

**ABSTRACTS OF PRESENTATIONS MADE AT THE
1997 CORESTA JOINT MEETING OF THE
SMOKE AND TECHNOLOGY STUDY GROUPS
HAMBURG, GERMANY**

(by alphabetical order of first authors)

AGRUPIS S.C.; MAEKAWA E.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST32.

Industrial utilization of tobacco stalks: Chemical analyses and evaluation of tobacco stalks for biomass resources.

In an attempt to evaluate tobacco stalks of different tobacco types as a renewable material for biomass resources, summative chemical analyses were conducted, compared and evaluated with the previous analytical data of the established wood biomass resources. Year round supply was also evaluated using the Food and Agriculture Organization (FAO) data in order to evaluate its potential to sustain development. Standard laboratory protocols of the Technological Association for Pulp and Paper Inc. (TAPPI) were adopted with some modifications to suit the tobacco stalk materials. Summative results of the chemical analyses showed the following: 1) Holocellulose, alpha-cellulose and lignin (the three major biomass components of wood) contents of tobacco stalks are generally the same regardless of species and stalk parts; 2) alpha-cellulose content is at high (33.92- 42.92%) and comparable with the usually used softwood and hardwood species for pulp production; 3) holocellulose and lignin content are comparably closer to hardwood than softwood species, a condition that gives tobacco stalks a distinct advantage over the other agricultural residues; 4) Syringyl/Vanillin (S/V) ratio was found to range from 0.9 to 1.1. This result suggests that tobacco stalks contain more of the guaiacyl than the syringyl type lignin, a characteristic closely related to hardwood species. Such condition is favorable during pulping process as this requires lesser pulping chemicals and energy; 5) carbohydrate composition was found to contain glucose, xylose, arabinose and mannose in decreasing order of abundance and 6) extractives and ash content of tobacco stalks were generally observed higher than the wood species. The year round supply of tobacco stalks is very promising. Based from the FAO data (1995), and to cite a few, China has 10,962,000; USA 1,632,000; Philippines 204,000 and Japan 162,000 tons annual yield of tobacco stalks after tobacco season. This and the above result satisfy the three major basic criteria (high cellulose, low lignin content and continuous year round supply) for a good material for pulp and other related woodbased applications. This study is a part of a research project on the total utilization of tobacco stalks for industrial uses.

Faculty of Agriculture, Wood Chemistry Laboratory, Shizuoka -shi, Japan.

ASAI T.; ISHII I.; KOMATSUBARA O.; NISHINA T.; MATSUKURA M.; TAKUSAGAWA T.; TAKAHASHI K.; EGAMI K.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST48.

The development of a tobacco smoke ventilation system in an airplane cabin.

Problems with environmental tobacco smoke to be called ETS in this presentation have become a cause for widespread concern and restrictions on smoking in public spaces have become common place. The problem of ETS may be reduced significantly if there is a sufficient ventilation system in place. Commercial airplane cabins are divided into smoking and non-smoking sections and this has caused some problems. The environment around the "Common Smoking Seats" located at the left side end of the cabin is one of them. "Common Smoking Seats" are left available to smokers who have to sit in non-smoking seats, as long as two seats are vacant in economy compartments. The authors developed a new ventilation system to improve the environment around these seats. The new system

has been developed after conducting several measurements of air flow pattern and calculating the velocity distribution through numerical simulation in cooperation with Japan Tobacco Inc. and Japan Airlines. The system has two smoking seats back-to-back with the seats positioned near the stern of the airplane and there is a special grill on each nozzle to regulate the supply airflow directions. Numerical simulation indicated that one smoking seat could be located at the left-hand side end and another at the right-hand side and the optimum angle of the supply airflow directions. After the introduction of this system on international Boeing 747-400 of Japan Airlines, the environment around these "Common Smoking Seats" was remarkably improved.

Japan Tobacco Inc., Tobacco Science Research Laboratory, Yokohama, Japan.

ASTL G.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST42.

Determination of talc in pulp and cigarette paper samples by Fourier Transform Infrared Spectrometry (FTIR).

Talc is added in pulp and/or cigarette paper production as a rosin adsorbent. Talc can therefore be considered as one of the major mineral impurities in pulps. As talc is covered with the rosin, the amount of talc also correlates with the remaining rosin in the finished paper. Therefore a method for the quick and reliable quantitative determination of talc in pulp and cigarette paper by infrared spectroscopy was developed. Similar to the more classical X-ray diffraction technique, FTIR allows the differentiation between similar phyllosilicate minerals, such as clinocllore chlorite and carbonate minerals e.g. calcite and aragonite. The FTIR method is compared to X-ray diffraction in terms of detection limits, speed of measurement and minimum sample amount required. FTIR analysis is calibrated on peak areas of the talc peaks at 1017 cm^{-1} and 1046 cm^{-1} . Calcite is used as an internal standard. The FTIR transmission measurements are compared to Diffuse Reflectance Infrared Fourier Transform spectroscopy (DRIFT) measurements. DRIFT measurements are faster, but detection limits are higher. In transmission, talc concentrations of 100 ppm and below are measured easily, which is at least comparable to X-ray diffraction measurements. Finally univariate calibration is compared to multivariate calibration methods (principal component regression - PCR, partial least squares - PLS).

Papierfabrik Wattens G.m.b.H., Wattens, Austria.

BAKER R.R.; DIXON M.; REEVES N.; HILL C.A.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST5.

Measurement of mouth insertion depths amongst British smokers.

Vent blocking, the intentional or unintentional covering of the filter ventilation holes during smoking, is an aspect of smoking behaviour which could influence mainstream smoke yields. This study was designed to determine if, and to what extent, vent blocking by smokers' lips occurs. Three groups of British smokers were asked to smoke their own brand of cigarette which was either an unventilated filter brand or a brand containing one of two levels of filter ventilation. 300 Smokers were used in each group and the filter butts were collected. Approximately 10 filter butts per smoker were collected. The filter tipping papers were removed and treated with a ninhydrin solution. This stained the saliva imprint on the paper so that the mouth insertion depth of the cigarette could be measured. In addition, levels of retained nicotine on the filters were also determined. This, together with the known filtration efficiencies of the filter, enabled an estimate to be made of the mainstream nicotine yield of the cigarette during the smoking. Both sets of data on mouth insertion depth and nicotine will be presented. The results will be used to estimate the proportion of smokers who block the filter vents with their lips during smoking.

British American Tobacco, Southampton, U.K.

BANYASZ J.L.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST38.

An approach to modeling water sorption isotherms.

At the 1996 CORESTA Congress a thermodynamic model, based on the Hailwood-Horribin (HB) isotherm, was shown to account for the influence of moisture on a number of the physical properties of tobacco. The formulation has been further developed and extended to cellulose acetate (CA), a hydrophobic substance. The model carried over from the HB equation an activity coefficient term for free water which remains constant over the whole range of the isotherm and cannot extrapolate to a value of one as the mole fraction of water approaches unity. This behavior is thermodynamically unacceptable. The anomalous behavior was eliminated and the isotherm equation simplified by setting the activity coefficient to unity. Deviations from ideality are attributed entirely to the removal of free water by complexation with the substrate. The new equation was found to describe the behavior of tobacco as well. The behavior of cellulose acetate (CA) is more interesting. The equation was tested using the water sorption and menthol migration data for unplasticized CA presented at the Vienna CORESTA Meeting in 1995. The original HB equation fits the water sorption data well with a water activity coefficient of 0.67 whereas the new equation fails. However, based on the menthol migration data the modified equation yields the correction prediction of free water whereas the HB equation does not. The failure of the reformulated equation to fit the isotherm results from the fact that it assumes CA interacts with water in manner identical to a hydrophilic substrate such as tobacco. Unplasticized CA is a hydrophobic glassy polymer in which water aggregates form as the relative humidity rises above 50-60%. Inclusion of a term which accounts for water aggregation results in an equation which fits the isotherm and predicts the correct free water concentration.

Philip Morris USA, Research Center, Richmond, VA, U.S.A.

BLÖCKER K.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST2.

