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5	Rostad Mortuary Crematory Air Quality Impact Analysis performed in March 2006 by URS Corporation

6	DVD of University of Calgary Medical School depiction of the impact of low level mercury exposure at cellular level
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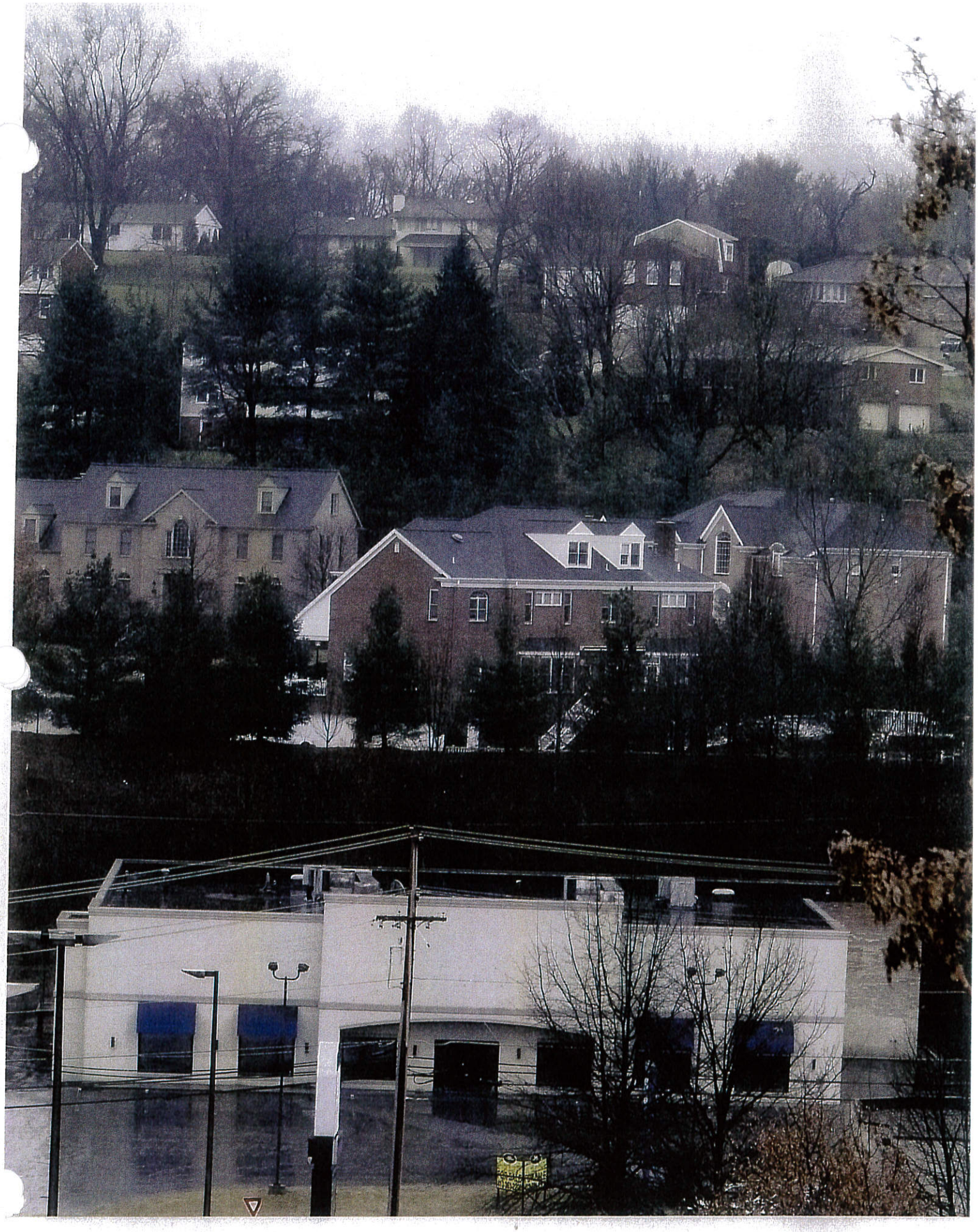


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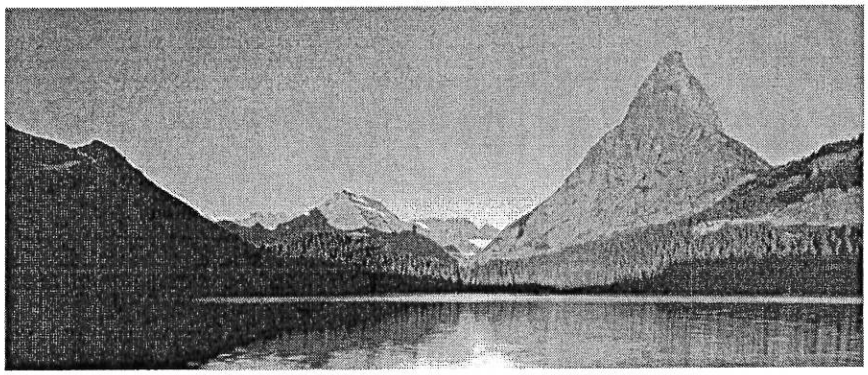

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California Legislation Debates Bio Cremation (MORE)

Consumers Chose an Eco-Friendly Disposition (MORE)

Environment

Consider The Environment First!

This more eco-friendly process offers distinct environmental advantages even beyond traditional flame cremation. Through the Bio Cremation process, we create the following highlights...

No vaporized mercury emissions and no filtration or abatement systems required. Note: Mercury from dental amalgam is contained and recycled not vaporized

Caskets are not burned; protects our natural resources and produces less CO_2.

Low carbon footprint; 4x less carbon impact versus traditional flame cremation. Note: Reduces the use of fossil fuels and minimizes greenhouse gases/climate change

Energy efficient – 1/8 the energy usage versus traditional flame cremation.

By-product (effluent) is safe with no harmful chemical or microbial contamination.

Preserves 20+% more bone fragments than traditional flame cremation.

Embalming fluid is neutralized and cytotoxic drugs are destroyed in the process.

Pacemakers do not need to be surgically removed prior to the process.

Medical implants are unaffected and can possibly be recycled.

White Papers

Cremation of Human Remains: A Comparison of Alkaline Hydrolysis versus Combustion
By Craig Sinclair

The Press-Enterprise

'Green' road to 'greener pastures' approved, May 7, 2010 (PDF)

Latimes.com

Funeral homes seek to legalize 'bio-cremation' as a green alternative, May 4, 2010 (PDF)

Reuters.com

Dying to be green, March 30, 2010 (PDF)

Funeral Business Advisor

Going Green, January 2010

Theithacajournal.com

Treatment plan to accept CU vet waste, July 2010
Teamwork in waste plan, June 2010

American Chemical Society

Eternally Green: New Eco-Friendly Cremations And Burials, July 2, 2010

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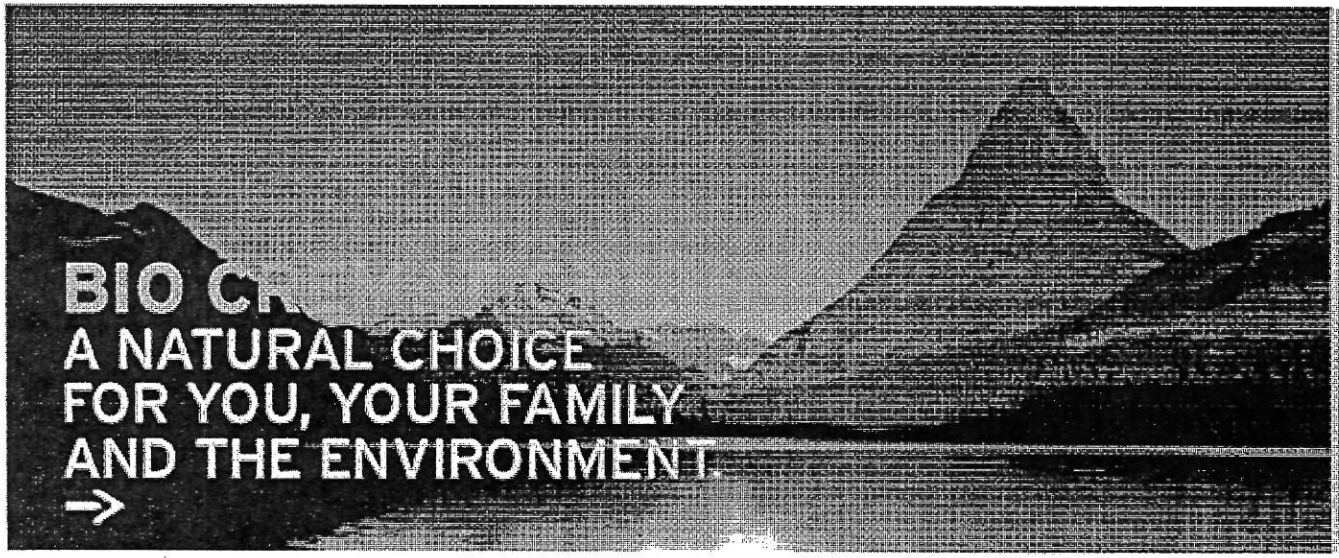

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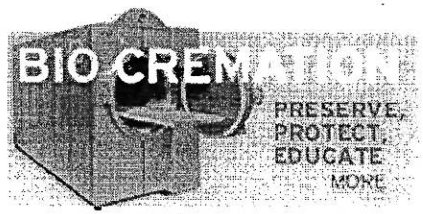

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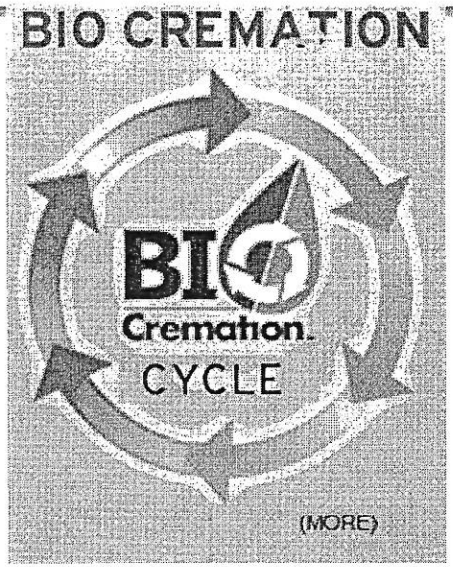

lower the individual's carbon footprint while at the same time reducing greenhouse gases and stabilizing climate change.

