# **Comparative Aerosol HPHC Evaluation of Seven Flavors of a Temperature-Regulated** Nicotine Salt-Based Connected ENDS Product with Combustible Tobacco Cigarettes Manoj Misra, Ed Carmines, Lise Fraissinet, Chemular Inc, Hudson MI, USA

Poster #20

## ABSTRACT

The Glas G<sup>2</sup> ENDS (Glas) is a temperature-regulated nicotine salt pre-filled disposable pod connected system with two power settings, and age-gated technology, designed to minimize the combustion byproducts across a range of operating environments. Comparatively, combustible cigarettes can reach temperatures of 1000 degrees Celsius and consequently generate over seven thousand identified thermal degradation products including compounds characterized as Harmful and Potentially Harmful Constituents (HPHCs)

Seven different Glas e-liquids (three tobacco, two menthol, two non-characterizing; 50 mg/ml nicotine) were analyzed for HPHCs and compared to a 3R4F Kentucky Reference Cigarette and the market leading tobacco cigarette, Marlboro Gold. The Glas eliquids and combustible tobacco cigarettes were vaped under intense puffing conditions.

No significant increase in the HPHC profile was observed with the two power settings, vaped under non-intense and intense conditions, therefore presenting minimal risk to the consumers.

On a per day use basis (total e-liquid consumption for Glas pods and cigarette use for tobacco products), there was a significant reduction in minor nicotine alkaloids (98%), carbonyl compounds (95-99%), volatile organic compounds (VOCs) (99%), metals (45-95%).

On a product use per mg nicotine basis, carbonyl compounds, nicotine alkaloids, VOCs, and metals (cadmium and lead) levels were 95% to 99% lower and nickel was 25%-60% lower in the Glas pods compared with the 3R4F reference cigarette and Marlboro Gold.

This comparative HPHC analysis demonstrated that Glas test products in combination testing with the Glas G<sup>2</sup> device with two power settings yielded significantly lower HPHC compared to combustible tobacco cigarettes.

## **STUDY OVERVIEW**

Two combustible tobacco cigarettes, Kentucky reference, 3R4F and Marlboro Gold are used as benchmarks in assessing the potential HPHC exposure of the seven Glas test articles (Table 1) relative to tobacco cigarette.

#### Table 1. Glas e-Liquid Products Tested

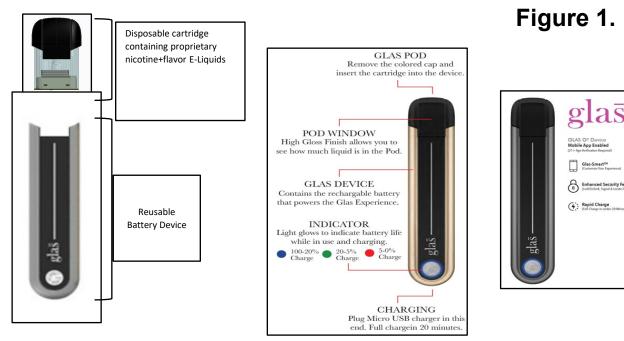
	-		
	Test Articles	Flavor	Nicotine Concentration
1	BLUE TOBACCO	Tobacco	50 MG/ML
2	<b>BLONDE TOBACCO</b>	Tobacco	50 MG/ML
3	SIGNATURE TOBACCO	Tobacco	50 MG/ML
4	FRESH MENTHOL	Menthol	50 MG/ML
5	CLASSIC MENTHOL	Menthol	50 MG/ML
6	SAPPHIRE	Non characterizing	50 MG/ML
7	GOLD 50	Non characterizing	50 MG/ML

#### Table 2. Glas G<sup>2</sup> Device Power Settings

Power Setting	Power during Puff
ECO	8 Watt for 0.5 second followed by 6W for the rest of the puff
STD	10 Watt for 0.3 second followed by 8W for the rest of the puff

### **GLASS DEVICE AND PRINCIPLE OF OPERATION**

The Principle of Operation of the Glas ENDS product (G<sup>2</sup> ENDS) including a proprietary prefilled disposable pod containing proprietary nicotine+flavor e-liquids and battery device. The schematic design diagram and G<sup>2</sup> Glas power specifications are shown in Figure 1 and Table 2.



