

EPS Densifier Niagara Region

CIF Project No. **821.3.1**

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Prepared for:
Resource Productivity and Resource Recovery Authority
Continuous Improvement Fund Office
Barrie, Ontario

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1. INTRODUCTION

1.1 Introduction

Niagara Region installed a new Polystyrene Densifier System (PDS) at its Materials Recycling Facility (MRF). The PDS was purchased from INTOCO GreenMax through Basic International Inc. Hallex Engineering was selected for engineering and design services of the PDS within the MRF. Global Technologies was selected for the installation and commissioning of a PDS processing line, which included the purchased PDS equipment. The PDS was commissioned in February 2016.



1.2 Project Goals and Objectives

The PDS was installed in the MRF to manage expanded polystyrene (EPS) independently from mixed plastics, to produce higher revenues from curbside-collected mixed plastic material produced by the MRF. Specifically, the PDS will enable Niagara Region (the Region) to increase its revenue stream from the sale of mixed plastics.

2. BACKGROUND

2.1 Community Profile

Known world-wide as both the home of Niagara Falls and as a wine producing region, the Regional Municipality of Niagara (herein referred to as Niagara Region) is comprised of 12 local municipalities: Fort Erie, Grimsby, Lincoln, Niagara-on-the-Lake, Niagara Falls, Pelham, Port Colborne, St. Catharines, Thorold, Wainfleet, Welland and West Lincoln.

Geographically, Niagara Region has a total area of 1,852 km² and is situated on the Niagara Peninsula, bordered on the north by Lake Ontario, on the south by Lake Erie, on the east by New York State and the Niagara River, and to the west by the City of Hamilton and the County of Haldimand. The population of Niagara Region, according to the 2016 Statistics Canada population estimate, is 447,888.



Niagara Region reported to Resource Productivity & Recovery Authority (RPR) in 2015 that Blue Box recycling included 163,930 single-family residences and apartments with two (2) to six (6) units, and 31,521 multi-residential units with seven (7) or more units. At that time, Niagara Region reported that 37,375 tonnes of residential Blue Box recyclables were marketed.

2.2 Waste Management System

Niagara Region provides all waste collection, processing and disposal services for the residential sector and eligible Industrial, Commercial and Institutional (IC&I) sector for its member municipalities, including:

- A weekly, two-stream recycling collection and processing program. Collection services are contracted out to Emterra Environmental Inc.; processing services are contracted out to Niagara Recycling;
- Weekly organics (Green Bin/Cart) diversion program;
- Weekly garbage collection with garbage limits;
- Bulky/white goods and leaf & yard waste collection;
- Three permanent Household Hazardous Waste (HHW) Depots located in Welland, Thorold and Grimsby;

- One partial HHW Depot located in Fort Erie;
- Four landfill/drop-off depot locations, including a privately-owned site at Walker Industries, are available to serve the public as recycling centres, where typically the following residential materials are accepted:
 - Tipping fees apply to:
 - Household waste;
 - Scrap metal;
 - Construction and Demolition materials;
 - Appliances containing CFC's;
 - Shingles
 - Accepted, at no charge:
 - Leaf & Yard Waste;
 - Blue and Grey Box Recyclables;
 - Tires;
 - Electronics;
 - HHW materials

Niagara Region is also responsible for by-law enforcement, public education and promotion of the programs offered.

2.3 Current Waste Management Performance

Based on posted RPRA Generally Accepted Principles (GAP) data, Niagara Region's 2015 diversion rate exceeded 50% of waste generated. Less than 20% of Niagara Region's 2015 residential waste stream was recycled through the Blue Box program. The performance information is summarized in Table 1 below.