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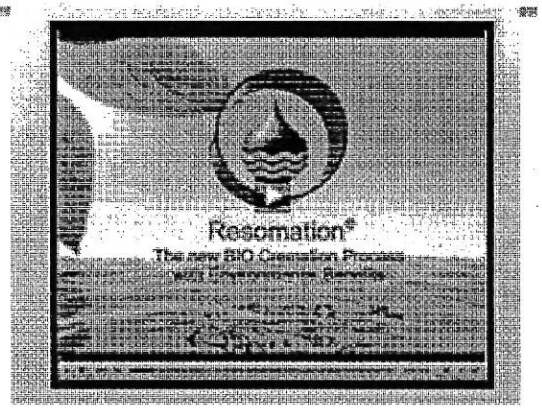

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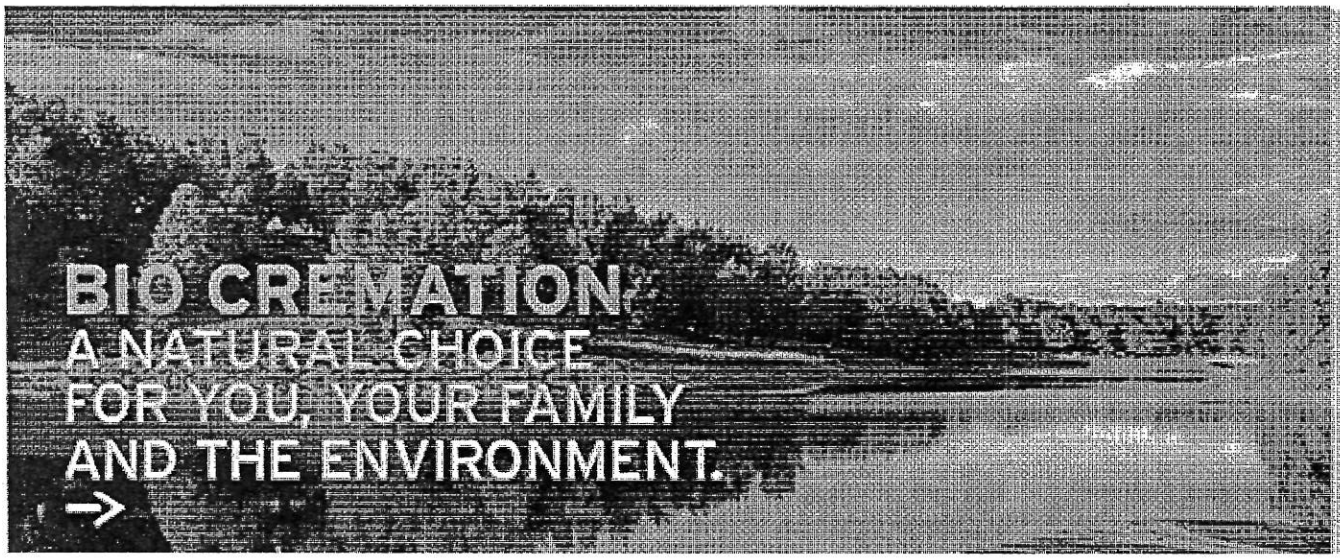

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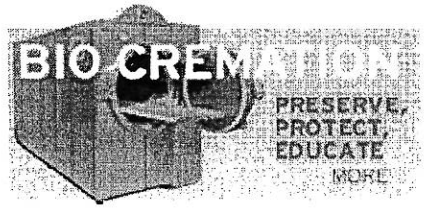

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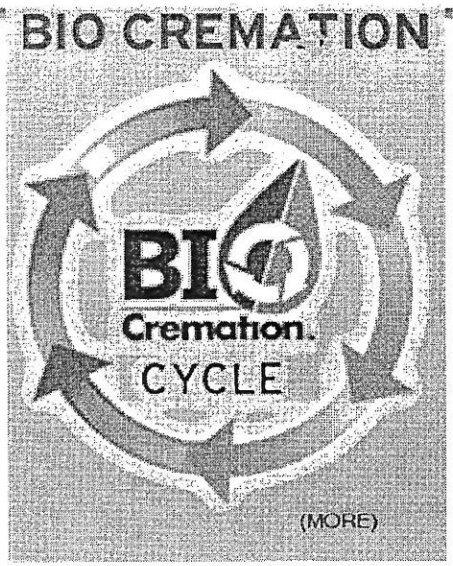

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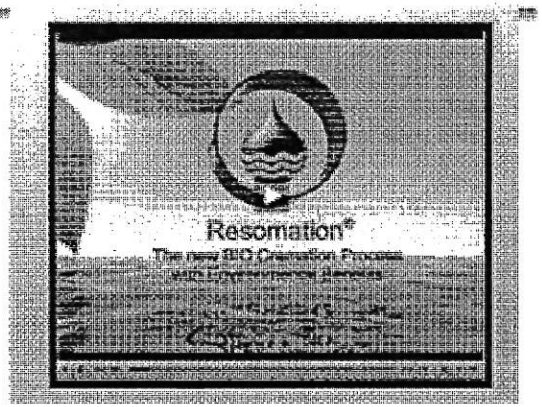

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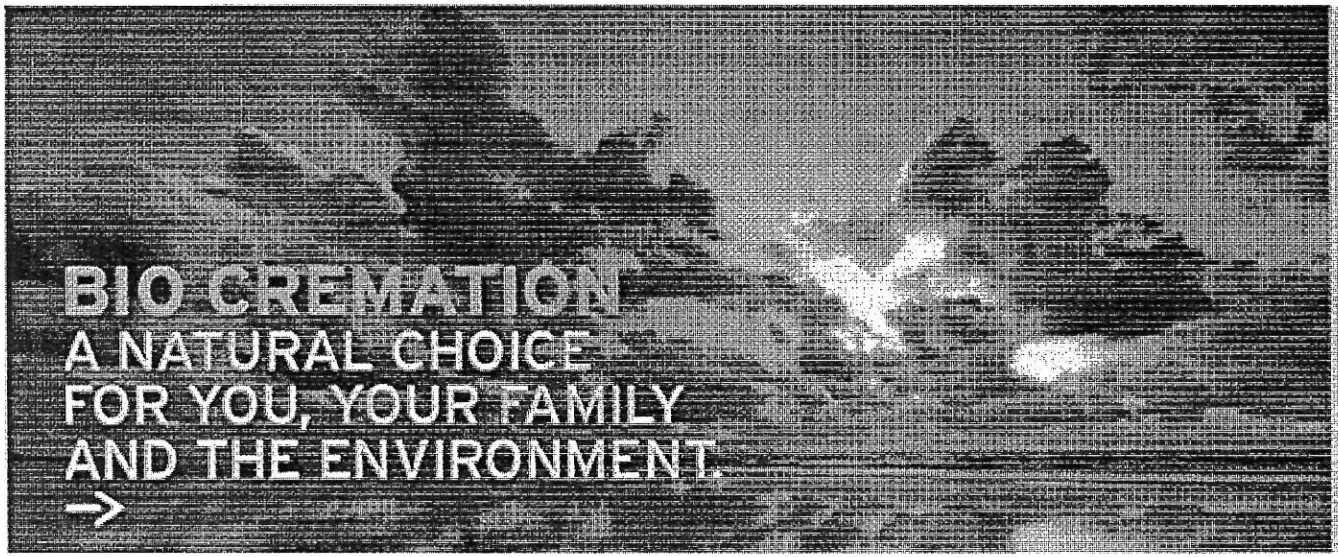

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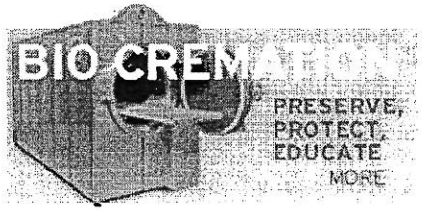

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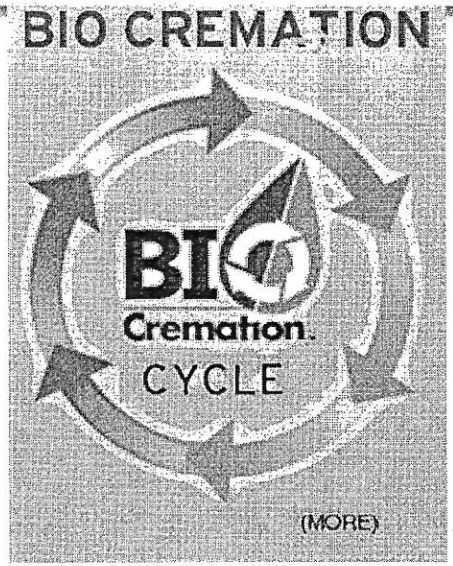

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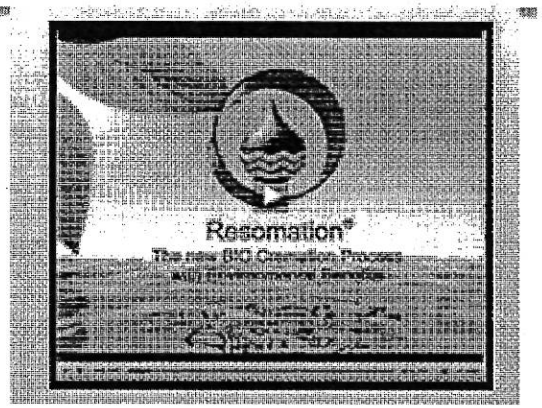

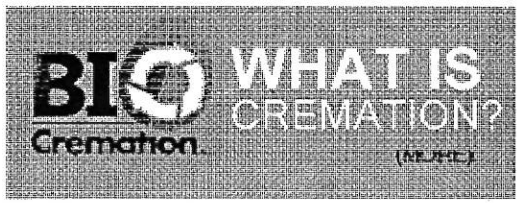

Cremation of Human Remains:
A Comparison of Alkaline Hydrolysis versus Combustion

by Craig Sinclair, Engineering Manager - Resomation Ltd

Background

The combustion of human remains is commonly known as cremation. It has served the funeral industry well for the last 100 years or so and will continue to do so for the foreseeable future. However, with a rapidly growing population and an ever increasing environmental awareness, the time has arrived to consider other alternatives for the disposition of human remains.
At the forefront of this consideration is the process of ***"High Pressure Alkaline Hydrolysis"***, also known as Bio Cremation™. This technology was originally developed for the decontamination and disposal of infected animal tissues and later reengineered to assist teaching hospitals with the disposition of donated cadavers.

Today, the alkaline hydrolysis process has been perfected as a commercially viable alternative to traditional cremation and burial. This article gives a basic description of the Bio Cremation process and evaluates the various environmental, social and logistical aspects of the technology in relation to traditional cremation.

