

国际学术动态

Recent Advances in the Technology of Straight Virginia Cigarettes (SVC)
Development of Premium Cost-effective Lower-Tar
SVC Products with Acceptable Smoking Qualities*

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Part 1. Basic Principles

This is the first article in a series of three that is based on Dr. Abdallah's presentation at China Tobacco Society Convention, December 11-13, 2003, in Shanghai. The series discusses the contributions of manufacturing in general, and blending and processing in particular, to the development of premium cost-effective lower-tar SVC products with acceptable smoking qualities.

After a brief introduction, this article covers four main topics: Definitions; Manufacturing Operations; Blending Concepts; and Blend Development.

It is evident that there are several ongoing efforts, within the Chinese tobacco industry and between the industry and pertinent national and provincial institutions, to produce "safer" cigarettes for those who choose to smoke. It is also evident that what is known as Straight Virginia Cigarettes (SVC) represent the majority of cigarettes consumed in China. The most important task facing the Chinese

cigarette industry today is developing SVC products with lower tar and nicotine deliveries as well as reduced yield of harmful compounds. The complexity is not in producing such "safer" cigarettes, but how to make them with acceptable smoking qualities because developing a lower-tar cigarette with undesirable smoking qualities does not contribute to safety if no one smokes it.

I DEFINITIONS

First, I will explain the nature of cigarette smoke and what is meant by smoke chemistry, smoke yield and smoking qualities, then, define the term additives.

1.1 Cigarette Smoke

Smoke is the actual product of consumption because the cigarette is technically a smoke-delivery system. The smoke formation occurs in the burning cone where the processes of pyrolysis degradation take place as well as in the thermal gradient zone ahead of the burning cone, where the processes of distillation, volatilization, sublimation, cellular eruption and chemical interactions take place.

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The nature of smoke is determined as the mainstream smoke (MSS) travels in the tobacco column and is subjected to air dilution by the cigarette paper, tipping, perforation and ventilation, where condensation and re-volatilization take place. It is important to recognize that cigarette smoke is a dynamic aerosol system, as evidenced by the different physical, chemical and sensory properties of “fresh” smoke versus stale smoke or smoke condensate that is set in solution for chemical analysis.

1.2 Smoke Chemistry

The definition of smoke chemistry differs according to the type of investigation. Research and analytical chemists identify the thousands of component substances in the total particulate matter (TPM), commonly called tar, and in the gaseous phase of cigarette smoke.

Blenders work on the foundation blend and develop the extenders and additives that complement the blend in order to have a total blend cut rag with the target nicotine and sugars while maintaining the desired smoking qualities.

Process engineers determine the processing parameters and cigarette design configuration that are required to produce cigarettes with the target tar and nicotine deliveries and acceptable smoking qualities.

1.3 Smoke Yield

Toxicologists, biologists and workers on smoking and health are concerned not only with the deliveries of tar and nicotine in the cigarette MSS but also its content of specific harmful compounds, such as nitrosamines; benzo-a-pyrene; phenols; and carbon monoxide. Studies on smoke yield investigate the carcinogenic, co-carcinogenic, antagonistic and other risks of smoke compounds to test animals in an effort to explore the health risks to humans (smokers).

1.4 Smoking Qualities

Product developers refer to smoking qualities in terms of the physical and chemical properties of the MSS that are required to meet the target cigarette.

Sensory analysts refer to smoking qualities as the overall sensory properties of the “fresh” MSS as determined by flavor (taste, smell and feel), aroma, mildness, after-taste, impact, burning qualities, etc. Sensory analysts train and use smoking panels, as a measuring device, to evaluate the smoking qualities of the test cigarettes.

Marketing specialists conduct consumer tests using focus groups and market surveys to determine the overall acceptability in terms of smoking qualities, price, brand identity, etc.

1.5 Additives

Casings, flavorings, humectants and any other non-tobacco ingredients added during cigarette manufacturing are collectively called additives. Additives cover anything added to tobacco during processing other than water and to the cigarette paper, filter and tipping during making and packing.

Additives should meet the regulations required by one or more pertinent authorities, such as the U. S. Food and Drug Administration (FDA); Institute of Food Technologists (IFT); American Society for Testing & Materials (ASTM); Flavor and Extract Manufacturers Association (FEMA); World Health Organization's Joint Expert Committee for Food Additives (JECFA); and the Council of Europe (CoE).

Since the actual product consumed is the mainstream smoke and not the cigarette per se, the acceptability of certain ingredients for use in food does not necessarily mean approval for use in smoking products such as cigarettes.

