

# The Characterization of Cigarette Smoke from Cytrel® Smoking Products\* and its Comparison to Smoke from Flue-Cured Tobacco

## I. Vapor Phase Analysis\*

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### INTRODUCTION

The composition of cigarettes has changed considerably over the past twenty years. Partly because of economics, the utilization of "blown tobaccos", cut-rolled stems, and sheet reconstituted tobacco has become an accepted practice in many countries. Also, where permitted by law, the use of non-tobacco ingredients such as humectants, flavorings and casings, and gum binders for reconstituted tobacco is common. The latest innovation to be introduced into cigarette manufacture is the development of tobacco supplements. Ideally these supplements should add nothing new to the smoke produced by all-tobacco cigarettes and in fact they should reduce where possible those compounds known or suspected to irritate the respiratory tract or display other biological activity.

The purpose of this article, the first of a series, is to begin to describe the composition of smoke from Cytrel smoking products\*\*. In these articles the three major fractions of cigarette smoke — vapor phase, semi-volatile phase, and particulate phase — will be dealt with individually. The description of these three phases will include the determination of more than 250 compounds and 67 elements in mainstream smoke from tobacco and Cytrel-containing cigarettes and account for more than 90% of Cytrel mainstream smoke. This first paper describes the determination of more than 50 compounds in that fraction of cigarette smoke which is generally classified as vapor phase plus the determination of hydrogen cyanide, ammonia and certain amines which have been measured in whole smoke.

### EXPERIMENTAL

#### Cigarette Manufacture.

Cytrel was incorporated at three different levels (10, 20, and 50%) into a blend of flue-cured tobaccos typical of that found in commercial U. K. cigarettes. Filter-

tipped cigarettes were made from these three Cytrel-tobacco blends as well as the 100% materials according to the specifications shown in Table 1.

#### Smoking Procedure

The cigarettes for these tests were conditioned and smoked according to test procedures established by the United States Federal Trade Commission and commonly practised by the U.S. tobacco industry. All cigarettes were conditioned at least 48 hours at  $74 \pm 2^\circ\text{F}$  and  $60 \pm 2\%$  relative humidity before they were weight-selected and smoked to a 23 mm butt length (filter tipping paper plus 3 mm) according to the internationally recognized standards of one 35 ml puff of 2 seconds' duration, once per minute. A piston-action machine (1) was used for smoking where the analyses required either liquid-filled or solid adsorbent gas-scrubbing traps. An alternate restricted smoking machine, designed by Keith and Newsome (2, 3), was used for the remainder of the tests. A listing of the analyses done with each smoking machine is shown below. Only one style of smoking machine was used in any specific analysis; 100% Cytrel, Cytrel-tobacco blends, and 100% tobacco cigarettes were smoked identically for any given test.

#### Piston-action smoking machine:

Hydrogen cyanide  
Nitric oxide  
Ammonia  
Primary amines  
Hydrogen sulfide  
Sulfur dioxide

#### Keith-Newsome smoking machine

Hydrocarbons  
Aldehydes and ketones  
Furans  
Nitriles  
Carbon monoxide  
Carbon dioxide

#### Analytical Procedures

**Organic Vapor Phase:** Compounds determined by this procedure were the volatile hydrocarbons, aldehydes and ketones, furans, and nitriles. The smoke sampling device used in this analysis has been described in detail (3, 4). Six cigarettes were inserted into the smoking machine and a timer was started. The individual cigarettes were then ignited, one per puff, on puffs one

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\*\* Cytrel smoking product Type 361, Lot 227, was the specific variant used in these studies.

\* Cytrel® is a registered trademark of Celanese Corporation.