Basic Description of the Process

Unlike traditional cremation which uses a combustion reaction to reduce the cadaver to bone fragments, the Bio Cremation process utilizes a reaction known as alkaline hydrolysis. Due to the extensive research and development to date, and the considerable knowledge attained through studies in both Europe and North America, this article primarily considers high pressure alkaline hydrolysis. Low pressure systems are also available but are generally deemed not to be commercially viable as an alternative to cremation due to the significantly longer processing times (up to 24 hrs), odor issues and lack of data/testing.

The alkaline hydrolysis process involves breaking down organic molecules to their basic components using a combination of water, alkali, heat and pressure. The cadaver is placed inside a stainless steel chamber which is then filled with water. A small amount of potassium hydroxide alkali (KOH) is then added and the contents heated to around 350°F. After a specified period of time the vessel is cooled and emptied leaving behind bone fragments that can be returned to the bereaved as with traditional cremation.

From start to finish the entire process is automated and controlled using a simple touch screen operator interface and PLC. The liquid from the process is a sterile aqueous solution of basic organic molecules and is directed to a water treatment facility, a topic covered in more detail later in this document.

Emissions and Carbon Footprint

The primary disadvantage associated with the combustion reaction used in traditional cremation is that it creates gaseous emissions, primarily in the form of carbon dioxide (CO_2), which are associated with global warming and climate change.

With growing awareness of climate change, regulators are coming under increased pressure to reduce CO_2 emissions in all areas of industry and as a result it has become more challenging to gain planning permissions and operating permits for crematoria. Although there are CO_2 emissions resulting from the Bio Cremation™ process (generating steam for heating), these are significantly less than for traditional cremation. In fact, looking at the both processes in their entirety, a recent UK independent study concluded that the carbon footprint associated with traditional cremation was approximately 4 times larger than that of Bio Cremation.

Other harmful emissions which can be created from the combustion of human remains include nitrogen oxides (NO and NO_2) which again contribute to climate change and, of particular concern in recent times, mercury vapor (Hg). Although less popular today, mercury has historically been a main component of the amalgam used in dental fillings. When exposed to the combustion temperatures involved in cremation this mercury will vaporize and travel into the atmosphere where it will mix with water vapor, cool, condense, and fall to the earth as rain. Recent studies have shown that even trace amounts of mercury can contaminate lakes and rivers and have toxic effects on fish and other animals or humans who consume them. In many parts of Europe this has led to the compulsory introduction of expensive filtration equipment to separate the mercury vapor from the other combustion gases prior to exiting the crematorium.

As for the Bio Cremation process, it operates at significantly lower temperatures than traditional cremation which prevents the mercury from vaporizing. Instead the amalgam is separated from the bone fragments in solid form at the end of the process.

As a result of the factors mentioned above the Bio Cremation technology has the potential to be installed in built-up commercial and/or residential areas without creating a nuisance or hazard to the surrounding population, something which would be strictly forbidden with traditional cremation due to strict zoning regulations.

Energy Consumption

Due to the high temperatures involved in traditional cremation (approximately 1500° – 1800°F), and the need to pre-heat the cremator chamber, it can be a highly energy intensive process. In contrast, the Bio Cremation chamber does not have a pre-heating requirement and operates at significantly lower temperatures (approximately 350°F). Studies have indicated that the combined electrical and gas energy requirement for the Bio Cremation process is approximately 85% less than traditional cremation.

Based on a rate of 40 cremations/month and natural gas consumption figures taken from an independent environmental study, the cost savings on gas achieved by adopting Bio Cremation™ over traditional cremation are in the region of $1,700 - $2,220 per month.

Efficacy and Sterilization

Both alkaline hydrolysis and high temperature combustion have been proven to be highly efficacious in the destruction of all pathogens, bacteria and viruses. Studies have shown that the corresponding wet and dry heats and exposure times involved in both processes ensure that the resultant products from each are sterile.

TSEs/Prions

Unlike other kinds of infectious disease which are spread by microbes, the infectious agent in TSEs is a specific protein called the prion protein. This makes them notoriously difficult to destroy/inactivate as they can survive much harsher conditions. Some examples of TSEs are BSE in cattle, Scrapie in sheep and CJD in humans.

The most common method for the destruction of TSE infected material is incineration (combustion). However in the last 10 to 15 years there have been numerous papers written by leading scientists in both the UK and the US stating that alkaline hydrolysis is a suitable alternative treatment in the destruction of TSE's. In Europe extensive research was commissioned by the European Scientific Steering Committee and carried out over a number years at the Roslin Institute in Scotland, one of the top research centers globally in this field.

Dr. David Taylor, a world leading expert in the field of TSE contamination, and a team of other researchers concluded that alkaline hydrolysis at elevated temperature and pressure was indeed a suitable method for the destruction of prion infected material. This is reflected in the official EU Animal By-Products Regulation (92/2005 amendment to 1774/2002) which lists alkaline hydrolysis as an acceptable method for the treatment of Category 1 (confirmed and high risk TSE) material. The USDA APHIS (United States Department of Agriculture Animal and Plant Health Inspection Service) also recognizes alkaline hydrolysis as an approved method for the disposal of prion infected material and in some cases has documented this as the preferred method to be applied.

Liquid

During a traditional cremation the combustion gases are emitted into the atmosphere. Once in the atmosphere much of this gas will mix with water vapor, cool, condense into liquid and fall as rain. During a Bio Cremation, the hydrolyzed liquid produced is typically sent to a water treatment facility. This liquid contains no DNA or genetic material but instead is a simple bio-chemical mix of small organic molecules.

Due to the nature of its origins, this liquid is obviously significantly higher in organic content (known as Biological Oxygen Demand or BOD) than the typical material flowing into the water treatment facility and is also typically higher in alkalinity (pH). Historically, when alkaline hydrolysis has been used on a larger scale in veterinary schools and research laboratories it has proven difficult on occasions to obtain permission from the water authorities to receive this liquid. However, where permission has been granted it has also been proven to have little or no effect on the operation of the water treatment facility.

In addition, given the process developments achieved in the new Bio Cremation™ system and the fact that the process is taking place on a smaller scale, the liquid produced from the Bio Cremation process will be less concentrated and of a much smaller volume than that of previous animal systems. As a result this liquid will not have any impact on an average sized water treatment facility. In addition the alkalinity (pH) of the liquid can be reduced to any desired level prior to discharge. The fact that the starting material is a human cadaver, rather than infected research animals will certainly make water authorities more amenable to accepting this liquid.
The viscosity of the alkaline hydrolysis liquid from animal systems has been an area of concern from water treatment companies in the past. It is essential that the liquid going to the treatment plant does not impede the flow through the pipes in any way. This concern has been raised due to the fact that older animal alkaline hydrolysis systems used sodium hydroxide (NaOH) as the alkali in the process which often resulted in a highly viscous liquid. As mentioned above, the newer Bio Cremation systems use potassium hydroxide instead of sodium hydroxide which prevents this viscous liquid being formed. In 2009 United Utilities (one of the largest water companies in the UK) carried out tests on the liquid derived from a potassium hydroxide based Bio Cremation. These tests demonstrated that there are no issues with viscosity and/or gelling of the liquid even when added to cold, raw sewage.

In remote locations or where it is not possible or desired to release to the water treatment plant there are other potential routes for the liquid. It can be collected and sent to an anaerobic treatment plant where it will be converted into a soil nutrient for land application and biogas for green energy production. This option has many benefits for the environment and is likely to become more popular as the anaerobic treatment technology becomes more available across the US. There is also the potential to apply the liquid directly onto cemetery/memorial gardens to fertilize the ground as the liquid is rich in potassium, nitrogen and phosphorus, the nutrients essential for plant life. However further research is required for this option to determine where it may be suitable, in what quantities and the benefits/overall environmental impact.

Worker Safety

Worker safety is a key consideration for all employers and crematoria operators are no different. The primary dangers associated with traditional cremation are exposure to the extreme heat and light (infrared/UV) involved in the process as well the potential to inhale harmful dust/emissions. These workers are supplied with Personal Protective Equipment (PPE) such as heatproof gloves, face shields and dust masks and given the necessary training to use the equipment safely.

Similarly, workers in a Bio Cremation™ facility will also be required to be trained in the safe use of the equipment and given suitable PPE chemical resistant gloves and aprons to protect them from exposure to alkali.

Potentially dangerous chemicals are used in many industries and must always be treated with care and all OSHA guidelines followed regarding spill procedures, Material Safety Data Sheets (MSDS) etc. However, as the Bio-Cremation unit is fully automated, manual handling of the alkali is not required at any time during normal operation and when the alkali supply does need to be replenished this can often be carried out by the supplier, not the equipment operator.

Materials That Can Be Processed

The Bio Cremation technology generally does not allow for synthetic fabrics to be processed. Therefore the bodies of the deceased are dressed in respectful gowns made from organic fibers such as silk or wool.

Unlike traditional cremation, pacemakers do not have to be removed prior to the process and medical implants such as titanium hip or knee joints are not damaged or charred in any way. Another advantage of Bio Cremation is that items of jewelry can be recovered in pristine condition following the process.

Remains

In traditional cremation the body is converted to bone fragments via the process of combustion. It is then crushed and returned to the bereaved.

Similarly, in Bio Cremation the body is also converted to bone fragments and is crushed and returned to the bereaved in exactly the same way. The only difference is that bio-cremated bone fragments have a smaller particle size and are pure white in color.

Caskets

Unlike traditional cremation a wooden casket is not used in the Bio Cremation process. Instead a silk or wool container is preferred offering a sustainable option for the environment and further reducing carbon emissions to the atmosphere.

As with traditional cremation a wooden rental/transfer casket can be used for the purposes of the ceremony and viewing.

Funeral Ceremony

There is little change, if any in the funeral service for a Bio Cremation™ versus traditional cremation. Both are dignified and respectful. The differences between the two processes only occur after the body is committed from public view.

Costs

In North America the capital cost of a Bio-cremation unit can be significantly greater than that of a traditional cremator.

In Europe, where mercury filtration is mandatory, the cost of the Bio-Cremation is typically less than that of traditional cremator plus filtration equipment.

Overall operating costs for the Bio-cremation unit are expected to be similar, if not less than that of a traditional cremator.

Company Information

Resomation Ltd was formed in Scotland in early 2007 to promote Resomation as a real alternative to burial and cremation. The basic technology behind the resomation process has been well established for many years. However, the vision of Resomation Ltd, to make the process widely available to all is relatively new. Resomation Ltd have expanded and developed the resomation process to make it useable and potentially available to all.