2 MANUFACTURING OPERATIONS

The manufacturing of Straight Virginia Cigarettes (SV C) is a combination of primary operation covering blending and processing and secondary operation covering cigarette making and packing as well as certain requirements.

2.1 Primary Operation

The primary operation requires working in four

areas simultaneously: Foundation Blend; Extenders; Additives; and Processing. This will be explained in detail later.

2.2 Secondary Operation

– Cigarette Making including Tobacco Column's moisture content; weight; density; firmness; filling value; pressure drop, etc. and the Cigarette Configuration's paper; porosity; filter; tipping; ventilation; perforation, etc.

– Cigarette Packing including package design and packaging materials

2.3 Requirements

Producing a quality and cost-effective SVC product requires a combination of science, technology and know-how in blending and processing and cigarette making and packing.

3 BLENDING CONCEPTS

3.1 Why Blending?

Because of the inherent variation among flue-cured Virginia tobacco, by variety, origins, crop and stalk position, and due to the incompatibility between the elements of tobacco quality, there is no perfect grade. Leaf grades that have more aroma and smoke flavor usually have a slower burning rate and are high in tar and nicotine deliveries in the mainstream smoke. Grades that are high in filling value are low in tar and nicotine but have less desirable smoking qualities. Each flue-cured type is grown under certain weather conditions using a variety of cultural practices; therefore, there is no uniformity from one year's crop to the next or from one region to another.

In principle, each grade is selected to contribute specific traits, in terms of physical properties, smoking qualities and value. The quality of a particular grade is the degree to which it possesses characteristics that are required for the target blend.

Blending know-how allows for the development of the desired SVC blend in a step-wise technique. Blending is an ongoing effort that requires extensive

experience in handling the continuous changes in the quality and cost of the blend components from year to year and one origin to another. Good blending is achieved when the overall quality of the blend is more desirable than the sum of the qualities of the grades therein.

3.2 Deciding Factors

There are five deciding Factors that determine the target blend

1. Blend chemistry, especially content of nicotine and sugars
2. Physical properties, with regard to filling value and processing ability
3. Smoke chemistry, especially tar and nicotine deliveries
4. Smoking qualities, covering sensory properties and burning qualities
5. Economics, involving cost, availability and continuity of leaf tobacco and extenders

3.3 Basic Principles

Blending is governed by five principles: Balance; Foundation; Categories; Criteria; and Philosophy.

3.3.1 Balance The objective of blending is to create the desired balance between the pertinent physical, chemical and sensory properties of the component grades.

3.3.2 Foundation A typical SVC product consists of a Foundation Blend that is mainly made of flue-cured Virginia grades along with small amounts of burley and oriental grades on a case-by-case basis.

3.3.3 Categories The components in the foundation blend are classified into three categories

a. Full Flavor (FF) grades provide desirable flavor attributes and the right intensity of irritation. This category contributes the most to the deliveries of tar and nicotine in the mainstream smoke.

b. Medium Flavor (MF) grades contribute to the overall taste and, although they do not possess a noticeable flavor of their own, MF grades enhance the flavor attributes of the FF grades. This category contributes moderately to the tar and nicotine

deliveries.

c. Filler Grades (FG) increase filling power and absorptive capacity and reduce cost. They contribute least to flavor and must be neutral with no off-taste or undesirable odor. This category contributes the least in terms of tar and nicotine.

3.3.4 Criteria There is no set of criteria that can fit all tobacco types. There are different criteria for each tobacco type and within type according to the origin, crop year and stalk position. A tobacco blender works on the assumption that each of the three tobacco types in the foundation blend contains grades that fit one or more of the three categories – FF, MF and FG. As a general rule, the blend of a typical SVC product consists of all three categories of the major flue-cured type and only one carefully selected category of each of the burley and oriental types.

Processing plays a major role in maximizing the contribution of the flue-cured and enhancing the contribution of the burley and oriental grades. In other words, a good SVC product is largely dependent not only on the careful selection of the component grades therein but also on the adequate processing of such.

3.3.5 Philosophy The basic philosophy for a balanced, consistent and cost-effective blend is that of optimization between the amount and ratio of the different tobacco types and the grades within each type as well as the cost, availability and continuity.

3.4 Blend Categories

I will now briefly discuss the categories of the grades in the main flue-cured portion of the blend and the burley and oriental supplements.

3.4.1 Flue-cured Categories Table 1 summarizes the flue-cured categories that are included in a typical SVC product. The number and proportions of the grades in each category – full flavor, medium flavor and filler grades, vary according to the target product in terms of smoking qualities, smoke chemistry and cost.