Determination of hot collapse on filters and cigarette rods performed with a new device.

The hot collapse (HC) both on filters and on tobacco rods during smoking (HDS) is of great importance when developing new cigarettes. Already in 1988 a CORESTA task force had investigated the matter. The results of the study including some recommendations about the design of a suitable hot collapse tester were published in 1991. However, since no device could meet the requirements shown in the CORESTA study, no final collaborative study was made at that time. On the recommendation of CORESTA, the smoking of cigarettes should be performed in compliance with the CORESTA Methods N° 22, 23 and 25. Between puffs the distance from loading stamp to char coal line as well as the deformation of the cigarettes have to be determined. In view of these recommendations BORGWALDT developed the HC Tester R 72 in 1995. On the one hand, this device comprises a new one-channel smoking machine which smoked cigarettes in compliance with CORESTA Methods N° 22, 23 and 25. On the other hand, the instrument comprises a loading system equipped with an integrated displacement transducer. The distance between loading stamp position and char coal line is determined by a moving IR-sensor. First trials applied on the CORESTA Monitor Cigarettes CM 2 have been made with the HC-Tester R 72. The hot collapse of filters and tobacco rods have been measured on fifty cigarettes each. The measurements have been analysed in compliance with methods used by the CORESTA task force. A good reproducibility of the HC Tester R 72 has been proved. Under these circumstances the subject "Hot Collapse" may be of interest for a new CORESTA task force.

Heinr. Borgwaldt Technik GmbH, Hamburg, Germany.

BOHANON H.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST49.

Survey of indoor air quality, ventilation and smoking activity in restaurants (Part 1).

Evaluations of indoor air quality were conducted in restaurants where smoking occurs as a CORESTA sub-group activity. This survey was accomplished in six different countries by six different participants. The evaluations were conducted in order to examine the relationships between five variables: location, ventilation, occupant perception of smoking rates, and concentrations of indicators of indoor air quality and environmental tobacco smoke. This presentation will introduce the protocol used in conducting the survey and discuss the differences in methods and approaches used by the various participants. A future presentation will discuss results and conclusions from the survey.

R.J. Reynolds Tobacco Co., Winston-Salem, NC, U.S.A.

CAMM B.J.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST35.

ASM500 automated (linear) smoking process.

At the 1996 CORESTA Congress held in Yokohama, Japan, B.J. Camm made a presentation of a marketing brief which outlined the concept and design requirements for a new and automated smoking machine. This was formulated from the results of a customer survey commissioned by Filtrona and undertaken by Harry Dymond. This 2nd paper is a continuation of the previous which reviews the design and development of an automated, modular, linear smoking array and discusses the features of the individual elements comprising the ASM500 design. Sub-modules comprising the ASM500 smoking system: alternative smoking regimes: - 15 channels: 15 ports (individual traps - traditional linear array); - 15 channels: 1 port (single trap - rotary smoking with benefits of the linear array); master & slave smoking system; cigarette ignition system; puff termination system, automatic butt marking system; air flow control and smoking hood design; pre & post smoking laboratory automation links. The smoking process is largely automatic therefore particular emphasis is placed on the laboratory automation links to facilitate pre- and post-smoking activities, which bracket the ASM500 smoking system, when used for routine analysis. The objective is to: increase through-put, reduce set up time, reduce labour support requirements, increase precision in determination of smoke compounds. The ASM500 is designed as a modular system taking full advantage of the latest available technology having the 'hooks' laid in at the design stage to accept future 'automation modules' such as in-holder extraction, and automatic processing and loading of trap assemblies. Filtrona Instruments & Automation Limited have linked forces with Bohdan Automation Inc., based in Chicago Illinois, who are established experts in laboratory automation to provide full automation and integration of routine testing methods.

Filtrona Instruments and Automation Limited, Milton Keynes, U.K.

CASTRO R.C.; AGRUPIS S.C.; LORENZO J.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST45.

Particleboard from tobacco stalks: development and commercialization strategies.

Particleboards were successfully manufactured from tobacco stalks. Generally, these boards passed the standards set by the Philippine Standards Association. Commercial production run showed that it is even cheaper to produce particleboards using tobacco stalks than when wood is used as raw material. To ensure the commercialization of the technology, the active participation of the private sector and the local and national government officials is being tapped.

National Tobacco Administration, Batac, 2906, Ilocos Norte - Philippines.

CHEN P.; KELLOGG D.S.; WAYMACK B.E.; McRAE D.D.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST50.

A model of fabric smoldering ignition by cartridge heaters.

The initiation of fabric smoldering combustion is known to be influenced by a heat source and the properties of the fabrics. In order to understand what is most critical to the smoldering ignition of fabric, it is important to develop a predictive model. In the present study, a mathematical model has been developed based on the heat transfer mechanism involved in the heating cotton ducks and upholstery fabrics by vertically and horizontally placed cylindrical cartridge heaters. The reaction kinetics of the cotton pyrolysis and char combustion are considered in the model. The effect of temperature on the material properties and the surface heat transfer coefficient is also taken into account. The integral method is used in solving the governing heat transfer equations. The model prediction of the temperature history of the fabrics and the time to ignition agrees quite well with the experimental results. The theoretical ignition temperature of fabrics may be defined as the material temperature at which the char combustion becomes dominant. Thus, the ignition temperatures of cotton ducks of different basis weight or treated to various ion content levels can differ.

Philip Morris R&D, P.O. Box 26583, Richmond Va. 23261, U.S.A.

DELMAN F.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST24.

Global trends in the tobacco industry.

This presentation is an analysis of various worldwide trends in the tobacco industry including an examination of worldwide cigarette consumption, as a whole and at the regional and country levels, focusing on both major cigarette consuming nations such as the US, China, and Brazil as well as key emerging nations. The paper also analyzes the growth in the American-Blend cigarette, the fastest growing segment of the world cigarette market, and the ancillary effects created by this growth vis-a-vis changing patterns of flue-cured, burley, and oriental tobacco leaf production. Regarding the evolution of cigarette production, the paper also describes the proliferation of multinational joint ventures and the various shares of world production held by these companies compared with state and independent national enterprises. While concentrating on cigarettes, the paper concludes with a review of various consumer trends in the consumption of other tobacco products such as cigars, smoking tobacco (pipe and roll-your-own), kreteks, and bidis as well as more specialized types of cigarettes and evaluates some of this evolution from the perspective of various social trends related to the anti-tobacco movement.

Tobacco Merchants Association, Princeton, NJ, U.S.A.

DEMMER U.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST40.

Application of image analysis as a method of measuring tobacco and cigarette parameters.

A measuring system based on the method of image analyses is introduced. With this system it is possible to measure relevant assessment criteria for tobacco and cigarettes, *i.e.* blend homogeneity, particle size, cut width, cigarette quality (spots, stamps, tobacco emerging etc.). Image analysis is a computer-based method for the transformation of images into numeric results via geometric, densitometric or colorimetric characteristics. A general advantage of image analysis is the touchless measurement of objects which is absolutely free of destruction. Further advantages can be seen in the measurement of real geometric characteristic parameters such as area, perimeter, length and the measurement of colour and optical density. Image analysis can be applied in the primaries of factories

as an on-line measurement process. In laboratories the measurement concentrates mainly on single particles. Analyzing for example fiber lengths leads to results on particle size distributions. This again improves the chance of analyzing technical and processing parameters in advantage to sieve analysis. Furthermore the high processing speed generates a large quantity of measuring data, which is an improved basis for statistical evaluation. The application of image analysis as an on-line method gives the advantage of evaluation of a complete tobacco batch, *i.e.* 5000 kg. In many questions it is not so interesting to receive a highly precise measurement of a sample of 1 kg tobacco. More important is the description of the homogeneity of blend components or particle size within the complete batch. Practical examples demonstrate the chances and the limits of the application of image analysis in primaries.

H.F. & Ph.F. Reemtsma GmbH, Research & Development, Hamburg, Germany.

DEUTSCH L.J.; SHIMANSKI C.A.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST1.

Electronic aroma analysis.