Resomation Ltd

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Goes with Penn State Study

ROSTAD MORTUARY CREMATORY AIR QUALITY IMPACT ANALYSIS

Prepared by

URS Corporation
8181 East Tufts Avenue
Denver, CO 80237

March 2006

URS
8181 East Tufts Avenue
Devner, CO 80237
(303)694-2770

1 Introduction and Summary of Results

This report provides an analysis of the air quality impacts of air pollutants from the incineration of human bodies in a CMS Millennium II cremator located at the Rostard Mortuary in Rawlins, Wyoming. A crematory is a source of criteria pollutants and toxic air contaminants. These pollutants are listed in Table 2. These pollutants are emitted into the atmosphere through an exhaust stack during the cremation process, which may have an impact on the nearby properties in the neighborhood. Since the Rostad Mortuary Crematory is surrounded by a residential area and is located within 600 meters of the nearest schools (Mountain view school and St. Joseph school), it is important to examine the potential impact of the emissions from the crematory. In order to predict the impact of the emissions, an air quality impact analysis was performed using the current version of the EPA-approved Industrial Source Complex Short Term, Version 3 air dispersion model (ISCST3).

The emissions from the crematory stack were categorized into 20 species and modeled as a point source. The major emissions from crematories are nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SOx), particulate matter (PM10), mercury, hydrogen fluoride (HF), hydrogen chloride (HCl), non-methane volatile organic compounds (NMVOCs), other heavy metals, and some persistent organic pollutants (POPs) including dioxins and furans, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), etc. The detailed emission rates and stack information are described in Section 3.

Default options of ISCST3 were used along with building downwash information and one year (1994) of hourly meteorological data. Fine nested grid receptors were used to predict the impact more accurately including 25-meter spaced fine grid receptors for the area within the vicinity of the crematory.

The modeling results are shown in Table 3 and indicate that the criteria pollutants (NOx, SO, SOx, and PM10) and most of the toxic pollutants except cadmium and dioxin/furan do not exceed the National Ambient Air Quality Standards (NAAQS) and Wyoming Ambient Air Quality Standards (WAAQS) or the preliminary remediation goal (PRG) levels (URS, 2006). However, the annual cadmium and dioxin/furan concentrations exceed the PRG significantly, by 205% and 2200%, respectively.

The modeling results show that the maximum impact is predicted to occur on the immediate vicinity of the crematory as shown in Figures 5 through 9.

2 Modeling Analysis Design

The air quality dispersion model and related options used to determine ambient impacts are described in this section, along with the receptor network employed.

2.1 Model Selection

The air quality impacts in the areas surrounding the Rostad Mortuary Crematory were determined with the latest version of the EPA ISCST3 model, which is commonly used for

regulatory analyses involving the prediction of impacts (concentration or deposition) within 50 kilometers (km) of a source. The ability of the ISCST3 model to accommodate varying source types and terrain makes it an appropriate selection for this analysis.

2.2 Model Input Defaults/Options

The ISCST3 model was run with regulatory default options. These options are:

- Stack tip downwash (except for Schulman Scire downwash);
- Buoyancy induced dispersion (except for Schulman Scire downwash);
- No gradual plume rise (except for building downwash);
- Calms processing routines;
- Upper bound concentration estimates for sources influenced by building downwash from super squat buildings;
- Default wind profile exponents; and
- Default vertical potential temperature gradients.

As noted above, the model was executed with the calms processing invoked. Periods of calm winds are identified in the meteorological data processing by defining a threshold wind speed. If the recorded wind speed is less than the threshold wind speed, then the wind speed for that given hour is reset (and wind direction adjusted) to reflect a period of calm wind. The option for modeling elevated terrain was also selected.

2.3 Rural/Urban Classification

The ISCST3 model includes rural and urban algorithm options. These options affect the wind speed profile, dispersion rates, and mixing-height formula used in calculating ground-level pollutant concentrations. A protocol was developed by the EPA to classify an area as either rural or urban for dispersion modeling purposes. The classification is based on average heat flux, land use, or population density within a 3-km radius of the modeled facility, with land use being the most definitive criterion (USEPA, 2003). The urban/rural classification scheme based on land use is as follows:

> *The land use within the total area, A0, circumscribed by a 3-km circle about the source, is classified using the meteorological land use-typing scheme proposed by Auer (1978). The classification scheme requires that more than 50% of the area, A0, be from the following land use types in order to be considered urban for dispersion modeling purposes: heavy industrial; light-moderate industrial; commercial; single-family compact residential; and multi-family compact residential. Otherwise, the use of rural dispersion coefficients is appropriate.*

Since most of area is the medium low density of residential and rural area as shown in the aerial photomap, the rural land use classification was used in this analysis.

2.4 Receptor Network

A receptor grid, or network, defines the locations of predicted air pollutant concentrations that are used to assess compliance with the relevant standards or guidelines. The following receptor network was used for this analysis:

- 25-m spaced receptors along the facility fence line and out to 100 m from the fenceline;
- 50-m spaced receptors from beyond 100 m to 250 m from the fence line;
- 100-m spaced receptors from beyond 250 m to 1000 m from the fence line; and
- 250-m spaced receptors from beyond 1000 m to 2000 km from the fence line.

This network is composed of Cartesian (X, Y) receptors with Universal Transverse Mercator (UTM) coordinates. For consistency with the terrain elevation data, the modeling was conducted using the North American Datum of 1927 (NAD27). Receptors were modeled with terrain elevations for each point interpolated from US Geological Survey (USGS) 7.5-minute Digital Elevation Model (DEM) data.

The near field and far field receptor networks are illustrated in Figure 1. Detailed locations of buildings, the stack, and the fenceline are shown in Figure 2 and Figure 3.

