Abstract

As a leading institution in medical research, McGill University operates hundreds of labs which generate wastes of a hazardous nature. Along with that waste comes the responsibility to manage them in a manner which respects legal, moral and financial obligations and in keeping with the University's commitment to sustainability. The hazardous waste stream which translates into the largest volume at McGill consists of biomedical waste i.e. waste of a biological origin, most of which is generated by departments engaged in medical research.

There are 2 generally accepted methods for the destruction of biomedical waste: incineration and steam sterilization. Incineration involves the complete breakdown of the waste through combustion, resulting in the conversion of most of the mass into carbon dioxide and a correspondingly large carbon footprint. Sterilization, on the other hand, simply kills all microorganisms, thereby rendering the material non-hazardous waste and suitable for disposal as solid waste into landfill.

Incineration can be used to destroy biomedical waste of both an anatomical and non-anatomical origin[1], whereas steam sterilization is used strictly for treating non-anatomical wastes. Most of the biomedical waste (>80%) collected by HWM is non-anatomical, thus sterilization is a possible option for the bulk of the waste. At present, the biomedical wastes collected by McGill's Hazardous Waste Program are trucked weekly to a commercial incinerator over 1000 km. away. The purpose of this document is to examine the feasibility of investing in an in-house steam sterilization system and to provide the background information necessary to develop a budget estimate. This estimate will form the basis of a business case to determine the feasibility of making such an investment.

Statement of the Problem

Every week, the Hazardous Waste Management (HWM) department picks up over 150 boxes of biomedical waste from locations on the downtown campus, brings them to the HWM cold room for storage and then arranges for disposal. At present the disposal is carried out by the company Stericycle, who collect this waste from the University every Friday and truck it to their incinerator located in Moncton, New Brunswick. As this is the only biomedical waste incinerator licensed to operate in eastern Canada, Stericycle currently holds a monopoly on the biomedical waste disposal business, leaving the University at their mercy when it comes to pricing and service continuity.

[1] As per definitions of Biomedical Waste in the Quebec Regulation Respecting Biomedical Waste, under the Environmental Quality Act, See Appendix 1

In addition to the biomedical waste sent for incineration, there are a number of departments within the University who operate their own autoclaves to sterilize their wastes. According to figures gathered by EHS, there are 26 local autoclaves on campus used to sterilize instruments and waste. These autoclaved wastes are collected by HWM who transfers it to a designated dumpster, which is then trucked off for disposal in a regular landfill. To verify whether an autoclave has effectively sterilized its load there is a test, referred to as a "spore test" which must be performed. Unfortunately, random tests conducted by EHS has revealed that users are not consistently doing their tests and that many of the loads tested in fact failed, meaning that the quality control applied to the local autoclaves is sub-standard. If such is the case, the university could be found in contravention of the hazardous waste regulations, which leads to substantial fines and stoppage of research activities. Finally, if the establishment of a centralized autoclave results in the decommissioning of a good number of local units, the benefits will be vast – less space demand, less equipment, better compliance with quality control and compliance requirements, less manpower devoted to local autoclaving and a great reduction in energy (steam, electricity, and ventilation) consumption.

The Proposal

The proposal under consideration is to install a shredder/sterilizer (also known as an autoclave) for use by HWM to treat non-anatomical biomedical waste.

This new autoclave would be principally for the sterilization of the wastes collected by HWM, however it can also be made available to the departments who autoclave their own wastes and could result in the elimination of some of the local autoclaves.

Benefits/Impact Statement

A switch to a centralized autoclave would result in an immediate reduction by 80% of the number of boxes trucked to New Brunswick each week and a corresponding **decrease in the carbon footprint** associated with this operation.

In terms of cost, there is a **potential decrease in the $65,000 annual fees** paid by HWM per year. A more accurate projection of the savings will be derived from the results of this business case evaluation.

The **monopoly on biomedical waste disposal** held by the current contractor is worrisome given that an accident at their plant, a suspension of their operations, or their loss of permit to operate could leave the University with no means to dispose of the waste. Establishing a centralized autoclave adds a second option and reduces the risk of a waste management crisis.

The centralized autoclave which is being considered is designed to facilitate spore tests and will better insure that loads sent to landfill are indeed sterilized properly and in full **conformity with waste disposal regulations.**

A centralized autoclave stands to **reduce energy consumption** in the form of steam, electricity and ventilation demands, especially if departments take advantage of the new system by decommissioning their local units.

The closure of local autoclaves would also **free up space, eliminate costly equipment and save on manpower** for the departments, thus meriting a contribution from them towards the new system.