Sensory analysis is an interesting and often difficult challenge. Aromas are particularly troublesome to quantify. Chemical analyses are usually based on the established principle of a proportional response to the concentration of a single chemical or a group of related chemicals. Aromas are not easily characterized by classical chemical analysis, because they are often complicated mixtures of many different compounds. In addition, the human perception of "odor" is frequently a non-linear response to the concentrations and ratios of the compounds in the mixture. In many cases the trace quantities of these compounds may not even be measurable by standard chemical means. A new type of instrument commonly referred to as an "electronic nose" has shown value as a technology that can supplement the costly and time-consuming human sensory panel. The AromaScanner from AromaScan, Inc. is an example of this class of instrument and is under evaluation at the Hoechst Celanese Filter Products laboratories in Charlotte. At the heart of the AromaScanner is a sensor array consisting of 32 different semiconducting polymers. Each polymer responds differently to volatiles adsorbed onto its surface from the headspace of the sample. The output from the sensor array provides a "fingerprint" of the sample volatiles, which can be used in a variety of ways. Examples of applications of the AromaScanner will be discussed.

Hoechst Celanese Corporation, Charlotte, NC, U.S.A.

DJORDJEVIC M.V.; HOFFMANN D.; THOMPSON S.; STELLMAN S.D.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST7.

Distribution of smoking parameters and self-administered doses of select smoke components among different population groups.

Human smoking behavior is characterized by a wide spectrum of smoking patterns which result in significant variations in "tar" and nicotine exposure. In an ongoing, large population study we are measuring puff volume, duration, interval between puffs and number of puffs taken, as well as cigarette butt length, for smokers of low- and medium-nicotine cigarettes using a microcomputer-assisted flow transducer. The study has a multi-factorial design aimed at evaluating differences in smoking behavior and exposure to cigarette smoke constituents between White American and African-American smokers of both genders. On average, smokers of low- and medium-nicotine cigarettes both draw 48 mL puffs every 23 seconds, yielding a total volume per cigarette of 610 mL. More than 80% of the smokers puffed more intensely than machines operated with the CORESTA/FTC parameters (*i.e.*, they drew puffs larger than 35 mL and left intervals between puffs of less than 30 seconds instead of 58 sec.). The average smoke yields per cigarette as determined by simulating human smoking behavior were 2.3 mg nicotine and 27 mg "tar". Moreover, we found that the differences in the

administered doses of smoke constituents are not driven as much by the type of cigarette but by overall smoking patterns and number of cigarettes smoked per day. A comprehensive statistical analysis of smoking patterns and actually inhaled doses of specific smoke constituents will be presented in detail. The implications of our findings will be discussed.

American Health Foundation, Valhalla, NY, U.S.A.

DUNN P.; PORTER A.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST6.

Mouth insertion depths in Canadian smokers.

There is the potential for smokers of ventilated cigarettes to block the ventilation holes either accidentally or deliberately thereby increasing the smoke deliveries beyond the declared values. One way in which the holes can be blocked is by inserting the cigarette in the mouth so that the holes are partially or completely blocked by the lips of the smoker. We have attempted to assess if and to what extent this occurs by measuring the saliva patterns on 2000 cigarette butts collected in Montreal and Toronto. The butts were a cross-section of brands smoked in Canada. Saliva stains were visualised by treating the tipping paper with ninhydrin solution. The insertion depth was assumed to be the maximum extent of the saliva stain from the mouth end of the tipping. The brand of each cigarette butt was identified where possible as well as whether the filter was ventilated and if so the distance of the vent holes from the mouth end. The butt lengths were also determined. Of the 2000 butts collected, 1614 had saliva stains that could be visualised with ninhydrin solution. 58.7% of the butts were ventilated. The mouth insertion depths and the proportion of holes that could have been blocked or partially blocked will be reported. This data will be compared to similar data collected 15 years ago in regard to any changed smoking behaviour as related to changed yields.

Imperial Tobacco Ltée, Canada, Montréal, Canada.

FUNKE P.; FISCHER C.; GRIGUTSCH T.; LIEBE R.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST18.

Reduction of emissions in tobacco drying.

Legislation regarding emissions from primary processing plants has resulted in many manufacturers installing biological exhaust air cleaning plants for odour control downstream of conventional filter plants. This development is documented by the work of a CORESTA task force that is examining this issue. This contribution discusses various methods of reducing at source the emissions generated by tobacco drying. The following pilot plant systems were constructed and tested: an air circulation system installed on a conventional cylinder drier, a superheated steam drier system, and a multistage drier consisting of a superheated steam drier and an air drier. Emissions can be avoided entirely with the installation of closed air circulation systems. However cooling water has to be used and condensate generated by the condensation of the water vapour in the air has to be drained. Emissions can be minimised by using steam instead of air as a drying agent. Heat recovery is an interesting feature because emissions from this type of dryer are at a high temperature level. Therefore a two-stage drying system was tested using superheated steam in the first stage and air as a drying agent in the second stage. Both stages were coupled by a heat exchanger. This system delivers emissions at low temperature. The investigations demonstrated that a unique system fulfilling all demands with respect to emissions and energy consumption is not available. Prevailing local conditions determine which system can be operated most advantageously.

Hauni Maschinenbau AG, Hamburg, Germany.

GIBBIN B.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST15.

Cigarette factory primary process emissions survey.

There is increasing world-wide interest in the control of emissions from cigarette and tobacco processing factories. At the 1996 CORESTA Congress a paper was presented detailing the findings of a survey conducted to establish the elements likely to be contained in vapour extracted from various process stages. The factory surveyed processed Virginia, Oriental and Burley tobaccos. Burley toasting was not carried out on the site. This survey presents findings obtained after installation of emission control equipment, process vapours were collected and mixed in a common exhaust duct and treated via a two stage chemical deodourising system. Sampling was conducted in accordance with HMIP Technical Guidance Note M2 (UK). Measurements of gas stream static and velocity pressure were taken using a Zambelli 6000 isokinetic sampler. Gas temperatures were measured using an integral Type K Thermocouple. Total particulate matter was collected following method BS3405:1993. Samples for odour characterisation were collected by drawing measured volumes of gas from the combined gas duct prior to the chemical scrubber, and from the exhaust stack through which the gases passed to atmosphere. Gas extraction was carried out non-isokinetically, the gas being drawn through Tenax sampling tubes. Samples were analysed for individual compounds using gas chromatography and mass spectrometry.

GBE Environmental Engineering, Andover, Hants, U.K.

HAFKE M.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST16.

A concept for an energy balance that refers to the causes of the energy consumption and is closely related to the production process.

The concept realizes an energy balance referring to the causes of the energy consumption and being closely related to the production process. The concept's objective is an energy balance that takes into account the different energy carriers and receivers. Therefore the balance areas with their measuring device are defined accordingly. That means that the energy receivers such as lighting, air-conditioning/heating and air-filtration can be related with their causes and the effects can be interpreted. The absolute energy consumption and absolute energy cost are not sufficient for an evaluation of the used energy. Therefore these data have to be related to the production figures. The characteristic numbers of specific energy consumption and specific energy cost combine the consumed energy with the produced tobacco quantity and cigarette quantity respectively and calculated cost sets. These characteristic numbers can be calculated as a balance that firstly does not refer and secondly refers to the causes of the energy consumption. Finally, the energy is balanced per kg tobacco and per thousand cigarettes respectively. A calculation with the known cost sets demonstrates that a balance that refers to the causes of the energy consumption obviously changes the result in comparison with a balance that does not refer to the causes of the energy consumption. This is exemplarily demonstrated in the Reemtsma factory Langenhagen, Germany. The described concept holds the following advantages and benefits: an evaluation is realized that shows if an energy consumption is exaggerated; therefore saving potential can be detected; the energy receivers are related to the initiators that cause a consumption. This is the basis if cost of manufacture for third parties has to be calculated. This concept is part of technology support and transfer because it can be used in future as planning tool for new factories abroad.

H.F. & Ph.F. Reemtsma GmbH, Technology Development, Langenhagen, Germany.