## METHODS: SAMPLES COLLECTION AND STUDY DESIGN

All HPHC testing were conducted at Enthalpy Analytical LLC with locations in Durham, North Carolina and Richmond, Virginia.

For aerosol generation, Glas G<sup>2</sup> device was used. Glas test articles were smoked under intense puffing regime (110/cc puff, 5 second puff duration, 30 second inter-puff interval). The 3R4F and Marlboro Gold cigarettes were smoked under Canadian intense conditions. These HPHC per puff values were calculated on a per cigarette basis using the average of 9.1 puffs per cigarette (Jaccard et al. 2019). For aerosol HPHC analysis, 7 replicates for each constituent analysis were measured as suggested by FDA guidelines.

For comparative purpose, since the HPHC constituents list of tobacco cigarettes and ENDS are different, the comparative analysis lists the common HPHC analytes.

#### Data Analysis:

To compare and demonstrate the realistic comparative daily HPHC exposure of Glas test articles relative to conventional tobacco combustible cigarette, Glas HPHC values were normalized by the daily upper limit (in mL) of the product use classified by flavors (Glas Clinical Study) and 14.1 cigarette consumption/day for conventional tobacco burning cigarette based on MMWR 2018 study. (Jamal et al. 2016).

For HPHC exposure on per mg nicotine basis, the HPHC constituents from the Glas test articles and tobacco cigarettes, 3R4F and Marlboro Gold, were normalized to nicotine content based on the estimated or reported consumption.

#### Glas Product Daily Use

The daily Glas product use (upper limit in mL) classified by flavors derived from the Glas Clinical Study in Table 3.

#### Table 3. The Estimated Upper limit (mL) Product Daily Use of Glas Test Articles

Glas Test Articles	Glas Device Power Settings	Estimated Median Daily Usage (mL/day)
BLUE TOBACCO	ECO & STD	0.61
BLONDE TOBACCO	ECO & STD	0.61
SIGNATURE TOBACCO	ECO & STD	0.61
CLASSIC MENTHOL	ECO & STD	0.87
FRESH MENTHOL	ECO & STD	0.87
GOLD	ECO & STD	0.52
SAPPHIRE	ECO & STD	0.87

## COMPARATIVE AEROSOL HPHC ANALYSIS GLAS TEST ARTICLES AND COMBUSTIBLE CIGARETTES (3R4F AND MARLBORO GOLD BOX)

#### TABLE 4. BLONDE TOBACCO: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

BLONDE TOBACCO		% Difference	- Per day Basis		% Difference- Per day/mg Nicotine Basis				
50MG/ML	ECO	ECO	STD	STD	ECO Vs 3R4F	ECO	STD	STD Vs Marlboro Gold	
Analyte	Vs 3R4F	Vs Marlboro	Vs 3R4F	Vs Marlboro Gold		Vs Marlboro	Vs 3R4F		
Anabasine	- 99.80%	NA	- 100.00%	NA	- 99.80%	NA	- 100.00%	NA	
Nornicotine	- 99.70%	NA	- 100.00%	NA	- 99.70%	NA	- 100.00%	NA	
Acetaldehyde	- 99.98%	- 99.97%	- 99.98%	- 99.97%	- 99.98%	- 99.97%	- 99.99%	- 99.98%	
Acrolein	- 99.98%	- 99.97%	- 99.97%	- 99.97%	- 99.98%	- 99.97%	- 99.98%	- 99.97%	
Butanal	- 99.99%	NA	- 99.98%	NA	- 99.99%	NA	- 99.99%	NA	
Crotonaldehyde	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Formaldehyde	- 99.61%	- 99.58%	- 99.32%	- 99.26%	- 99.61%	- 99.52%	- 99.52%	- 99.40%	
Cadmium	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.99%	- 99.98%	
Chromium	NA	- 96.54%	NA	- 97.26%	NA	- 96.04%	NA	- 97.79%	
Lead	- 99.66%	- 99.71%	- 99.84%	- 99.86%	- 99.65%	- 99.67%	- 99.88%	- 99.89%	
Nickel	NA	- 77.78%	NA	- 45.39%	NA	- 74.57%	NA	- 56.07%	
Acrylonitrile	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 100.00%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 99.40%	NA	- 99.40%	NA	- 99.40%	NA	- 99.58%	NA	
Toluene	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 100.00%	- 99.99%	

