Research & Development

SSPT1:THE EFFECT OF CIGARETTE DESIGN VARIABLES ON ASSAYS OF INTEREST TO THE TOBACCO INDUSTRY: -

1) EXPERIMENTAL DESIGN AND SOME INITIAL FINDINGS ON HOFFMANN ANALYTE YIELDS

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BRITISH AMERICAN TOBACCO

TOPICS TO BE COVERED

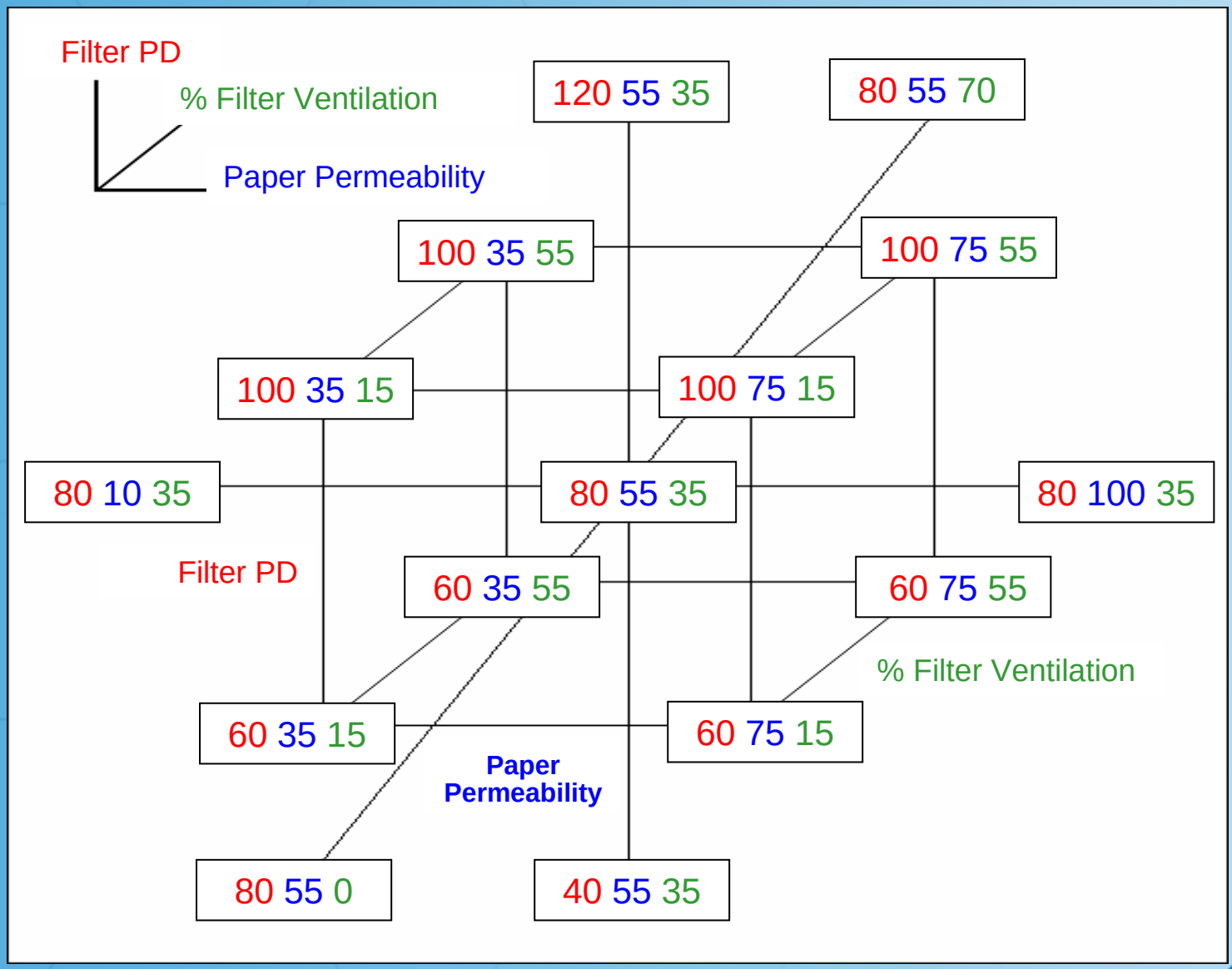
- EXPERIMENTAL DESIGN / PHILOSOPHY
  CENTRAL COMPOSITE:-
  PAPERS, FILTER, CIRCUMFERENCE
  4 BLENDS

- MECHANISTIC EXPLANATIONS / INTERPRETATIONS

- CONCLUSIONS / LIMITATIONS

- ACKNOWLEGDEMENTS

Three Dimensional Representation of the Central Composite Design



Blend and Filter Details

Blend Code	Nic (% DWB)	Total Sugar (% DWB)	Reducing Sugar (% DWB)	Density at Manufacture (mg/cc)	Number of Grades	Fill Value (cc/g)
Virginia	2.80	13.2	12.2	240	8	5.5
Burley	2.63	0.1	0.5	210	4	6.3
Oriential	1.14	12.5	11.2	290	4	4.9
1:1 Mix Virginia: Burley	2.69	6.0	5.7	210	12	6.4

Tow item	Filter PD (mmWG)	% NFDPM Filtration Efficiency	% Plasticizer Level	Rod Weight (mg)
8.0Y39K	38.6	35.4	4.22	684
5.0Y34K	58.9	43.9	4.32	715
3.8Y34K	68.9	48.0	4.27	689
2.8Y31K	78.8	52.2	4.38	666
2.1Y32K	97.9	58.8	4.26	663
2.1Y34K	119.0	63.6	4.18	717