Table 1: Niagara Region's Waste Management System Overview (2015 RPRA GAP)

Total Residential Waste Generated		Total Residential Waste Diverted		Total Residential Waste Disposed		Residential Blue Box Recyclables Diverted	Total Residential Diversion Rate	Total Residential Disposal Rate
Tonnes	Kg/Cap	Tonnes	Kg/Cap	Tonnes	Kg/Cap	%	%	%
195,149	434.53	104,564	232.83	90,585	201.70	19.15%	53.58%	46.42%

2.4 Program Challenges

In April 2013, the Region applied for Continuous Improvement Fund (CIF) funding to purchase and install a new PDS in its MRF. The main motivation for the installation was to remove EPS from the mixed plastics stream, to produce higher revenues from curbside collected, mixed plastic material produced by the MRF. Specifically, the PDS will enable the Region to increase its revenue stream from the sale of mixed plastics.

At the time, the Region was blending its EPS with its 2 to 7 mixed plastics stream (excluding #2 HDPE bottles) and selling this material at a discounted price to an Ontario based mixed plastics processor. The selling price with the EPS in the mixed plastic stream was typically around \$20 per metric tonne whereas processing these two plastic grades independently will allow the Region to realize an ongoing pricing increase on its mixed plastic stream of at least \$45 per tonne. It was projected that the new PDS would generate over \$55,000 per year in additional mixed plastics revenue, after factoring in PDS net processing costs.

The CIF funding request for the PDS was \$96,073 and would have a payback period, based on the CIF grant amount, of 0.5 years or 6 months.

3. APPROACH

3.1 Set Up and Implementation

The GreenMax Apolo Silo was purchased by the Region from INTCO GreenMax through Basic International Inc., after investigating different densifiers/compactors and speaking with public and private recycling companies in collaboration with Canadian Plastics Industry Association (CPIA). CPIA was committed to working with the Region to find an innovative solution that would improve the efficiency of recycling plastic resources. An RFP was issued for the installation and commissioning of a PDS processing line. The vendor selected was Global Technologies. Table 2 below provides a summary of the budgeted and actual procurement and installation dates for the PDS.

Table 2: Procurement and Installation Process of the Polystyrene Densifier System

#	Item	Date Budgeted	Date Actual	Comments
1	Procurement – Engineering		April 2014	
2	Procurement – Equipment	January 2014	July 2015	
3	Procurement - Installation		August 2015	
4	PO issued - Installation		August 2015	
5	Fabrication		Sept – Dec 2015	
6	Installation commences		January 2016	Installation delayed due to installation of fibre optical sorting system
7	Installation complete	June 2014	February 2016	Conveyors & crusher certified
8	Component testing/ESA certification		February 2016	
8	Dry run testing		February 2016	
10	Commissioning complete	June 2014	February 2016	
11	System accepted – Sign off by ESA		February 2016	
12	System operational	June 2014	February 22 nd 2016	
13	Post installation troubleshooting		Mar – Apr 2016	

3.2 Monitoring and Measurement Methodology

In order to effectively measure and monitor the performance of the PDS, sales revenue, tonnage reports for mixed plastics and audits from 2015 were used as baseline information. The post-installation performance of the PDS was measured and reported against 2016 sales and audit data from the end market (see Tables 3 and 4 below). The true measurement of the PDS performance is whether densified EPS can be processed cost effectively, to produce a marketable commodity and whether the mixed plastics stream can be sold consistently at a higher price point.

3.2.1 End Market Composition Audits

On an annual basis, the amount of EPS present in the pre-installation marketed mixed plastics stream (prior to February 2016) ranged between 45 to 75 metric tonnes or 2 to 3% by weight. Post-installation of the EPS, the amount of EPS present in the marketed mixed plastics stream decreased to less than 0.25%. As a result, the Region increased its quality of the mixed plastics revenue stream by over 80%.

3.2.2 Recovery and Revenue

Table 4 below provides the quarterly tonnage and revenue performance, pre (2015/16) and post (2016/17) installation of the EPS at Niagara Region’s MRF. Figures are based on tonnes sold to end market by the Region and the sales revenues received.