HAMPL V.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST19.

The effect of calcium carbonate on the ash appearance of cigarettes.

The objective of the study was to determine how different types of calcium carbonate affect cigarette paper ash appearance, mainly ash color and degree of cohesiveness. Handsheets were made in the laboratory using precipitated calcium carbonates of different shape and size. The handsheets were subsequently treated with a small amount of citrate, at a level commonly used on conventional cigarette papers. Handrolled cigarettes were made using these handsheets and a standard tobacco blend. The handrolled, unfiltered cigarettes were smoked in a puffed mode using a smoking machine and/or in a static mode where the cigarettes were placed on pins. The ash appearance of the cigarettes was observed visually and photographs of the burning cigarettes were also taken. The ash appearance was ranked relative to a control cigarette for ash whiteness and cohesiveness. Generally, as the size of the precipitated calcium carbonate particle decreased, the ash became more cohesive. As the particle size decreased, the ash became slightly whiter until an optimal particle size was reached at about 0.3 microns. Further reductions in precipitated calcium carbonate size caused the ash to become grayer.

Schweitzer-Mauduit International, Alpharetta, GA, U.S.A.

HORLER J.W.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST41.

The Louisville combustibility test.

The Louisville Combustibility Test (LCT) is a simple method for the measurement of the rate of burn of cigarette paper which has been used, in a variety of formats, for over 50 years by paper manufacturers. Over the last two years there has been a renewed interest in the test as a means of classifying wrappers and cigarette papers used by roll-your-own smokers and for this reason the method has been further developed and standardised by the CORESTA Roll-Your-Own Task Force. This paper describes the development and present status of the test. The test, in brief, takes a 60 mm length of cigarette paper, rolls it around a needle and measures the smoulder rate in seconds over a marked width of 15 mm. LCT values for a range of cigarette paper wrappers are given together with the variability of the results both within and between laboratories. The major interest in the Louisville Combustibility Test lies in its ability to classify wrappers and cigarette papers according to the smoke yield of the subsequent roll your own product. Such comparative tests between cigarette paper parameters and smoke yields carried out by the CORESTA RYO Task Force are given and the results discussed.

Association of the European Cigarette Paper Converting Industry.

HWANG K.J.; RHEE M.S.; RA D.Y.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST47.

Interpretation of urinary nicotine and cotinine values in smokers and non-smokers.

This study was conducted to evaluate the personal effects of tobacco smoke and environmental tobacco smoke (ETS) by measuring the concentration of nicotine and its major metabolite, cotinine, in urine. While 129 urine samples of Koreans were collected, personal characteristics, such as sex, age, number of years of smoking, level of cigarette consumption and number of smokers at home were also surveyed. Collected urine samples were used for analysis of nicotine and cotinine by GC/NPD after passing extrelut column. In the urine of smokers, the average values of nicotine and cotinine were 5.87 µg/ml and 3.38 µg/ml, respectively. The average values of nicotine and cotinine were 0.2 µg/ml and 0.06 µg/ml in the urine of non-smokers, respectively. The possible sources of nicotine and cotinine in non-smoker's urine appeared to be linked to ETS. The levels of nicotine and cotinine in the

urine of smokers were 30 times higher than those of non-smokers. Whereas the changes of nicotine and cotinine in the non-smokers' urine were dependent on sex and age, the changes of nicotine and cotinine in smokers' urine were dependent on the level of cigarette consumption. The difference of nicotine levels between smokers and non-smokers highly correlated with age. Also, there was a direct relation between nicotine and cotinine levels of smokers' urine, and the level of cigarette consumption. Our results indicate that the number of smokers at home has no increasing effect on nicotine and cotinine values in the urine of non-smokers.

Korea Ginseng & Tobacco Research Institute, Daeduk Science Town, Taejeon, Korea.

KAO J.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST14.

A general smoke delivery model for parametric studies.

Numerous observations have shown that the smoke delivery of a cigarette is dependent on the design parameters such as length (puff number) and wrapper permeability. There are many smoke delivery models existing in the literature for conventional cigarettes and these models are reviewed. Although these theoretical models are appropriate to explain the observed experimental data, their focuses are usually limited to a few key design parameters. Furthermore, some models are mainly concerned with the single-puff delivery while the majority of experimental data are expressed as the total delivery of a cigarette. A combination of simple fluid mechanics and empirical equations obtained through regression analysis are proposed to provide a practical alternative to explore the effects of design parameters on the smoke generation and delivery of a cigarette. The general mathematical equation by considering dilution, diffusion, and filtration can be simplified to the gaseous phase delivery model, which was presented previously in the 1996 CORESTA Congress. In this work, we apply the general equation to tar. Thus, a simple integrated model is derived for the tar delivery of a cigarette, which is represented as a function of design and derived parameters such as coal volume and puff count. The design parameters considered in this work include filter parameters such as filter ventilation, wrapper parameters such as wrapper permeability, wrapper additive level and type, and wrapper basis weight, and construction parameters such as rod length, butt length, and circumference.

Philip Morris USA, Research Center, Richmond, VA, U.S.A.

KREUTZFELDT H.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST17.

Reducing odour substances resulting from the tobacco process by biotrickling technology.

Since December 1995, the Reemtsma plant in Berlin has been using a bio-trickling filter for the reduction of odour substances in the exhaust of the tobacco primary. This technology substituted the chemical-scrubber system and meets all present requirements. The bio-trickling filter plant works as follows: After having passed a cleaning and cooling process, the untreated exhaust (~1.000 odour units/m³) will be distributed on six containers loaded with plastic blocks. The exhaust passes these blocks which are permeable and provided with a high specific surface, enabling the contact of microorganisms. Every 4 hours the containers will be splashed with water in order to wash off the water-soluble odour substances. Furthermore the water contains special nutrients for the microorganisms. Finally the treated exhaust will be blown into the air after having passed a stack of 35 m. The efficiency of the bio-trickling filters reaches more than 90%, and the treated exhaust does not have typical tobacco odours anymore. The whole plant will be controlled by a programmed computer system. In general the staff only have to check the function of the aggregates as well as the tightness of the water circulation system. This plant had to be approved by the local environmental authorities. In order to get the permission it was necessary to evaluate the estimated odour distribution round the factory in Berlin. It had to be proved that the odour annoyance, caused by the emission

sources of the whole factory, does not reach the legal thresholds in the neighbourhood. The presentation starts with a specification of the bio process. The results of the odour distribution modelling required by the local authorities will be presented.

H.F. & Ph.F. Reemtsma GmbH, Research & Development, Environmental Management, Hamburg, Germany.

LI Y.; XIAN K.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST33.

Analysis of the neutral flavor constituents in tobacco using the gas co-distillation method.

Neutral flavor constituents of tobacco extracted by dichloromethane were separated using an improved gas co-distillation method, and analysed by capillary gas chromatography. The method involved co-distillation of the neutral extract of tobacco with water under the continuous stream of an inert gas (N₂). The coefficients of variation of 14 flavor constituents of all 18 constituents analysed by the method were less than 10%. Several flue-cured tobacco samples of Henan and Yunnan were analysed. The 18 important flavor constituents were identified and quantitatively determined. They are furfural, benzaldehyde, 6-methyl-5-hepten-2-one, benzyl alcohol, linalool, β-phenylethylalcohol, isophorone, oxoisophorone, β-damascenone, β-damascone, geranylacetone, β-ionone, furfuryl alcohol, acetyl pyrrole, solanone, dihydroactinidiolide, megastigmatrienones (4 isomers) and neophytadiene. The method has a good reproducibility, a high rate of recovery and is easy to operate. The improved gas co-distillation method is effective in separating the flavor constituents in tobacco.

Zhengzhou Tobacco Research Institute, Henan, P.R. China.

LIU B.Z.; ZHU X.L.; YAH Y.Q.; GUO Y.D.; PENG R.H.; MA J.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST44.

Determination of tobacco nicotine alkaloids by megabore capillary gas chromatography.

