SPF00024 FINAL REPORT: FLUORESCENT LAMP RECYCLING

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1. TABLE OF CONTENTS

2. EXECUTIVE SUMMARY

All fluorescent lamps, including Compact Fluorescent Lamps (CFL), contain hazardous materials in the form of phosphor powder, mercury, as well as recyclable material like glass and metal. Up until 2011, McGill was considering all burnt fluorescent lights to be regular garbage and custodial staff were instructed to dispose of them in the regular waste stream. Considering that some of these lights have a mercury content well above the 0,1 mg/kg limit set by the Quebec "Ministère du Développement Durable, de l'Environnement et des Parcs" (MDDEP) for regular waste landfill, McGill was out of compliance. To follow the steps of other Montreal Universities, we asked the SPF to help us with setting up a fluorescent light recycling program. In collaboration with McGill Building Services, the Hazardous Waste Management department (HWM) determined 21 locations where we can store fluorescent lamp recycling drums to hold the intact burnt lamps waiting for collection by HWM. As part of their regular schedule, the HWM drivers are instructed to collect full drums and leave empty ones. Full drums of lamps are stored in our facility (McIntyre building) until ready for shipment. The recycler, ChemTECH Environnement, already comes every 6 to 8 weeks to collect McGill's chemical waste generated by laboratories, so we just added the lamps to their actual run, minimizing GHG emissions. ChemTECH then ships the lamps to their recycling facility so they can be sorted and crushed. The crushed lamps then go through a series of filters which will separate the white phosphor powder and mercury from the glass and the metal. The metal and glass will be recycled, while the phosphor powder and mercury will be disposed of as hazardous material. From October 2011 to December 2013, we were able to recycle 1391 bulb type lamps (CFL, HID) as well as 103 788 feet of linear fluorescent tubes, for a total of close to 5 tons of recyclable and hazardous materials diverted from landfill.

3. INTRODUCTION

3.1 Our department: The McGill Hazardous Waste Management (HWM) department is responsible for disposal of all hazardous material generated on both MacDonald and Downtown campuses. Our main focus is on research waste such as chemical, biomedical and radioactive waste. In addition, we also dispose of various scrap metals collected on campus as well as old electronic equipment, which contains highly toxic materials like lead, nickel, cadmium and many other heavy metals.

3.2 The problematic: In order to provide adequate lighting, the University utilizes approximately ninety thousand feet of fluorescent lights across campus. For the sake of improving energy efficiency, most incandescent bulbs have been replaced with Compact Fluorescent Lamps (CFL). When spent, those lamps are going straight to the regular garbage for landfill. What most people don't know is that fluorescent lamps (including CFLs) contain mercury, a very toxic chemical that can cause irreversible damage to human and animal health, even death. The Quebec Environment Quality Act defines the maximum concentration of mercury allowed in a liquid or in leachates from solid material [1]:

"Leachable material" means

(1) any liquid containing a contaminant with a concentration higher than the standard set forth in the following table (table I); or

(2) any material which, when tested in accordance with the method prescribed in the "Liste des méthodes d'analyses relatives à l'application des règlements découlant de la Loi sur la qualité de l'environnement" published by the "Ministère du Développement durable, de l'Environnement et des Parcs", produces a leachate containing a contaminant with a concentration higher than the standard set forth in the following table:

3.3 Table I: MAXIMUM CONCENTRATION OF A CONTAMINANT IN LIQUIDS OR IN LEACHATES FROM SOLID MATERIAL

Contaminant	Standard (mg/L)*
Arsenic	5
Barium	100
Boron	500
Cadmium	0.5
Total cyanides	20
Chromium	5
Total fluoride	150
Mercury	**0.1**
Nitrates + nitrites	1000
Nitrites	100
Lead	5
Selenium	1
Uranium	2

One way to determine the mercury concentration of a lamp is to go to the supplier website and look at the fact sheet. The information indicated is not necessarily consistent from one supplier to another. Some will give you exact concentrations, others will just mention that the lamp passes or fails the leachate test according to Canadian or American standards. Taking this into consideration, it is very difficult to determine the actual mercury concentration of waste fluorescent lamps purchased by McGill, but we know that it is more than likely above the limits indicated in the Quebec legislation.

In order to comply with the regulation and be more sustainable, we propose to start collecting those lamps, recycle what we can (glass, metal) and dispose of the hazardous components properly (phosphor powder, mercury).