Table 3: Niagara Region’s Tonnage and Revenue Performance for Mixed Plastics – Pre Installation (2015/16) vs. Post Installation (2016/17) of the EPS Densifier System

Pre-Installation

#	Period	Revenue/Tonne	Sales Revenue	Tonnes Sold
1	March 2015 - February 2016	\$50.69	\$122,809.80	2,422.59
2	Total	\$50.69	\$122,809.80	2,422.59

Post-Installation

#	Period	Revenue/Tonne	Sales Revenue	Tonnes Sold
1	March 2016 – February 2017	\$72.20	\$ 190,941.36	2,640.82
2	Total	\$72.30	\$ 190,941.36	2,640.82

Tonnes of mixed plastics sold to end markets increased in 2016/17 by approximately 218 tonnes or 9%, and sales revenues increased by \$68,131.56, or 55%. The increase in revenue is primarily due to the increased quality of mixed plastics being sold to end markets. The increase in tonnage is due to increased volumes and higher capture rates at Regional drop off facilities.

3.2.3 Monitoring Challenges, Limitations and Solutions

The main metrics for measurement for this project did not present any unusual challenges. Records for material recovery and sales are tracked as part of the day-to-day management of the MRF, and readily available for year-to-year comparison. Systems are in place to manage and report this data annually to the Resource Productivity and Recovery Authority.

4. PROJECT RESULTS AND ANALYSIS

4.1 Project Results and Analysis

Niagara Region installed and commissioned the PDS in February 2016. The new PDS has met our project objectives for EPS recovery and increased mixed plastics revenue generation.

As previously noted, post installation audits at the downstream processor revealed that EPS was largely removed from the marketed mixed plastics stream. In general, the installation of the PDS has resulted in the following:

- Higher revenue generation
- Sustainable market for mixed plastics stream

4.2 Lessons Learned and Next Steps

There are a number of lessons to be shared by Niagara Region's experience, particularly for those programs which might be considering installing an PDS:

- 1) In terms of purchasing equipment from international suppliers, sales contracts should include detailed specifications for measuring and testing equipment and include provisions for failure to meet specified standards. Prior to purchasing the equipment, INTCO GreenMax confirmed that the PDS conformed to CSA standards. During testing, the PDS was found to not be in compliance with CSA standards. Several modifications were required in order to obtain certification. Some of the components that required addressing after installation included: wiring, overload switches, safety interlock switch, and e-stop button functionality.
- 2) After installation, additional modifications were required due to ongoing issues that were experienced after start-up, including:
 - Due to the configuration of the foam crusher and blower, EPS was jamming at the bottom of the foam crusher chamber at the crusher exit pipe to the densifier; requiring a system stop approximately every 20 minutes. If the EPS is not shredded or broken into small enough pieces, the material will jam the exit pipe. The feed hopper was modified to direct material into the grinder blades to effectively grind and break foam into smaller pieces and prevent jamming.
 - Pressure settings can create significant issues with operations. Higher pressure settings create system friction, which slows down the output of densified blocks. Friction caused EPS to melt, more specifically, expanded polystyrene food packaging foam (I.e. meat trays) due to the composition of the material, causing down time to remove melted blocks from the densifier exit chamber. Pressure settings were modified until an optimal setting was found and the issue was resolved.
 - Material entering the silo may cause premature wear and tear to the silo fabric due to the material being highly porous and permeable to air flow. The fabric was custom made by the supplier for this particular piece of equipment. This is still an on-going issue that needs to be resolved.
 - Warranty period needs to be effective from date of commissioning for all system components. Since installation, two motor failures occurred on separate components (blower and crusher).
- 3) At the time the equipment was being considered, there was a secure end market for processing densified polystyrene by INTCO Green Max. INTCO Green Max representatives had visited the Region's MRF prior to the purchase of the densifier to examine the curbside collected foam and determined curbside foam quality would meet INTCO's quality requirements. Since that time INTCO has not accepted the densified foam citing the curbside foam needs to be cleaner. These types of investments are not recommended unless there is a guaranteed and strong sustainable market. At the time of submitting this report, the Region has not been able to secure a consistent end market for this material.
- 4) It is recommended that a system such as the one installed at the Region's MRF be integrated within the existing system in order to minimize double handling of material. At the time of submitting the REOI application, the original concept for this system was to act as a stand-alone system. A stand-alone system would have required sorters to pick the material from the container sorting line and place the material into bunkers. A loader operator would have then been required to transfer the material from the bunker into the system. This would have decreased the quality of the material as a result of not having a sorter for quality control. The final system design integrated the PDS into the existing system by adding two new conveyors to transfer and sort EPS feedstock.
- 5) The PDS is not a fully automated system. In addition to the manual sorting required to remove the material from the container line, additional labour costs are required to recover and process EPS. At a minimum, one additional sorter/operator is required to oversee the PDS operation on a daily basis; this includes quality control by removing non-PS Foam contaminants and packaging from the foam material stream and PS foam packaging that has attachments (E.g. tape or film wrap) to ensure a clean densified end product for the market.

