

IMPLICATIONS OF PRODUCT TESTING: Method variability & suitability and ratio of smoke emissions to nicotine

Workshop on Toxicant Ceilings

M. Intorp, X. Cahours, T. Verron

Toxicants Suggested for Ceilings

World Health Organization TobReg recommends a strategy for regulation based on product performance measures with the goal of reducing toxicant levels in mainstream smoke.

Nine priority compounds were identified for testing in cigarette smoke, representing different groups chemicals, have been prioritized :

- *NNN, NNK*
- *Benzo[a]pyrene*
- *Acetaldehyde, Acrolein, Formaldehyde*
- *Benzene, 1,3-Butadiene*
- *Carbon monoxide*

Purpose of Method Standardisation

- Internationally standardised methods are required to enable the generation of reliable data.
- CORESTA has strongly supported the development of robust methods to deliver information on method variability based on sound science.
- This information will enable regulatory authorities to take method variability into account when considering setting ceilings for smoke constituents.

CRM Reproducibility of Yield Data from CORESTA Monitor



ISO smoking

Smoke Constituent	Mean CM6	R CM6	R% CM6
NFDPM (mg)	14.2	2.1	14
Nicotine (mg)	1.37	0.16	12
CO (mg)	14.4	1.9	13
NNN (ng)	20.0	8.1	41
NNK (ng)	26.5	8.6	32
B[a]P (ng)	15.5	5.2	34
1,3-butadiene (µg)	61.1	34.6	57
Benzene (µg)	60.4	25.7	43
Formaldehyde (µg)	47.2	22.3	47
Acetaldehyde (µg)	694	193	28
Acrolein (µg)	68.5	19.4	28

Intense smoking

Smoke Constituent	Mean CM6	R CM6	R% CM6
NFDPM (mg)	28.9	7.3	25
Nicotine (mg)	2.68	0.49	18
CO (mg)	26.2	3.3	13
NNN (ng)	37.9	21.3	56
NNK (ng)	50.8	27.4	54
B[a]P (ng)	27.9	8.45	30
1,3-butadiene (µg)	108.1	59.1	55
Benzene (µg)	108.5	37.4	34
Formaldehyde (µg)	104.2	50.1	48
Acetaldehyde (µg)	1309	365	28
Acrolein (µg)	133.3	36.7	28

CORESTA Recommended Methods - Current Status

- Six methods encompassing 25 analytes were taken to CRMs. Four of these methods have already been submitted to ISO as potential ISO standards
- High levels of inter-laboratory variability observed
- These levels of variability may be “as good as it gets”
- Round-table open discussions have provided invaluable insight into causes and ways of reducing to some extent inter-laboratory data variability
- Data between replicates may be precise within one laboratory but inter-laboratory variability is still high even when working to a “standardised method”

Ceilings on Toxicants – Criteria suggested

TobReg recommends establishing **levels for selected mainstream smoke compounds per milligram of nicotine (HCl)** and prohibiting the sale or import of cigarette brands that have yields above these levels.

- The median values for NNN and NNK are used as recommended levels
- An initial level of 125% of the median value is recommended for the other smoke compounds.

