAL SPECIFICATIONS

Technical Spec.	A200	A400	A600	A850	A200(A)	A400(A)	A600(A)	A850(A)	A200(Sec)	A400(Sec)
Capacity (Cubic Mtr)	0.18	0.36	0.54	0.75	0.18	0.36	0.54	0.75	0.18	0.36
Ave Capacity kgs	100	200	300	400	100	200	300	400	100	200
Shipping weight Kgs	630	920	1350	1850	880	1170	1600	2100	850	1090
External Dimensions										
Length (mm)	1070	1220	1520	1520	1070	1220	1520	1520	1070	1220
Width (mm)	660	910	910	1130	660	910	910	1130	660	910
Height Incl. Flue (mm)	2600	3300	4400	4400	3800	4100	5200	5200	3800	3900
Door Opening (cm)	46 x 51	56 x 74	66 x 76	53 x 69	46 x 51	56 x 74	66 x 76	53 x 69	46 x 51	56 x 74
Fuel Consumption *(NB these consumption figures take into account the use of a temperature controller / thermostat being fitted)*										
LPG Gas Ltr / hr	6	7	9	10	6	7	9	10	7	8
Diesel Oil Ltr / hr	5	6	8	9	5	6	8	9	6	7
Natural Gas M3	4.1	4.8	6.2	6.8	4.1	4.8	6.2	6.8	4.8	5.5
Operation										
Min. Operating Temp.	900	900	900	900	900	900	900	900	900	900
Max. Operating Temp.	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350
Secondary chamber	No	No	No	No	YES	YES	YES	YES	YES	YES
Residency Time	N/A	N/A	N/A	N/A	2 secs	2 secs	2 secs	2 secs	.5 sec	.5 sec
Temp Monitoring	Extra	Extra	Extra	Extra	YES	YES	YES	YES	Extra	Extra
Thermostat Control	Extra	Extra	Extra	Extra	YES	YES	YES	YES	Extra	Extra
Constant Run fan	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Burn Rate kgs / hr	35	45	45	48	35	45	45	48	35	45

Technical Spec.	A600(Sec)	A850 (Sec)	B60	A1600	A1600(HF)	A2600	A2600(HF)	P16	P25	P25 M1
Capacity (Cubic Mtr)	0.54	0.75	0.13	1.18	1.18	1.92	1.92	0.47	0.65	0.65
Ave Capacity kgs	300	400	60	750	750	1200	1200	200	350	350
Shipping weight Kgs	1520	2050	600	3500	3500	5500	5500	1100	1800	2100
External Dimensions										
Length (mm)	1520	1520	750	3110	3110	3110	3110	2000	2300	2600
Width (mm)	910	1130	750	1800	1800	2150	2150	1220	1220	1500
Height Incl. Flue (mm)	5000	5000	2000	3300	3300	3300	3300	6120	7700	7700
Door Opening (mm)	66 x 76	53 x 69	55 x 35	77 x 200	77 x 200	100 x 200	100 x 200	61 x 71	61 x 71	61 x 71
Fuel Consumption (NB these consumption figures take into account the use of a temperature controller / thermostat being fitted)										
LPG Gas Ltr / hr	10	12	4	10	12	10	12	8	12	13
Diesel Oil Ltr / hr	9	11	3	9	10	9	11	7	11	12
Natural Gas M3	6.8	8.2	2.7	6.8	8.2	6.8	8.2	4.8	8.2	8.9
Operation										
Min. Operating Temp.	900	900	600	900	900	900	900	900	900	900
Max. Operating Temp.	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350
Secondary chamber	YES	YES	YES	YES	YES	YES	YES	YES	YES	Yes
Residency Time	.5 sec	.5 sec	1 secs	2 secs	2 secs	2 secs	2 secs	.5 sec	.5 sec	1 sec
Temp Monitoring	Extra	Extra	EXTRA	YES	YES	YES	YES	YES	YES	YES
Thermostat Control	Extra	Extra	EXTRA	YES	YES	YES	YES	YES	YES	YES
Constant Run fan	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Burn Rate kgs / hr	45	48	15	45	150	50	300	55-70	65-100	65-100

Appendix 4. Detailed Operating Procedures for Optimal Operation of A2600HF

Report on emissions testing during SOP of slaughter waste incinerator

Prepared by: Gustav Rogstrand, BC Ministry of Agriculture and Lands Waste Management Engineer

Rodear Meats, July 2nd, 2009

The following information can be used to develop standard operating procedure for incineration of mixed slaughter waste in a A2600 incinerator from Inciner8.