4. PROPOSED SOLUTIONS

There are 2 different approaches we can use for disposal:

4.1 **Lamps to be crushed on site:** using the "Aircycle bulb eater" [2], lamps are crushed before shipment to a certified recycler.

This device will safely break the lamps into a 45 gallon drum. The result is a mixture of broken glass, metal, as well as a mixture of a white phosphor powder and mercury compounds.

4.2 **Lamps to be shipped intact.** The tubes will be stored in special drums with inserts and shipped, as is, to a certified recycler, who will break them and treat the crushed solid.

After discussion, we decided to go with the second approach (intact tubes). Here is why:

- **Manpower:** In order to operate the bulb eater, we would need to have someone dedicated to the task. Neither HWM nor Building Services have that luxury, so institutionalization would be an issue.
- **Occupational hazard:** the bulb eater is equipped with mercury filters to prevent hazardous dust from escaping the 45 gallon drum. When the drum is full, one needs to remove the bulb eater and close the drum properly, exposing himself to the dust. It is very minimal but still worse than not being exposed at all. According to *Aucott et al.* [3], 3 to 8 mg of mercury can still vaporize in the drum for over 2 weeks, depending on the type of bulb and temperature.
- **Maintenance costs:** the filters and bags inside the bulb eater need to be changed on a regular basis, increasing long term costs.
- **No real benefit:** the only benefit of the bulb eater is the storage space. Crushed lamps do take a lot less room that intact ones. But there are ways to work around that issue. Also, drums filled with crushed lamps weight a lot, increasing the risk of injuries while manipulating.

5. SELECTED PROJECT IMPLEMENTATION

5.1 Timeline: We originally proposed the following schedule for implementation.

1. *Project start: January 3rd 2011*
2. *Set up storage rooms: by February 4th 2011*
3. *First milk run: March 4th 2011, then twice a month or less depending on demand*
4. *Follow up meeting with project team: April 2011*
5. *Project ends: May 31st 2012*

In reality, here is the chain of events that occurred:

1. Project start: We received the SPF award letter on January 19th 2011.
2. Set up storage rooms: This really took more time than we expected. It was easy for HWM to get the empty fluorescent lamp recycling drums and to deliver them to our hazardous waste rooms. The challenge was to determine locations for buildings where we do not have a hazardous waste room. To do so we had to organize a meeting with an officer from building services and it took 6 months before we managed to do it.

On July 12th 2011, we managed to sit down with George Lazaris, Building Services Officer, in order to determine the best location for the lamp recycling bins. Here are the locations (by sector):

5.2 Table II: FLUORESCENT LAMPS RECYCLING DRUM LOCATION

North West	North East
- McIntyre (loading dock) - Education (Garage area) - Stewart (loading dock, 3rd floor) - Gelber Law (loading dock, 2nd floor) - Ludmer (side door entrance) - Wilson Hall	- Wong (stockroom 0200) - Lyman Duff (Stockroom) - Meakins Christie (Stockroom) - Currie gym - Rutherford (mechanical room)
South West	**South East**
- Leacock (room 107) - Bronfman (room 109) - McLennan library (stockroom) - University Centre (basement)	- McConnnell (room 015) - Strathcona Music (garbage room) - James Admin - 688 Sherbrooke
Macdonald Campus:	
- Macdonald Stewart - Laird Hall	

Since Building Services were already replacing the fluorescent lamps, they will keep on doing it. But instead of trashing them in the regular garbage, they will fill up the fluorescent lamp recycling drums.

3. First milk run: Once the locations were determined, we were able to generate a schedule and begin collecting the lamps. We already had a weekly schedule to collect hazardous waste in various buildings, including some where we have the lamp recycling drums. Those will be collected and replaced with empty ones at the same time we do the hazardous waste pickup. The remaining locations will be done on a bi-weekly basis or as needed. The custodial staff has been instructed to give us a call if a drum is full. We try as much as possible to include lamps collection with our other duties in order to minimize our travel time with the trucks.

The recycler, "Chemtech Environnement", will pick up the drums at the same time they come for our hazardous waste, thus keeping transport to a minimum. Empty drums will also be delivered at the same time. We also have an agreement with them that, for a minimal fee, they can go and collect the lamps directly to our multiple storage locations. This will occur only in the event of an emergency when we are not able to go get the drum.

4. Follow up meeting: We did not actually have a formal meeting. We adjusted as things progressed through the year. There were a few logistic issues which were addressed on the spot, mainly regarding the proper use of the lamp recycling drums and a few location additions to the regular milk run.

