



# GC-MS Analysis of 16 mg/g Electronic Cigarette from '10 Motives'

Report Number: F378B

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18<sup>th</sup> January 2011

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## Background

Several packs of "**Electronic Cigarette (16mg/g)**" were supplied for analysis by '**10 Motives**' as part of their due diligence to confirm the components currently found within the Nicotine Solution formulation.

Solutions of this type can be used in an electronic cigarette which replicates the action of smoking, producing a tobacco aromatized smoke, which when inhaled quickly delivers the nicotine to the lung.

The Electronic Cigarette does not emit a tarry smoke, or produce an ash deposit, and can be used to wean the smoker off 'cigarette smoking' in a controlled manner.

## Sample

The following samples were received for analysis

- **Electronic Cigarette** (8 cigarettes) 16 mg/g

Each electronic cigarette had been individually packed, and consisted of a **steel body covered with brown/white self-adhesive print giving the appearance of a traditional tobacco cigarette**. The grey coloured cap at the 'illuminated end' and the translucent cap at the 'mouth' end were both removed. A clean glass rod was then used to force out the combined electronic/ battery/ atomiser unit. The atomiser unit was then cut free and placed within the barrel of a clean glass syringe. Other atomiser units were similarly sampled. The syringe barrel was then inserted and pressure applied to compress the atomiser felts that are loaded with the nicotine solution.

A total of 4 electronic cigarettes were opened and sampled in this manner, and the nicotine solution extracted was subsequently collected in a small septum capped glass vial ready for GC-MS analysis.

## GC-MS Method

The samples were analyzed by an external laboratory to determine the components present by GC-MS (gas chromatography mass-spectrometry).

Column: Capillary Column, HP5-MS 30 m x 250  $\mu$ m x 0.25  $\mu$ m  
Temperature: 50°C 4 min, ramp 10°C/min to 210°C, 210°C 30 min  
Analysis Time: 50 min  
Carrier gas: Helium  
Injection Vol: 2 $\mu$ l  
Injection: Split injection ratio 50:1, temp 250°C  
Detection: Transfer line temp 280°C, MSD scan m/z 40-450  
Database: Search NIST08

The GC method employed may not detect some less volatile components that may be found in the samples, or where components are present in such low levels that they are below detection limits for the GC-MS method estimated to be  $\sim$  0.01% nominal area percentage.

The GC method employed was of the '**normalization type**' where the detector response for each eluted component was set at the default value of 1.000 and the peak areas normalized to evaluate nominal area percentage value for each eluted component.

The GC-MS method will screen for the various chemical present in the nicotine solution (qualitative analysis) and give some indication of the levels of the various chemicals as 'nominal area percentages' (semi-quantitative analysis). Experience shows that these nominal area percentage values are not very accurate.

If accurate nicotine levels are required, then it is advisable to use an alternative method such as the 'nicotine assay test' which uses a traceable nicotine drug standard for method calibration.

## GC-MS Results

The sample was diluted for analysis 1:4 in pure methanol.

**Table 1 - Summary of GC-MS peak identification, CAS Number, and associated Risk Phrases**

No	Component Name	Nom. Area %	CAS No.	Effects to Humans of pure product in isolation via inhalation route <b>R20 = Harmful by inhalation</b> <b>R23 = Toxic by inhalation</b> <b>R26 = Irritating to respiratory system</b> <b>R39/23 = Danger of serious irreversible effects through inhalation</b>
1	Propylene Glycol	11.30	57-55-6	Not currently recognized as giving any health hazards. So some MSDS's say no harmful effects from inhalation, while others may list some possible health hazards including by respiration route  However, it is listed as a suspected respiratory toxicant, suspected skin or sense organ toxicant, suspected neurotoxicant, and a suspected immunotoxicant.
2	Octamethyl-Cyclotetrasiloxane	0.28	556-67-2	R53 = May cause long-term adverse effects in the aquatic environment R62 = Possible risk of impaired fertility
3	3-methylpyridazin-5-one	2.02	1000130-58-4	R10 = Flammable
4	Glycerin	71.06	56-81-5	Non Hazardous
5	Dodecamethyl-Cyclohexasiloxane	0.07	540-97-6	R36/37/38 = Irritating to eyes, respiratory system, and skin
6	3-(1-methyl-2-pyrrolidinyl)-Pyridine, (S)-	15.11	54-11-5 (nicotine)	R27 = Very 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
7	3-(2-piperidinyl)-pyridine, (S)-	0.05	494-52-0	R23/24/25 = Toxic by inhalation, in contact with skin, and if swallowed
8	1,2,3,6-Tetrahydro-2,3'-bipyridine	0.05	2743-90-0	No information on risks available
9	3-oxo-2-pentyl-Cyclopentaneaceticacid, methyl ester	0.06	24851-98-7	R23/24/25 = Toxic by inhalation, in contact with skin, and if swallowed

The composition of the solution has been investigated by LPD Laboratory Services Limited, in order to try and re-affirm that nicotine solution with is a much safer alternative when used in the electronic cigarette, when compared to smoking with traditional cigarette types.

The solution contains the addictive yet poisonous nicotine. This has been determined by a separate GC Assay technique to be present at about 1.4% (see report F378A).

The GC-MS results also indicate that the solution does appear to contain significant amounts of glycerine (or glycerol) & propylene glycol aerosol forming solvents.

Different suppliers of propylene glycol appear to offer differing hazard ratings on their respective MSDS's. Some indicate no ill effects from inhalation which is fine, while others indicate CNS and spleen health issues may exist from prolonged inhalation of the chemical.

Researching the chemical profile for propylene glycol<sup>1</sup> indicates that although there would appear to be 'no current recognized health hazards', the chemical is 'suspected to be a respiratory toxicant'.

Low levels of Octamethyl-cyclotetrasiloxane (0.28%) were detected which is generally considered an irritant and carries the risk phrases R53 (May cause long-term adverse effects in the aquatic environment) and R62 (Risk of impaired fertility). Trace levels of a related Dodecamethyl-cyclohexasiloxane (0.07%) were also detected and carries the risk phrases R36 (Irritating to eyes), R37 (Irritating to respiratory system) and R38 (Irritating to skin). Silicone-based materials are widely used in industrial applications and can therefore find their way into some consumer products at detectable levels. The exact origin of these silicone based materials detected in the Nicotine solution is unknown. Several of the components within the electronic cigarette appear to be composed of a translucent rubber compound, possibly of a silicone nature. This may therefore explain where the silicone compounds have come from. It may therefore be possible to eliminate the silicones from the nicotine formulation by discussion with the manufacturer.

Trace levels of tobacco related chemicals were also found. Anabasine or 3-(2-piperidinyl)-Pyridine was detected at low levels (0.05%) together with Anatabine or 1,2,3,6-Tetrahydro-2,3'-bipyridine (0.05%). Anabasine carries the risk phrase R23 (Toxic by inhalation), R24 (Toxic in contact with skin), and R25 (Toxic if swallowed). No hazard information was found for Anatabine, but this is chemically related to Nicotine and would possibly attract similar hazard phrases to Nicotine if due consideration be given.

Trace levels of the methyl ester of 3-oxo-2-pentyl-cyclopentaneacetic acid (0.06%) were also found. This can impart a 'Jasmine' like aroma to the Nicotine solution vapour.

**References**

1. [www.scorecard.org/chemical-profiles](http://www.scorecard.org/chemical-profiles); The Pollution Information

This report is a supplement to report F378A

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End of Report