Slims Design

8 super slim products : 17 mm circumference
72 mm tobacco column and a 27 mm filter

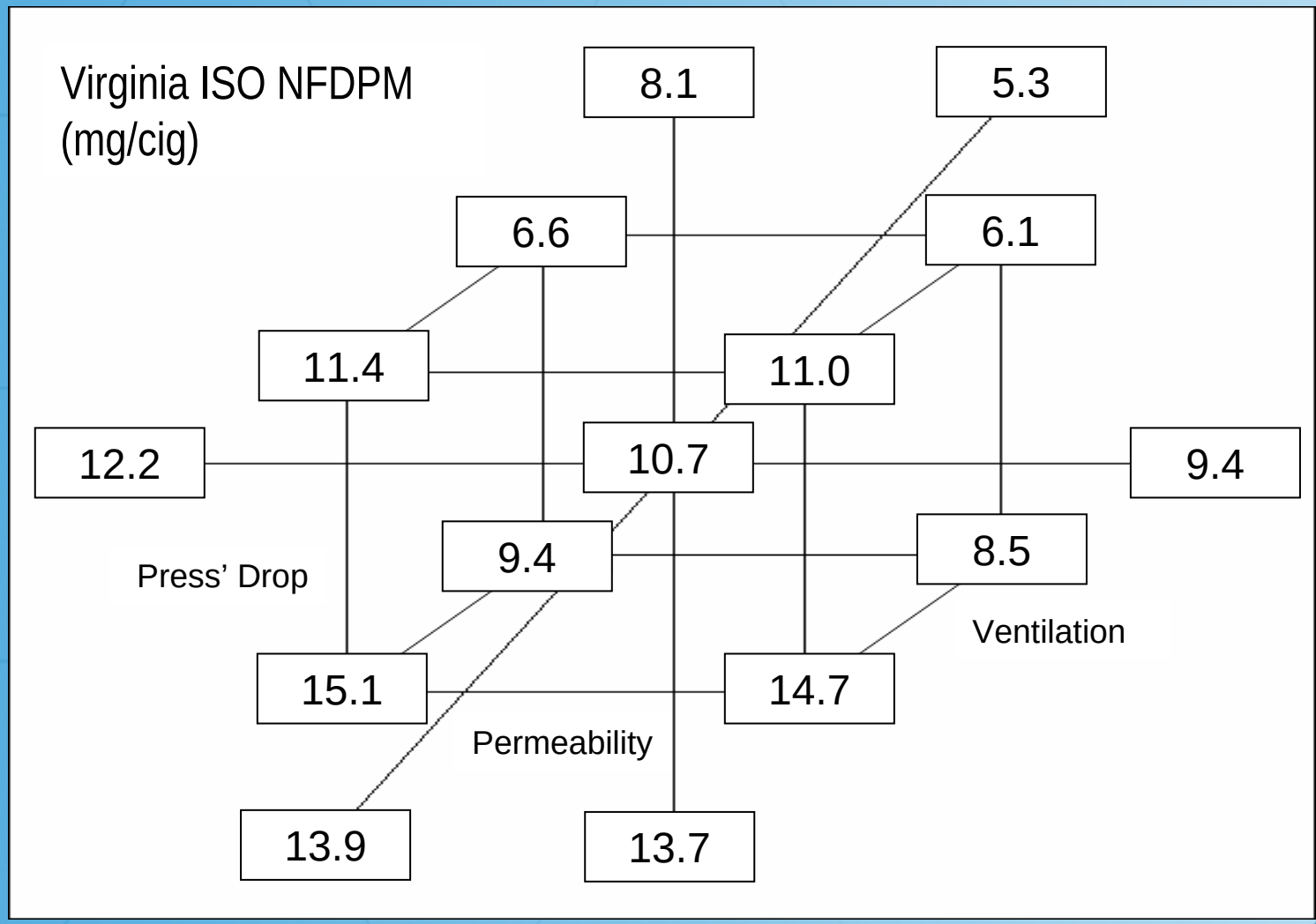
Only the Virginia blend

Changes to the:-

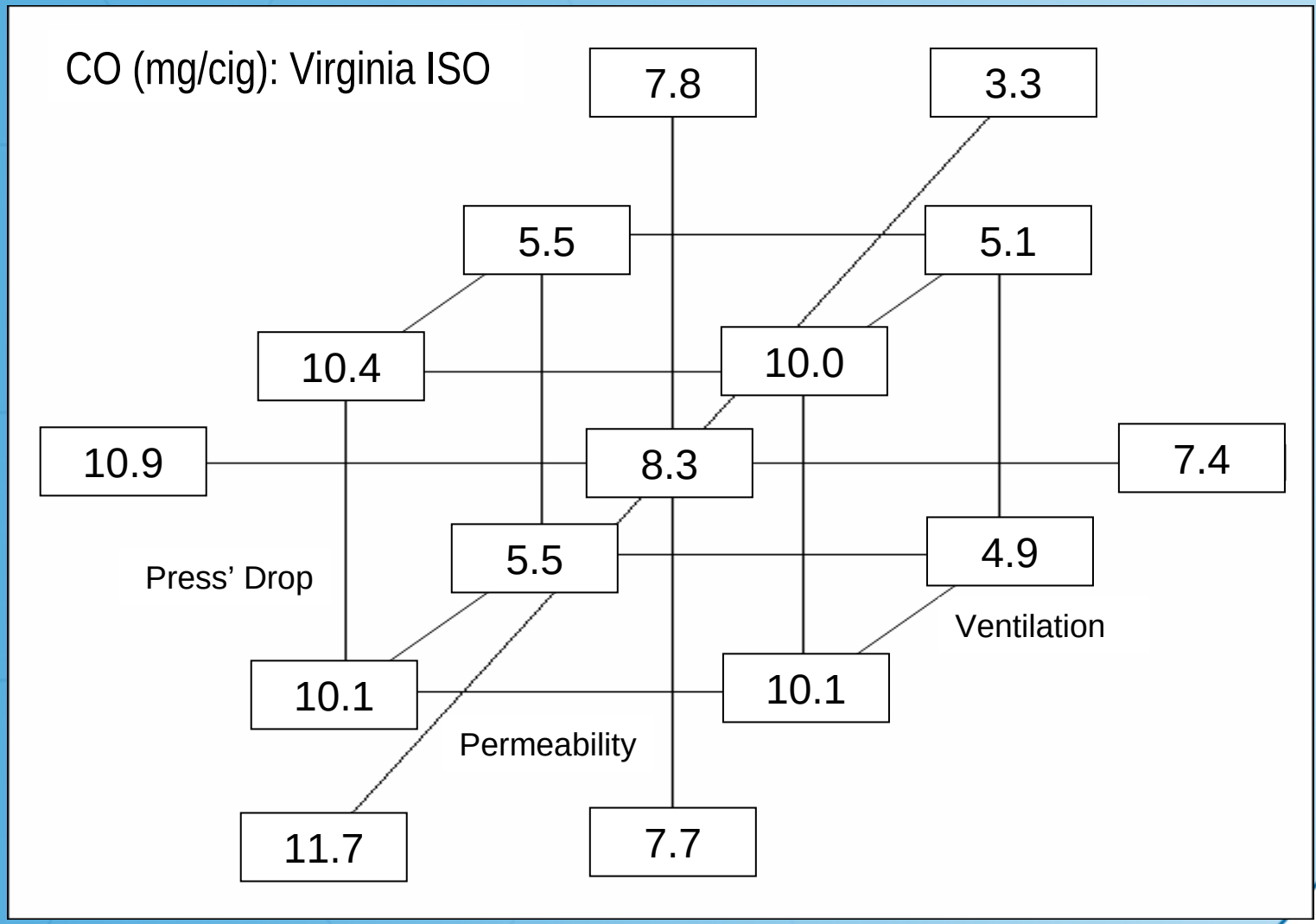