Niagara Region and its materials broker are working in partnership with CPIA to secure a stable end market for clean densified EPS blocks.

5. PROJECT BUDGET

5.1 Project Budget

The budget versus actual procurement and installation costs for the EPS appear in Table 4 below.

Table 4: Budget vs. Actual Procurement and Installation Costs for the Polystyrene Densifier System

Budgeted Procurement and Installation Costs

#	Item	Cost	Date
1	Order placed – 50% deposit	\$23,608.32	January 10, 2014
2	Before delivery – 40% deposit	\$32,054.40	April 30 2014
3	Commissioning and final payment	\$6,410.88	June 30, 2014
4	Engineering and Contract Administration	\$9,000.00	July 2014
5	Electrical and Installation	\$25,000.00	June 30, 2014
6	System Integration	\$0	
7	Total	\$96,073.60	

Actual Procurement and Installation Costs

#	Item	Cost	Date
1	Order placed – 50% deposit	\$31,488.02	July 15, 2014
2	Before delivery – 40% deposit	\$25,725.00	June 2016
3	30 days after delivery, final payment	\$6,225.72	Jan/Feb 2016
4	Engineering and Contract Administration	\$12,838.70	Apr 2014-Aug 2015
5	Electrical and Installation	\$21,613.07	Jan-Apr 2015
6	System Integration – 2 new conveyors & sort platform	\$129,112.00	August 2015
7	Total	\$227,002.50	

Budget vs. Actual Procurement and Installation Costs

#	Item	Difference
1	Order placed – 50% deposit	\$7,879.70
2	Before delivery – 40% deposit	(\$6,329.40)
3	30 days after delivery, final payment	(\$185.16)
4	Engineering and Contract Administration	\$3,838.70
5	Electrical and Installation	(\$3,386.93)
6	System Integration – 2 new conveyors & sort platform	\$129,112.00
7	Total	\$130,928.91

At the time submitting the REOI application, system integration was not part of the system design. The final design integrated the system into the existing system at the Region's MRF by adding two new conveyors and a sorting platform. The total cost to integrate the system was \$129,112.

5.2 Payback Period

Table 5 below provides a breakdown of the payback calculation for the PDS. These results are based on the total capital and installation cost, divided by the difference in revenue between the pre-installation (2015/16) and post-installation (2016/17) of the PDS.

Table 5: Payback Calculation for the Polystyrene Densifier System

Pre-Installation Costs and Revenues (2015/16)

#	Item	Revenue	Tonnes	Rev / Tonne
1	Baling cost savings of EPS (Mar 2015 - Feb 2016)	\$1,800	60	\$30
2	Cost Summary	\$1,800	60	\$30

Post-Installation Costs and Revenues (2016/17)

#	Item	Cost	Tonnes	Cost / Tonne
1	Hydro	\$6,000	34	\$176
2	Repairs & Maintenance	\$1,000	34	\$29
3	Labour	\$39,500	34	\$1,162
4	Packaging Supplies	\$100	34	\$3
5	Cost Summary	\$46,600	34	\$1,371

#	Sales	Revenue	Tonnes	Rev / Tonne
6	Mixed Plastics Premium	\$118,837	2,641	\$45
7	Densified Bricks of EPS	\$1,537	34	\$45
8	Revenue Summary	\$120,374	2,675	\$45