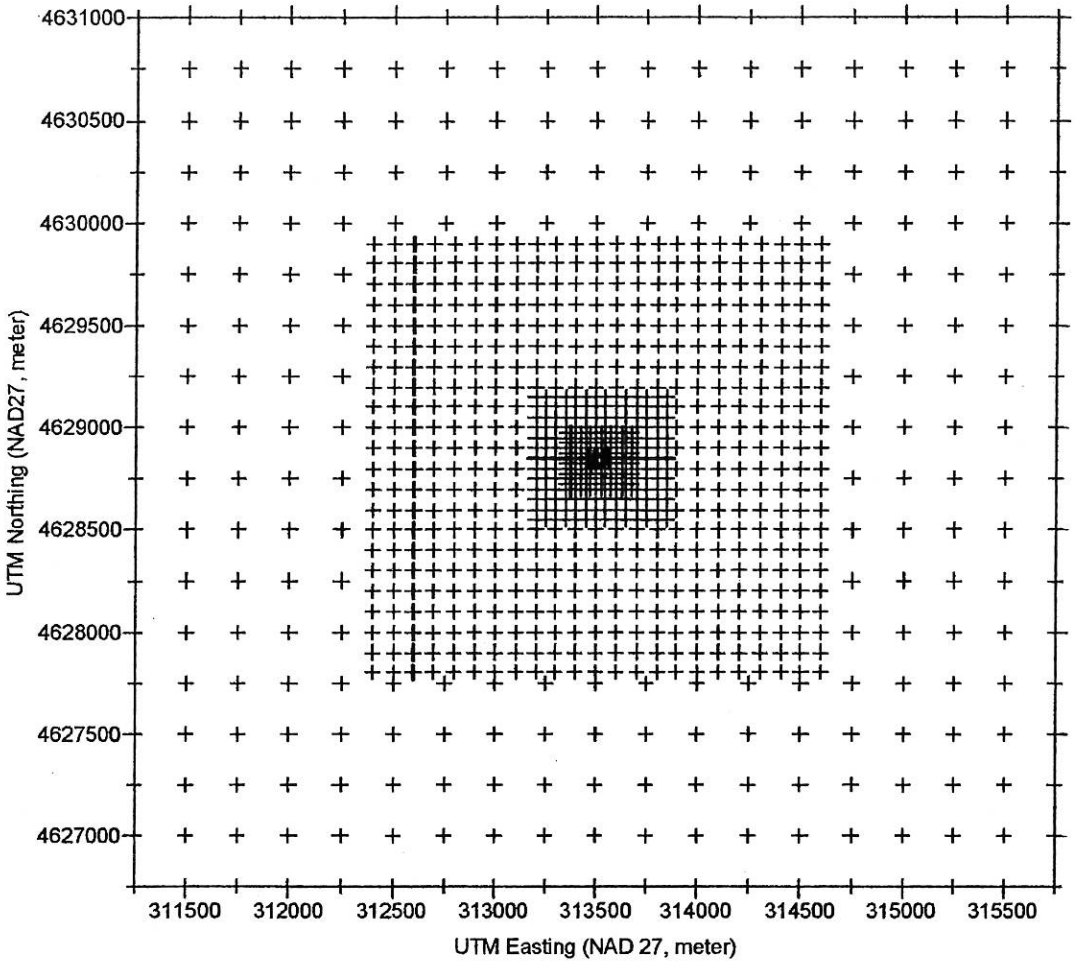

Figure 1. Near Field and Far Field Receptor Networks

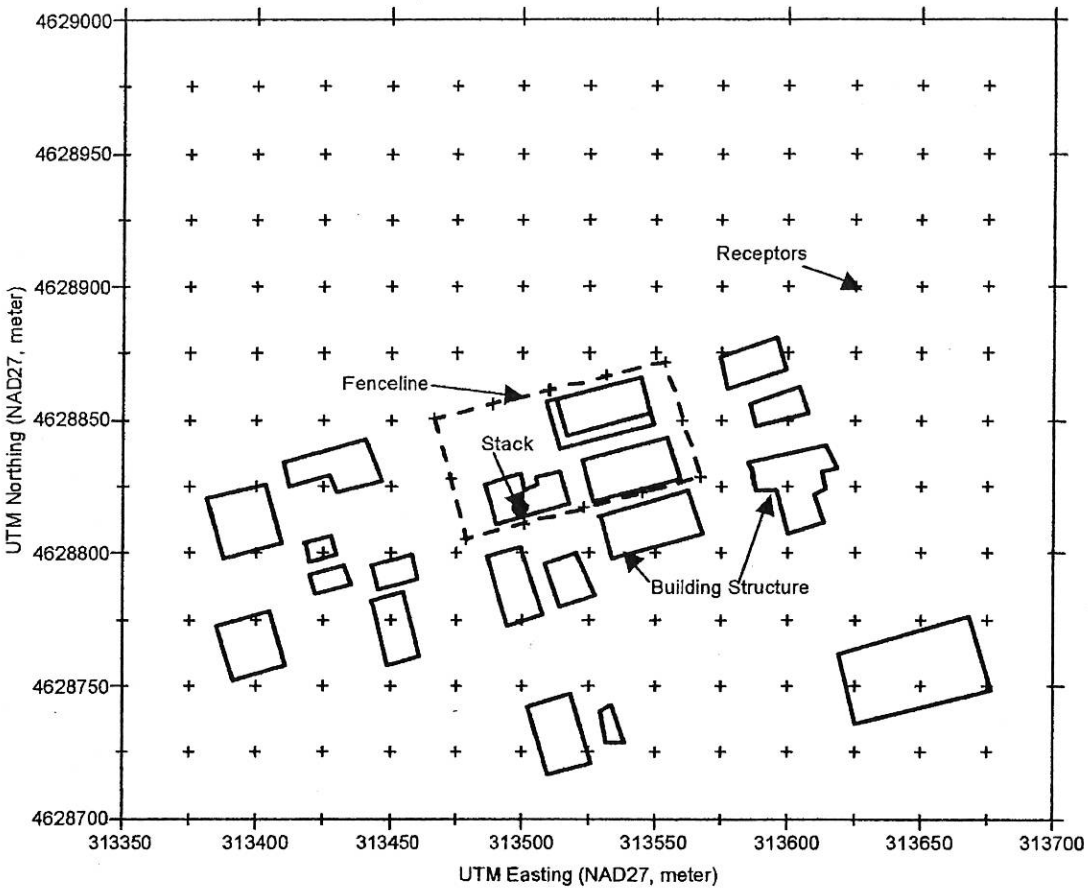

Figure 2. Location of Buildings, Stack, Property Fenceline, and Receptors

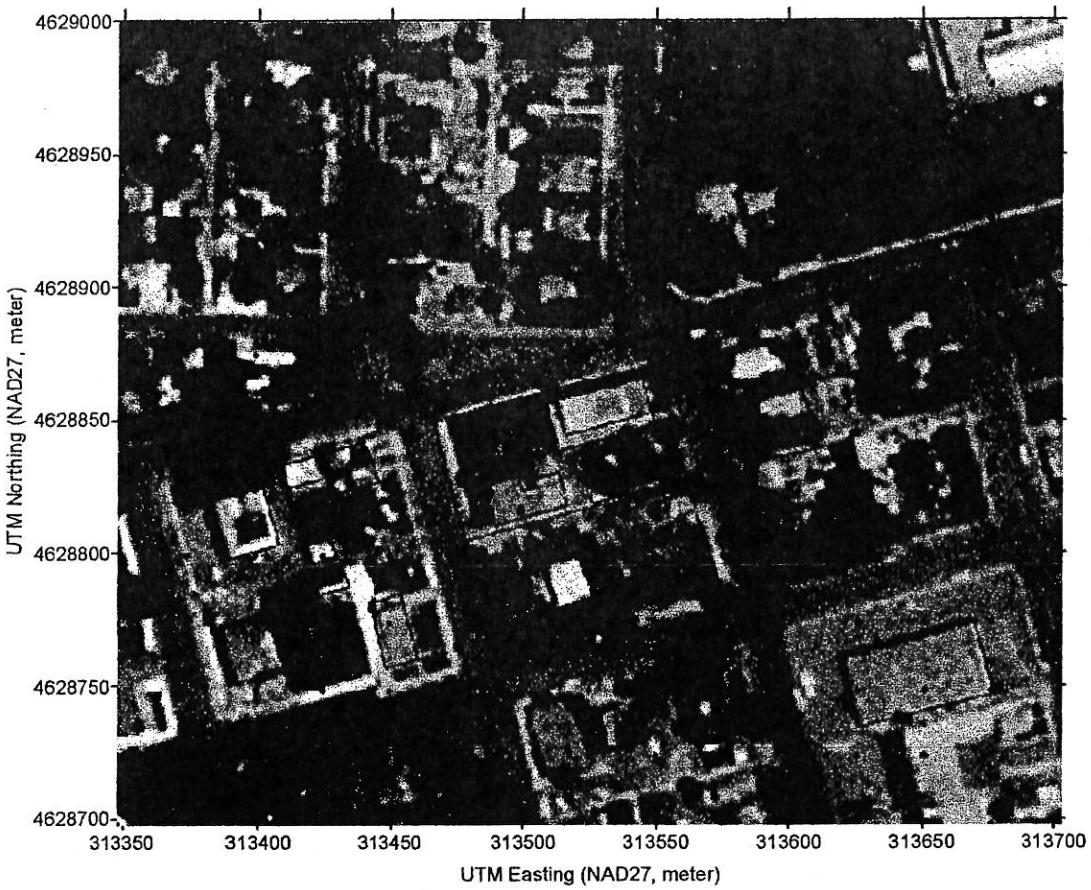

Figure 3. Location of Buildings, Stack, Property Fenceline, and Receptors on the Aerial Photomap

3 Source Data

3.1 Pollutants Emissions

The major emissions from crematories are nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SOx), particulate matter (PM10), mercury, hydrogen fluoride (HF), hydrogen chloride (HCl), non-methane volatile organic compounds (NMVOCs), other heavy metals, and some persistent organic pollutants (POPs) including dioxins and furans, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), etc. The emission rates depend on the design of the crematory, combustion temperature, gas retention time, duct design, duct temperature, and any control devices (Environment Canada, 1999).

Particulates such as dust, soot, ash and other unburned particles originate from the cremation container, human remains, and other contents of the container. Carbon based organic particulates should be removed in the secondary combustion chamber and through proper adjustment and operation of the cremation equipment. Carbon monoxide results from the incomplete combustion of containers, human remains, fuel, and other contents.

Carbon monoxide may be minimized through proper adjustment and operation of the cremation equipment (Environment Canada, 1999).

Sulfur dioxide is produced from the combustion of fuel, containers, and contents. The sulfur content of natural gas and human remains is relatively lower than other fuels. Nitrogen oxides are formed by high temperature combustion processes through the reaction of the nitrogen in air with oxygen (Environment Canada, 1999).

Mercury emissions originate from the dental fillings that may contain 5 to 10 grams of mercury depending on the numbers and types used. Mercury may be removed through the use of selenium salt in the cremation chamber or scrubbers. Hydrogen fluoride and hydrogen chloride results from the combustion of plastics contained in the container and from stomach contents. NMVOCs are produced from incomplete or inefficient combustion of hydrocarbons contained in the fuel, human remains, and casket. Dioxins and furans result from the combustion of wood cellulose and chlorinated plastics in the correct temperature range (Environment Canada, 1999).

3.2 Emission Source Description

Crematory emissions exhaust from a stack, and thus it is modeled as a point source. The stack parameters are shown in Table 1.

Table 1. Source Stack Parameters (Rostad Mortuary, 2006)

Source Name	Stack Height		Stack Gas Exit Temperature		Stack Gas Exit Velocity		Stack Diameter		UTM Coordinates (NAD27) Easting/Northing	
	(ft)	(m)	(°F)	(K)	(ft/s)	(m/s)	(ft)	(m)	(m)	(m)
Stack1	15	4.572	1413	1040	16.08	4.902	2.03	0.619	313499	4628817

Emission rate for various pollutants from crematory operations are described on the basis of 100 lbs of body per hour. The emissions associated with the fuel combustion during the cremation were also included, and the fuel type was assumed to be natural gas. All emission rates are shown in Table 2, and the maximum emission rate was chosen conservatively as a model input emission rate among various references.

Table 2. Source Emission Rates

Reference	Established Emission Factors Note1	Stack Test Data Note 2	Keaton's Mortuary Note 3	US EPA Note 4	US EPA 1996 Note 5	CANA, 1993 Note 6	Canada 1996	US EPA/CANA Woodlawn Crematory Test 1999 Note 7	Max Emission Rate	
Pollutant	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Emission Rate (lb/hr)	Max (lb/hr)	Max (g/sec)
PM10	2.6619E-05	0.276	0.171233		3.902E-05	3.445E-01		0.283	3.445E-01	4.340E-02
NOX	0.323809524		0.32911		4.746E-01	9.791E-02		0.43	4.746E-01	5.980E-02
SOX	0.057142857		0.05		8.374E-02	7.003E-01		0.148	7.003E-01	8.824E-02
CO	4.74286E-10	0.064	0.160616		2.163E-01	3.263E-01		0.0099	3.263E-01	4.111E-02
VOC	0.147619048								1.476E-01	1.860E-02
ARSENIC					1.689E-08				1.689E-08	2.128E-09
CADMIUM					4.780E-09			0.000161	1.609E-04	2.028E-05
LEAD					2.862E-08			0.00097	9.700E-04	1.222E-04
CHROMIUM					1.298E-08				1.298E-08	1.635E-09
MERCURY					1.438E-06			0.000573	5.732E-04	7.222E-05
NICKEL					1.654E-08				1.654E-08	2.084E-09
COPPER					1.186E-08				1.186E-08	1.495E-09
COBALT					2.512E-09				2.512E-09	3.165E-10
DIOXIN				8.14335E-13	3.574E-11			8.12E-08	8.12E-08	1.023E-08
FURAN				8.14335E-13	4.669E-11			8.12E-08	8.12E-08	1.023E-08
HCL						2.446E-02	7.077E-02	0.39	0.39	4.914E-02
HF					2.882E-07				2.882E-07	3.631E-08
Fluoranthene					9.072E-11				9.072E-11	1.143E-11
Benzo[a]-pyrene					1.591E-11				1.591E-11	2.004E-12
Benzo[a]-anthracene					5.812E-12				5.812E-12	7.323E-13

Note:

1) According to NCDENR-DAQ, these emission factors were developed from testing performed by the California Air Resources Board. The test results are published in the October 29, 1992 report entitled "Evaluation Test on Two Propane Fired Crematories at Camellia Memorial Lawn Cemetery". A full copy of the report is generally unavailable. However, the report is based on testing of 2 propane-fired crematories (max. capacity 1.4 MMBTU/hr each). The minimum process rate (hr/case) for the similar crematory (see Note 2 below) is used to convert from lb/case to lb/hr.
2) The emission rates were obtained from "Air Compliance Test Report" for a crematory incinerator at Haisley-Hobbs Funeral Home in Fort Pierce, FL (attached). The average emission rates have been converted to lb/hr for presentation and comparison.
3) Engineering Evaluation Report Keaton's Mortuary Plant Number 14968, Application Number 6416. Emission Factors for PM10, SO2, NOx, CO, and POC are taken from AP-42, 1/95, Table 1.4-1, and 1.4-3. Based on the Emission factors from AP-42, Pathological Waste Combustion was added. Operating schedule: 16hrs/day, 7days/wk, 52wks/yr
4) Source of Dioxins and Furans in Australia:Air Emissions May 2002, Page 38 Chapter 6.1.9. Crematoria
5) Emission Factors are for 1 55 to 70 kg body, about 65kg on average, No emission control devices were present in the creation of the emission factors. US-EPA emission factors include a 2 kg cardboard and 1kg wood container.
6) CANA emission factors averaged from test data in report for cardboard, cloth covered and finished wood containers.
7) Maximum outlet emission rate was used among the average values of 3 sets of 3 various runs.