- **filter pressure drop**
- **filter ventilation level**
- **citrate level within the cigarette paper**

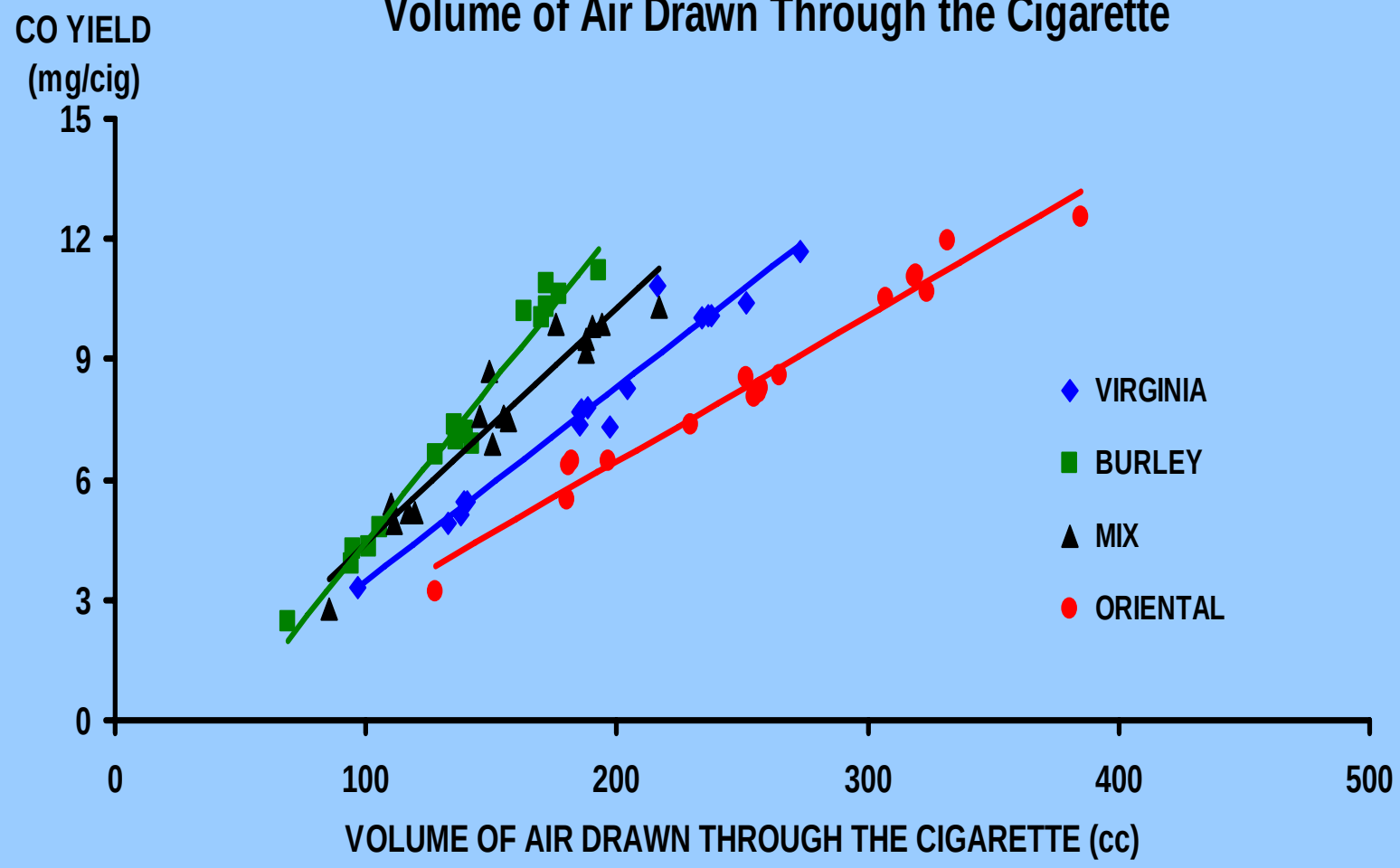
Based around a 2^3 factorial experimental design