9	Profit/(Loss) Total Summary	\$75,574	2,675	\$28
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PS Densifier - Payback Period

#	Item	Cost / Revenue
1	Capital and Installation Cost without CIF Funding	\$227,003
2	Pre Installation EPS Baling Expense (savings)	\$1,800
3	Post Installation Densifier Operational Costs	-\$46,600
4	Post Installation Mixed Plastics and EPS Brick Revenues	\$120,374
4	Profit / (Loss) Total before Capital and Installation	\$75,574
5	Capital Payback Period (months) without CIF and CPIA Funding	36
6	CIF Funding for Purchase of PS Densifier	\$23,812
7	CPIA Funding for Purchase of PS Densifier	\$17,000
8	Capital and Installation Cost, net of CIF and CPIA Funding	\$186,191
9	Capital Payback Period (months), net of CIF and CPIA Funding	30

Based on the above payback calculations, the PDS would pay for itself in approximately 2.5 years, or approximately 30 months. It should be noted that had the PDS not have been installed, the Region estimates a loss in revenue of approximately \$114,016 per year from the sale of mixed plastics based on receiving a \$45/tonne premium for mixed plastics with EPS removed. EPS tonnages have declined due to reduction of incoming IC&I sources as well as selective sorting of EPS.

6. CONCLUSIONS

Overall, the Region is pleased with the installation and operation of the PDS, despite the initial challenges faced with the equipment. The primary objective of the system was to ensure a long-term sustainable market and to realize higher revenues for mixed plastics.

The Region is currently working with its materials broker and the CPIA on more secure local North American end market solutions. The PS Foam market issue is a short-term challenge and Niagara and the CPIA believe that long term sustainable market solutions are available to the industry.

The Region anticipates that the amount of EPS that is generated in the region will continue to grow as stewards continue to shift towards single serve packaging hence Niagara Region is well positioned to process this material. In addition, there is future opportunity to generate additional revenue by expanding polystyrene recovery and processing from the IC&I sectors that produce pure white, clean streams of EPS protective packaging that has high value and secure markets.

7. PHOTOS OF POLYSTYRENE DENSIFIER SYSTEM



Figure 1 PDS Silo and Densified PDS Blocks



Figure 2 PDS Crusher, Storage Silo and Compactor



Figure 3 Infeed Conveyor from Container Sorting Station



Figure 4 Infeed Conveyor to PDS Crusher



Figure 5 Densified EPS Blocks

APPENDIX A

**Letter from Downstream Processor –
EPS in Mixed Plastics Stream –
Pre and Post EPS Installation**



April 04-2017

Region of Niagara Fall
Attn: Norman Kraft


Prior to installation of the polystyrene densifier system in February 2016, Niagara Region supplied us with mixed plastic containing expanded polystyrene (EPS). The percentage of EPS in the mixed plastic bales ranged between 2 to 3% by weight or between 45 to 75 metric tonnes annually. This material resulted in significant operating challenges and additional costs for EFS Plastics. As a result, it was necessary for EFS Plastics to reflect these costs in the price it was able to offer Niagara Region for its mixed plastics.

In February 2016, Niagara Region installed and commissioned an EPS processing system that removes almost all of the EPS from the mixed plastic bales. The percentage of EPS in the mixed bales decreased from 2 to 3% to less than 0.25%, which is in line with other suppliers of similar mixed plastics to EFS Plastics.

This investment by the Niagara Region has allowed EFS Plastics to pay market value for the Region's mixed plastic bales. This investment also ensures that the Niagara Region will have a solid local long term market for its mixed plastic bales. Based on the current deteriorating market for plastics, EFS Plastics would not be able to accept bales containing EPS from Niagara.

EFS Plastics greatly appreciates the Niagara Region's financial investment in the EPS system and its commitment to ensuring a sustainable future for mixed plastic recycling.

Sincerely,


Martin Vogt
Owner
EFS Plastics