RUVIAN

A comparative study on delivery of nicotine, humectants and endogenous aroma constituents from reconstituted tobacco materials in granule and sheet form under heat-not-burn condition

Liu Shengyi[1], Zhu Libing[1], Dou Jinxi[1], Liu Weijuan[2]

1. Ruvian Technology Ltd., Kunming, China
2. Yunnan Reascend Tobacco Technology (Group) Co., Ltd, Kunming, China

CORESTA Congress 2022

Background

- A great variety of heat-not-burn products (HnBs) available in market;
- Heating devices are various and the tobacco materials in heating rods come in different forms too;
- Central heating, peripheral heating, resistance heating, electromagnetic heating;
- Tobacco substrate in sheet or granule form;

Questions:

- The delivery pattern of core compounds (nicotine, humectants and endogenous volatile aroma constituents) of tobacco substrate in different forms;

Objectives:

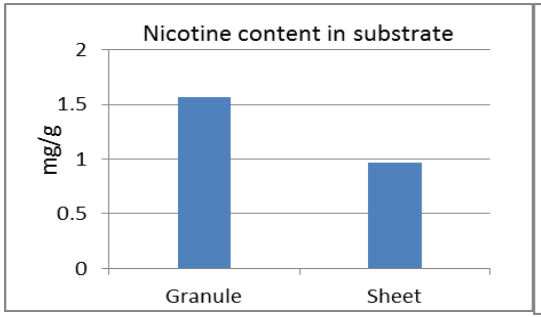
- To quantitatively determine the delivery of the nicotine and endogenous volatile aroma constituents from tobacco substrate in sheet and granule forms;
- To study the puff-by-puff performance of tobacco substrate in sheet and granule forms.

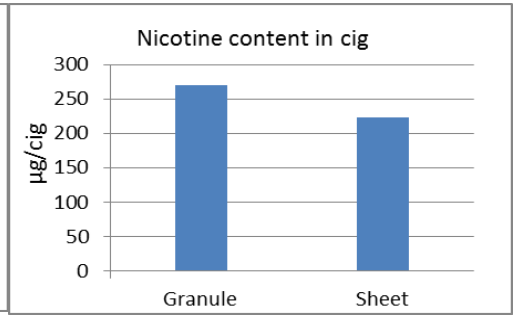
Methods:

- Two different forms of reconstituted tobacco materials (A: granule and B: sheet) were prepared using same tobacco leaves blend;
- Same formula was designed to ensure a similar content of humectants and tobaccos;
- Nicotine, humectants and aroma constituents in prepared material were quantitatively determined;
- Tobacco rods filled with either reconstituted tobacco materials form A or B were heated by the same device with central heating blade, and emissions were generated by linear smoking machine;
- Smoking regime: HCI (55mL, 2s duration, 28s interval), 8 puffs taken from each tobacco stick;
- Nicotine, humectants and aroma constituents in emissions were collected by Cambridge Filter Pad and quantitatively determined;
- Puff-by-puff analysis was carried out to study delivery of the compounds of interests on puff basis.

