COMPARATIVE CARBON FOOTPRINT ANALYSIS: HOT-IN-PLACE RECYCLING (HEATER SCARIFICATION/SURFACE RECYCLING AND RE-HEAT) VERSUS TRADITIONAL ASPHALT PAVING

Prepared for:
Gallagher Asphalt

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Prepared by:
Conestoga-Rovers & Associates

14496 Sheldon Road
Suite 200
Plymouth, Michigan 48170

Office: (734) 453-5123
Fax: (734) 453-5201

web: http:\\www.CRAworld.com

SEPTEMBER 2011
REF. NO. 075785 (1)

EXECUTIVE SUMMARY

This study presents the comparative carbon foot print analysis for Gallagher's Hot-in-Place Asphalt Recycling processes and Traditional Asphalt Paving. The study covers the rehabilitation of existing asphalt surface roads.

Gallagher has two Hot-in-Place Asphalt Recycling Processes; these are Recycled Hot Emulsified Asphalt Treatment (Re-Heat) and Heater Scarification (a.k.a. Surface Recycling). These processes recycle existing asphalt surface roads on site.

CRA utilized greenhouse gas emission calculations for Re-HEAT, Heater Scarification and traditional asphalt recycling to calculate the carbon footprint of each process.

Based on the calculations, Gallagher's Hot-in-Place Asphalt recycling processes emit lesser GHG emissions than traditional asphalt recycling.

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1.0 INTRODUCTION

Conestoga-Rovers and Associates (CRA) was retained by Gallagher Asphalt Corporation (Gallagher) to perform a comparative carbon foot print analysis (Analysis) for Gallagher's two Hot-in-Place Asphalt Recycling processes, Re-HEAT Asphalt Surface Recycling (Re-HEAT) and Heater Scarification (a.k.a. Surface Recycling) and traditional asphalt paving.

This report discusses the carbon foot print analysis of each asphalt recycling process from the recovery of asphalt from existing paved surface, the recycling process, compaction and paving.

2.0 PROCESS DESCRIPTION

Gallagher's Hot-in-Place asphalt recycling processes allows existing asphalt roadways to be rejuvenated without removing and replacing the asphalt surface. These processes offers an economical and more environmentally friendly alternative to conventional asphalt roadway reconstruction.

Heater Scarification is an asphalt rehabilitating process where the surface of the existing pavement is heated to a maximum of 375°F using two heater units. A rejuvenating agent is sprayed into the heated pavement to soften and revitalize the asphalt. The surface is scarified using spring-loaded scarifiers to a maximum depth of one and one-half inches. The revitalized surface is then leveled by distributing heated, scarified and treated (HST) material to produce a uniform cross-section. Following distribution, the HST is compacted with an 8 to 10-ton vibratory wheel roller. A one and on-half inch overlay of hot mix asphalt (HMA) is commonly added by municipalities after the Heater Scarification process.

Re-HEAT is an asphalt recycling process where the surface of the existing pavement is heated to a maximum of 350°F using two heater units. A self-contained recycling unit then loosens/shears the heated asphalt pavement to maximum depth of two inches, loading the removed asphalt into an on-board asphalt drum mixing plant and adding heated rejuvenator. The recycling unit then distributes the recycled asphalt to produce a uniform cross-section. While inside the self-contained recycling unit, the asphalt/recycled asphalt is not exposed to the atmosphere. Similar to Scarification, the final step is compaction with an 8 to 10-ton vibratory wheel roller.

In the traditional asphalt paving process, asphalt pavement is removed from the road base and then transported to an asphalt plant where it is crushed and screened to the appropriate size for further processing. New HMA is produced by the asphalt plant by heating the crushed, screened pavement (recycled asphalt pavement or RAP) and mixing with new aggregate and the proper amount of new asphalt cement. Amounts of RAP used to produce new HMA may range from 0% to 20%. The new asphalt is transported to the project site and loaded into an asphalt paver, which distributes and levels the HMA. As with the Gallagher processes, the final step is compaction with an 8 to 10-ton vibratory wheel roller.