Nicotine and other minor tobacco nicotine alkaloids (e.g. nornicotine, anatabine, etc.) are important constituents in tobacco and tobacco smoke. A modified gas chromatographic method for the determination of nicotine alkaloids in tobacco and tobacco smoke has been developed. Separations of the alkaloids were carried out by megabore capillary column with 0.53 mm i.d., moderate thick film (2.0 μm), 15 meters length, cross linked SE-54 stationary, the detector was a conventional FID. The split/splitless liner was packed with 0.5 cm Na₂CO₃ (10-20 mesh) mainly in order to minimize the active adsorption of alkaloids. The sample pre-treatment procedure was as follows: 0.3 g tobacco powder (or one piece of Cambridge filter with five cigarettes smoked) was extracted with 20 ml ether, 5.0 ml 5% NaOH, 0.1 ml internal standard solution (8 mg n-C17 alkane/ml in petroleum ether), after shaking for 0.5 h, the ether layer was transferred into sample vial and analyzed by GC. The alkaloids determination results were in close agreement with those obtained with the conventional distillation and UV spectrophotometric method. The reproducibility and recovery results were good, the coefficient of variation of nicotine was 1.53% (n=6), the recovery rates were 97.31-99.61%. The dynamic linear range of nicotine in tobacco ranged from 0.7% to above 14%.

HeFei Economics and Technology Institute, HeFei 230052, P.R. China.

LIU B.Z.; ZOU W.Y.; CONG H.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST34.

Determination of non-volatile organic acids in some Chinese flue-cured tobaccos.

The non-volatile organic acids in tobacco play an important role in the flavor and taste of cigarette smoke. Non-volatile organic acids in Chinese Yunnan, Gui Zhou and Henan flue-cured tobaccos were determined. The organic acids in tobacco were derivatized into methyl esters by 7% H₂SO₄-CH₃OH,

and extracted by CH_2Cl_2 , GC separations were carried out on a 25 m \times 0.25 mm i.d. PEG-20M column (W.C.O.T), identifications of organic acids were achieved by comparison of the retention times with authentic acids, quantitations were carried out by internal standard method. The results showed that the Henan tobaccos had the highest amount of total organic acids, followed by Yunan tobaccos, then Gui Zhou tobaccos. As to the relative levels of the individual acid in the total organic acids, Henan tobaccos had the highest proportion of malic acid, Yunan tobaccos had the highest proportion of citric acid, and Gui Zhou tobaccos had the highest proportion of oxalic acid. In the low grade and low stalk position leaves, the contents of total organic acids were higher, but the citric acid and oxalic acid were relatively lower. The derivatization procedure is also discussed.

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LUO L.; HU J.; XIE J.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST43.

Studies on the Maillard reaction products derived from L-Valine and a reducing sugar in a no-oxygen closed model system.

The Maillard reaction products (MRPs) derived from equimolar amounts of L-Valine and a reducing sugar in glycerol were prepared at 160 °C for 45 min in a no-oxygen closed model system and in an open system. The MRPs' color intensity and amino-acid residues were investigated by UV and HPLC respectively. The volatile components from the closed and open systems were isolated by steam distillation and analyzed by GC and GC-MS. The volatile products were further evaluated for antioxidative activity, measured by the oxidation of heptanal to heptanoic acid at room temperature. It was observed that the rate of browning in the open system is quicker than in the no-oxygen closed system. However, the closed system gave more volatile compounds and stronger antioxidative effects. Twenty-six compounds, including pyrazine, dioxolane, acids, ester and pyridine, pyrrole, pyranone were identified in the closed system, but only fifteen compounds were found in the open system. The formation pathway and sensory properties of these flavorant components are discussed.

Zhengzhou Tobacco Research Institute, Henan, P.R. China.

MARCUSSON K.; FRANZEN L.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST37.

Better control of the air velocity around cigarettes during analysis that meets the requirements in ISO 3308 when using a smoking machine.

Ever since 1991, when the new ISO-standards were reviewed, ambient air flow around cigarettes in routine analytical smoking machines has become a more important factor to minimize variations in smoke yields and to obtain better repeatability and reproducibility. The air velocity shall be set at the standard value at least daily. If required it should be adjusted to the standard air velocity at the reference point within the smoking machine. In practical work, however, this can lead to difficulties caused by differences in constructions of laboratories, ventilation systems, fans etc. This paper will describe the components needed to obtain an air flow system that reaches such a degree of reliability that it reduces most of the practical labour in measurements and adjustments to keep the conditions within stated limits. The stability obtained with this system will be discussed. The paper will also present a ventilation system and the adjustments of linear smoking machine hood necessary to accomplish the improvements.

Swedish Match, Snuff Division Research & Analysis, Stockholm, Sweden.

MARINER D.C.; TUCK D.J.; FROST B.E.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST3.

Benzo(a)pyrene analysis in mainstream cigarette smoke.

Benzo(a)pyrene, along with other polycyclic aromatic hydrocarbons, is formed during the incomplete combustion of organic matter and its presence in tobacco smoke is well documented. The low levels present in tobacco smoke and the complexity of the matrix result in a challenging analysis. Methods for the analysis of benzo(a)pyrene generally involve lengthy sample preparation procedures and suffer from co-extraction of substances which interfere with the analysis. A simple method is presented using a clean-up based on solid phase extraction and liquid-liquid partition followed by analysis by HPLC with fluorescence detection. For this method 20 cigarettes are smoked under ISO 3308/4387 conditions. The particulate matter is extracted with hexane/dichloromethane and subjected to a Florisil cartridge clean-up. Following a liquid-liquid partition stage and a further Florisil clean-up, the eluate is taken up in HPLC mobile phase (acetonitrile/water) for analysis. A 250 × 4.6 mm Zorbax ODS column is used for separation with fluorescence detection using excitation and emission wavelengths of 378 and 405 nm respectively. Quantitation is by standard addition and an internal standard (benzo(a)pyrene) is used to correct for any losses. A selection of cigarette styles and deliveries have been analysed and results from 8 to 20 ng/cigarette have been obtained which are in agreement with the literature. Although multi-stage, this method is straightforward using manufactured Florisil cartridges and automated solvent evaporation.

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MARTIN P.; JUPE R.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST39.

A method of evaluating factors contributing to environmental degradation.

Many factors contribute to the degradation of materials, or components, under environmental weathering. Primary contributions are expected to come from exposure to sunlight, exposure to moisture and mechanical agitation. Since these vary so much with the location and the time of year it is difficult to draw comparisons between the results of external weathering tests. Even if the exposure conditions are carefully monitored a comparison cannot be made without knowing how the exposure factors contribute to the degradation of the sample. This dilemma is usually resolved by setting up a standardized laboratory test where factors influencing degradation are controlled and the sample is run through cycles that are designed to simulate environmental weathering. By running some experiments where factors thought to influence environmental degradation are controlled, it is possible to isolate and quantify the contribution of each of the degradation mechanisms, and also to show the relative importance of any interactive effects. Such an analysis can also be used to identify the sensitivity of the degradation metric to other experimental variables, and to define practical ranges for the controllable parameters.

Philip Morris USA, Research Center, Richmond, VA, U.S.A.

MBULAWA R.E.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST31.

Determination of imidacloprid and its metabolic residues in tobacco.

An analytical method is described for the determination of imidacloprid [1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine] and its metabolic residues in tobacco. The method allows for the determination of the parent compound (imidacloprid) and total residues from a single extract. The parent compound is determined by reversed phase high performance liquid chromatography (HPLC) with ultra violet (UV) detection, while the total residue is determined as 6-

chloronicotinic trimethyl silyl ester by gas chromatography with mass spectrometric detection. Imidacloprid, a chloronicotinyl insecticide is degraded in plant material to metabolites all containing the 6-chloropicoyl moiety. The imidacloprid and metabolites are extracted by homogenation from tobacco with an acetonitrile/water mixture and partitioned into dichloromethane from the aqueous residue of the homogenate. The dichloromethane extract is halved and one portion taken for Florisil; column clean-up and HPLC analysis for parent compound. The other dichloromethane extract is subjected to potassium permanganate oxidation to yield 6-chloronicotinic acid. The 6-chloronicotinic acid is esterified to the trimethyl silyl ester and determined by gas chromatography with mass spectrometric detection as total residue.