TABLE 5. BLUE TOBACCO: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

BLUE TOBACCO		% Difference-	- Per day Basis		% Difference Per day/mg Nicotine Basis			
50 MG/ML Analyte	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Mariboro Gold	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold
Anabasine	- 99.80%	NA	- 100.00%	NA	- 99.80%	NA	- 100.00%	NA
Nornicotine	- 99.70%	NA	- 100.00%	NA	- 99.69%	NA	- 100.00%	NA
Acetaldehyde	- 99.97%	- 99.96%	- 99.98%	- 99.97%	- 99.97%	- 99.96%	- 99.98%	- 99.97%
Acrolein	- 99.95%	- 99.95%	- 99.95%	- 99.94%	- 99.95%	- 99.94%	- 99.96%	- 99.95%
Butanal	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	- 100.00%	NA
Crotonaldehyde	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%
Formaldehyde	- 99.50%	- 99.45%	- 99.42%	- 99.36%	- 99.49%	- 99.37%	- 99.59%	- 99.49%
Cadmium	- 99.98%	- 99.98%	- 99.98%	- 99.99%	- 99.98%	- 99.98%	- 99.99%	- 99.99%
Chromium	NA	- 96.53%	NA	- 73.20%	NA	- 96.03%	NA	- 78.44%
Lead	- 99.66%	- 99.71%	- 95.88%	- 96.57%	- 99.65%	- 99.67%	- 97.08%	- 97.24%
Nickel	NA	- 77.74%	NA	- 9.02%	NA	- 74.52%	NA	- 26.82%
Acrylonitrile	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 100.00%	- 100.00%
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%
Propylene oxide	- 99.35%	NA	- 99.35%	NA	- 99.34%	NA	- 99.54%	NA
Toluene	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%

#### TABLE 6. CLASSIC MENTHOL: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

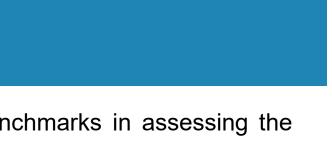
CLASSIC		% Difference	– Per Day Basis		% Difference – Per Day per mg Nicotine Basis				
MENTHOL 50 MG/ML	ECO	ECO	STD	STD	ECO	ECO	STD	STD	
Analyte	Vs 3R4F	Vs Marlboro	Vs 3R4F	Vs Marlboro Gold	Vs 3R4F	Vs Marlboro	Vs 3R4F	Vs Marlboro Gold	
Anabasine	- 99.73%	NA	- 100.00%	NA	- 99.73%	NA	- 100.00%	NA	
Nornicotine	- 98.96%	NA	- 100.00%	NA	- 98.95%	NA	- 100.00%	NA	
Acetaldehyde	- 99.96%	- 99.95%	- 99.96%	- 99.95%	- 99.96%	- 99.94%	- 99.97%	- 99.96%	
Acrolein	- 99.97%	- 99.96%	- 99.96%	- 99.96%	- 99.97%	- 99.96%	- 99.97%	- 99.97%	
Butanal	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	
Crotonaldehyde	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.99%	
Formaldehyde	- 99.47%	- 99.42%	- 99.66%	- 99.63%	- 99.46%	- 99.34%	- 99.76%	- 99.70%	
Cadmium	- 99.97%	- 99.97%	- 99.97%	- 99.97%	- 99.97%	- 99.97%	- 99.98%	- 99.98%	
Chromium	NA	- 95.09%	NA	- 95.47%	NA	- 94.38%	NA	- 96.35%	
Lead	- 99.51%	- 99.59%	- 97.74%	- 98.12%	- 99.51%	- 99.53%	- 98.40%	- 98.49%	
Nickel	NA	- 68.45%	NA	- 13.57%	NA	- 63.90%	NA	- 30.47%	
Acrylonitrile	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 99.06%	NA	- 99.06%	NA	- 99.05%	NA	- 99.33%	NA	
Toluene	- 99.89%	- 99.88%	- 99.99%	- 99.99%	- 99.89%	- 99.86%	- 99.99%	- 99.99%	

