

Rainwater Haversting Unit

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Abstract. In this paper we will present a rainwater harvesting system for the CAMTAC Linamar Plant in Guelph, Ontario. The main concept is to capture precipitation on the plant roof and gather it to a local point inside the facility. This water will then be treated and used for CAMTAC cooling processes instead of using municipal water. The design consists of new collection piping, 20 000 gallons of holding capacity, a low maintenance grid trap chamber, and an ultraviolet disinfection system. The systems results show a potential savings of \$16,750 per year and a payback of 24 months.

Key words: grid chamber, industrial, rainwater harvesting, ultraviolet

1 Introduction

Blue Sky Consulting was contracted by the Linamar Corporation for the CAMTAC plant located in Guelph, Ontario to analyze and asses the possibility of installing a rainwater harvesting system. Rainwater harvesting systems can range from simple structures such as rain barrels, to complex systems that purify collected water to a municipally governed potable standard. Some major constraints that the design will pursue are:

- Rainwater system must be able to be implemented on, in, or around the existing plants structure,
- Rainwater must be at or above the quality standards for the machine tool cooling use, and
- System must not place any workers at the CAMTAC plant in any form of danger.

Some major Criteria are:

- The system should minimize the return period on the design, and
- The system should minimize the amount of maintenance needed (i.e. tank, and basin cleaning, filter changes etc.).

A few major assumptions of the design being proposed are that the collection efficiency of the water runoff would be 75 percent taken from general values used for assessing collection potential. Also only rain data (not total precipitation) would be analyzed due to the fact that the collection of snow would be too unpredictable, and this would yield a more controversial analysis. The cost of municipal water would be $\$1.53/m^3$ using the original information from CAMTACs RFP.

The design team went through many stages of analysis before coming to the final concept. There were various approaches taken to analyze the rain data of Guelph, which in turn would affect the storage tank sizing. The actual filtration processes however did not fluctuate that much, the design team was very adamant on this aspect from the initial contract.

2 Conceptual Design/Methodology

2.1 Overall design

The rainwater harvesting design is a cost effective systems that incorporates 20 000 gallons of holding capacity, a low maintenance grid trap chamber, and an ultraviolet disinfection system. Blue Sky plans on capturing the rainwater through a ceiling hung piping system and transport it to two holding tanks. The rainwater will then be filtered with a 5 micron filter and treated using an ultraviolet radiation system at a rate of 5 GPM. This steady stream of clean water will then be pumped to the existing reverse osmosis system. The design was chosen because of the simplicity of the system, the ability for the system to attach to the existing structure and the potential with Guelphs precipitation history.

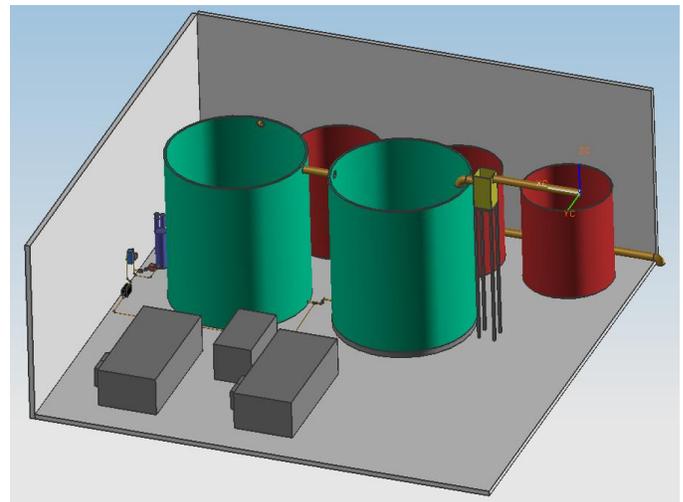


Fig. 1. Proposed water savings for CAMTAC Linimar plant over 1 year.

3 Detailed Design

3.1 Collection Pipes

The collection pipes for the system were decided to be implemented on the interior of the factory with collection lines under and connecting to all the existing downspouts. This was decided in order to use gravity flow to direct the runoff towards the storage area. The pipes will range in size from 4 inch to 6 inch for the collection lines and then to a final 8 inch main collection line to connect them all which will lead to the storage.

3.2 Grid Chamber

Instead of using a first flush system where some of the water runoff would be diverted and lost, it was decided to optimize the collection efficiency of the system with the use of a grid chamber. The grid chamber would give the system the ability to settle the bulk sediments in the system without losing a large volume of rainwater due to first flush. The chamber will sit just before the first storage tank where the rainwater will enter through the bottom of the tank, as the water rises the unwanted particles will have an opportunity to settle and the ascending water would flow to the storage tanks. The chambers area was sized appropriately using the settling velocity of sand for the particles and the flow rate for a 40mm storm with duration of a day.

3.3 Storage Tanks

The tanks were sized after the most probable occurring storm intensity. From rain data from 1950 to 2005 for Guelph Ontario, it was found that this intensity was 2.5 to 5mm. Using these values it was found that this range could yield between 8430 to 16860 gallon of collected water. The design team then decided to implement two 10 000 gal tanks into the system which would optimize the most probable occurring storms allowing the tanks to fill without overflow. Also, incorporated in the tanks will be a chlorine tablet dispenser which will keep the water within the necessary pH range (7.2 to 8.5). The dispenser will need no maintenance except for tablet refills.

3.4 Treatment

The treatment system that Blue Sky Consulting incorporated in their design will be an ultraviolet radiation system. An ultraviolet system was chosen because it kills microorganisms using a simple flow through system that requires a short contact time. It also have a low installation cost and the only maintenance on it involves the changing of a filter and a low pressure mercury lamp. There will be a 5 micron filter to ensure that the water is clear and clean before the lamp.

3.5 Backflow Prevention

All the collected and treated water will be directed to the existing reverse osmosis system that is already in the plant. Since Blue Sky's rainwater harvesting system will not, at all times, provide the water needed for the demand of the manufacturing process due to lack of rain, the municipal water line will also need to feed into the reserve osmosis system. Therefore, before the inlet to the reverse osmosis, the rainwater line and the municipal line come together with a solenoid valve which will specify what water will be used. Because of this fact, a backflow prevention valve will be installed in the municipal line before the solenoid valve to insure that no water from the rainwater line goes into the municipal drinking water line. This will increase safety and is also specified by the Ontario Building Code.

3.6 Overflow

There is a large probability of having a storm or multiple storms that produces more water then the storage tanks can hold. For this situation, the two storage tanks will be plumbed in series at the bottom with a 2 inch line and at the top with an 8 inch pipe. The first tank will be raised 6 inches higher then the second to insure that the second tank will receive the entire first tanks overflow. The rainwater will enter the first tank and proceed to the second tank, in the second tank there will be the main 8 inch overflow that will take all excess rainwater out to the collection area and will dispose of it to a sewer line.

4 Discussion

Originally the design team wanted to implement a first flush system into the design to get rid of unwanted debris before storage. However it was concluded that a first flush system of this magnitude would prove to be too costly and complicated. Thus, the team came to a decision on a grid chamber which would be incorporate both simplicity and cost effectiveness.

The overall cost of the system will incorporate \$10, 000 for installation as a plumber will need to set up the ultraviolet system and a company to install the new piping for the collection system. The total cost of the system will be \$34, 500 with the conservative potential of saving \$16, 750 on CAMTACs yearly water bill as depicts. Using this information a return period of 24 months was produced for Blue Skys Design.

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