4 Building Downwash Analysis

Stack exhaust has the potential to be influenced by building wakes, which in effect "wash down" the plume, causing increased ground-level concentrations. The EPA Building Profile Input Program (BPIP), adapted for use with ISCST3, was used to determine the direction-dependent building input parameters (USEPA, version 04274, 2004). This program was also used to calculate the Good Engineering Practice (GEP) stack height for each source location. The crematory stack height was not greater than the calculated GEP stack height; therefore, building downwash was considered.

Figure 2 shows the structures (purple solid line) that could influence the stack gas exhaust and are included in the downwash analysis. These structures were input to the BPIP program. Inspection of the BPIP output showed that some of these structures were of sufficient stature to cause some downwash of the stack exhaust.

5 Meteorological Data

ISCST3 model-ready meteorological data were obtained from the State of Wyoming Department of Environmental Quality (WDEQ). The meteorological data were collected near Rawlins, Wyoming and summarized into hourly averaged values for 1994. The anemometer height used to collect the wind data was 10 meters. According to the State Department of Environmental Quality, the average background NO_2 concentration for this area is 10 micrograms per cubic meter ($\mu g/m^3$) (State of Wyoming, 2006).

A wind rose for the 1994 data set is shown in Figure 4. The prevailing wind directions are from the Southwest.

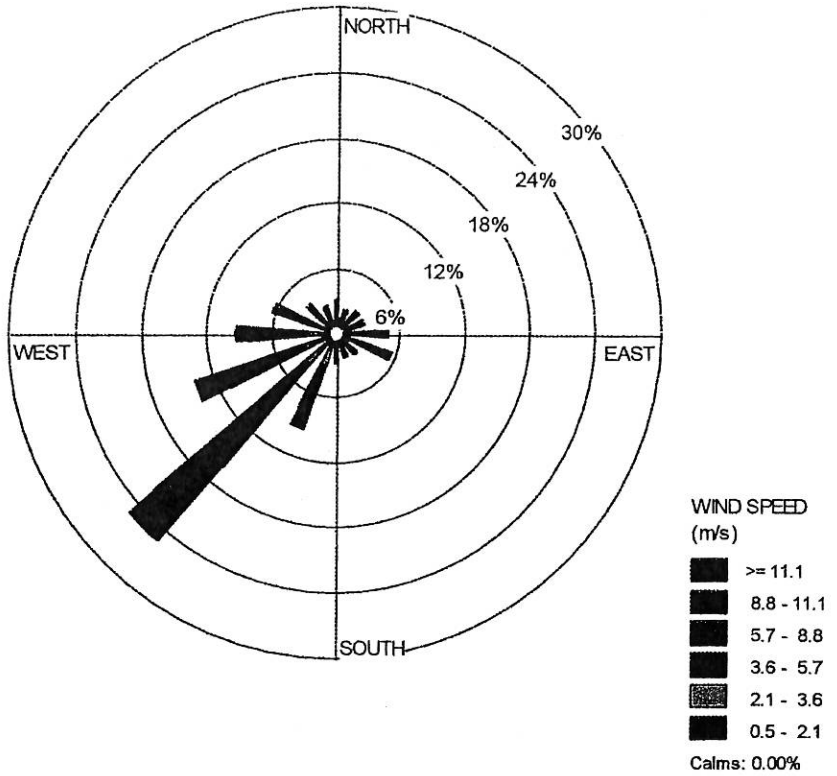

Figure 4. Rawlins Wind Rose

6 Modeling Results

The dispersion modeling was conducted to assess if all the estimated pollutant emissions listed in Table 2 from the crematory source would result in local concentrations that exceed the NAAQS and Wyoming AAQS. PM10, NOx, SOx, and CO were modeled for the various averaging periods compatible with the averaging period of the NAAQS and Wyoming AAQS. There is not a Wyoming AAQS for 1-hour NOx and 1-hour SOx, so the corresponding California AAQS were used for comparison. All other toxics and chemicals were modeled on 1-hour and annual averaged periods. The maximum impact of each pollutant is shown in Table 3 with the NAAQS and Wyoming AAQS.

The maximum 1-hour averaged impact of all the pollutants was predicted to occur to the east of the crematory stack, on the south central portion of the fenceline. Figure 5 shows the 1-hour averaged emission concentration isopleth for mercury. Figure 6 shows the 1-hour averaged emission concentration isopleth for NOx, and the maximum impact points

are indicated as a red star symbol on both figures. The trend of the isopleths for 1-hour averaged concentrations of all pollutants is similar to what is shown in Figures 5 and 6.

The maximum 3-hour averaged impact of SOx occurred north of the crematory stack, at the northwest portion of the fenceline on W. Walnut St. Figure 8 shows the 3-hour averaged emission concentration isopleth for SOx and the maximum impact points are indicated as a red star symbol.

The maximum annual averaged impact of all the pollutants occurred northeast of the crematory stack, at the northeast portion of the fenceline on W. Walnut St. Figure 7 shows the annual averaged emission concentration isopleth for NOx, Figure 9 shows the annual averaged emission concentration isopleth for cadmium, and the maximum impact points are indicated as a red star symbol on both figures. The trend of the isopleths for the annual averaged concentrations of all pollutants is similar to what is shown in Figures 7 and 9. The maximum 24-hour averaged impact of PM10 and SOx also occurred at the same location that the maximum annual averaged impact occurred.

For the toxic pollutants such as arsenic, cadmium, chromium, mercury, nickel, dioxin/furan and HCl, the annual averaged concentrations were predicted and compared with the annual preliminary remediation goal (PRG) for ambient air for EPA Region 9.

The 1-hour averaged concentrations of arsenic, chromium, nickel, and dioxin/furans were predicted by the model, but the annual averaged concentrations of these pollutants were not quantified because they were less than the model's minimum calculation limit of 0.00001 (0.1E-05). Even though the annual averaged concentration is shown as 0.00000 in the model output, this value is not actually zero. Therefore, the annual averaged concentrations of these pollutants were extrapolated from the 1-hour averaged concentrations. The ratio of the other pollutants' 1-hour average to their annual average was found to be 30. By applying this ratio to the 1-hour averaged concentration of arsenic, chromium, nickel, and dioxin/furans, the annual concentrations were found to be 3.33E-07 $\mu g/m^3$, 3.33E-07 $\mu g/m^3$, 3.33E-07 $\mu g/m^3$, 1.0E-06 $\mu g/m^3$ rather than 0.00000 $\mu g/m^3$ respectively.

Annual Cadmium and Dioxin/Furan concentrations exceed the PRG significantly by 205% and 2200%, respectively.

Table 3. Comparison of Maximum Predicted Impact of crematory emissions with the NAAQS, Wyoming AAQS, and Annual Preliminary Remediation Goal of EPA Region 9

Pollutant	Avg. Period	Primary NAAQS	Secondary NAAQS	Wyoming AAQS	Annual Preliminary Remediation Goal (EPA Region 9)	Model Predicted Impact	Percent of Model Predicted Impact to Standard
Unit	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(%)
PM10	24-hour	150	150	150		16.07	10.71%
	Annual	50	50	50		4.84	9.68%
NOX	1-hour	NA	NA	470 (California AAQS)		203.70	43.34%
	Annual	100	100	100		6.67	6.67%
SOX	1-hour	NA	NA	655 (California AAQS)		300.56	45.89%
	3-hour	NA	1300	1300		138.81	10.68%
	24-hour	365	NA	260		30.67	11.80%
	Annual	80	NA	60		9.85	16.42%
CO	1-hour	40000	NA	40000		140.05	0.35%
	8-hour	10000	NA	10000		35.73	0.36%
VOC	1-hour					63.36	
ARSENIC	Annual				0.00045	3.33E-07 (Estimated Value from Annual)	0.07%
	1-hour				NA	0.00001	*2.22% (Annual Standard Applied)*
CADIMUM	Annual				0.0011	0.00226	*205%*
	1-hour				NA	0.06908	*6280% (Annual Standard Applied)*
LEAD	Annual				NA	0.01364	
	1-hour				NA	0.41624	
CHROMIUM	Annual				0.000023	3.33E-7 (Estimated Value from Annual)	1.44%
	1-hour				NA	0.00001	*43.48% (Annual Standard Applied)*
MERCURY	Annual				0.31	0.00806	2.6%
	1-hour				NA	0.246	*79.35% (Annual Standard Applied)*
NICKEL	Annual				0.008	3.33E-7 (Estimated Value from Annual)	0.004%
	1-hour				NA	0.00001	*0.13% (Annual Standard Applied)*
COPPER	Annual				NA	0.00001	
HCL	Annual				21	5.48468	26.12%
	1-hour				NA	167.38	*797.05% (Annual Standard Applied)*
HF	Annual				NA	0.00012	
Dioxin/Furan	Annual				14 4.5E-08	1.0E-06 (Estimated Value from Annual)	2200%
	1-hour				NA	0.00003	66667% *(Annual Standard Applied)*

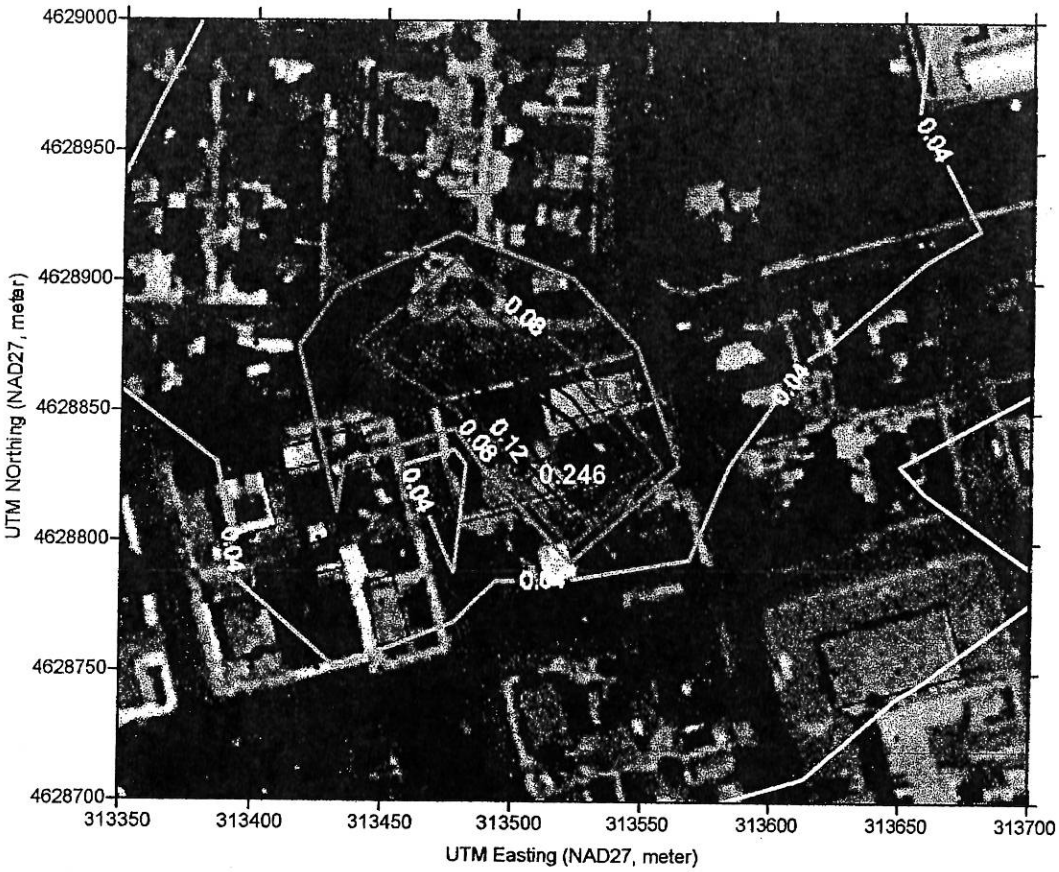

Figure 5. Isopleth of 1-hour averaged Mercury Impact (Max: 0.246 $\mu g/m^3$)

