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Summary of Operation of Plasco Trail Road – Demonstration Period

(2008 to 2011)

Introduction

A monthly report was prepared with independent engineers review, filed with the Ministry of the Environment (MOE) and was posted on [zerowasteottawa.com]. A final report was similarly prepared, filed with MOE, and provided to the City of Ottawa on September 7, 2011 summarizing the demonstration program.

Principle of System

The Plasco Trail Road (PTR) facility was operated on a scheduled/campaign basis which allowed for maintenance and modifications to be performed effectively. With the completion of each operating campaign, the resultant data provided a platform based on solid engineering principles to improve Plasco's technology, process and equipment on a phase by phase basis. The data that resulted from this approach has allowed Plasco to proceed in concerted engineering design to bring the technology to commercial readiness.

As a result of the various operating campaigns that were executed during the demonstration period, mechanical, process, and other challenges were discovered, evaluated and ultimately solved. One of the key variables that was improved and stabilized was the production of consistent high-quality synthesis gas that would efficiently fuel the Jenbacher reciprocating engines and generate optimal output.

Table 1: Plasco's Processing Days vs Engine Quality Syngas Days

	Total # Days Processing	Total # Days Engine Quality Syngas	% Days Engine Quality Syngas
2008	83	47	57%
2009	117	112	96%
2010	94	93	99%

Summary of Operation

Each year of operation during the demonstration period focussed on specific process and reliability improvements.

2008

Operational campaigns were run in February/March of 2008, during which weaknesses and bottleneck points in the ability of the system to feed waste were identified. The entire fuel feed system from waste shredding to delivery into the converter was redesigned, incorporating the decoupling of the preparation equipment from the delivery equipment. A shredding/preparation line was created and a vibratory feeder was added for uniform distribution and delivery of the fuel to the converter. The steep drag chain of the feed system was replaced with a shallow-angle belt with robust capacity to the handle the required feed volume. Downtime from feed preparation and delivery to the converter was reduced to less than 1%.

These initial campaign runs also demonstrated that the system to condition solid residue from the conversion chamber was of insufficient capacity to perform both melting the solid residuals and collection of carbon rich (energy generating) residual gas. This characterization of the initial operation of the carbon recovery system resulted in an adjustment in design that separated the melting process to condition the slag from the carbon recovery process of the gas. The original single melt chamber was separated into two chambers: one to recover the carbon from the solid residue from the converter and one to condition the remaining solids to exit the system. This separation allowed for each of the three steps – conversion, refining and carbon recovery – to be optimized in energy use and energy output.

2009

During 2009 the system was operated and adjustments were made to the operational parameters of the system to optimize conversion efficiency and test various adjustments to movement through the chamber to determine the optimum movement method to allow for consistent runs. During this year, data indicated that the method being used for the material movement system in the converter was not sufficiently robust to run for more than four days, which would be interrupted by several hours for maintenance. It was recognized that the movement system required replacement with a more robust system with the same process characteristics to achieve commercial availability and reliability. The conversion efficiency of the performance was achieving target objectives.

The PTR facility was further improved in 2009 by the design and installation of the initial Recovered Water Treatment System (RWTS). The first load of sewer-grade water was shipped to the City of Ottawa in May 2009. Each operational run allowed for the continuing optimization of the RWTS and for the identification of the various bottlenecks within the water treatment process.

2010

The system was operated to develop data for the design of the bottom grate of the converter: a design that would be sufficiently robust to move material through the system while maintaining or further improving the proven conversion efficiency. These operational campaigns allowed the system to demonstrate efficiency and demonstrate environmental performance. The campaigns also allowed for the isolation of equipment changes, so they could be designed and tested. In July 2010 additional investment capital allowed for necessary changes to the system to allow for performance and compliance testing.

Between July and September 2010, the improved RWTS was installed. These improvements allowed the water treatment system to process water at a rate that would facilitate the completion of the performance testing. The existing movement system was optimized to allow it to perform on a predictable schedule to prove efficiency and conversion during a 21-day reliability test. A further 16-day test was conducted to prove the system air emissions.

Over the course of the demonstration project, the PTR facility has processed 6,694 tonnes of municipal solid waste (MSW) and generated 287 MW-h of power. Most of the waste processed and power generated in 2010 was during the fourth quarter of the year after equipment and process adjustments had been implemented.