3.0 METHODOLOGY

This Analysis covers the rehabilitation of existing asphalt paved roads. For traditional asphalt paving, the scope includes grinding the entire roadway surface, followed by the application of tack coat to the milled surface, machine placement of a new HMA surface, and compaction using smooth steel wheel and pneumatic wheel rollers.

For the Heater Scarification process, the scope includes the rehabilitation of an asphalt pavement by heating, applying a rejuvenating agent, scarifying, distribution, and compacting the existing pavement by Gallagher. Additionally, the scope includes the addition and compaction of one and one-half inches of HMA to the scarified asphalt by the municipality.

For the Re-HEAT process, the scope consists of preparing the surface, heating the pavement, applying a rejuvenating agent, mixing in self-contained, portable asphalt drum mix plant, distribution, and compacting the pavement surface.

4.0 ANALYSIS

Estimates were developed for greenhouse gas (GHG) emissions associated with the production and transportation of materials significant to the asphalt paving process. The calculations were based on the use of petroleum fuel products, limited to diesel fuel and propane consumed by equipment during the rehabilitation of existing asphalt-paved roads, and the amount of HMA processed. CRA did not include emissions from electricity consumption.

Emissions from traditional asphalt paving emissions, the Gallagher Heater Scarification process, and the Gallagher Re-Heat process are presented in Tables 1 through 3, below.

Table 1: Traditional Asphalt Paving Process GHG Emissions

Traditional Paving (2" Depth)							
				CO2	**CH4**	**N2O**	**GWP**
Activity	Amount	Unit	Type	Kg/km	Kg/km	Kg/km	Tonnes/km
Lift (recover) RAP	657.0	gallons	Diesel Fuel	6,705.71	0.27	0.05	6.728
Remove (truck) RAP	6720.0	gallons	Diesel Fuel	68,587.55	2.78	0.56	68.816
Asphalt Plant (0% RAP	2.42	tonnes	HMA	76,771.7	185.725	0.115	81.077
Asphalt Plant (20% RA	2.42	tonnes	HMA	74,601.1	170.200	0.115	78.550
Deliver Asphalt	7360.0	gallons	Diesel Fuel	75,119.69	3.05	0.61	75.370
Truck Bed Emissions	1,489.09	tons	HMS	0.000	0.049	0.000	0.001
Paving off-gassing	1,489.09	tons	HMA	0.000	84.835	0.000	1.951
Asphalt Paver	56.05	gallons	Diesel Fuel	572.08	0.02	0.00	0.574
Compactor (CB-434D)	0.83	gallons	Diesel Fuel	8.52	0.00	0.00	0.009
						TOTAL (0% RAP)	**234.527**
						TOTAL (20% RAP)	**231.999**