Three Dimensional Representation of Virginia NFDPM yields



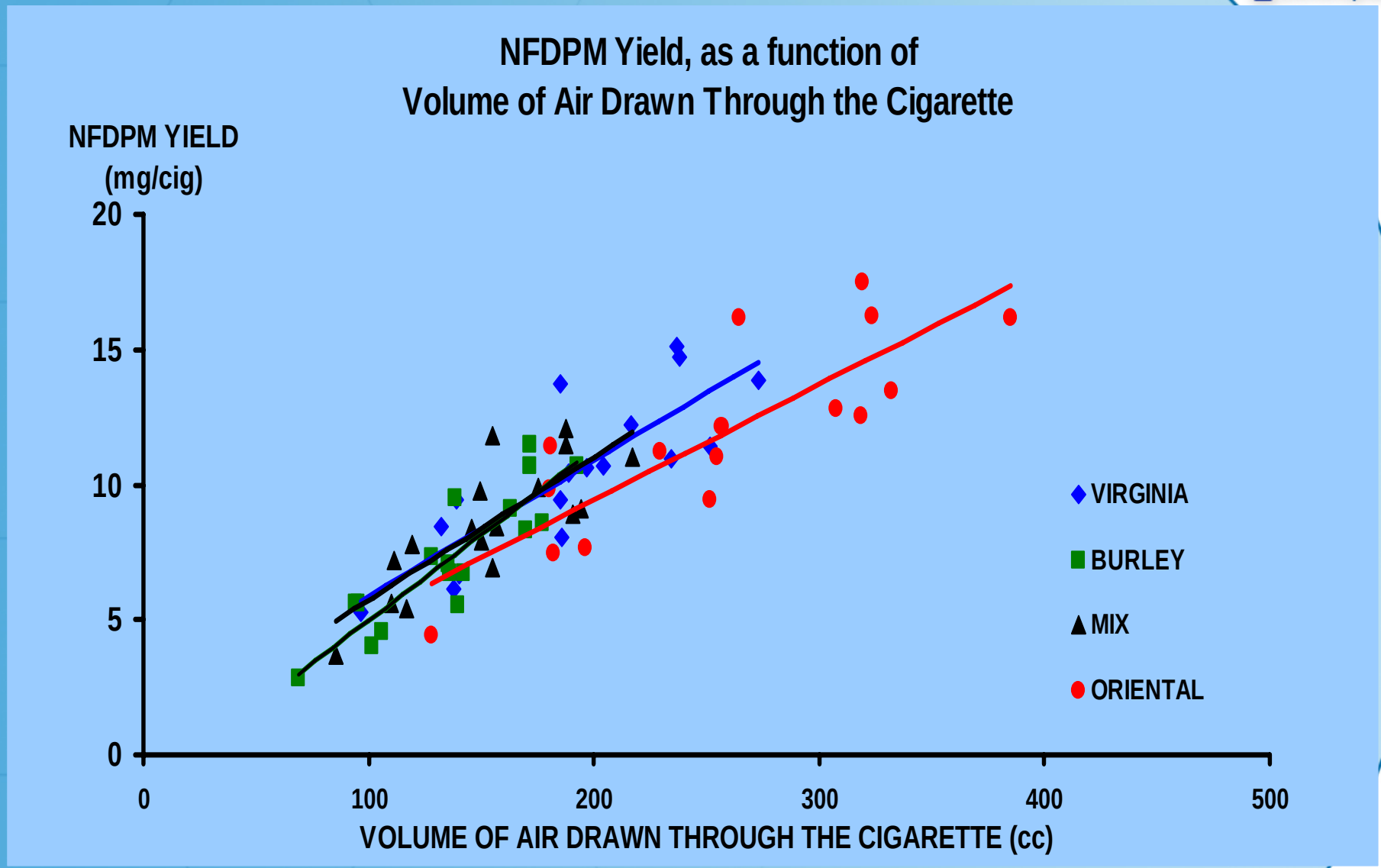
Three Dimensional Representation of Virginia CO yields