Parameter	2008	2009	2010	Total
MSW Processed (tonnes)	1386	2875	2433	6694
Power Generated (kWh)	1,300	64,400	222,000	287,000

System Tests

Two principle system tests were conducted at the PTR facility in the fall of 2010: the 21-day reliability run and compliance source testing.

21-Day Reliability Run

In November 2010, Plasco conducted an availability run, the purpose of which was to demonstrate that the facility could achieve an availability of 65% over a 21-day period under test conditions designed to represent a steady-state operation. The availability test was completed successfully.

Table 2: Run Statistics

Parameter	
Availability	93%
Throughput	841.5 tonnes
Elapsed Time	537.5 hours (22.4 days)
Elapsed Test Time	382 hours (16 days)
Maintenance Time	27 hours
Run Time	355 hours (15 days)
Engine Run Time	255 hours
MWh Generated	124 MWh (124,000 kWh)

This 21-day availability test also demonstrated that the conversion efficiency of the system matched the Plasco financial model.

Plasco isolated that the primary change required for commercial availability was an improved material movement system and the redesign of the bottom grate. A prototype of the bottom grate was designed and tested in parallel with the reliability and environmental performance tests. The data from the operation of the prototype provided confidence that the bottom grate design would resolve the durability issues. That bottom grate design was subsequently implemented and installed at PTR in 2011, as part of the Integrated Conversion and Refining System (ICARS) which incorporates all changes and is the system to be delivered to commercial facilities.

Compliance Source Testing

In December 2010, Plasco conducted source tests in accordance with the requirements of PTR's Certificate of Approval (Air). A third party testing firm, ORTECH Environmental (ORTECH), was selected to complete the testing program. Prior to commencing the test program, ORTECH prepared a Pre-Test Plan for review and approval by the MOE. Triplicate emission tests were completed for particulate and metals, organic compounds including dioxins and furans, acid gases, and combustion gases. A total of 260 tonnes of MSW were processed during the source testing period. The emissions profile for the Flare + Engine exhaust is presented in Table 3.

Table 3: Plasco's Emission Profile

Parameter	Units	PTR Maximum Limits (2008 -2010)	Plasco Actuals*	Plasco Emissions as a % of Maximum Limit
Particulate Matter	mg/Rm^3	17	0.73	4%
Organic Matter	ppm	100	0	-
Hydrogen Chloride	ppm	18	0.19	1%
Sulphur Dioxide	ppm	21	14	67%
NOx	ppm	110	57	52%
Carbon Monoxide	mg/Rm^3	-	3.5	-
Mercury	mg/Rm^3	0.02	0.0002	1%
Cadmium	mg/Rm^3	0.014	0.00004	0.3%
Lead	mg/Rm^3	0.142	0.0002	0.14%
Dioxins and Furans (TEQ)	pg/Rm^3	80	1.47	2%

Notes:
1. All values are expressed at 11 % O_2 and regular conditions (101.3 kPa, 25^{o}C)
2. Plasco test data as submitted to the MOE including CEMS and source testing
3. NOx is not representative of commercial operations which will have Selective Catalytic Reduction systems added

Particulate, metals, acid gases and organic compounds including dioxins and furans were sampled using source test extractive methods. Combustion gases, including nitrogen oxides (NOx), sulphur dioxide,

carbon monoxide and organic matter were monitored by the third party continuous emissions monitoring system (CEMS). ORTECH monitored the emissions over a series of 4-6 hour test periods, in accordance with the MOE-approved pre-test plan, and did not measure the emissions on a 24-hour continuous basis.

The MOE confirmed on June 7, 2011 that source tests were successfully completed at the PTR facility in accordance with the facility's Certificate of Approval (Air).

Three emissions: NOx, SO_2 and HCl are measured on 24 hour average output. Source testing is conducted by collecting samples during periods as specified in the Pre Test Plan, generally 4 to 6 hours. Source tested data does not provide sufficient information to determine 24 hour average output of NOx, SO_2 and HCl. These emissions were monitored CEMS, as prescribed by the PTR Certificate of Approval. Emissions data was published on the website and reported monthly to MOE.

On July 21, 2011 MOE confirmed that the PTR demonstration program had met the requirements of its Certificate of Approval.

Moving Forward

Each of the identified bottlenecks in the system has been isolated. The bottom grate has been replaced and tested. The enhanced PTR system is in the process of commissioning.