Results-Contents in substrate material

Nicotine content

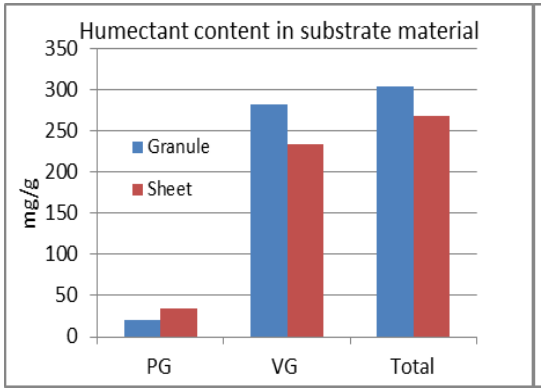


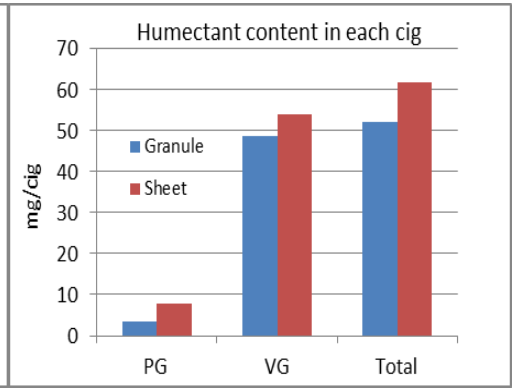


Substrate form	Nicotine content in material (mg/g)	Nicotine content in each cig (μg/cig)
Granule	1.57	**270.04**
Sheet	0.97	**223.10**

- Nicotine and humectants in two substrate materials were determined and their contents in each cig were calculated;
- Similar contents were determined.

Humectant content

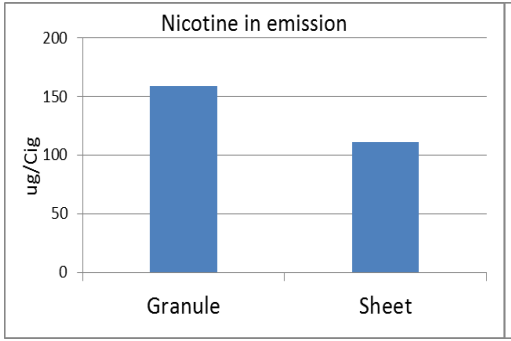


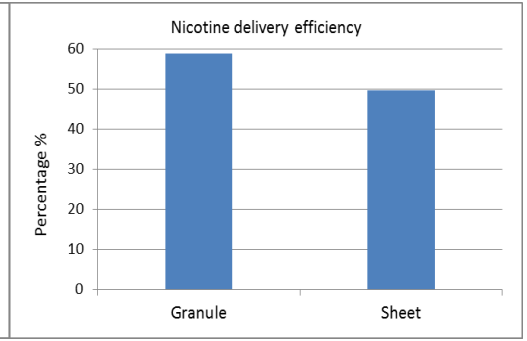


Substrate form	PG content in material (mg/g)	VG content in material (mg/g)	Total (mg/g)
Granule	20.70	283.30	**304.0**
Sheet	34.20	234.50	**268.7**
Substrate form	**PG content in cig (mg/g)**	**VG content in each cig (mg/g)**	**Total (mg/cig)**
Granule	3.56	48.73	**52.29**
Sheet	7.86	53.94	**61.80**

Results- Emission analysis

Nicotine in emission

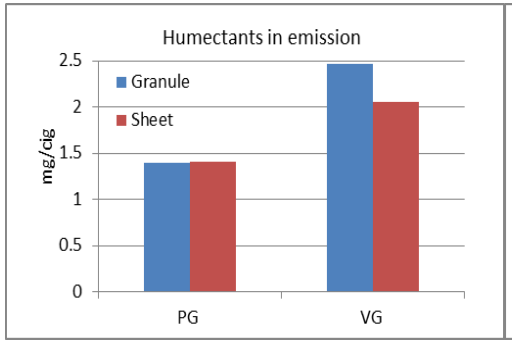


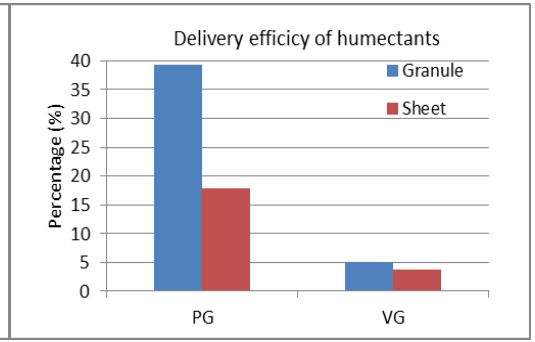


Substrate form	Nicotine in emission (μg/cig)	Delivery efficiency (%)
Granule	159.0	**58.9**
Sheet	111.0	**49.8**

- **Nicotine delivery efficiency of tobacco granules is higher than that of tobacco sheet.**

