Please note: some portions of this document have been blacked out to protect confidential information that does not affect the results or interpretation of the testing. Thank you for your understanding.
-Johnson Creek Enterprises, LLC

Characterization of Liquid "Smoke Juice" for Electronic Cigarettes

prepared for

Johnson Creek Enterprises
Johnson Creek, WI

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Client:	Johnson Creek Enterprises 320 N Watertown St. Suite F Johnson Creek, WI 53038
Requestor:	Robert Kieckbush
Study:	**Characterization of Liquid "Smoke Juice" for Electronic Cigarettes**
LIMS #:	20090187

SUMMARY

A liquid "smoke juice" formulation used in electronic cigarettes was tested by gas chromatography mass spectrometry (GC-MS) to identify the ingredients in the mixture and their relative concentrations. In addition, vapor produced from an electronic cigarette containing this smoke juice was assayed to compare the relative smoke composition to that of the liquid.

EXPERIMENTAL

One sample of smoke juice and some blank cartridges were submitted for these experiments. The smoke juice and vapors generated from the cartridges infused with this smoke juice were characterized by gas chromatography mass spectrometry. The samples were designated as follows:

Table I: Sample Designations

LIMS #	Client ID	Description
20090187-01	Blank Mini "103" Premium Cartridges	Johnson Creek Cartridges
20090187-02	Original smoke juice 15 ml	Johnson Creek Smoke Juice

A Liberty Stix brand "smokeless nicotine mist cigarette" (Figure 1) was used as per the product instructions to produce the nicotine mist or vapor while 2 dilutions of the smoke juice were prepared in order to estimate the ingredients of the juice or collected vapors.

To capture the vapor emitted from an assembled Liberty Stix cigarette containing the Johnson Creek smoke juice, a 40ml evacuated gastight vial was used to draw

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air through the Liberty Stix device and into the vial. The white vapor produced was captured and diluted with a solvent prior to GC-MS analysis.

Each of the prepared samples was characterized on a Shimadzu 2010S GC-MS instrument equipped with a ZB-5HT (Phenomenex) high temperature capillary column. Observed peaks were identified based on spectral matches with commercial MS libraries. Relative concentrations were estimated from the peak areas.

RESULTS & DISCUSSION

A Total Ion Chromatogram (TIC) of a 1:100 diluted sample of the smoke juice (20090187-01) is shown in Figure 2. Since the concentration of propylene glycol (the first large peak) was significantly higher than the other ingredients, a second dilution was prepared to quantify the propylene glycol. Figure 3 shows the 1:1000 diluted sample overlaid with a 0.1% propylene glycol standard. Spectral library matches identified 3 ingredients – propylene glycol, glycerin, and nicotine – with retention times of about 3 minutes, 7 minutes and 11 minutes respectively.

The captured vapor dissolved in solvent resulted in the chromatogram shown in (Figure 4). Since the concentrations of glycerin and nicotine were much smaller than the propylene glycol and even more dilute in the vapors compared to the liquid smoke juice, single ion monitoring (SIM) was used to enhance the signal of each ingredient and estimate their relative concentrations (Figure 5).

Table II summarizes the estimated relative % of each ingredient in the smoke liquid and the extracted vapors. This analysis assumed that all of the volatile components were observed in the GC-MS analysis and that the sensitivity of the detector to each compound was similar.

General hazard and toxicity data were taken from published literature and a report titled [redacted] MSDS information for each material is provided at the end of this report. Online resources for additional safety or toxicity information can be found for the 3 ingredients here:

http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?sid=24898528#safety
http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?sid=24895092
http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?sid=24862741

or on Toxnet (http://toxnet.nlm.nih.gov/index.html).