Tobacco Research Board, P.O. Box 1909, Harare - Zimbabwe.

McCORMACK A.D.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST13.

The effect of paper properties on cigarette filter performance.

Although paper has been used as a cigarette filter material for many years, little is understood about how the properties of such papers affect smoke filtration. In order to build up a better understanding of this area, an investigation has been conducted into the effect of surface properties of cigarette filter papers on filter performance. From this information, it may be possible to specify the paper properties required to give desired smoke filtration performance. A number of experimental papers incorporating fibres of markedly different coarseness were manufactured on a pilot plant and their physical properties characterised. Cigarette filter tips were prepared from these papers and the filter tar and nicotine retentions measured. These data were compared with corresponding figures obtained from current commercial filter papers. The surface roughness of the papers, as measured using both Talysurf and Bendtsen equipment, received particular attention as this property may be expected to exert an effect on particulate phase filtration. A correlation was confirmed through the development of empirical relationships between tar retention, paper surface properties and filter tip draw resistance. Whilst these models could be applied to several of the papers investigated, it is clear that other phenomena, such as those associated with the paper bulk properties, also affect smoke filtration. Further work is required to unravel the complex interactions and mechanisms involved.

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NGUYEN T.T.; JUPE R.; FINLEY A.L.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST12.

A study of the effect of cigarette rod construction on filtration efficiency.

Since the pressure drop and ventilation levels are the most important parameters contributing to filtration efficiency, it follows that one can predict changes in efficiency if changes in pressure drop and ventilation are predicted. An earlier paper demonstrated the ability to predict ventilation levels and pressure drop. The continued study of the volumetric flows generated in the dynamic interactive system, called a ventilated filtered cigarette, has resulted in additional predictive tools. The effects on filtration efficiency with changes in tobacco rod construction and its changing length during consumption are represented mathematically in this study. The consumption of the tobacco rod is more than a reduction in length, it also presents an additional pressure drop term and changes in the dynamic volumetric flows resulting from the burning coal. Presented is a mathematical model that predicts the total cigarette pressure drop and filter ventilation values. The model is flexible enough to predict the ventilation and pressure drop changes of any filter constructions. This capability gives the ability to predict filtration efficiency on a puff-by-puff basis.

Philip Morris USA, Research Center, Richmond, VA, U.S.A.

OGDEN M.W.; CONRAD F.W.; KELLY S.P.; MAIOLO K.C.; RICHARDSON J.D.; NELSON P.R.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST46.

Environmental tobacco smoke particle markers: an international cigarette study.

In indoor air quality investigations, marker compounds are often used to estimate the amount of respirable suspended particles (RSP) that originated from environmental tobacco smoke (ETS). Typically, the relationship between various markers and ETS particles (ETS-RSP) has been determined from laboratory studies utilizing US cigarettes. Applicability of these ratios to studies conducted in other countries has often been presumed, but not verified. A study was performed to determine the ratios between ETS-RSP and the following ETS-RSP markers: ultraviolet particulate matter (UVP), fluorescent particulate matter (FPM), and solanesol. Cigarettes from the following 19 countries were tested: Argentina, Australia, Brazil, Canada, China, Czech Republic, England, France, Germany, Hong Kong, Italy, Japan, Korea, Malaysia, Portugal, Spain, Sweden, Switzerland, and USA. For each country, one cigarette each of the six leading brand styles was smoked simultaneously in an unventilated environmental chamber. Real-time measurements of CO, oxides of nitrogen, total hydrocarbons, and particulate mass concentrations were obtained. Time-weighted average determinations of nicotine, 3-ethenylpyridine (3-EP), gravimetric RSP, UVP, FPM, and solanesol were also performed. Concentrations of CO, NO_x, total hydrocarbons, nicotine, 3-EP, and particulate matter were relatively similar among countries. Average ETS-RSP yields of 14.6 (11.3-19.6) mg/cigarette were calculated. The ratio between marker and ETS-RSP concentrations was very similar among most countries tested. Average ratios between UVP and FPM surrogate standards and ETS-RSP were approximately 7.7 and 43, respectively. ETS-RSP contained approximately 2.4% solanesol by weight, which results in an apportionment factor of 41. With few exceptions, the average factors can be applied in indoor air studies in different countries.

R.J. Reynolds Tobacco Co., Winston-Salem, NC, U.S.A.

RASMUSSEN G.T.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST10.

The effects of cigarette component variability on filter ventilation variability by Monte-Carlo analysis.

The variability of a ventilated filter cigarette depends on the variabilities of its components and on the details of its construction. Variations in cigarette pressure drop and filter ventilation arise from many sources including variations in tobacco rod pressure drop, filter tip pressure drop, tipping paper permeability, and plug wrap paper permeability. Mathematical models which relate properties of cigarette components to cigarette pressure drop and filter ventilation level have been used to study the expected variability of alternative cigarette designs. This previous work has shown that, for given levels of component variabilities, the choice of tipping perforation size, tipping paper permeability, and plug wrap paper permeability used to achieve a target ventilation level with a given tobacco rod and filter tip has only a small effect on the predicted pressure drop variability of the finished cigarette. However, vent system design choice does affect filter ventilation variability. The same Monte-Carlo analysis method can be applied to study the effects of changes in the component variabilities on filter ventilation variability. In addition to variability in the cigarette components, variability in the tipping process can also be simulated. These calculations predict the anticipated benefits of specific reductions in the variability of cigarette components. Monte-Carlo analysis offers a convenient way to compare alternative means to achieve reduced variation in cigarette performance.

Eastman Chemical Company, Kingsport, TN, U.S.A.

REEVES N.; DIXON M.; HILTON D.C.; AYYA N.; St CHARLES F.K.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST8.

Measurement of puffing behaviour in lights and ultra-lights cigarette smokers with ventilation holes partially and fully blocked.

This study was conducted to assess alterations in puffing behaviour amongst lights (10 mg), high ultra lights (5 mg) and low ultra lights (1-3 mg) smokers smoking their own brands with none, half and all the ventilation holes blocked. In the experimental condition, subjects smoked their cigarettes through holders connected to a pressure transducer that recorded differential pressure across an orifice. Flow rate was derived from these observed changes in pressure and the number, frequency, volume and duration of puffs were recorded. Subjects also smoked their own brands without holders in the same facility, and smoked cigarettes at home, and filters from these conditions were collected as well. Filters from all sessions were analyzed for tar and nicotine. In addition to the filters from the smokers, filters from cigarettes machine-smoked under the various vent-blocking regimes were also analyzed for tar and nicotine. Behavioural data and corresponding analytical data (tar and nicotine) will be presented to provide a picture of differences in smoking behaviour.

British American Tobacco, Southampton, U.K.

RENFRO L.W.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST11.

An enhanced algorithm for the computer-assisted design of ventilated filtration systems.

There is a continuing need in the industry for fast, reliable methods for designing filtration systems for ventilated filter cigarettes. In a previous paper, a method was described for selecting tow items, filter pressure drops, and ventilation levels to meet cigarette performance criteria. That method used plots of the boundaries of filament denier and total denier combinations which meet the design criteria. These boundary plots reduced the number of complete filter design calculations required, eliminated the need for tow item lists, and improved the reliability and robustness of tow searches over alternative approaches. However, the filament-denier/total-denier boundaries could only be computed efficiently at relatively low resolution, and estimating the starting point could be time consuming. This paper describes a faster, more reliable method for mapping the boundaries. A simplex optimization is used to quickly find one point within the boundary region, and an edge tracking algorithm is used to map the range of the possible tow items. At the heart of these calculations is a routine which uses a detailed understanding of the effects of filter pressure drop and ventilation level on cigarette pressure drop and tar yield to construct a simple, reliable test to see if a tow item falls inside or outside the boundary region. These speed improvements enable a significant increase in the resolution and the accuracy of the design-space boundaries which improves the overall performance of the filter design method.

