

CHEMICAL STUDIES OF SMOKE

Effect of Filter Tip Length on Phenol Selectivity

The effect of filter tip length on phenol selectivity of plasticized secondary acetate filter tips was studied in two different plans. In the first plan, Case A, filter tip lengths of 10 mm, 15 mm and 20 mm on 68 mm lengths of Pall Mall tobacco columns were examined, along with corresponding all-tobacco lengths. The latter was done to show that tobacco does not selectively filter phenol from mainstream cigarette smoke. All cigarettes were conditioned and smoked at 60% R.H. ± 3% and 72°F ± 2°F. A standard smoking cycle was used, i.e., a 35 cc puff of two seconds duration once a minute. Smoke condensate was collected at -80°C. Phenol was determined by gas chromatography, following the isolation of the weakly acidic fraction from the condensate. Phenol selectivity, S, is defined:

$$S = \frac{\left(\frac{\text{Micrograms Phenol per Cigarette}}{\text{Milligrams Condensate per Cigarette}} \right)_{\text{Tobacco}}}{\left(\frac{\text{Micrograms Phenol per Cigarette}}{\text{Milligrams Condensate per Cigarette}} \right)_{\text{Filter}}}$$

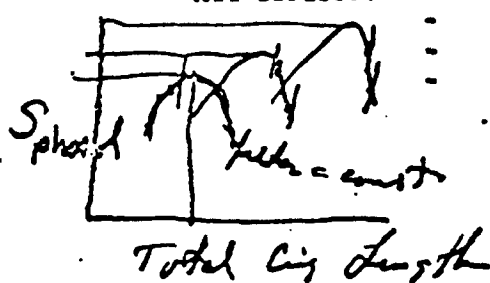
for Case A

The pertinent data are tabulated in the table below in which the average of duplicate analyses are reported.

The filter tip was Charlotte APD #TA 1449, 3.2/50,000 secondary acetate with 6.7% triacetin. The pressure drop and weight are normal for 17 mm length.

CASE A: EFFECT OF FILTER TIP LENGTH ON PHENOL SELECTIVITY

Cigarette	Filter Tip	Total	Length	Phenol	Condensate	µg Phenol	S
Filter Tip:	Length	Length	Smoked	µg/cig	mg/cig	mg Condensate	
	10 mm	78 mm	60 mm	50 ± 2	46 ± 3	1.09	2.1
	15	83	60	35 ± 3	39 ± 3	0.90	2.3
	20	88	60	32 ± 4	38 ± 2	0.84	2.6
All Tobacco:	-	78	60	121 ± 7	53 ± 4	2.3	
	-	83	60	101 ± 4	48 ± 3	2.1	
	-	(85)	(60)	(89)	(41)	(2.2)	
	-	88	60	91 ± 7	60 ± 3	2.3	



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In this study, 60 mm of the 68 mm tobacco column was smoked and the overall cigaret lengths therefore changed by 5 mm increments with changing filter tip lengths. The second phase of the study, Case B, deals with varying tip lengths within a constant, 85 mm, overall cigaret length and is described below.

It is immediately apparent that phenol selectivity increases with increasing filter tip length. The 20 mm tip is significantly better than the 10 mm or 15 mm tip. It is pertinent to state that 20 mm filter tip cigrates are common today in the retail market.

Tobacco shows no selectivity for phenol. The amount of phenol found is directly proportional to the amount of condensate. The micrograms of phenol per milligram condensate was constant, within experimental error, for all lengths of all-tobacco column. The value was 2.2 ± 0.1 . The values in parenthesis are those for Fall Mall (85 mm) found previously.