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Figure 1: Smoke Juice Sample & Cartridge with Electronic Cigarette

Figure 2: TIC of Smoke Juice (1:100 dilution)

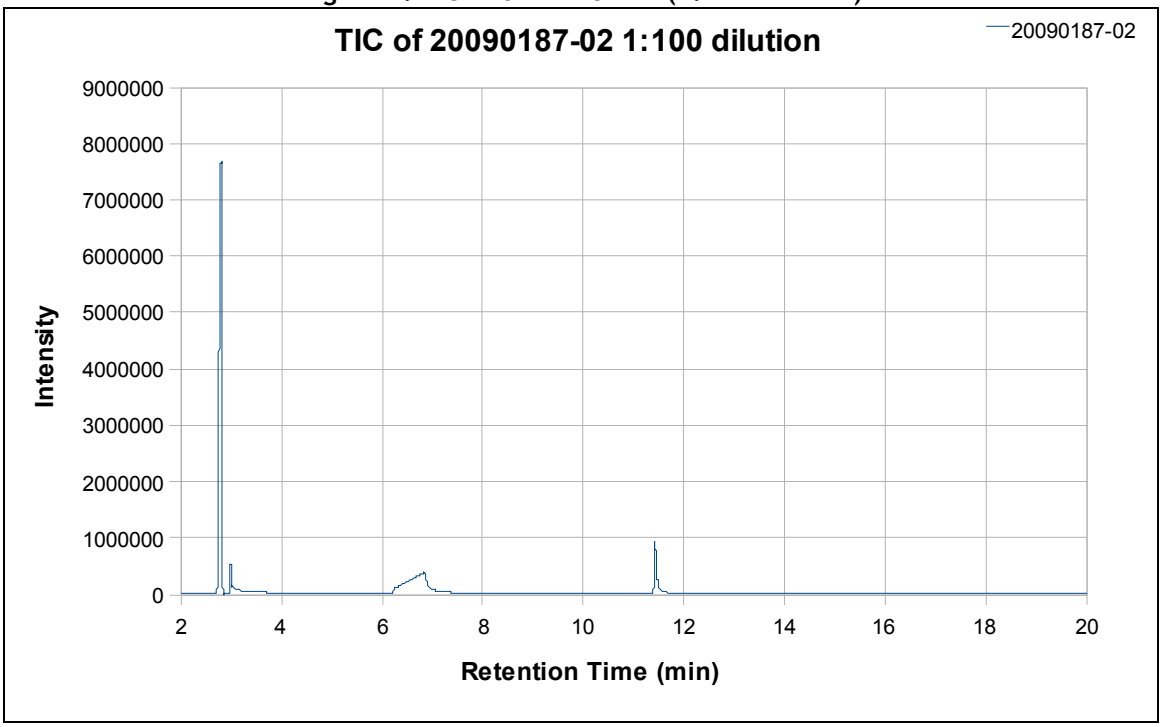

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Figure 3: TIC of Smoke Juice (1:1000 dilution) vs. 0.1% Propylene Glycol Standard