Table 2: Gallagher Heater Scarification Process GHG Emissions

Gallagher Heater Scarification (1.5" Depth)							
				CO2	CH4	N2O	GWP
Activity	Amount	Unit	Type	Kg/km	Kg/km	Kg/km	Tonnes/km
Gallagher Scarifying Equipment Set 1							
Set 1 Heater	280.58	MMBTU	Propane	17,244.30	0.18	0.00	17.249
Set 1 Heater	137.17	gallons	Diesel Fuel	1,400.04	0.06	0.01	1.405
Set 1 Scarifier/Heater	54.30	MMBTU	Propane	3,337.09	0.18	0.00	3.341
Set 1 Scarifier/Heater	171.46	gallons	Diesel Fuel	1,750.04	0.07	0.01	1.756
						SUB-TOTAL SET 1	**23.750**
Gallagher Scarifying Equipment Set 2							
Set 2 Heater	280.58	MMBTU	Propane	17,244.30	0.18	0.00	17.249
Set 2 Heater	137.17	gallons	Diesel Fuel	1,400.04	0.06	0.01	1.405
Set 2 Scarifier/Heater	249.40	MMBTU	Propane	15,328.26	0.18	0.00	15.333
Set 2 Scarifier/Heater	137.17	gallons	Diesel Fuel	1,400.04	0.06	0.01	1.405
						SUB-TOTAL SET 2	**35.390**
Remaining Gallagher Scarifying Equipment							
Generator	13	gallons	Diesel Fuel	132.58	0.01	0.00	0.133
Paving off-gassing	1,029.37	tonnes	RAP	0.000	0.336	0.000	0.008
Compactor (CB-434D)	0.83	gallons	Diesel Fuel	8.52	0.00	0.00	0.009
						SUB-TOTAL REMAINING	**0.149**
Hotmix Paving after Scarifying (1.5" HMA)							
Asphalt Plant	438.15	cubic meter	HMA	56,846.0	129.7	0.1	59.855
Deliver Asphalt	7360.0	gallons	Diesel Fuel	75,119.69	3.05	0.61	75.370
Truck Bed Emissions	1,134.69	tons	HMA	0.000	0.037	0.000	0.001
Paving off-gassing	1,134.69	tons	HMA	0.000	64.645	0.000	1.487
Asphalt Paver	56.05	gallons	Diesel Fuel	572.08	0.02	0.00	0.574
Compactor (CB-434D)	0.83	gallons	Diesel Fuel	8.52	0.00	0.00	0.009
						SUB-TOTAL HOTMIX PAVING	**137.295**
						TOTAL SET 1 w/ HOTMIX	**161.195**
						TOTAL SET 2 w/ HOTMIX	**172.835**

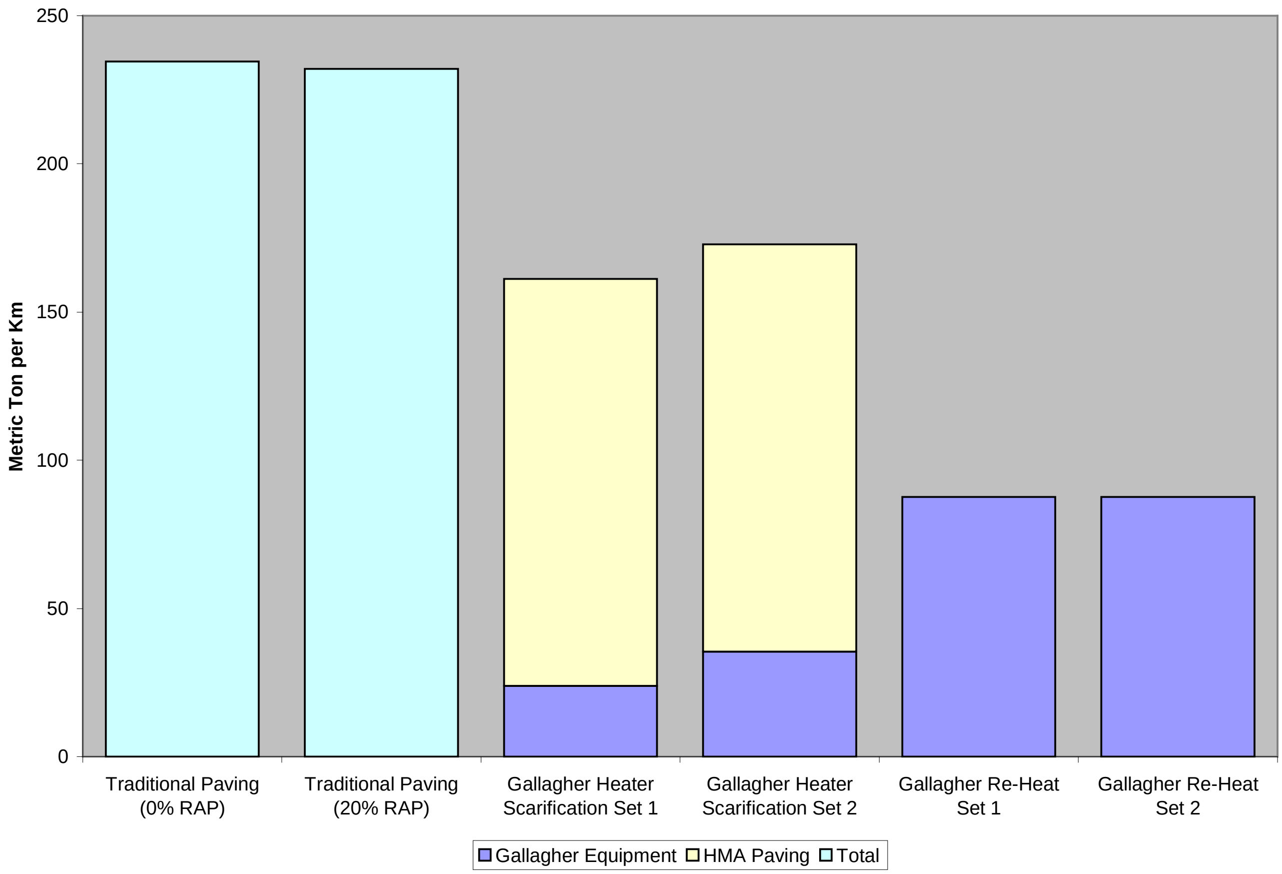
Table 3: Gallagher Re-HEAT Process GHG Emissions