Humectants in emission



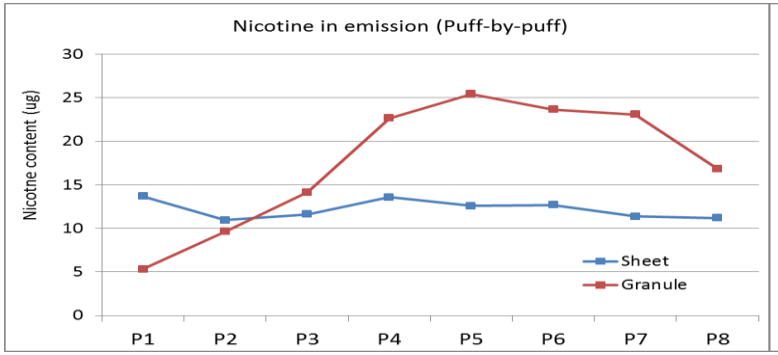


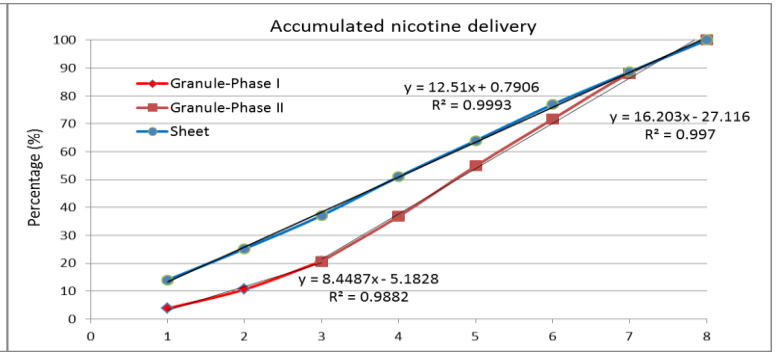
Substrate form	PG in emission (mg/cig)	VG in emission (mg/cig)	PG Delivery efficiency (%)	VG Delivery efficiency (%)
Granule	1.40	2.47	**39.23**	**5.07**
Sheet	1.41	2.05	**17.94**	**3.81**

- **Humectants delivery efficiency of tobacco granules is higher than that of tobacco sheet**