Table 1 Flue-cured Categories Used in SVC Products

| | FF Grades | MF Grades | FG Grades |
|-----------------|---------------------------------|--------------------------------------|----------------|
| Stalk Position | leaf & tips | cutters & leaf | mainly lugs |
| Filling Value | med/low | med/high | high |
| Smoking Quality | flavor with a little irritation | taste, enhance flavor of FF & flavor | least in taste |
| Chemistry Nic | med/high | medium | low |
| Sugars | med/low | med/high | medium |
| Smoke Tar | med/high | medium | low |
| Nic | med/high | medium | low |
| Cost | high | medium | low |

3.4.2 Burley Category Table 2 illustrates the burley category that is recommended for a typical SVC product. This burley component is carefully selected to complement the flue-cured components and provide certain impact and subtle flavor notes.

Table 2 Burley Category Used in Some SVC Products*

| | MF Grades |
|-----------------|-------------------------|
| Stalk Position | leaf & cutters |
| Filling Value | medium to high |
| Smoking Quality | med flavor – med impact |
| Chemistry Nic | medium |
| Ammonia | medium to low |
| Smoke Tar | medium |
| Nic | medium |
| Cost | medium |

* Traditionally, no burley tobacco was included in SVC products.

3.4.3 Oriental Category The main purpose of including oriental tobacco is to provide neutral taste and impart subtle aroma characteristics that should blend with the flavor notes generated by the flue-cured components, especially the full flavor and medium flavor grades. See Table 3.

Table 3 Oriental Category Used in Some SVC Products*

| | Neutral Grades |
|-----------------|-------------------------------|
| Filling Value | medium |
| Smoking Quality | subtle taste & delicate aroma |
| Chemistry Nic | medium to low |
| Sugars | medium |
| Smoke Tar | medium to low |
| Nic | low |
| Cost | medium |

* Traditionally, no oriental tobacco was included in SVC products.

3.5 Procurement

For proper procurement of the right categories of full flavor, medium flavor and filler grades, four major factors are usually considered in advance

1. Variety, type and stalk position
2. Origin, region and cultural practices
3. Growing conditions and crop year
4. Cost, availability and continuity

The complexity arises from the fact that grades of the same type and stalk position can vary in quality (in terms of categories) and cost according to the country of origin, region and the growing conditions or crop year.

As a basic rule, a combination of different grades from several origins and crop years make a more balanced and cost-effective blend on a long-term basis.

4 BLEND DEVELOPMENT

4.1 Blending Steps

The development of a premium and cost-effective SVC product should be undertaken in steps or building blocks through a well-coordinated blending program.

4.2 Blending Program

An adequate blending program reflects a collective effort in the following six areas simultaneously.

4.2.1 Foundation Blend Select the component grades of the flue-cured basic blend and decide on the burley and oriental supplements.

4.2.2 Extenders Select the required recon sheet, expanded cut tobacco and cut-rolled expanded stems (CRES) that complement the foundation blend.

4.2.3 Additives Carefully select the ingredients and application ratio of the required light casings and light flavorings that complement the total blend.

4.2.4 Processing Develop the required processing parameters for the total blend of flue-cured, burley, oriental and extenders.

4.2.5 Cigarette Design Determine the specifications of the tobacco column and cigarette configuration that can deliver the target smoke chemistry and smoking qualities.

4.2.6 Product Evaluation Conduct trial runs for proto-types, followed by physical and chemical tests by the R&D staff and sensory evaluation by trained smoking panels. Compare results, make fine-tunings, conduct further trial runs and so on.

4.3 Blend Maintenance

The main aim of blend maintenance is to preserve the SVC product integrity from operation to operation, one location to another and year to year. Following are the three most important tasks of blend maintenance

1. Minimize the effect of inherent variability in specifications
2. Reduce the cost of raw materials, especially leaf tobacco
3. Maximize profits in order to meet competition and gain market share

A variety of tools are employed, including routine testing and monitoring procedures using adequate information technology that accounts for the parameters affecting the physical, chemical and sensory properties as well as the cost of the SVC product.

Several procedures can be implemented for blend maintenance, including;

- Input Data cover results of physical, chemical, sensory testing and cost of the foundation blend, extenders and additives as well as the specifications of the cigarette design, including filter; paper; tipping; ventilation; perforation; pressure drop, etc.
- Output Data provide recommendations on how to

- * Preserve the integrity of the current SVC product; or

- * Develop a new SVC product that meets target specifications and cost.

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