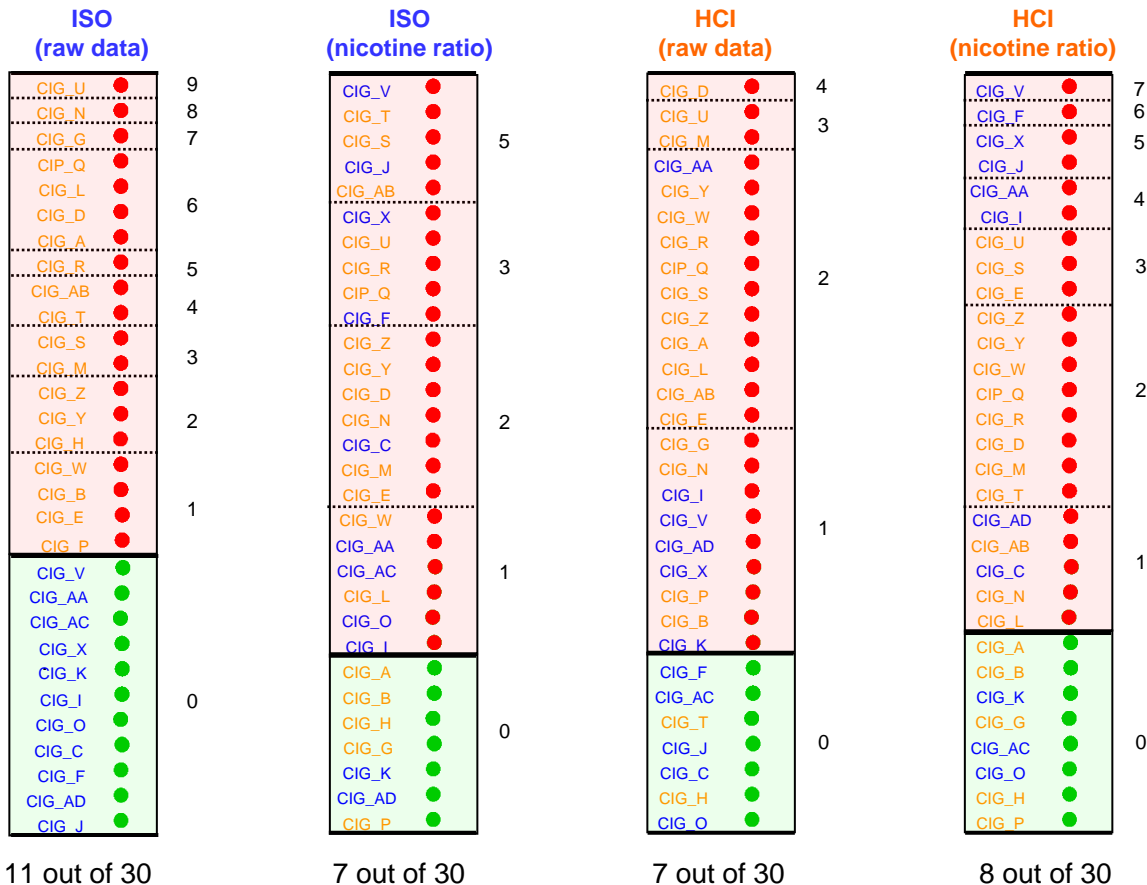
Survey of Cigarette Emissions from EU&US Market Products conducted by ITL

- Study on 30 cigarette blends with ISO tar yields ranging from 1 mg to 18 mg/cigarette
- Analytical program consists of TobReg 9 priority compounds and tar yields
- Smoking program was conducted under ISO and Canadian Intense smoking regimes.

“Regulators should use data reported for their own markets to set levels, if they are available, or select the values derived from the data set that conforms most closely to the cigarettes available on the market being regulated”

Multiple Ceilings Assessment

(without taking into account the variability of measurement)



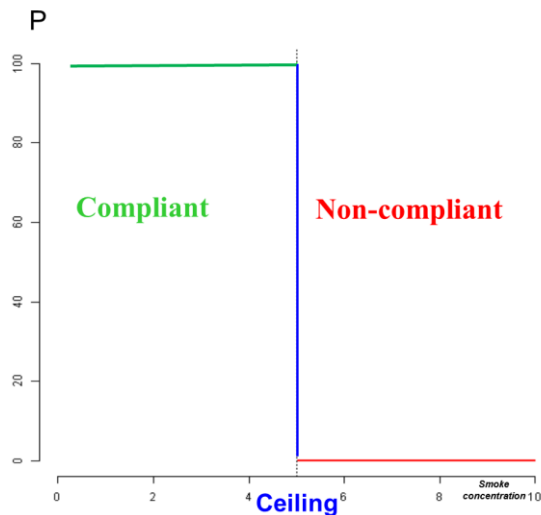
Intermediate Conclusions

- The scenario (ISO, ISO/NIC, HCI, HCI/NIC) used for establishing levels for selected mainstream smoke compounds has a significant impact on the products compliance.
- The dataset used for ceiling computation has also a strong consequence on the products compliance.
- Ceilings based on nicotine ratio could increase the average smoke compounds yields of product remaining on the market.

Multiple Ceilings Assessment

(taking into account the variability of measurement)

Without variability

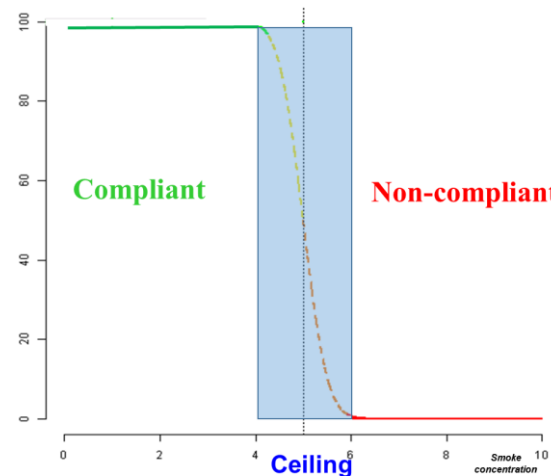


P_i can be 0 or 1

- | | | |
|---------------|---|-------|
| B(a)P | ⇒ | P_1 |
| NNN | ⇒ | P_2 |
| NNK | ⇒ | P_3 |
| CO | ⇒ | P_4 |
| Formaldehyde | ⇒ | P_5 |
| Acetaldehyde | ⇒ | P_6 |
| Acrolein | ⇒ | P_7 |
| Benzene | ⇒ | P_8 |
| 1,3-butadiene | ⇒ | P_9 |

$$P_{\text{compliance}} = \prod_{i=\{\text{BaP}, \dots, \text{1,3-butadiene}\}} P_i$$