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RÖPER W.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST23.

The EC novel food regulation: wording, interpretation and some reflections concerning cigarette composition.

In January 1997, the Regulation (EC) N° 258/97 concerning novel foods and novel food ingredients was passed by the European Parliament. This regulation applies among others to food and food ingredients containing or consisting of genetically modified organisms and food or food ingredients produced from but not containing such organisms. In order to protect public health, it is necessary to ensure that novel foods and novel food ingredients are subject to a safety assessment before they are

placed on the market within the community. Article 8 of the Regulation specifies that additional specific labelling requirements shall apply to foodstuffs that are no longer equivalent to existing foods or food ingredients. The evaluation must be based on scientific assessment, demonstrating that the characteristics assessed are different in comparison to conventional food or food ingredients. The labelling must indicate the characteristics or properties modified, together with the method by which that characteristic or property was obtained. In consideration of consumers' concerns about genetic engineering in general and genetically modified products in particular, we have gone through cigarette constituents in order to identify potential sources of genetically modified materials or these possibly derived from gene technology processes. At present, merely genetically modified tobacco may be detected by valid analytical methods, and would be subject to labelling in the meaning of the EC Novel Food Regulation.

H.F. & Ph.F. Reemtsma GmbH, Research & Development, Hamburg, Germany.

ROSSI S.; BARCA L.; ALTIERI P.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST4.

Analysis of smoke fractions obtained from tobaccos extracted by supercritical carbon dioxide.

In previous papers we described the attempt to extract some precursors of smoke from tobacco, by supercritical carbon dioxide, carrying out tests using both a bench and a pilot plant, working under the same operating conditions, with the addition in some tests of ethanol as cosolvent. The extracted fractions were analysed by capillary gas-chromatography and mass-spectrometry. The results were given in a previous paper. The crude condensates, obtained by smoking 100 plain cigarettes made with the cut tobaccos of each test and with the untreated blends, were separated by using different extracting solvents and operating at different pHs, in five fractions which were analysed by capillary gas-chromatography and mass-spectrometry. The chromatograms were shown in a previous paper. The objective of the present work is to identify as many components of the different fractions as possible. In the neutral aliphatic fraction 47 compounds were identified, mainly normal, branched and unsaturated paraffins with some low-molecular aromatic compounds as benzene-derivatives. In the neutral aromatic fraction 16 compounds were identified, such as naphthalene, indole, anthracene and some fluorene-derivatives. In the third fraction, containing the organic acids, 16 compounds were identified, mainly phenol-derivatives. In the basic fraction, besides nicotine and cotinine, 13 compounds were identified, mainly derivatives of pyridine, pyrazine, pyrazole and carbozole. In the polar neutral fraction 16 compounds were identified with alcoholic, carbonylic and amidic functions. The chromatograms of the five fractions, obtained from treated and untreated tobaccos, show that the extraction by supercritical carbon dioxide has significantly reduced: a) the normal branched and unsaturated paraffins, mainly in the range C22-C31 in the aliphatic fraction; b) several compounds of aromatic fraction as naphthalene, indole, methyl-naphthalene, 3methyl-indole and others, unidentified. In the other fractions only small reductions were observed. The use of ethanol as cosolvent seems to have enhanced the extracting power of carbon dioxide only for some low-boiling compounds of aliphatic and basic fractions.

A.A. Monopoli di Stato, Piazza Mastai 11, 00153 Roma, Italy.

SCHNEIDER W.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST9.

Effects of occlusion of ventilation zones on tar yields.

The different increases of tar yields, if ventilation zones are occluded, are explained for different types of cigarettes. Simple approximate formulae which are derived from a more complex theoretical treatment provide an immediate insight into the several influences contributing to the yield "increase factor" (defined as the quotient "tar yield with occluded ventilation zones / tar yield with open

ventilation zones"). Increase factors calculated with these formulae agree with measurements within experimental error. The bandwidth of the increase factors of different cigarette design options for the same tar level can be determined for all tar levels. (Only conventional design components are considered here). Down to about 5 mg tar the increase factor can be expressed mainly in terms of the degree of ventilation or alternatively by the tar yield of the tobacco rod together with the degree of filter retention. For the lower part of the ultra low tar segment a considerable portion of the increase factor is determined by the influence of ventilation on filtration effects. Thus different filter constructions can have different effects on the increase factor (at the same tar, filter retention and ventilation level). The bandwidth of tar differences between cigarettes of the same tar level with a high and a low increase factor is similar for ultra low tar and full flavour brands (ventilation zones occluded).

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SEWART A.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST26.

Principles of public health risk assessment.

Attempts by various regulatory authorities to perform risk assessments on substances such as Environmental Tobacco Smoke (ETS) have been controversial and fraught with error. An understanding of Risk Assessment methodology is therefore useful. Public health risk assessment is a discipline which uses toxicological data derived from animal studies and human epidemiology, combined with information about the degree of exposure, to predict quantitatively the likelihood that a particular adverse response will be seen in a specific human population. Risk assessment is a process whereby the magnitude of a specific risk is characterized so that decision makers can conclude whether the potential hazard is sufficiently great that it needs to be managed or regulated. This approach has been employed since the 1980's to assess whether the broad array of environmental risks are significant or trivial, for example in establishing acceptable daily intakes (ADI) for pesticide residues in food, setting drinking water standards etc.. The risk assessment paradigm consists of four subdisciplines, (1) hazard identification, (2) dose-response assessment, (3) exposure assessment, and (4) risk characterization. Hazard identification involves determining whether exposure to an agent could, at any dose, cause an adverse health effect. Dose-response evaluations define the relationship between the dose of the agent and the probability of a specific adverse effect, typically derived from animal studies. Exposure assessment quantifies the uptake of the agent from the environment by oral, inhalation and dermal routes of exposure. Risk characterization summarizes and interprets the collated data, identifying the limitations and uncertainties in the risk estimates. To demonstrate the practical application of the risk assessment paradigm, the methodology employed to assess the (public) health risk from dioxin emissions for residents in the nearby vicinity of a Municipal Waste Incinerator is presented and the difficulties of applying such a model to ETS is discussed.

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SINCLAIR N.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST25.

Packaging issues in Europe.

Traditionally, CORESTA activities have focused on the tobacco plant, processed tobacco plant, processed tobacco and the finished product rather than the packaging in which the product is sold. In Europe, environmental (green) factors, culminating in the 1994 Packaging and Packaging Waste Directive (94/62/EC), have required considerable Industry resources to be devoted to our packs and the pack components themselves. This European Directive involves the whole packaging chain and requires the governments in member countries to create systems for the recovery and recycling of

packaging materials placed on their markets. Specific targets, applicable across all member states have been set by the European Commission from Brussels. Each country's Government has approached the task differently, creating major difficulties for international manufacturing industries - especially those who place importance on 'pack appeal' and 'brand recognition' as a component of their marketing strategy. One key issue is 'pack markings'. These are intended to inform the consumer about the reuse/recycle potential of the pack, the material it is made of and whether (or not) it conforms to the EU Directive. However, the information value of these proposed markings can be questioned. Furthermore, it can be argued that packs such as cigarette packs are too small to carry such markings without seriously destroying pack appeal. The requirements of the Directive will be outlined and the current status of its implementation in the European Community will be described. Attention will be given to specific aspects of the Directive which have already, or will soon, affect the tobacco industry. These include: the costs of systems for demonstrating compliance with the Directive and factors affecting the quality, visual appeal and costs of pack production.

Rothmans International Research & Development, Basildon, Essex, U.K.

TASCHNER P.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST27.

Experiences with laboratory accreditation in Germany.

In March 1995 Reemtsma's smoking lab in Hamburg was the first laboratory within the German cigarette industry receiving an accreditation according to DIN EN 45001 and DIN ISO 9002 respectively for smoke analysis performed according to the current ISO methods. The presentation will summarize the experiences we made during the 2.5 year period as an accredited smoking lab concerning the very specific tasks of a manufacturer laboratory considering external and internal procedures. Also a short overview will be included about what are the different intentions for an accreditation according to the 45000/9000 series depending on the type of lab (official, private or industrial) in Germany.