#### TABLE 7. FRESH MENTHOL: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

FRESH MENTHOL		% Difference	- Per day Basis		% Difference- Per day/mg Nicotine Basis				
50MG/ML Analyte	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold	
Anabasine	- 99.72%	NA	- 100.00%	NA	- 99.71%	NA	- 100.00%	NA	
Nornicotine	- 99.51%	NA	- 100.00%	NA	- 99.51%	NA	- 100.00%	NA	
Acetaldehyde	- 99.97%	- 99.95%	- 99.97%	- 99.96%	- 99.97%	- 99.95%	- 99.98%	- 99.96%	
Acrolein	- 99.95%	- 99.95%	- 99.95%	- 99.95%	- 99.95%	- 99.94%	- 99.97%	- 99.96%	
Butanal	- 99.99%	NA	- 99.98%	NA	- 99.99%	NA	- 99.99%	NA	
Crotonaldehyde	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.99%	
Formaldehyde	- 99.36%	- 99.30%	- 99.47%	- 99.42%	- 99.36%	- 99.20%	- 99.63%	- 99.54%	
Cadmium	- 99.97%	- 99.97%	- 99.98%	- 99.98%	- 99.97%	- 99.97%	- 99.98%	- 99.98%	
Chromium	NA	- 95.07%	NA	- 80.84%	NA	- 94.36%	NA	- 84.59%	
Lead	- 99.51%	- 99.59%	- 98.90%	- 99.08%	- 99.51%	- 99.53%	- 99.22%	- 99.26%	
Nickel	NA	- 68.32%	NA	- 23.44%	NA	- 63.75%	NA	- 38.42%	
Acrylonitrile	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 98.50%	NA	- 99.12%	NA	- 98.49%	NA	- 99.38%	NA	
Toluene	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.98%	- 99.99%	- 99.99%	

#### TABLE 8.: GOLD: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

GOLD 50 MG/ML Analyte		% Difference	– Par Day Basis		% Difference – Par Day per mg Nicotine Basis				
	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold	
Anabasine	- 99.83%	NA	- 100.00%	NA	- 99.83%	NA	- 100.00%	NA	
Nornicotine	- 99.75%	NA	- 100.00%	NA	- 99.74%	NA	- 100.00%	NA	
Acetaldehyde	- 99.97%	- 99.96%	- 99.98%	- 99.97%	- 99.97%	- 99.96%	- 99.98%	- 99.97%	
Acrolein	- 99.92%	- 99.92%	- 99.95%	- 99.95%	- 99.92%	- 99.91%	- 99.96%	- 99.96%	
Butanal	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	- 100.00%	NA	
Crotonaldehyde	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Formaldehyde	- 99.40%	- 99.35%	- 99.58%	- 99.54%	- 99.40%	- 99.25%	- 99.70%	- 99.63%	
Cadmium	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.98%	- 99.99%	- 99.99%	
Chromium	NA	- 97.05%	NA	- 51.58%	NA	- 96.63%	NA	- 61.05%	
Lead	- 99.71%	- 99.76%	- 99.77%	- 99.81%	- 99.70%	- 99.72%	- 99.84%	- 99.84%	
Nickel	NA	- 81.07%	NA	- 12.24%	NA	- 78.34%	NA	- 29.41%	
Acrylonitrile	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 100.00%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 99.45%	NA	- 99.45%	NA	- 99.44%	NA	- 99.61%	NA	
Toluene	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 100.00%	- 99.99%	