Results- Puff-by-puff Analysis

Nicotine delivery



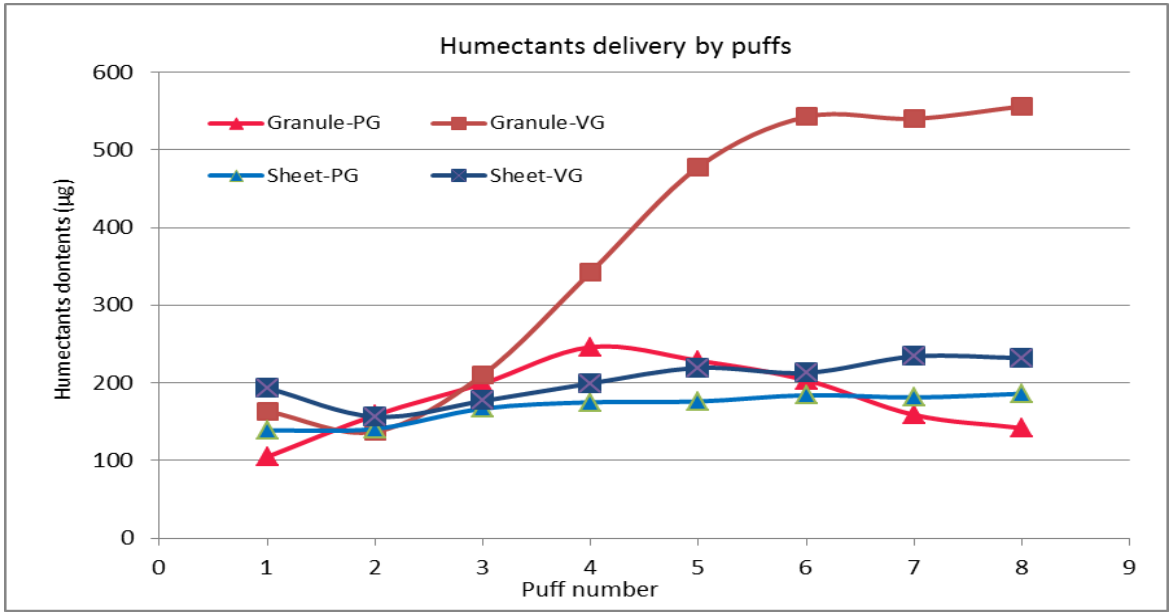


Nicotine content	Puff 1 (µg)	Puff 2 (µg)	Puff 3 (µg)	Puff 4 (µg)	Puff 5 (µg)	Puff 6 (µg)	Puff 7 (µg)	Puff 8 (µg)
Granule	5.35	9.65	14.15	22.65	25.45	23.65	23.10	16.85
Sheet	13.70	10.95	11.65	13.60	12.60	12.70	11.40	11.20
Accumulated nicotine	**Puff 1 (%)**	**Puff 2 (%)**	**Puff 3 (%)**	**Puff 4 (%)**	**Puff 5 (%)**	**Puff 6 (%)**	**Puff 7 (%)**	**Puff 8 (%)**
Granule	3.80	10.65	20.70	36.78	54.85	71.63	88.04	100
Sheet	14.00	25.20	37.12	51.02	63.91	76.89	88.55	100

- Tobacco substrate in sheet form shows a much more stable nicotine delivery;