With variability



P_i can be between 0 and 1

Multiple Ceilings Assessment

(taking into account the variability of measurement)

- 100 % Compliant
- 100% Non-compliant

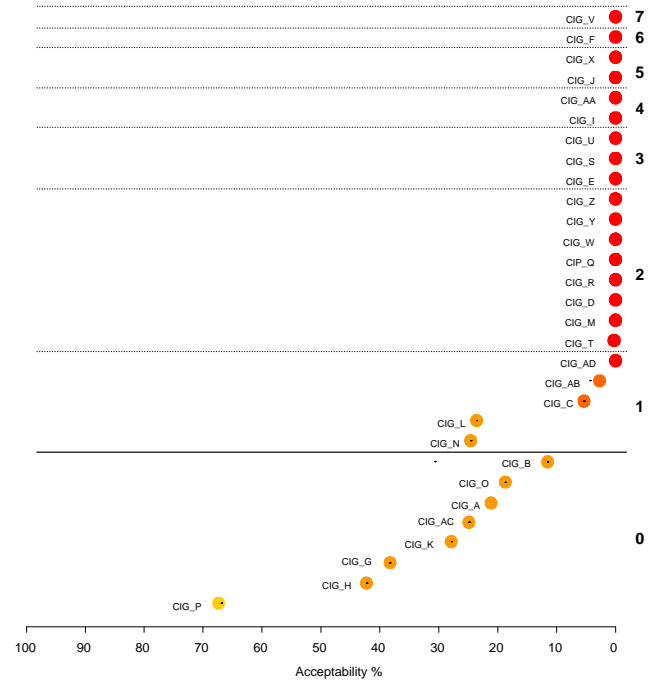
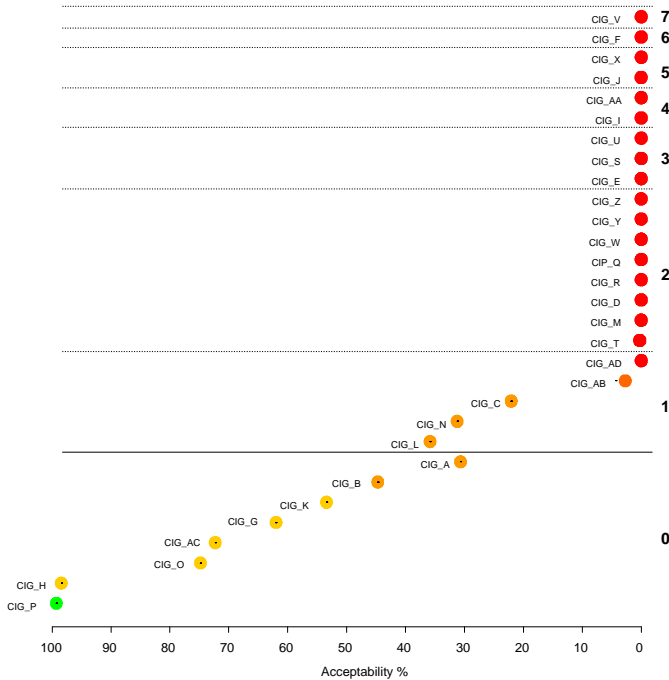
0%

20%

50%

Variability →

- CIG_V ●
- CIG_F ●
- CIG_X ●
- CIG_J ●
- CIG_AA ●
- CIG_I ●
- CIG_U ●
- CIG_S ●
- CIG_E ●
- CIG_Z ●
- CIG_Y ●
- CIG_W ●
- CIP_Q ●
- CIG_R ●
- CIG_D ●
- CIG_M ●
- CIG_T ●
- CIG_AD ●
- CIG_AB ●
- CIG_C ●
- CIG_N ●
- CIG_L ●
- CIG_A ●
- CIG_B ●
- CIG_K ●
- CIG_G ●
- CIG_AC ●
- CIG_O ●
- CIG_H ●
- CIG_P ●



8 out of 30

1 out of 30

0 out of 30

Summary

- **Product compliance was found to be dependent on the scenario and the dataset used for establishing limits on selected smoke compounds**
- **Methods variability has a strong impact on the product compliance and must be taken into consideration before setting up ceilings.**
- **Any meaningful use of reported data will require the validation and the standardization of methods.**

Consequences on the Introduction of Ceilings

- The introduction of **independent ceilings on multiple analytes** prohibit the sale of most products within a market.
- The unattended consequence, it could **increase the average yields of products remaining on the market** which it is not the intention of the regulation.