#### TABLE 9. SAPPHIRE: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

SAPPHIRE		% Difference	- Per day Basis		% Difference- Per day/mg Nicotine Basis				
50MG/ML	ECO Vs 3R4F	ECO Vs Marlboro	STD Vs 3R4F	STD Vs Marlboro Gold	ECO Vs 3R4F	ECO Vs Mariboro	STD Vs 3R4F	STD Vs Marlboro Gold	
Analyte	VS 3K4F		VS 3K4F		V5 3K4F		VS 3K4F		
Anabasine	- 99.72%	NA	- 100.00%	NA	- 99.72%	NA	- 100.00%	NA	
Nornicotine	- 98.97%	NA	- 100.00%	NA	- 98.96%	NA	- 100.00%	NA	
Acetaldehyde	- 99.89%	- 99.85%	- 99.98%	- 99.97%	- 99.89%	- 99.83%	- 99.98%	- 99.98%	
Acrolein	- 99.75%	- 99.74%	- 99.92%	- 99.92%	- 99.75%	- 99.70%	- 99.94%	- 99.93%	
Butanal	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	
Crotonaldehyde	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.98%	- 99.99%	- 99.99%	
Formaldehyde	- 95.90%	- 95.52%	- 99.68%	- 99.65%	- 95.87%	- 94.88%	- 99.77%	- 99.72%	
Cadmium	- 99.97%	- 99.97%	- 99.99%	- 99.99%	- 99.97%	- 99.97%	- 99.99%	- 99.99%	
Chromium	NA	- 95.07%	NA	- 94.62%	NA	- 94.36%	NA	- 95.67%	
Lead	- 99.51%	- 99.59%	- 99.63%	- 99.69%	- 99.51%	- 99.53%	- 99.74%	- 99.75%	
Nickel	NA	- 68.32%	NA	- 24.33%	NA	- 63.75%	NA	- 39.13%	
Acrylonitrile	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 99.07%	NA	- 99.07%	NA	- 99.06%	NA	- 99.34%	NA	
Toluene	- 99.98%	- 99.98%	- 99.99%	- 99.99%	- 99.98%	- 99.98%	- 99.99%	- 99.99%	

SIGNATURE		% Difference	- Per day Basis		% Difference- Per day/mg Nicotine Basis				
TOBACCO 50MG/ML	ECO	ECO	STD	STD	ECO	ECO	STD	STD Vs Marlboro Gold	
Analyte	Vs 3R4F	Vs Marlboro	Vs 3R4F	Vs Marlboro Gold	Vs 3R4F	Vs Marlboro	Vs 3R4F		
Anabasine	- 99.81%	NA	- 100.00%	NA	- 99.80%	NA	- 100.00%	NA	
Nornicotine	- 99.76%	NA	- 100.00%	NA	- 99.76%	NA	- 100.00%	NA	
Acetaldehyde	- 99.98%	- 99.98%	- 99.98%	- 99.97%	- 99.99%	- 99.98%	- 99.98%	- 99.98%	
Acrolein	- 99.98%	- 99.98%	- 99.97%	- 99.97%	- 99.98%	- 99.97%	- 99.98%	- 99.97%	
Butanal	- 99.99%	NA	- 99.99%	NA	- 99.99%	NA	- 100.00%	NA	
Crotonaldehyde	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	- 99.99%	
Formaldehyde	- 99.83%	- 99.82%	- 99.81%	- 99.79%	- 99.97%	- 99.79%	- 99.87%	- 99.83%	
Cadmium	- 99.97%	- 99.97%	- 99.97%	- 99.97%	NA	- 99.97%	- 99.98%	- 99.98%	
Chromium	NA	- 95.81%	NA	- 96.52%	- 98.54%	- 95.20%	NA	- 97.20%	
Lead	- 98.56%	- 98.80%	- 99.72%	- 99.77%	NA	- 98.63%	- 99.80%	- 99.81%	
Nickel	NA	- 69.97%	NA	- 62.01%	- 100.00%	- 65.63%	NA	- 69.44%	
Acrylonitrile	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 99.99%	- 100.00%	- 100.00%	
Benzene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 99.44%	- 100.00%	- 100.00%	- 100.00%	
Propylene oxide	- 99.44%	NA	- 99.46%	NA	- 99.48%	NA	- 99.61%	NA	
Toluene	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	- 100.00%	