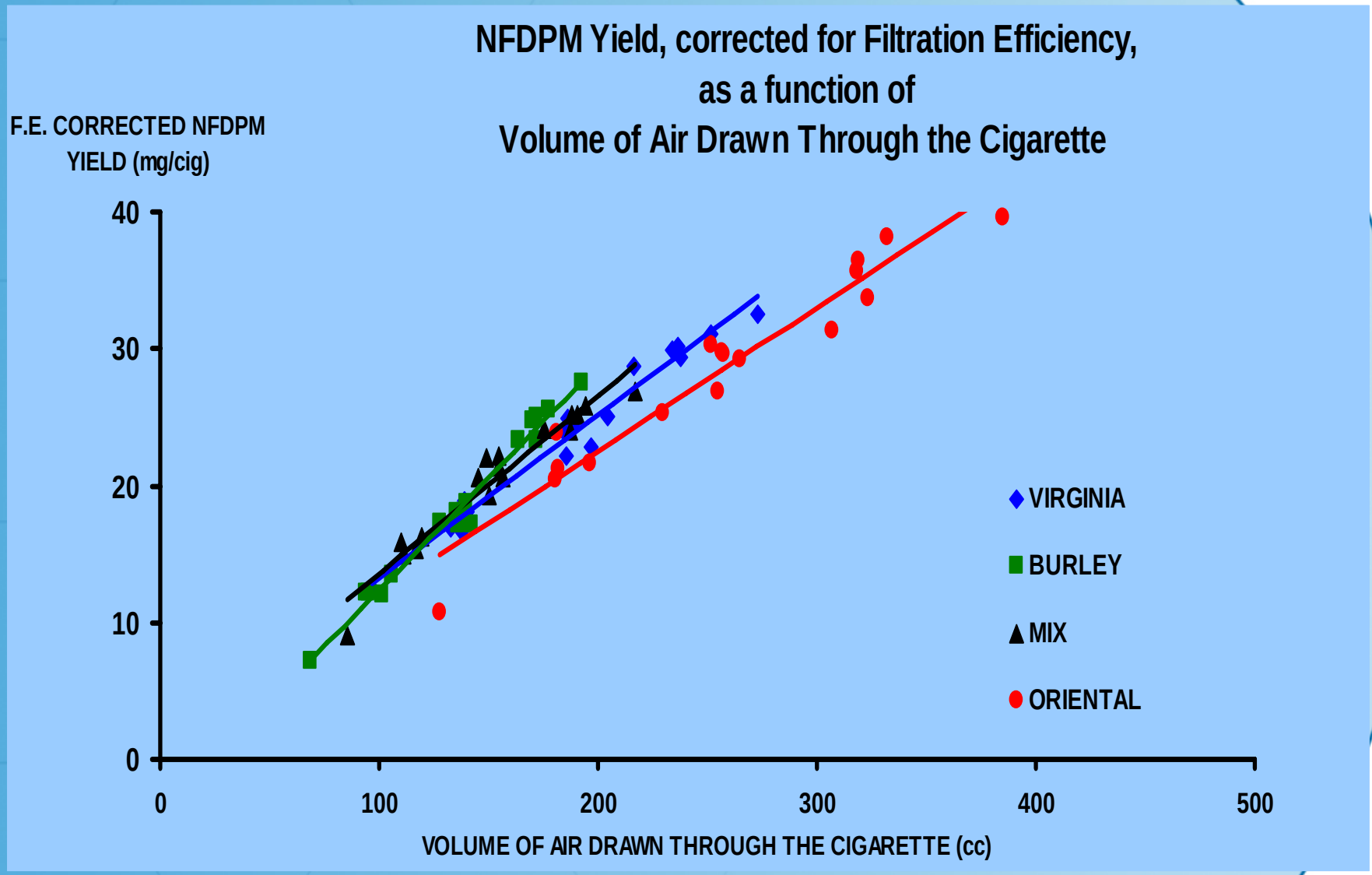


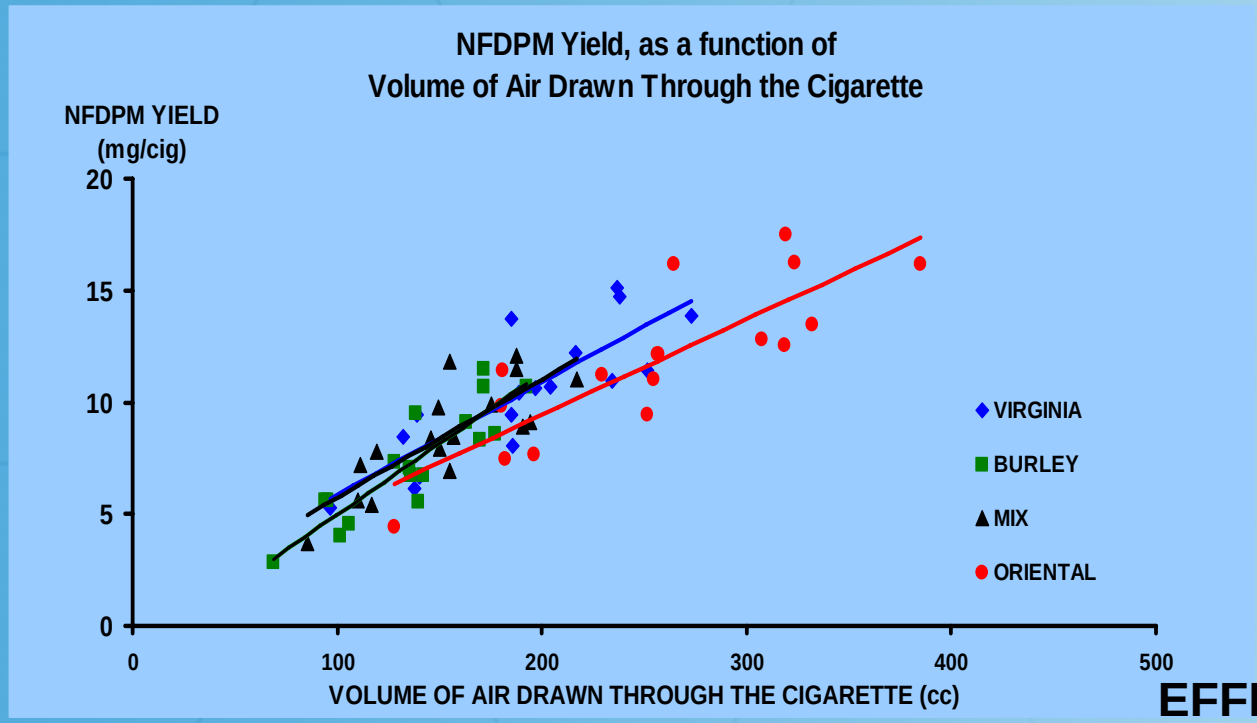


Puff No. x Puff Volume x $\left(1-\frac{V}{100}\right)$

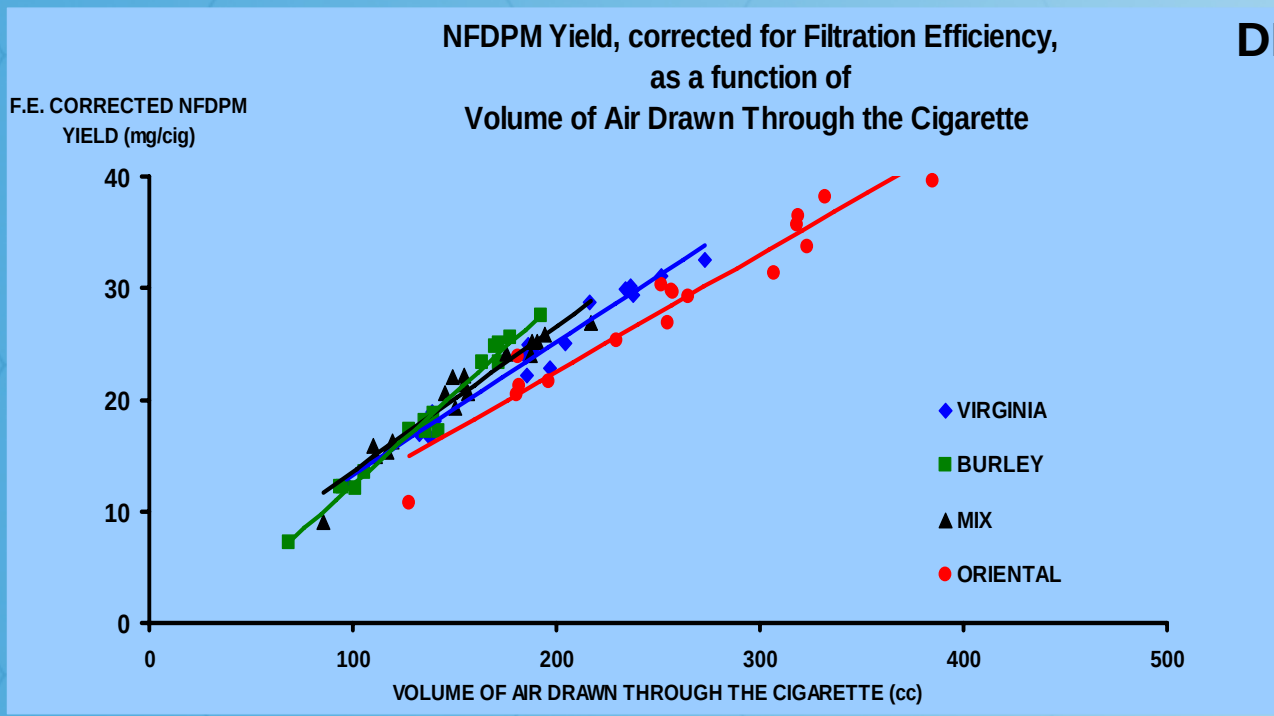
where V is the % filter ventilation level