H.F. & Ph.F. Reemtsma GmbH, Research & Development, Hamburg, Germany.

TOWNSEND D.E.; BORGERDING M.F.; LEWIS L.S.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST20.

The FTC Method and proposed alternative smoking conditions.

The U.S. Federal Trade Commission (FTC) method for the determination of 'tar' and nicotine in mainstream cigarette smoke has been recognized as the official standard in the United States since 1967. In 1980, the FTC method was expanded to include the determination of carbon monoxide. The FTC method was established to provide comparative 'tar' and nicotine yield information obtained with the arbitrary laboratory method which could provide useful information for consumers and provide advertising substantiation. Even the FTC recognized that the method was useful for comparative purposes and was never intended to represent 'tar' and nicotine yields which smokers actually receive under "human puffing conditions". During the past several years, the FTC method has come under intense scientific and public scrutiny leading to calls for changes to the method. The objectives for the proposed revisions are varied and often unclear. This paper will review a current FTC proposal for changes to the standard method as well as legislation for alternative smoking parameters by the Commonwealth of Massachusetts. Recent applications of alternative smoking parameters reported in Canada and Germany will also be reviewed. The effects of altering machine smoking parameters (puff volume, puff frequency, and puff duration) and cigarette vent blocking parameters will also be summarized.

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WARD M.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST21.

Current issues on the commercialisation of genetically modified food crops.

Over the past ten years plant biotechnology has advanced from research in a small number of specialised laboratories to commercial crop production of genetically modified plants. The food products from these crops are being sold widely in the USA and some European countries. The type of crop modifications grown commercially are either with agronomic enhancements which are of direct benefit to the farmer or product quality improvements which are for processor and consumer benefit. The way that these two types of modifications have been handled in the food chain and the issues raised at each stage of the chain are different. In some countries there are still problems with the growing and commercialisation of food crops and this raises further problems, especially with commodity crops that are traded internationally. The contrast between these crops and tobacco, which was the first plant to be genetically modified in research laboratories and is used as a model species in many field trials, is distinct. Recent field trials and developments suggest that modified tobacco is at the final stage of testing and many of the same issues faced by the food industry will have to be addressed by the tobacco industry in the near future. This paper examines the progress that has been made in crop biotechnology and the different issues that the food industry has and is facing in terms of public perception and the commercialisation of genetically modified food.

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WILLMUND R.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST22.

Identification of transgenic food produced by means of genetic engineering.

Until now at least 25 genetically modified plants were approved for cultivation and commercialization in the U.S.A., Canada, and in the European Community. Consequently methods for the detection of recombinant genes in food derived from transgenic organisms have been developed. A first standardized method based on the Polymerase-Chain-Reaction (PCR) technique to detect recombinant potatoes is still available in Germany. With PCR there is a possibility to amplify specifically very little amounts of DNA using primers corresponding to the gene of interest. Detection of other transgenic plants can be done in most cases with some modifications of this method. Two prerequisites to establish PCR assays are necessary: knowledge of DNA sequence of the recombinant gene, presence of amplifiable DNA in the sample. The present paper describes methods for the detection of transgenic plants and maize and related food products.

Gene-Scan Service, Freiburg, Germany.

WINTER R.; KLUSS B.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST36.

Smoking machine with integrated CO measurement.

CORESTA Recommended Method N° 5 as well as ISO 8454 describes the determination of vol.% CO in the gas phase and the calculation of mg CO per cigarette. Three steps are needed to get to the final result: 1. Gas phase collection during smoking; 2. Determination of vol.% CO in the gas phase using a CO analyser; 3. Calculation of mg CO per cigarette. Due to the integration of a CO-analyser into the automatic smoking machine RM 200, these steps are now automated. During smoking the gas phase is collected in a bag. When the smoking process is finished five clearing puffs are taken and as well pumped into the bag. The bag is then connected to a CO measuring cell using a system of valves and the gas phase is drawn through. Using the total puff number and the number of cigarettes smoked,

the CO content per cigarette in mg is then calculated. With the valve system it is possible to bypass the measuring cell and quickly empty the bag. The measuring cell is flushed with clean air (laboratory atmosphere) and zeroed before every measurement.

Heinr. Borgwaldt Technik GmbH, Hamburg, Germany

XIA Q.; ZHAO M.

CORESTA Meet. Smoke-Techno Groups, Hamburg, 1997, abstr. ST28.

Analysis of headspace volatile components of superior quality cigarettes.

Different kinds of cigarettes possess different aroma styles. In order to study the relationship between cigarettes and their headspace volatile components, the headspace volatile components of four brands of cigarettes (including foreign and domestic cigarettes, Virginia or American blended type) were analyzed. Dried nitrogen was passed through cut tobacco, and the headspace volatile components were collected by traps. These collections were analyzed and identified by capillary gas chromatography (GC) and GC/mass spectrometry (GC/MS). A total of 172 components were identified. The effect of headspace volatile components on cigarette styles was investigated. The headspace volatile components of different types and brands of cigarettes were compared. The results showed that there is a close relationship between the headspace volatile components and aroma components of cigarettes and the style of cigarettes, so it is possible to learn how to use some additives in order to improve and to form the style of cigarettes. The methods for collecting headspace volatile components of cigarettes will also be discussed.

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Application of NIR to determine the contents of expanded tobacco, reconstituted tobacco and stem in tobacco blends.

In the manufacturing process, it is most important to blend expanded tobacco (ET), reconstituted tobacco (RT) and stem correctly, since their proportions in tobacco blends have a great influence on the smoke components and physical properties of the final products. No studies have ever attempted to determine the ratios of ET, RT and stem rapidly, using an analytical method. We therefore studied a non-destructive and rapid method to measure these ratios in tobacco blends, based on Near Infrared Reflectance spectroscopy (NIR). We focused on the qualitative and quantitative differences of components in ET, RT, stem and lamina, and their characteristics were measured using NIR. The spectral data obtained were analyzed statistically and multivariate calibration models were built using partial least square regression (PLS) to predict ratios in the blend. Consequently, the models were shown to be able to accurately predict the ratios of ET, RT and stem in tobacco blends. Furthermore, factors that may affect the measurement, e.g. top dressing flavor and time elapsed since blending, were tested. Details of the study and practical procedures will be discussed in the presentation.

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Determination of alkaloids in tobacco using solid-phase microextraction and GC.

This work is to evaluate the potential use of solid-phase microextraction (SPME) in the analysis of tobacco components, mainly alkaloids. In SPME, sampling can be done either by taking vapor phase

in the headspace of a tobacco sample or by dipping the SPME fiber into an aqueous tobacco extract. Because of the low volatility of alkaloids, sampling from headspace of a dry or a damped tobacco sample requires additional effort to improve extraction efficiency. Thus, extraction of tobacco samples with an aqueous solution is also tested. A SPME fiber coated with polydimethylsiloxane was directly dipped into the tobacco extract, then injected onto a capillary column under split or splitless mode (with 1 or 2 mm i.d. injection liners). When combined with the practice of fast GC, nicotine and a group of selected minor alkaloids (*i.e.*, nornicotine, myosmine, anabasine and anatabine) can be separated with baseline resolution within 3 min. In addition, the carry-over problem frequently occurring in alkaloids analysis was eliminated. However, certain limitations in SPME applications need to be addressed. For example; SPME is an equilibrium process and its extraction efficiency is highly dependent upon the partitioning of target compounds between the polymeric phase and the sample matrix. The matrix effect can be compensated by the use of an internal standard, by the addition of individual target compound, or by the use of isotope-labeled internal standards as reported in the literature. In addition, the solvent-free injection of SPME essentially eliminates the refocusing effect of solvent on peak broadening, particularly for those early eluted peaks. Peak broadening and resolution in SPME analysis are also influenced by the mass transfer of target compounds, which is determined by temperature, pH, the agitation of solution, and film thickness of polymer coating on the fiber. The influence of the above factors and the optimization of experimental parameters will be discussed.

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