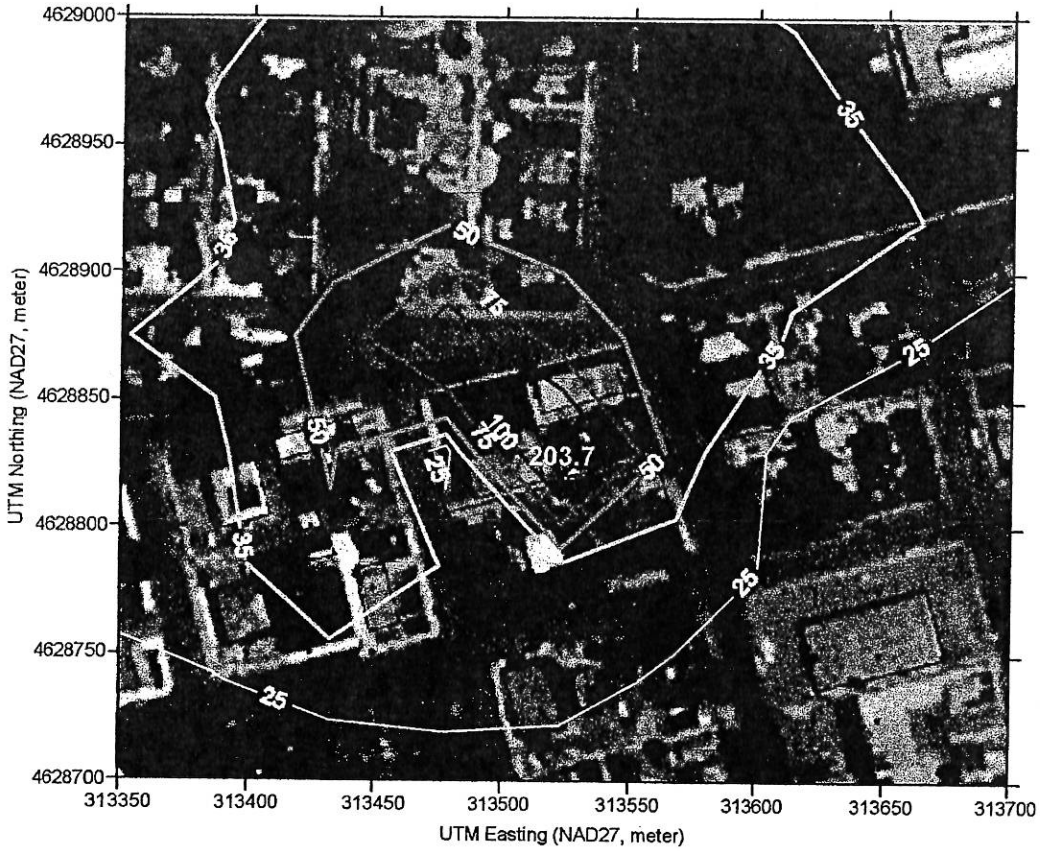

Figure 6. Isopleth of 1-hour averaged NOx Impact (Max: 203.7 $\mu g/m^3$)

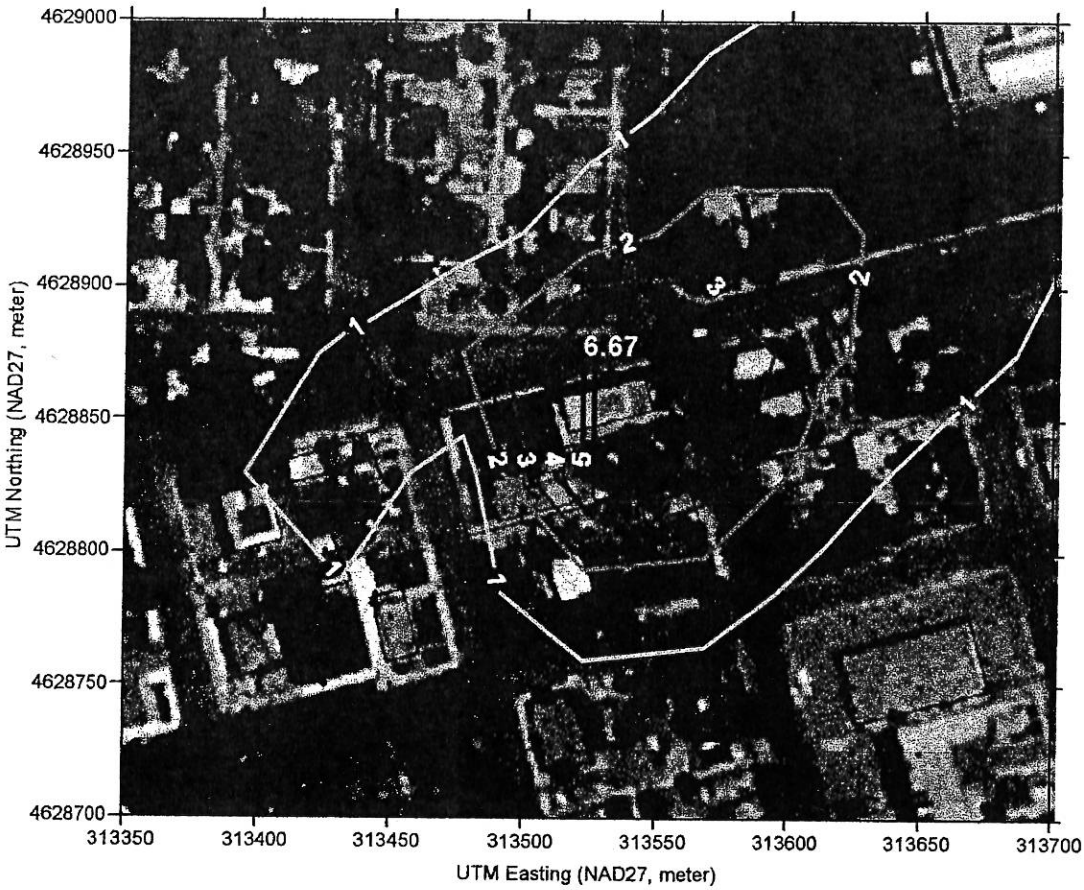

Figure 7. Isopleth of Annual Averaged NOx Impact (Max: 6.67 $\mu g/m^3$)

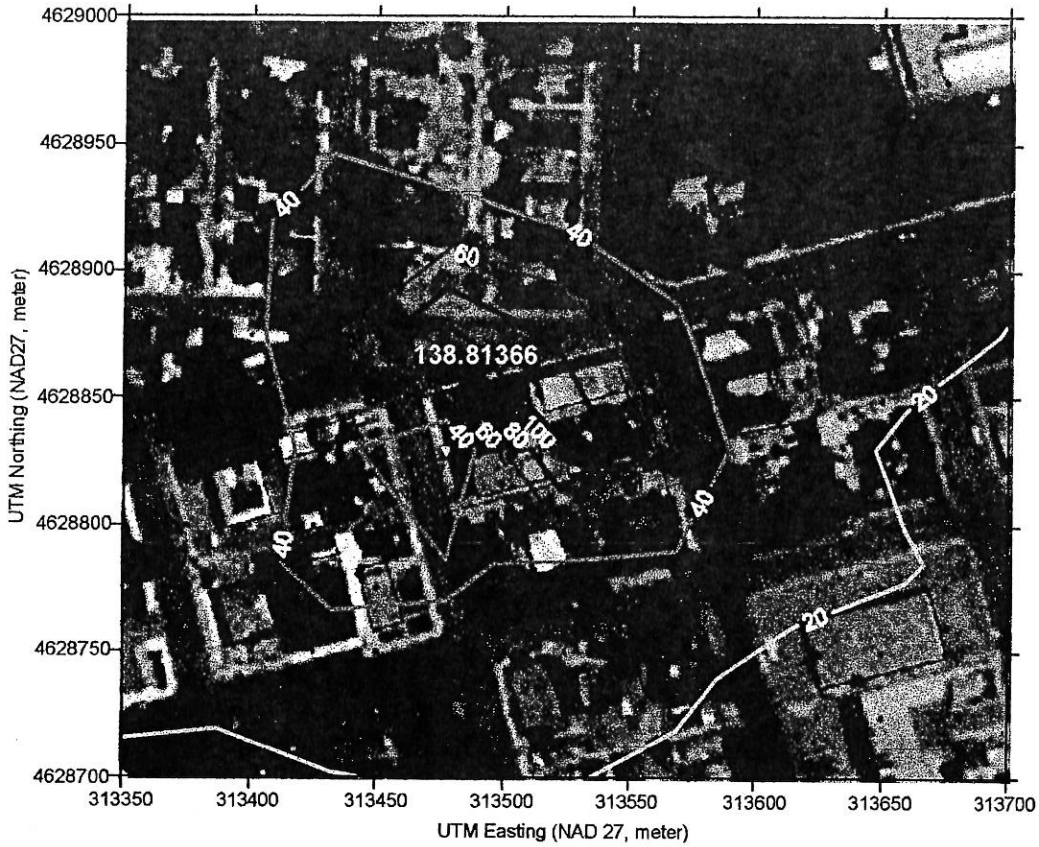

Figure 8. Isopleth of 3-hour Averaged SOx Impact (Max: 138.81 $\mu g/m^3$)