Results- Puff-by-puff Analysis

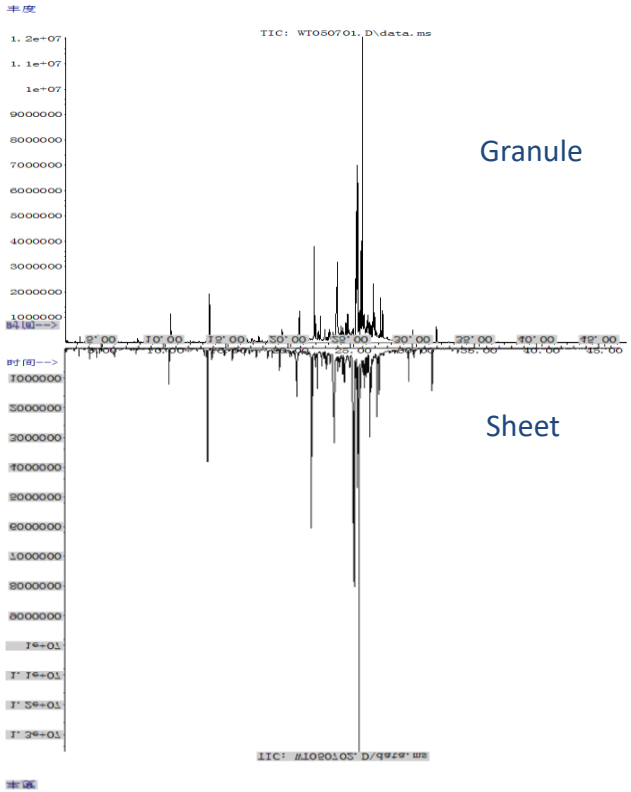
Humectants delivery

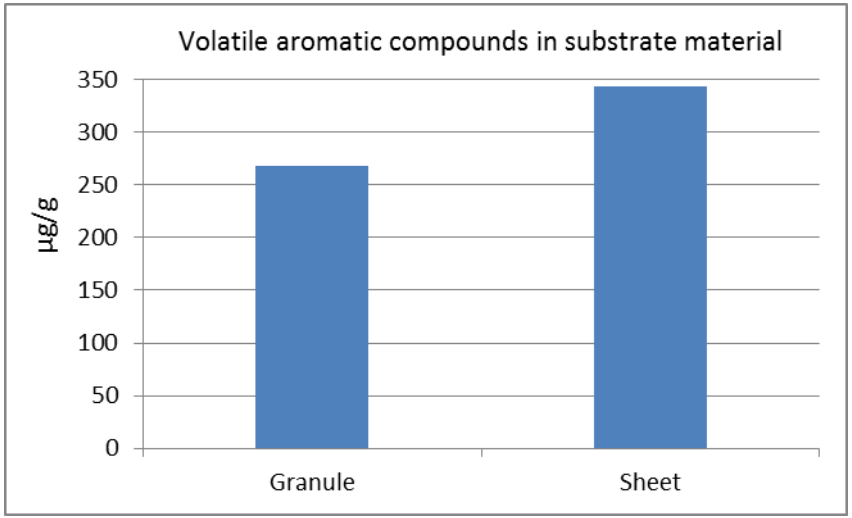


- Both PG and VG show a more stable delivery pattern from substrate material in sheet form;
- VG in substrate material in granule form was delivered in an inconsistent manner.

Results- Volatile aromatic compounds

Material analysis

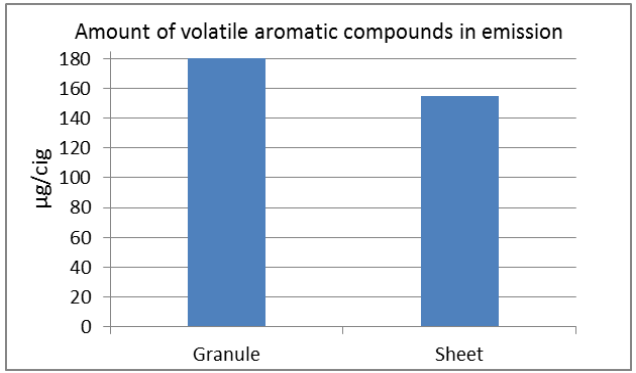




- 63 types of endogenous volatile aromatic compounds were defined;
- Higher level of volatile aromatic compounds were determined in substrate in sheet form.

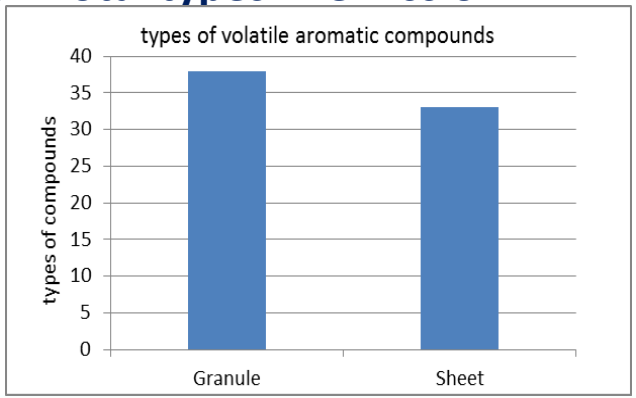
Results- Volatile aromatic compounds in emission

Total amount in emission



Substrate form	Total volatile aromatic compounds in emission (µg/cig)
Granule	180.42
Sheet	155.16

Total types in emission

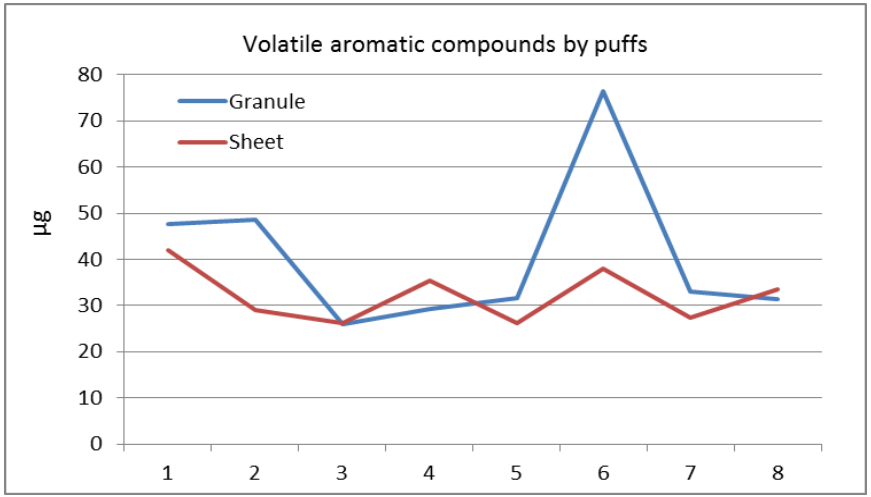


Substrate form	Total types of volatile aromatic compounds in emission
Granule	37
Sheet	32