Finally, the number of biohazard certificates, required for a researcher to work with infectious material, is on the rise, which suggest that the **volumes of biomedical waste generated by McGill research is going to increase in the short to mid-term.** Savings made by autoclaving that waste versus incineration would potentially be substantial.

Initial Specifications

The model of sterilizer proposed is the Ecodas T-300:

http://www.ecodas.com/en/savoir_faire/technique.php?menu=3&ssmenu=2&lang=en

Because it is both a shredder and an autoclave it has the advantage of being able to sterilize the waste in the least amount of time, enabling it to process the volumes generated by the University.

Considering the size, weight and mechanical requirements to install such a system, it is important to select a proper location that provides access to the necessary services and is within a reasonable distance from the HWM Centre. Jean Perrault, former supervisor FOD northwest sector, looked at 2 possible locations to install the biomedical waste sterilization system:

- HWM warehouse (room 110, GCRC): space currently occupied by HWM. Would require installation of a high pressure vapor line, 90 psig air line, a dedicated floor drain, a floor rated to hold 3100kg, ventilation, and a 380V electric supply box.

- Mechanical room (15th floor, McIntyre): Space occupied by FOD, location approved by Luc Roy. All amenities are close by (vapor, air, drain, ventilation and electric). Weight might be an issue.

Since it is was not possible for HWM alone to determine which one of these locations was the best choice without knowing the relative costs of installation, we sent a proposal to Daniel Chevarie, assistant-director project management, explaining our vision and asking for a project manager to be assigned to our project, which was accepted. Amanda Ceccarelli was put in charge and had the responsibility to determine the best location for the autoclave, as well as costs associated with installation. That would enable us to propose a relatively accurate budget request including not only costs for installation and operation, but also savings generated by the sterilization process.

A group of engineers (Dessau) and architechts (DMA) were mandated to come up with various scenarios to install the autoclave in the HWM warehouse. Ultimately, it was determined that it was possible to do

so, but it would require an initial investment of around 77 000$. In order to determine if the cost is worth it, we drafted the cost analysis below:

Initial costs	
Retrofit HWM warehouse	77 000$
Autoclave purchase	232 448$
Wheelie bins	7 000 $
5 gallons plastic pail	2 000$
TOTAL	**318 448$**

Recurrent costs	
Autoclave operator	9 000$ if using Work Study Program (2 students) 32 000$ if hiring full time MUNACA
Maintenance	10 000$ (approximation, most likely less)
Autoclave bags	8 000$
TOTAL	**27 000$ to 50 000$**

Eliminated costs	
Cardboard boxes	11 000$
Incineration	65 000$
Plastic bags for boxes	3 000$
TOTAL	**79 000$**

Annual savings (with work study program)	**52 000$**
Time to pay back investment	**6 years**

Annual savings (with full time employee)	**29 000$**
Time to pay back investment	**11 years**

In addition to location other options will need to be examined, for example:

- The relative merits of buying the unit (currently quoted at 232,448$) vs. leasing it (with the option to purchase)
- The costs of in-house maintenance vs. a preventive maintenance contract
- The optimal size of the unit
- The benefits of installing a second, smaller unit at Macdonald Campus

Funding Sources

Given the multiple benefits which could be derived from investing in a centralized autoclave it would be reasonable to expect contributions from a variety of sources, for example:

Benefit	Funding Source
• Savings in energy costs associated with closing local autoclaves i.e. less steam demand and reduced local ventilation • Reduced carbon footprint associated with discontinuing incineration • Better quality control (spore testing) in will assure loads are sterilized • Closure of localized autoclaves will eliminate equipment, maintenance costs, and manpower and free up space.	• Energy Conservation Fund • Sustainability Fund • Safety Capital Alterations Fund • Departments/Faculty (of Medicine)

Appendix 1

Definition of Biomedical Waste

Quebec Regulation Respecting Biomedical Waste

(1) human anatomical waste consisting of body parts or organs, but excluding teeth, hair, nails, blood and biological liquids;

(2) animal anatomical waste consisting of carcasses, body parts or organs, but excluding teeth, hair, claws, feathers, blood and biological liquids;

(3) non-anatomical waste consisting of any of the following:

(a) a sharp or breakable object having been in contact with blood or with a biological liquid or tissue and having been used in medical, dental or veterinary care or in a medical or veterinary biology laboratory, or such an object used in embalming;

(b) biological tissue, cell culture, microbial culture, or material in contact with such tissue or culture, used in a medical or veterinary biology laboratory;

(c) live vaccine;

(d) a blood container or material that has been saturated with blood and used in medical care, in a medical biology laboratory or in embalming;