5. Project end date: We originally set the date to be May 2012. That date had to be pushed back for many reasons:

    a. The project started 7 months after the original "go live" date.

    b. MUNACA (McGill University Non-Academic Certified Association) went on strike from September 2011 to December 2011. Considering that all technical staff needed to replace, collect and transport the burnt lamps were members of MUNACA, it was up to the supervisors to do their work. Recycling lamps was not considered a priority at the time so the project was delayed even more.

    c. Taking that into consideration, we decided to post pone the project implementation at MacDonald campus to early 2012.

6. PROJECT INSTITUTIONALIZATION

We originally thought that the costs associated with collection, transport and disposal of the fluorescent lamps would be part of a budget request made to the director of University Services, hoping for a positive answer. HWM has always strongly believed that lamp recycling should have been implemented a long time ago, just as in most other Quebec universities. There was a certain level of uncertainty regarding the continuity of this project but we were ready to do what was necessary to continue doing it.

But it ended up that none of that would be necessary. On June 5th 2012, Product Care Association (PCA)[4], a non-profit industry association, finalized an agency agreement with "Recyc-Québec"[5] who is the agency overseeing product stewardship in Quebec. The "RecycFluo" program (also non-profit)[6] was created under the management of PCA in order to

implement a recovery and reclamation system for mercury-containing lights. Ultimately, the RecycFluo program was developed in response to a new Quebec regulation, the "regulation respecting the recovery and reclamation of products by enterprises"[7].

In a nutshell, this means that the RecycFluo program will manage the recycling of all mercury-containing lamps in Québec for free, including institutions like McGill University. An eco-fee will be added at the purchasing level to finance the program for proper disposal. The program will be implemented in several phases. For example, institutions like McGill were able to use the system starting October 2012, which we did.

7. STATISTICS

7.1 Table III: LAMPS COLLECTED BETWEEN AUGUST 2011 AND DECEMBER 2013

Lamp type and size	Amount of lamps	Total amount of feet
1' fluorescent tube	23	23
2' fluorescent tube	352	704
3' fluorescent tube	63	189
4' fluorescent tube	24723	98892
6' fluorescent tube	138	828
8' fluorescent tube	330	2640
U-Shaped fluorescent tube	74	296
Compact Fluorescent lamp (CFL)	952	
Incandescent bulb	105	
Projector lamp	179	
Ultra-violet lamp	54	216
High Intensity Discharge lamp (HID)	155	
TOTAL	**1391 bulb type lamps**	**103788 feet of tubular lamps**
TOTAL WEIGHT		**4930 KG**

8. DISCUSSION AND CONCLUSION

We were very confident that this project would be successful when it began. Similar systems are already in place in many institutions across Canada, including universities. It also helped that I previously worked for a private company which picked up fluorescent lamps for recycling, as I was aware of the proper equipment we needed as well as the logistic aspect of fluorescent lamp collection and recycling.

The first challenge we encountered was to determine the right locations for the fluorescent recycling drums. It took us a lot more time than I thought to actually sit down and talk about it with McGill Facilities Management and Operations (7 months).

The second challenge was the MUNACA strike, which occurred from September 2011 to the end of December 2011. At that time, HWM had to prepare a contingency plan and prioritize the tasks which are part of their mandate. With recycling of fluorescent lamps being at the bottom of the list, the collection of lamps was slowed down drastically, even put on hold for a while.

In January 2012, the project was back on track and, since then, has run very smoothly. We added a few new locations along the way to meet the demand and maximize the collection of burnt fluorescent lamps. Two years after we started the project, we can now say that we are successfully collecting the majority of spent fluorescent lamps from both campuses, confirming our sustainability project as a success.

It was a great coincidence that the Quebec government decided to go ahead with the "RecycFluo" program right in the middle of our project. They will take care of the costs associated with recycling, which is a good chunk of our expenses. But we still need to absorb the extra hours to go and get the recycling drums as well as their rental fees of 10$ per unit. So far we can manage to fit the collection of lamps in our regular schedule and deal with the extra costs associated with it. But we might need a budget increase in the medium to long term. Nevertheless, we can consider institutionalization of the project as a success.

From October 2011 to December 2013, we were able to recycle 1391 bulb type lamps (CFL, HID) as well as 103 788 feet of linear fluorescent tubes, for a total of close to 5 tons of recyclable and hazardous materials diverted from landfill.

9. REFERENCES

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