- Substrate in granule released higher amount of endogenous volatile aromatic compounds;
- More types of endogenous volatile aromatic compounds were found in emission of granule from of substrate material.

Results- Volatile aromatic compounds in emission

Puff-by-puff analysis



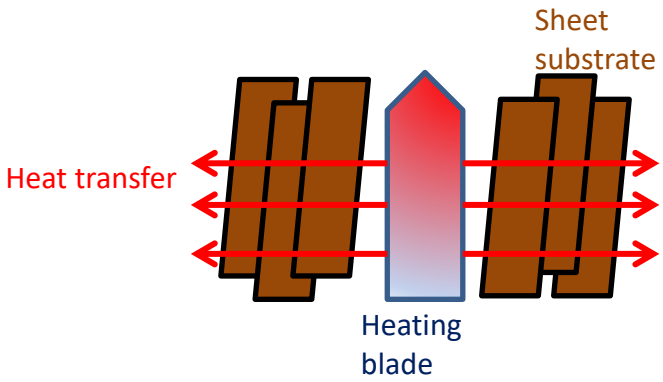
- Substrate in sheet form showed a relatively more stable delivery of endogenous volatile aromatic compounds through puffs

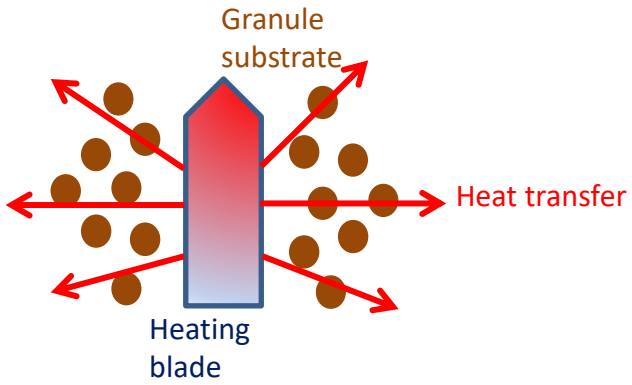
Summary of results

	Granule	Sheet
Nicotine delivery	√ Tobacco substrate in granule form showed higher delivery efficiency of nicotine	
Humectants delivery	√ Tobacco substrate in granule form showed higher delivery efficiency of humectants	
Volatile aromatic compound delivery	√ Tobacco substrate in granule form delivery higher level of endogenous volatile aromatic compounds. More types of compounds were delivered from granule form.	
Puff-by-puff/nicotine	Tobacco substrate in sheet form shows a much more stable nicotine delivery √	
Puff-by-puff/humectants	Tobacco substrate in sheet form shows a much more stable delivery of humectants √	
Puff-by-puff/volatile aromatic compounds	Substrate in sheet form showed a relatively more stable delivery of endogenous volatile aromatic compounds through puffs √	

Discussions

- Substrate in granule form arranged in random order might facilitate the thermal transmission, thus enhance the delivery of constituents release from tobacco material;
- Sheet material assembled in order might lead to a directional, ordered heat transfer that helped a more stable delivery of constituents.





Conclusions

- Forms of tobacco substrate significantly affect the delivery of crucial constituents;
- Under central heating condition, tobacco substrate material in granule form showed high delivery efficiency of nicotine, humectants and endogenous volatile aromatic compounds; compounds are delivered in a more stable manner in sheet form;
- This study provides some clues for the future optimization of HnB product;
- Further studies can be done on the effect of heating style.

云南拓宝科技有限公司

RUVIAN TECHNOLOGY LTD.

THANKS