Gallagher Re-Heat (2" Depth)							
				CO2	**CH4**	**N2O**	**GWP**
Activity	Amount	Unit	Type	Kg/km	Kg/km	Kg/km	Tonnes/km
Gallagher Re-Heat Equipment Set 1							
Set 1 Heater	909.28	MMBTU	Propane	55,884.30	0.18	0.00	55.889
Set 1 Heater	145.17	gallons	Diesel Fuel	1,481.70	0.06	0.01	1.487
Set 1 Recycler	389.69	MMBTU	Propane	23,950.41	0.18	0.00	23.955
Set 1 Recycler	617.27	gallons	Diesel Fuel	6,300.16	0.26	0.05	6.321
					SUB-TOTAL SET 1		**87.651**
Gallagher Re-Heat Equipment Set 2							
Set 2 Heater	909.28	MMBTU	Propane	55,884.30	0.18	0.00	55.889
Set 2 Heater	145.17	gallons	Diesel Fuel	1,481.70	0.06	0.01	1.487
Set 2 Recycler	389.69	MMBTU	Propane	23,950.41	0.18	0.00	23.955
Set 2 Recycler	617.27	gallons	Diesel Fuel	6,300.16	0.26	0.05	6.321
					SUB-TOTAL SET 2		**87.651**
Remaining Gallagher Scarifying Equipment							
Paving off-gassing	1,029.37	tonnes	RAP	0.000	0.336	0.000	0.008
Compactor (CB-434D)	0.83	gallons	Diesel Fuel	8.52	0.00	0.00	0.009
					SUB-TOTAL REMAINING		**0.016**
					TOTAL SET 1		**87.667**
					TOTAL SET 2		**87.667**

5.0 RESULTS

Figure 1 shows the comparison of global warming potential for traditional asphalt paving and Gallagher's Hot-in-Place Asphalt recycling processes.

Figure 1: Comparison of Global Warming Potentials



For HMA with both 0% and 20% RAP, traditional paving emits more GHGs than the Re-HEAT and Scarification processes based on life cycle perspective. Respectively, the Heater Scarification and Re-HEAT processes emit 28 percent, and 62 percent, less GHGs than traditional asphalt paving utilizing HMA with a 20% RAP content. Comparing the Re-HEAT and Heater Scarification processes, traditional asphalt paving requires more steps in their process. The recovery and the rejuvenation of asphalt for the Re-HEAT and Heater Scarification processes are done on site, while traditional paving requires an offsite asphalt mixing plant.

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