The pertinent data for Case B are tabulated below:

CASE B: EFFECT OF FILTER LENGTH ON PHENOL SELECTIVITY

Cigarette Filter Tip:	Filter Tip Length	Total Cigarette Length	Length Smoked	Phenol $\mu\text{g}/\text{cig}$	Condensate $\mu\text{g}/\text{cig}$	$\frac{\mu\text{g Phenol}}{\mu\text{g Condensate}}$	S
	10 mm	85 mm	60	64 ± 2	40 ± 2	1.60	1.33
	15	85	60	43 ± 2	41 ± 2	1.05	2.1
	20	85	60	31 ± 1	40 ± 2	0.78	2.8
All Tobacco:	--	85	60	89	41	2.17	

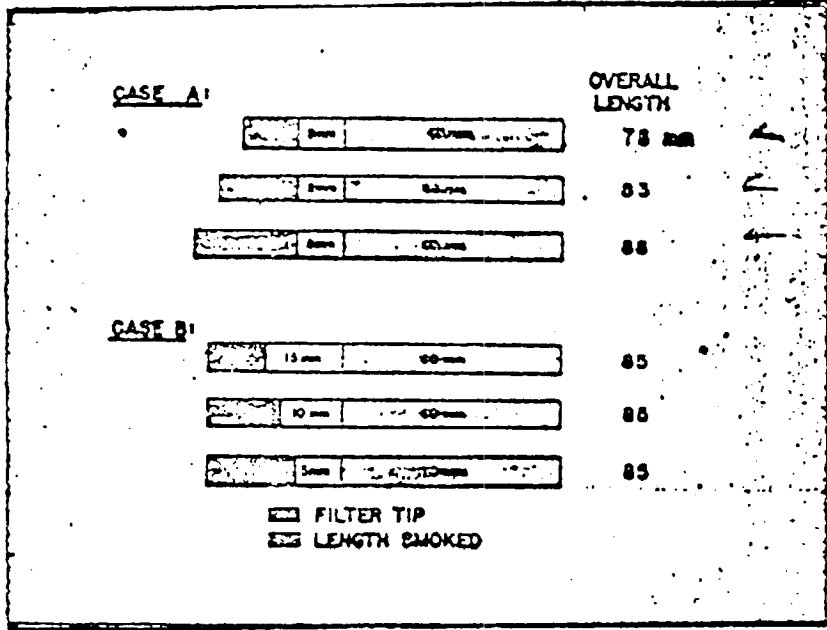
Again, it is seen that phenol selectivity increases with increasing filter tip length. The S value of 2.8 for the 20 mm tip is significantly better than the S value of 2.1 and 1.35, respectively, for the 15 mm and 10 mm tip. Based on practical considerations, Case B is believed to be a better demonstration of the effect of filter

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tip length on phenol selectivity that is Case A. In either case, the important fact is that greater selective filtration is achieved with increasing filter tip length. It would follow from the above that even greater phenol selectivity could be achieved with a 25 mm tip. One further observation is that the S value is apparently insensitive to the pressure drop across the tip.

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fused
 Total Revenue
 d.p.f. fused
 T.D. ~ 50,000
 f ~ 3.3
 76 Tr...



EFFECT OF FILTER TIP LENGTH ON PHENOL SELECTIVITY

Filter Tip Length	Cigarette Length	Length Smoked	Phenol $\mu\text{g}/\text{cigt}$	Condensate mg/cigt	$\mu\text{g Phenol}/\text{mg Condensate}$	S
FILTER TIP						
10 mm	78 mm	60 mm	60 \pm 2	46 \pm 3	1.09	2.1
15	83	60	35 \pm 3	39 \pm 3	0.90	2.3
20	88	60	32 \pm 4	38 \pm 2	0.84	2.6
FALL MALL (NON-FILTER)						
	78	60	121 \pm 7	53 \pm 4	2.3	
	83	60	101 \pm 4	46 \pm 3	2.1	
	88	60	89	41	2.2	
	88	60	91 \pm 7	40 \pm 3	2.3	

Filter: Secondary Acetate, 3.2/50,000, 6.7% Triacetin
 Tobacco column: FALL MALL
 ALL Conditioned and smoked at 60% R.H. and 72°F.

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