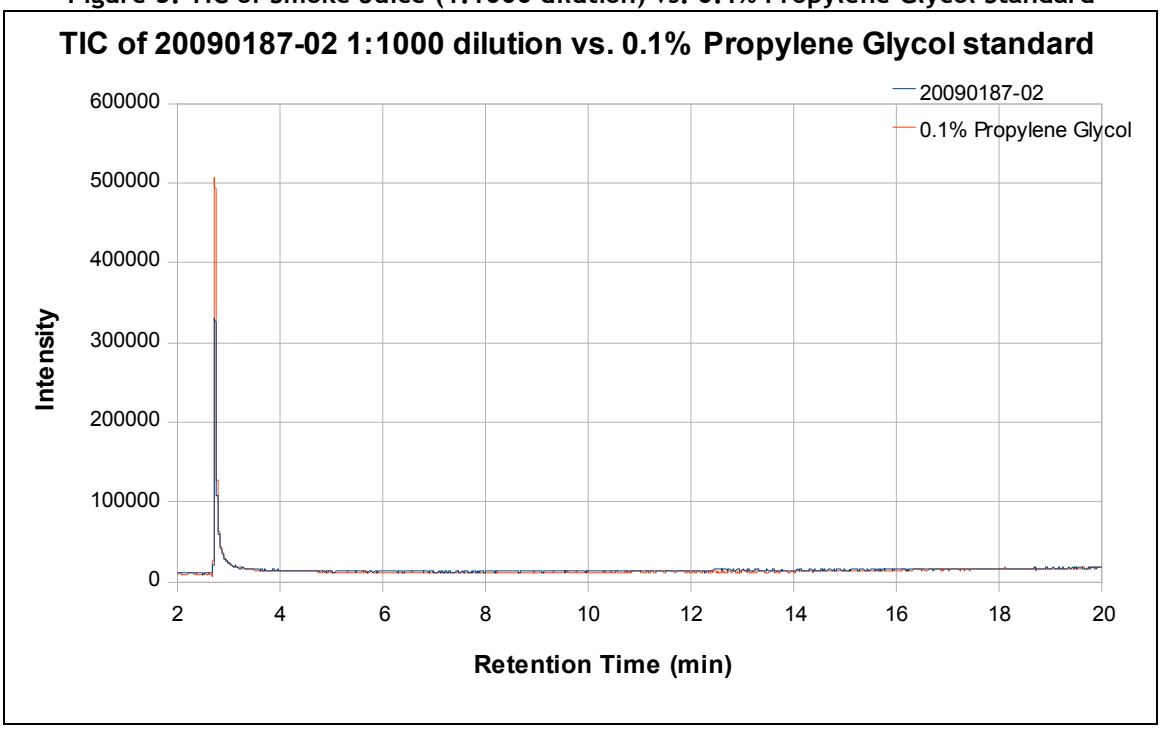

Figure 4: TIC of Captured Vapor from Johnson Creek Smoke Juice

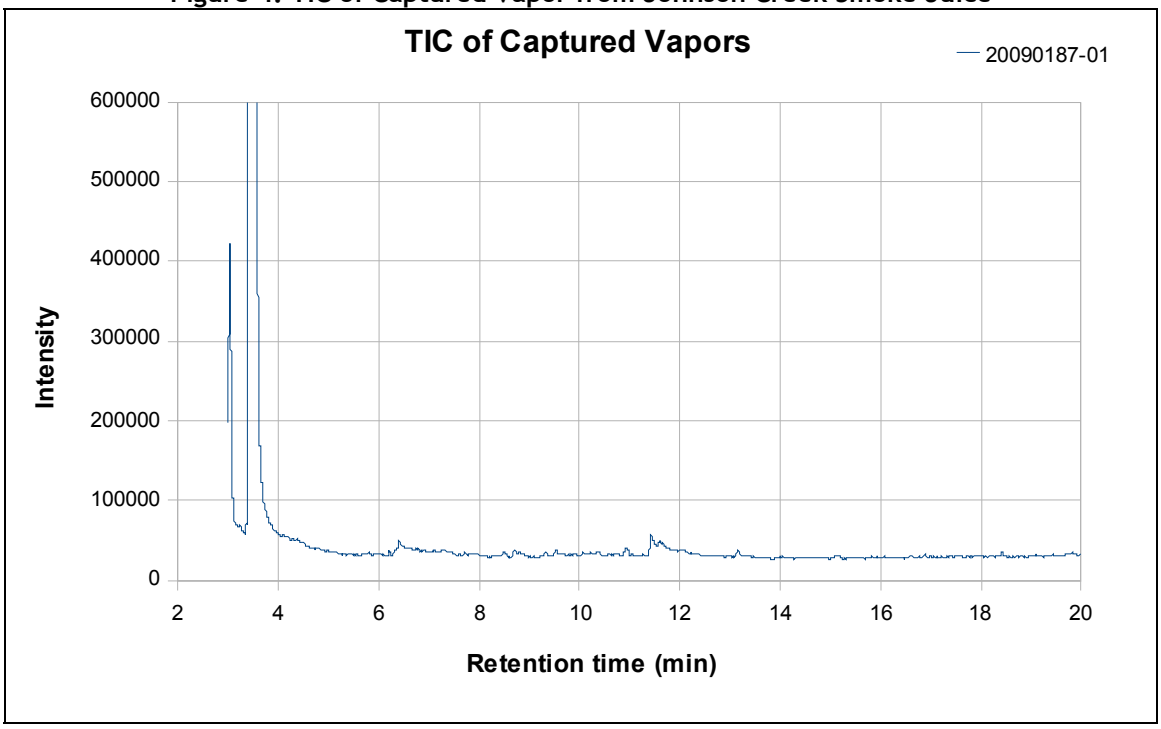

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Figure 5: Composite SIM Chromatogram of Captured Vapor from Johnson Creek Smoke Juice.