Introduction

The objective of the standard operating procedure is to ensure that the operation meets the following three objectives simultaneously:

- Temperature: Above 850 °C in secondary chamber continuously when there is waste in the incinerator and a minimum of 850 °C in the primary chamber for at least 15 minutes the last waste batch before cool down and ash removal.
- Emissions: Particulate emissions must be kept below 50 mg/m3 and opacity below 5%.
- Economy: The fuel consumption per unit mass of incinerated waste should be kept below $0.33/kg ($0.15/lbs).

These three objectives were met by following the procedures below. Major diversions from these procedures will likely mean that one or more of the above objectives will not be met.

Initial settings:

Burner	Nozzle	Oil pump	Air setting
1,2 (primary)	2.5 usg	15 bar	2.5
3 (secondary)	4 usg	15 bar	2.5

Since it is well known that an abattoir operator will not have much time to constantly adjust combustion parameters it was agreed that any adjustments that have to be made should be simple and possible to do when personnel are at the incinerator anyway to load

a batch of waste. The only things that need adjustment is air setting on burner 3 (secondary) and the set-point temperature of the primary chamber.

Naturally the following exact clock times have no other relevance than to give the reader a sense of the time required for each step.

Operating procedure

8.36 am Pre-heating from cold incinerator
All three burners are started. Settings are as initiated in the table above. The set-point temperature of the primary chamber is set to 600 °C and the set point temperature if the secondary chamber is set to 999 °C. Fuel consumption at this point is 0 liters for burner 1, 0 liters for burner 2 and 0 liters for burner 3. The relays for all burners (R2, R4 and R6) are set to ON to prevent on/off cycling of the burners during preheat in order to reach 850 °C in the secondary chamber as quickly as possible.

9.24 am Loading of primer batch
Secondary chamber reached 850 °C at 9.22 am after 54 minutes. 152 kg of mixed slaughter waste (88 kg from kill floor and 64 kg from cut floor) is loaded into the incinerator. The air setting of burner 3 (secondary) is increased from the initial 2.5 to 8. The set-point temperature of the primary chamber is kept at 600 °C and the set point temperature if the secondary chamber is kept at 999 °C. Fuel consumption at this point is 9.4 liters for burner 1, 9.7 liters for burner 2 and 16.5 liters for burner 3. The relays for all burners (R2, R4 and R6) are switched to AUT to allow on/off cycling in accordance with set point temperatures. The relays are kept on AUT until the incinerator has to be pre-heated from a cold state again the next time. The secondary chamber will momentarily loose temperature to below 850 °C, but the temperature was back up above 850 °C within 6 minutes of loading.

10.33 am Loading of second batch
400 kg of mixed slaughter waste (250 kg from kill floor and 150 kg from cut floor) is loaded into the incinerator. No changes to air setting, e.g. the setting for burner 3 (secondary) remains at 8. The set-point temperature of the primary chamber is increased to at 700 °C while the set point temperature if the secondary chamber is kept at 999 °C. Fuel consumption at this point is 10.8 liters for burner 1, 11.1 liters for burner 2 and 32.3 liters for burner 3. The secondary chamber does not loose temperature to below 850 °C when loading the second batch.

2.22 pm Loading of third batch
405 kg of mixed slaughter waste (255 kg from kill floor and 150 kg from cut floor) is loaded into the incinerator. No changes to air setting, e.g. the setting for burner 3 (secondary) remains at 8. No changes to set-point temperatures, e.g. they are kept at 700 °C and 999 °C respectively. Fuel consumption at this point is 16.0 liters for burner 1,

16.4 liters for burner 2 and 105.2 liters for burner 3. The secondary chamber does not loose temperature to below 850 °C when loading the third batch.

8.30 pm Shut down of incinerator
The incineration of slaughter waste was expected to be complete by this time so in order to ensure that not too much fuel was consumed for burn-out the incinerator was set to automatically shut down.

Results

Emissions:
Emissions were measured for three 1 hour periods during representative operation of the incinerator in accordance with standard emission testing procedures. Emissions data was collected 10.59 to 11.56 and 13.11 to 14.17 and 15.38 to 16.41. This represents the initial, middle and final stages of incineration of one 400 kg batch of mixed slaughter waste. Preliminary test results indicate an average particulate emission rate of 30 mg/m3 and less than 5% opacity (58 mg/m3 and 8.5%, 12 mg/m3 and 2%, 21 mg/m3 and less than 5% for test 1, 2 and 3 respectively). From an emission stand point the tested incinerator combined with the operating procedure described above resulted in compliance with existing regulations.