NA: Not applicable

NT: Not tested

### **Comparative HPHC Analysis On Daily Use Basis:**

- both ECO and STD Glas G<sup>2</sup> device power levels.
- Marlboro Gold at STD power level.
- Glas G<sup>2</sup> device power levels.

The comparative daily product use analysis of aerosol HPHC of Glas e-liquid test articles with Glas G<sup>2</sup> device relative to conventional combustible cigarettes vaped/smoked under intense puffing conditions demonstrated significant reduction in HPHC toxicants

### **Comparative HPHC Analysis On Daily Use per mg Nicotine Basis:**

- change the vaping topography to titrate nicotine consumption.
- about 25%-60% lower than 3R4F and Marlboro Gold.

This comparative study demonstrated that on a similar nicotine use basis the calculated potential daily HPHC exposure to consumers will be drastically reduced by Glas e-liquid test articles with Glas G<sup>2</sup> device compared to conventional tobacco cigarettes.

Guy Jaccard, Donatien Tafin Djoko, Alexandra Korneliou, Regina Stabbert, Maxim Belushkin, Marco Esposito. Mainstream smoke constituents and in vitro toxicity comparative analysis of 3R4F and 1R6F reference cigarettes. Toxicology Reports, Volume 6, 2019, Pages 222-231.

Jamal A., Elyse Phillips, Andrea S. Gentzke, David M. Homa, Stephen D. Babb, Brian A. King, Linda J. Neff. Current Cigarette Smoking Among Adults — United States, 2016. MMWR, January 19, 2018, Vol. 67, No. 2.



CHEMULAR

TABLE 10. SIGNATURE TOBACCO: Comparative Aerosol HPHC Analysis with 3R4F and Marlboro Gold Cigarette

## CONCLUSIONS

• The nicotine minor alkaloids (anabasine and nornicotine), carbonyl compounds (acetaldehyde, acrolein, crotonaldehyde and formaldehyde), and volatile organic compounds (VOCs) compounds (acrylonitrile, benzene, toluene) levels in all Glas test articles were over 98% lower than 3R4F and Marlboro Gold at

• The cadmium levels in all Glas e-liquid test articles were over 99% lower than 3R4F and Marlboro Gold at both ECO and STD Glas G<sup>2</sup> device power levels. The comparative chromium levels in all Glas eliquid test articles were over 95% lower than Marlboro Gold at ECO power level and 45-95% lower than

 The nickel levels in all Glas e-liquid test articles were 60%-80% lower than Marlboro Gold at ECO power level and 9%-60% lower than Marlboro Gold at STD power level. The comparative nickel levels in all Glas e-liquid test articles were over 95% lower than 3R4F and Marlboro Gold at both ECO and STD

• This comparison will provide an insight for comparative potential daily HPHC exposure if consumer

• This comparative analysis revealed that the in all Glas e-liquid test articles, the carbonyl compounds, nicotine alkaloids, VOCs, metals (cadmium and lead) levels were 95% to 99% lower and nickel were

## REFERENCES