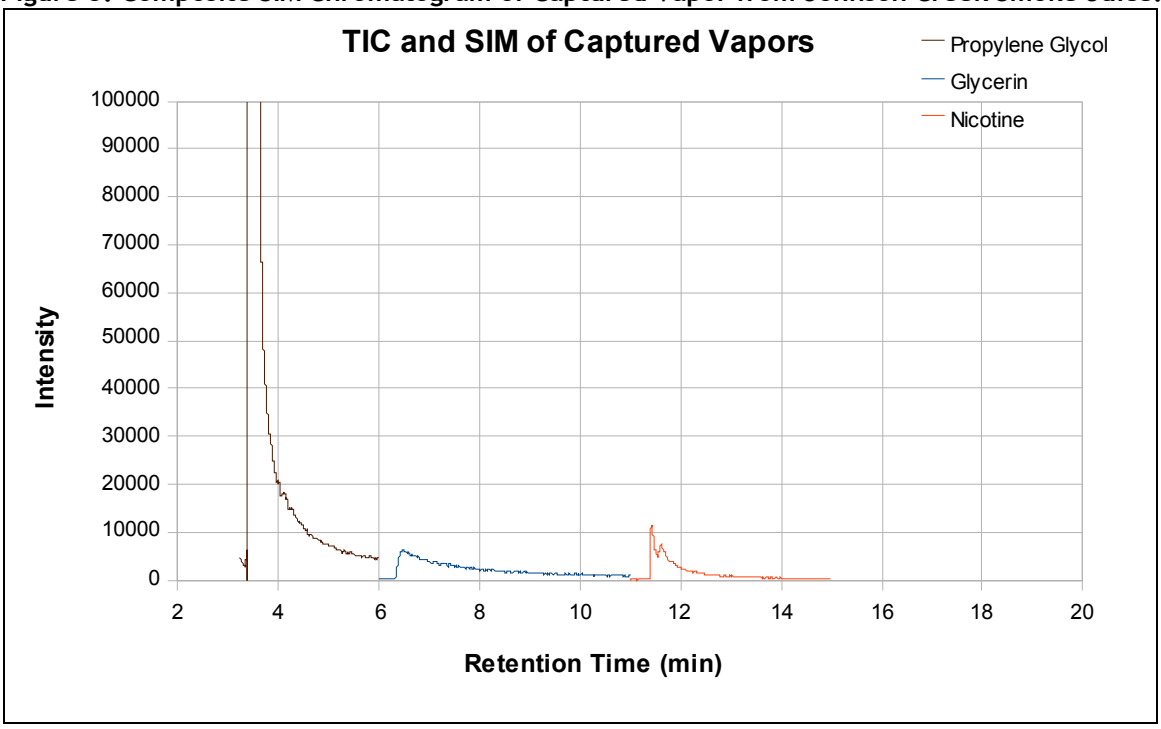

Table II: TIC Peak Report for Sample 20090187-01

#	Name	% in Smoke Juice (Peak Area %)	% in Vapors (Peak Area %)	CAS No.	Comments*
1	Propylene Glycol	[redacted]	99.1	57-55-6	Not currently recognized as giving any health hazards. Suspected respiratory toxicant, suspected skin or sense organ toxicant, suspected neurotoxicant and immunotoxicant
2	Glycerin	[redacted]	0.46	56-81-5	Non-hazardous
3	Nicotine	[redacted]	0.44	23950-04-01	R23 = Toxic by inhalation R24 = Toxic in contact with skin R25 = Toxic if swallowed R51/53 = Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Poison – may be fatal if inhaled

*cf. [redacted] report