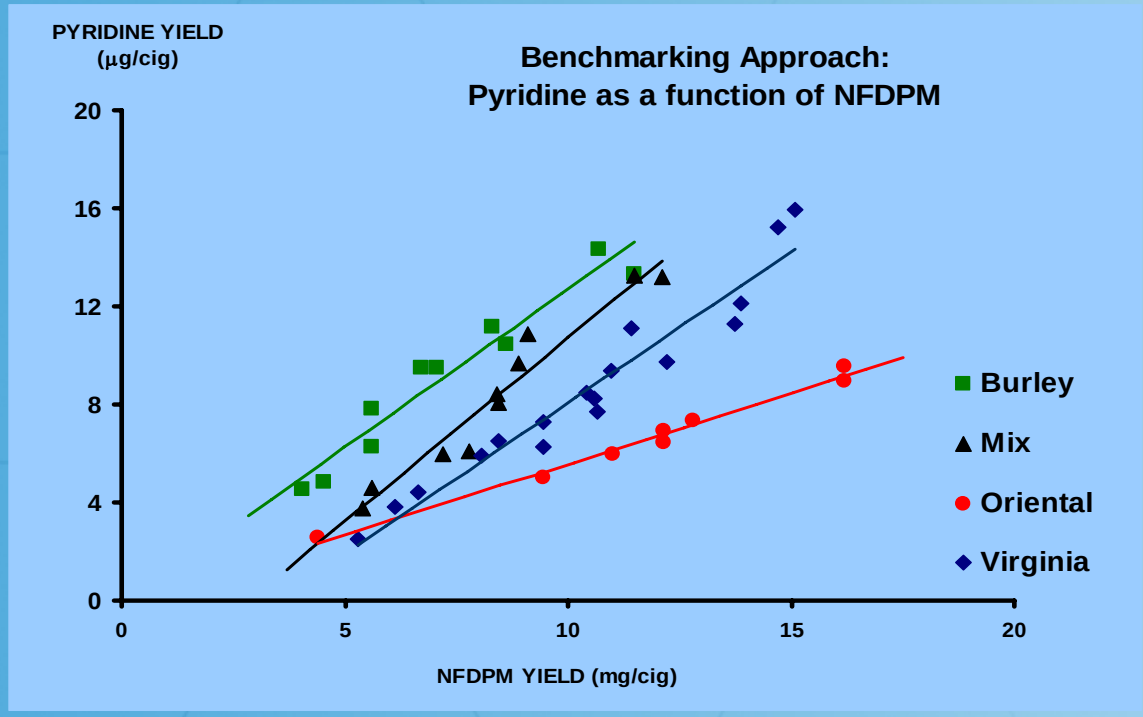

NFDPM Yield, as a function of
Volume of Air Drawn Through the Cigarette
NFDPM YIELD
(mg/cig)
20
15
10
5
0
0
100
200
300
400
500
VOLUME OF AIR DRAWN THROUGH THE CIGARETTE (cc)
VIRGINIA
BURLEY
MIX
ORIENTAL

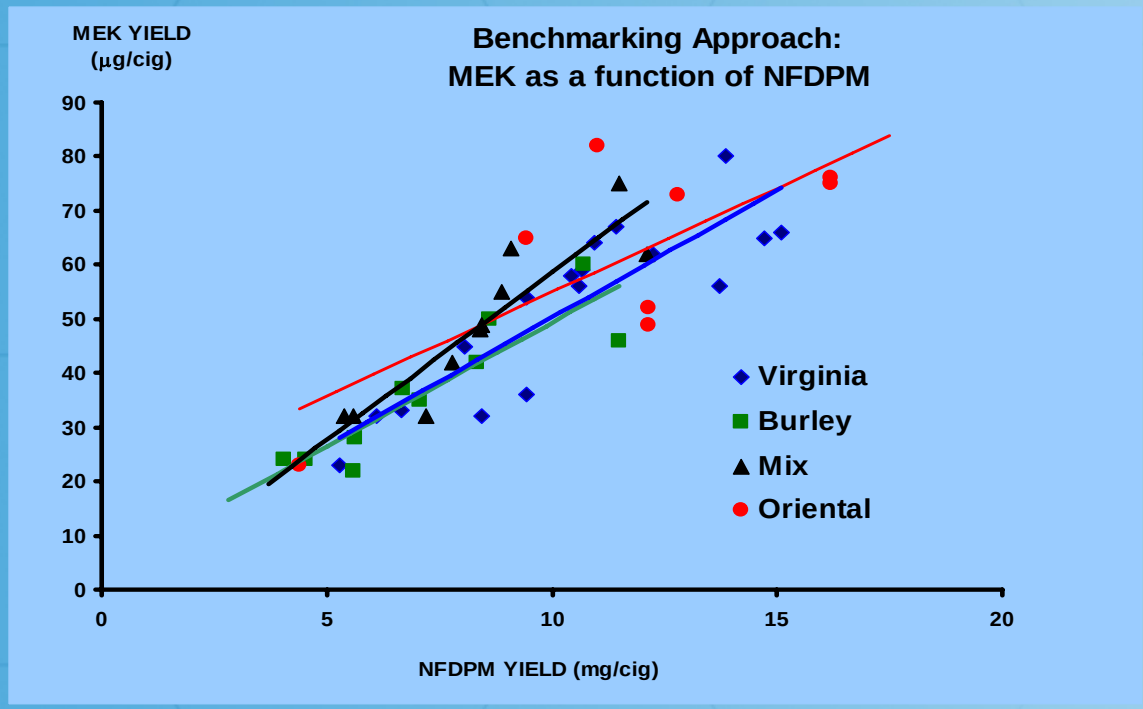

NFDPM Yield, corrected for Filtration Efficiency,
as a function of
Volume of Air Drawn Through the Cigarette
F.E. CORRECTED NFDPM YIELD (mg/cig)
40
30
20
10
0
0
100
200
300
400
500
VOLUME OF AIR DRAWN THROUGH THE CIGARETTE (cc)
VIRGINIA
BURLEY
MIX
ORIENTAL