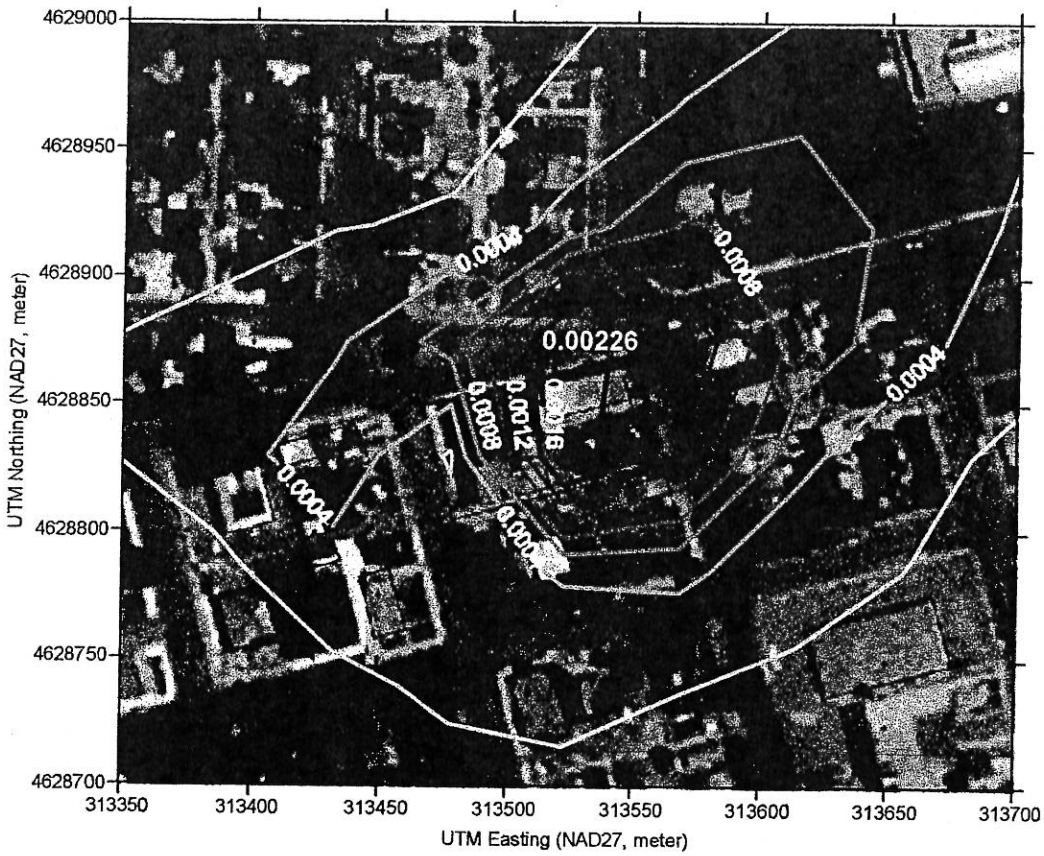

Figure 9. Isopleth of Annual Averaged Cadmium Impact (Max: 0.00226 $\mu g/m^3$)

7 References

1. Environment Canada, Emission Inventory Guidebook-Cremation Activity 090901, September 1999

2. Rostad Mortuary, Stack Information is obtained via the phone call with Rostad Mortuary Crematory, 2006

3. State of Wyoming, Department of Environmental Quality, Information obtained from Ken Rairigh, Air Quality Engineer, KRAIRI@state.wy.us, 2006

4. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. User's Guide to the Building Profile Input Program. EPA-454/R-93-038. April 2004.

5. United States Environmental Protection Agency, Emission Test Evaluation of a Crematory at Woodlawn Cemetery in the Bronx, NY, Volume I of III, 1999

6. US-EPA/CANA Crematory Test Summary, Woodlawn Cemetery, Bronx NY, June 11-17, 1999

7. United States Environmental Protection Agency. Guideline on Air Quality Models - Appendix W of Title 40 of the Code of Federal Regulations, Part 51. July 2003.

8. URS, William Ruoff, PRGTable2004 for Region 9, March 2006

Alexander Pilorusso <alexanderpilorusso@gmail.com>

Information on "How Mercury Destroys the Brain"

3 messages

Alexander Pilorusso <alexanderpilorusso@gmail.com> **Mon, May 16, 2011 at 2:44 PM**
To: nisyed@ucalgary.ca

Dr. Naweed,

My name is Alex Pilorusso and I currently live in a suburb of Pittsburgh, in Pennsylvania. There is a company that wishes to put a Crematory in one of the commercial districts of our township. Me and several other residents are looking into the possible chemicals that could come from such a crematory, and one of the chemicals we are looking at specifically is Mercury. We discovered your video and were very surprised about what we saw, but we had a question that we were hoping the video creators could clarify for us.

Q. How much mercury did you use in your tests described/shown in the video?

If you could send us a simple response we would very much appreciate it!

-- Alexander Pilorusso

Naweed Syed <nisyed@ucalgary.ca> **Mon, May 16, 2011 at 11:47 PM**
To: Alexander Pilorusso <alexanderpilorusso@gmail.com>

Dear Alexander,

Thank you for your interest. Regarding your question, we used very low concentrations of mercury (10-8M) - I will be happy to send the paper as well. What it would amount to be – if someone were to have 7-8 fillings and the mercury that they would excrete in their urine in the morning – would be equivalent to this amount. Similarly, if a body were to be cremated – all mercury contained in the fillings would be released into the environment. Depending upon the amount of the activity (bodies) and the numbers of the deceased with fillings – this could determine how much mercury would be released. There is no doubt that it would be toxic for the people living in the surroundings.

I hope that this would help.
Regards
Naweed
Dr. Naweed I. Syed (FRCP Edin)
Professor, Head
Cell Biology and Anatomy

From: Alexander Pilorusso < >
Date: Mon, 16 May 2011 12:44:45 -0600
To: Naweed Syed < >
Subject: Information on "How Mercury Destroys the Brain"
[Quoted text hidden]

Alexander Pilorusso <alexanderpilorusso@gmail.com> **Tue, May 17, 2011 at 1:42 PM**
To: Naweed Syed <nisyed@ucalgary.ca>

Dr Naweed,

Thank you so much for the response, if you could send the paper that would be great! If you need a mailing address, you can send it to;

1037 Waterford Court
Canonsburg, PA 15317

And thank you for the extra bit of information, that is just the kind of things we want to know so we know what we are dealing with and how to properly approach the crematory. Again thank you very much.

[Quoted text hidden]

TRAVELERS

90 Lamberton Road, Windsor, CT 06095
Phone #: 1-800-842-0355
Fax#: 860-687-7430

AIHA IHLAP Accredited - Laboratory ID 100126

Laboratory Work Order Number: 2011030209

Report Issued To:
Brandon Schaffer
Washington Penn Plastics
450 Racetrack Road
Washington, PA 15301

Date Samples Received: 3/7/2011
Report Date: 3/8/2011

Location Sampled: Washington Penn Plastic Co.
Sample Submitter: Brandon Schaffer

Sample ID	Sample Description	Results		Air Volume or Total Time
Mercury Vapor		mg/m3	µg	
3277400559	Area Sample of Unit #2	LT 0.0015	LT0.10	68.4 Liters
3277400554	Shed 32 ft away	LT 0.0014	LT0.10	72 Liters
3277400553	In Roof between Stacks	LT 0.0014	LT0.10	73.8 Liters
3277400552	Area Sample of Unit #1	LT 0.0015	LT0.10	68.4 Liters
3277400557	Blank		LT0.10	

COMMENTS:

Metal sample results have been blank corrected.

Analyte	Media type	MRL	Reference Method	Analysis Date
Mercury Vapor	226-17-1A	0.10 µg	OSHA 140 Digestion followed by ICP/MS - Modified OSHA ID 140	3/8/2011

Please Note: The method reporting limits (MRLs) listed are for normally processed samples. Samples requiring special processing (i.e. dilutions) may have elevated MRLs.
N.A. = Not Applicable

WORKORDER COMMENTS:

The reported data relate only to the samples as received by the Laboratory. The reported air concentrations have been calculated using information supplied by the customer and have NOT been adjusted to represent a Time Weighted Average (TWA). "LT" indicates less than the method reporting limit (MRL). The contaminant may or may not be present at levels below this concentration. This report shall not be reproduced except in full, without written approval of the laboratory. The samples have not been blank corrected unless otherwise noted. Unless otherwise noted, all samples were received in satisfactory condition.

Approved by:

Tom Surveski	Josef Chrzanowski	George E. Johnson	Marcel F. Baril
Tom Surveski	Josef Chrzanowski	George E. Johnson	Marcel F. Baril
QA Manager	Production Group Leader	Group Leader	Laboratory Director

Rullo, Kathleen

From: McDevitt, Jerry
Sent: Wednesday, May 25, 2011 4:02 PM
To: Rullo, Kathleen
Subject: FW:

-----Original Message-----
From: McDevitt, Jerry
Sent: Wednesday, May 25, 2011 4:01 PM
To: 'Tammy L. Ribar'
Subject: RE:

I would hope so, but did the bodies have any teeth with dental fillings?

-----Original Message-----
From: Tammy L. Ribar [mailto:ribartl@hh-law.com]
Sent: Wednesday, May 25, 2011 3:05 PM
To: McDevitt, Jerry
Cc: Mary-Jo Rebelo
Subject: RE:

Bodies.

Tammy L. Ribar, Esquire
Houston Harbaugh
Three Gateway Center
401 Liberty Avenue, 22nd Floor
Pittsburgh, PA 15222-1005
(412) 288-5018
(412) 281-4499 FAX
ribartl@hh-law.com
www.hh-law.com

-----Original Message-----
From: McDevitt, Jerry [mailto:Jerry.McDevitt@klgates.com]
Sent: Wednesday, May 25, 2011 2:38 PM
To: Tammy L. Ribar
Subject: Re:

What was being incinerated when he collected the samples?

----- Original Message -----
From: Tammy L. Ribar [mailto:ribartl@hh-law.com]
Sent: Wednesday, May 25, 2011 02:29 PM
To: McDevitt, Jerry
Cc: Mary-Jo Rebelo <mrebelo@hh-law.com>
Subject: RE:

Travelers was the lab that did the testing of the samples. Brandon Shaffer from Washington Penn Plastics collected the samples to measure for airborne mercury. The results revealed none.

Tammy L. Ribar, Esquire
Houston Harbaugh
Three Gateway Center
401 Liberty Avenue, 22nd Floor
Pittsburgh, PA 15222-1005
(412) 288-5018