Temperature:
All three batches experienced more than 15 min of temperatures over 850 °C in the primary chamber. Except for a couple of minutes immediately after the loading of the first primer batch, the temperatures in the secondary chamber remained above 850 °C from pre-heating to shut down. There was, however, a significant amount of fresh, unburned material left in the incinerator after shut-down. This is a major problem since it would seem that those tissue parts gets insulated by ash and never experience prion destruction temperatures. From what we could determine, none of the remaining fresh tissue was SRM tissue.

Fuel economy:
The operating procedure as presented here resulted in a total fuel consumption of 270.3 liters of diesel fuel to burn 957 kg of mixed slaughter waste. This equates to a fuel cost of $0.28/kg ($0.13/lbs). It is however believed that the extra time that it would have taken to burn the remaining fresh tissue would have increased the fuel cost to approximately $0.33/kg ($0.15/lbs).

Important points

- Incineration of purely SRM would likely result in significant fuel savings and less problems with unburned material at the end of burns while maintaining temperatures and operating with the same or lower emissions.

- The problem with unburned tissue when burning mixed slaughter waste is a major problem. One way to deal with it without increasing fuel costs would be to extend the burn time for the initial primer batch and the second batch to ensure that these have burned completely to ash before loading the last batch of the day. It takes less fuel to maintain combustion temperatures at the tail end of these initial batches (because the whole unit is hot) compared to doing “artificial” burn-out at the tail end of the last batch when the whole unit is cooling down.

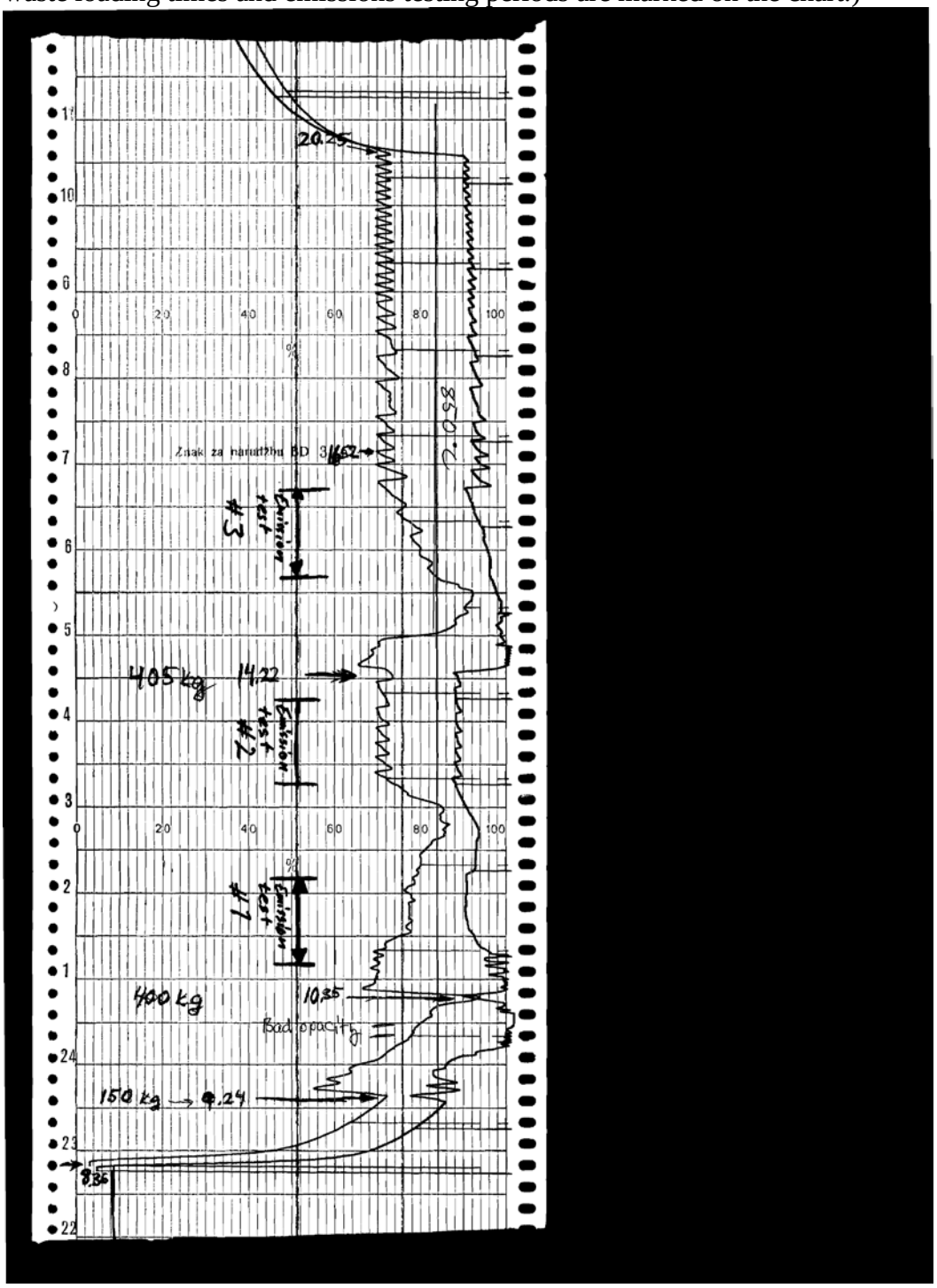
- Ash will need to be removed almost daily to avoid creating an insulating ash layer in the incinerator. This requires manpower which increases the total disposal cost. It is very important that there is no unburned material left when ash is removed. Removing the ash is a tedious labor consisting of manually climbing down in the incinerator chamber (primary) to hand-shovel the ashes out of the chamber. The operator of Rodear Meats estimates that one person will have to dedicate about 2-3 h per burn day to destroy 1000 kg of mixed slaughter waste.