EFFECTS OF VOLUME OF AIR DRAWN THROUGH THE CIGARETTE







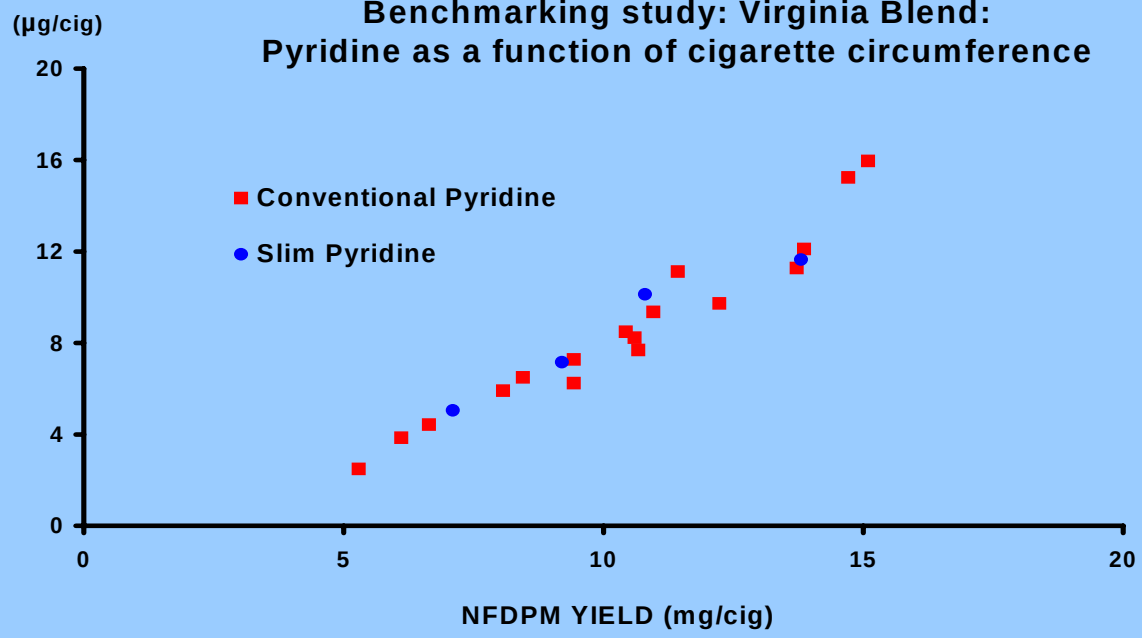
Benchmarking: Blend Effects

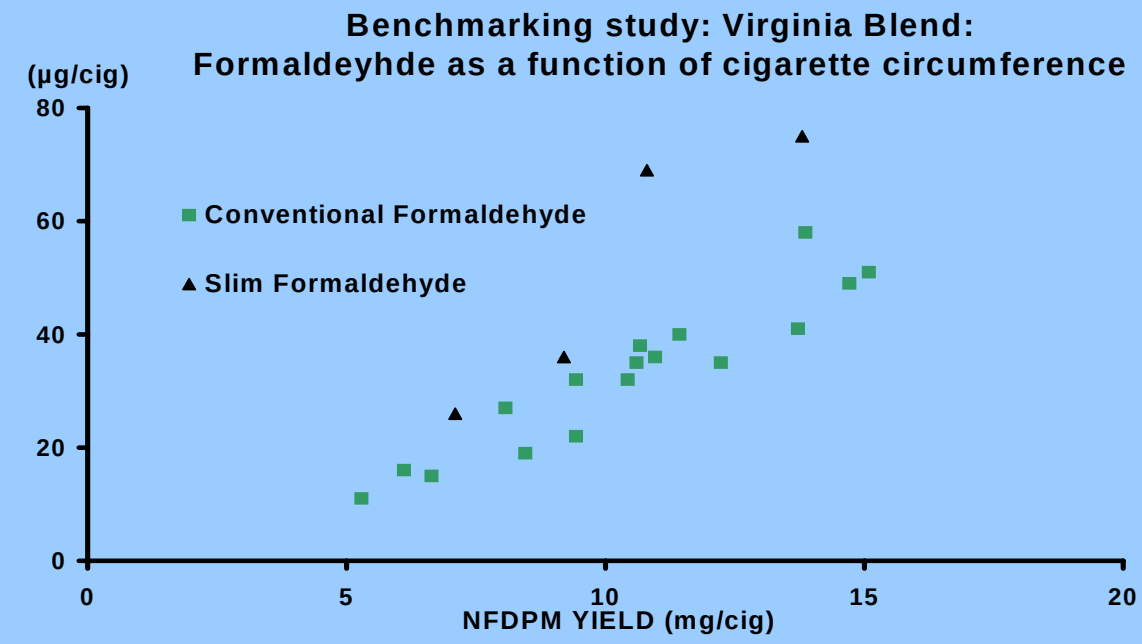
BENCHMARKING & SIGNIFICANT DIFFERENCES BETWEEN BLEND TYPES

	Number of Significant Differences	
Blend Comparison	**Benchmark using CO**	**Benchmark using NFDPM**
Virginia / Mixed	16 / 35	18 / 35
Virginia / Burley	23 / 35	23 / 35
Virginia / Oriental	12 / 35	10 / 35
Burley / Mixed	12 / 35	15 / 35
Burley / Oriental	19 / 35	19 / 35
Oriental / Mixed	9 / 35	12 / 35

Note 35 = 44 – 3 – 6

i.e. Conventional 44 Hoffmann – 3 Major smoke analytes – 6 metals





Benchmarking: Circumference Effects

CONCLUSIONS

- The form of experimental design described in this paper i.e. central composite can be applied to cigarette design and this compliments the work presented previously by PDM.
- Presentation of the results in a box plot form allows for simple visual inspection of the results, but is somewhat tedious in its application if all 44 Hoffman analytes are examined.
- The main stream yields of all Hoffman analytes can be related to the total volume of air drawn through the cigarettes. This does require that the filtration efficiency of a particular filter is known for the Hoffman analyte in question, if said particular Hoffman analyte is present in the particulate phase.
- Benchmarking can be applied to this form of data and has the advantage of being able to distinguish between different blend types.
- Slim cigarettes show similar characteristics to conventional circumferences cigarettes when assessed using the benchmarking approach. The exception to this being the results for Formaldehyde.

LIMITATIONS

- Studies of this nature generate significant massive quantities of data however information is only gained by appropriate analyses.
- With this massive amount of analytical data there is a need for an orderly database and analysis of the data requires team work and working to time lines.
- Analytical variability, precision and accuracy will all affect the information that is gained.
- The following 5 papers in this series will illustrate other methods by which information can be gained from this experimental design.