- This test was conducted with the fan of an additional tertiary burner (burner 4) running continuously, which, according to Inciner8 would improve combustion conditions in the stack. The burner was installed as an extra “emissions polishing” burner but it was never needed. If the fan is to run continuously it cannot, as is currently the case, be dependent on a suspended auxiliary tank of diesel for lubrication. If the fan is needed, and lubrication therefore is required, it has to be connected to the main fuel system just like the other burners.

- All burners for all installations in Canada must be 110V, 60Hz and be equipped with appropriate fuel line and fuel pressure fittings for Canadian spare parts and measurement equipment.

Appendix 5. Chart of Temperatures in Primary and Secondary Chambers during Emissions Testing

(Note: Top line is temperature in secondary chamber. Bottom line is temperature in primary chamber. Chart should be read from left to right (bottom to top). Start time, waste loading times and emissions testing periods are marked on the chart.)



Appendix 6. Protein and Amino Acid Analysis of Ash from Incinerated Slaughter Waste

Analysis Report

CANTEST

REPORT ON: Analysis of Ash Sample

REPORTED TO: B.C. Ministry of Agriculture and Lands
Sustainable Agriculture
Management Branch
1767 Angus Campbell Road
Abbotsford, BC
V3G 2M3

Attention: Mark Raymond

PROJECT NAME: INCINER8 - NOV 5, 08

NUMBER OF SAMPLES: One (1)
REPORT DATE: December 5, 2008

DATE SUBMITTED: November 17, 2008
GROUP NUMBER: 8504M

SAMPLE TYPE: Ash
RELATED WORK: 91118009

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHOD:

Amino Acids – analysis is performed by High Performance Liquid Chromatography (HPLC) with post column derivization. This analysis was performed by a subcontractor.

TEST RESULTS:

(See the following page)

CANTEST LTD.

Nilmini Wijewickreme, Ph.D.
Director, Food Safety

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: B.C. Ministry of Agriculture and Lands

REPORT DATE: November 24, 2008

GROUP NUMBER: 91118009

CANTEST

Nutritional Analysis (As Received) in Food

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Protein
Ministry of Agriculture-Ash	Nov 5/08	811180042	<
DETECTION LIMIT			0.1
UNITS			g/100 grams

g/100 grams = grams/100 grams (as received)
< = Less than detection limit

REPORTED TO: B.C Ministry of Agriculture and Lands

REPORT DATE: December 5, 2008

GROUP NUMBER: 8504M

CANTEST

Amino Acid Profile

CLIENT SAMPLE IDENTIFICATION:	Ash Sample
CANTEST ID:	8504M-1
Amino Acid	(%)
Aspartic Acid	<0.005
Theronine	<0.005
Serine	<0.005
Glutamic Acid	<0.005
Proline	<0.005
Glycine	<0.005
Alanine	<0.005
Cysteine	<0.005
Valine	<0.005
Methionine	<0.005
Isoleucine	<0.005
Leucine	<0.005
Tyrosine	<0.005
Phenylalanine	<0.005
Histidine	<0.005
Lysine	<0.005
Arginine	<0.005
Tryptophan	<0.005

Appendix 7. Results of Emissions Testing of A2600HF Incinerator

Note: Emissions testing reports are found as 3 separate PDF files identified as:
Emissions Testing Report 1 November 2008
Emissions Testing Report 2 December 2008
Emissions Testing Report 3 July 2009 (Final tests)

One additional report entitled Emissions Testing Refractory Assessment December 2008 discusses the assessment of the possible contribution of incinerator refractory material to emissions.

All emissions testing was conducted by A. Lanfranco and Associates Inc., Environmental Consultants, Surrey B.C. and all emissions testing reports were prepared by same.