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Maintaining the Fill Value Consistent In the GALT Process of Tobacco

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Abstract

The GALT (Expand) process is a parallel process in the manufacturing of cigarettes which converts the cut tobacco at moisture content of about 26% to expand tobacco by treating it with liquid and gas CO2 in pressure vessel at 23 bars. The tobacco moisture content is increased from 11% to 13.5% and this is blended back in the production line at any conventional step. The expanded tobacco should have a firm value (fill value) of 75cc/10gm, which is according to the estimated sensory and delivery targets of consumers. But the firm value observed in the process is in between 65-85cc/10gm. the co-relations study were made between firm value and variation parameters in graphical and theoretical method.

Keywords: Tobacco; Galactosyltransferase; Surface properties; Borgwaldt digital densimeter

Abbreviations: PREPS: Potential Reduced-Exposure Products; GALT: Galactosyl Transferase; VOV: Voice Of Tobacco Victims; HAG: Hot Air Generator; ROC: Re-Ordering Cylinder; MC: Moisture Content; Moisture Content (MC)

Introduction

Cigarettes contain blends of different types of tobaccos such as Virginia, Burley and Oriental. These main tobaccos are further classified into subgroups depending upon where the tobacco is grown, which part of the plant it is taken from and other characteristics like colour, maturity, uniformity etc [1-3]. These sub-groupings are called tobacco "grades". One tobacco plant can produce several grades of leaf. The sensory, physical, chemical and visual properties of a tobacco grade are generally determined by the leaf position on the plant like if the leaves at the top of the plant are more exposed to the sun than the ones at the bottom and typically contain higher levels of nicotine and other alkaloids [4-8].

Leaf is bought from growers, sorted by grade and sent for threshing to separate the stem and lamina parts of the leaves. The threshing process also enables the moisture content to be controlled, which is important as the tobacco is subsequently stored for several months to mature. The chemical content of the leaf is widely depending on the nature of tobacco, the soil and environmental conditions where it will be grown, the way it is cured [9]. Our research to develop Potential Reduced-Exposure Products (PREPs) includes looking at the factors that might lower tobacco toxicants in the blends used. Virginia or flue-cured tobacco is named after the US state where it was first cultivated [10-13]. It is also called bright tobacco because it turns in to yellow orange color during curing. It grows particularly well in subtropical regions with light rainfall. Flue-curing is a heat driven process that creates a dry manageable product, reduces the risk of mould and promotes chemical changes that improve the sensory quality [14].

It also produces a change in leaf color. Virginia tobacco can contain a wide range of levels of nicotine - 1% to 3.5% - and have reasonably high levels of naturally occurring sugars - 5% to 25%. Virginia blends contain only flue-cured Virginia tobaccos and no flavors or additives are included [15,16]. Owing the above facts, we made an attempt to determine the variations in the processing of expanded tobacco for cigarettes and its synergetic effects and cause by the tobacco processing to improve the sustainability and better-quality of health.

Experimental Details

Materials and Methods

The expansion of cut tobacco was carried out in an impregnator by using liquid and gas CO2 for particular holding time so that the liquid & gas CO2 should enter into the cells of tobacco for the purpose of expansion. The expanded tobacco should have a fill value of 75cc/10g.

Process Description

Leaf is issued from the go down as per a tobacco standard (BOM: 500151). Only certain grades are used for GALT process: WR2, WS2, MO2W, MS2M, and MFS2M as per the % composition of the blend. A standard clamp truck brings the requisite bales from the leaf go down. The bales are manually delaminated (hand teased) and fed to a band conveyor. Galactosyl Transferase (GaLT) grades are weighed before feeding into the in feed band using a load cell. Conditioning of product is achieved by two mechanisms, which occur simultaneously with in the DCC process. These are two factors such as conditioning by condensation and direct water addition from water sprays [17]. The condensation process is controlled by regulating the dry bulb temperature of the airflow within the conditioning cylinder. The airflow is concurrent i.e., in the same direction as the product flow along the cylinder and is re-circulated to the in feed end of the cylinder via a duct and a fan. There is no exhaust from the cylinder [18].

The dry bulb temperature of the process air is sensed by a fast responding temperature sensor within the re-circulating air duct. An automatic temperature controller compares the temperature set point with an actual value and out puts a signal to a control valve positioned [19]. Process Parameters should be maintained throughput 1080 Kg/hr, process air temperature 70oC and water Spray flow rate is manually controlled by operator. Then the feed moves into the bulking and blending bin. The Purpose of blending bin is to blend various grades of tobacco by sandwiching one grade on top of the other, and mixing with the use of a set of specially designed doffers while discharging. By this maximum blending is achieved. Also serves the purpose of bulking to even out moisture across the layers. Tobacco at 30% moisture after conditioning is fed to lamina bins. For 2 hours, the tobacco is bulked in these bins to even out the moisture content between various layers. The atmosphere around the bins is maintained at a constant relative humidity of 80 % using air atomized water sprays. Once the bulking process is over, the product is discharged via two doffers [20,21].

After discharge from the lamina bins, the tobacco is carried via a Voice of Tobacco Victims (VOV) to a rising band conveyor and towards the cutting section. Prior to the Unicutter is a metal detector to remove all metallic particles, and prevent them from damaging the cutter knives. Finally, the tobacco reaches the trough of the cutter. Cutters are comprised of two sections, a packer or feeder and a cutter. Tobacco is fed in to the cutter by an automatic compacting unit [13]. As the tobacco leaves the mouthpiece, it is cut by the rotating knife drum. The basic rotational speed is adjusted by means of a potentiometer on the control console. Cutting width is adjusted by manually altering the speed ratio between transport chain and knife drum.

The cutting capacity in kg/ hr depends on cut width, blend, tobacco moisture and compression. Process parameters should be in the cutting section as follows, Cut Width 1.16 mm, Variation of cut: 0.04mm, Throughput is1000 kg/hr. From the Unicutter, cut tobacco is fed to the Impregnator. Once the tobacco is filled up to the top of the impregnator, a sensor fitted to the pneumatic chute closes to the impregnator top will sense the high level and stop the feed hopper. At this stage, a continuous process diverges into a batch process.

The Impregnator is a pressure vessel used for impregnating cut tobacco with liquid CO2. The Impregnator is charged with cut tobacco through a chute by opening the top door; and after closing the top door, the air inside the Impregnator is purged with carbon dioxide gas until pressure inside the impregnator rises to a value of 22-23 bars. Thereafter, liquid carbon dioxide is pumped through a reversible pump into the impregnator from a process vessel. After the impregnation operation the excess liquid carbon dioxide from the Impregnator is drained by a pumping action to a process vessel maintained at the same pressure. Then the vessel is depressurized by opening the vent valve to atmosphere. After this operation the bottom door is opened and the impregnated tobacco is fed to an insulating band conveyor for further processing. Then the top door is opened, cleaned with compressed air and kept ready for the next batch.

Process parameters here are, Throughput: 220 kg/hr and Batch Size: 85 Kg. After the Impregnation operation, the impregnated tobacco will be taken through an insulated Discharge Band Conveyor, a Gravity Flow Pipe and an insulated Metering Band Conveyor. There is a Doffer provided at the discharge end of the Discharge Band Conveyor, which will control smooth filling of the GFP. A Metering Band is provided below the GFP, the speed of which could be set as per the requirement to get the required output by the AC drive, to feed the Pneumatic Conveyor Dryer through a venturi provided on the conveying duct. Process air from the Centrifugal Blower is blown through the Hot Air Generator (HAG) and the hot air at 320oC carries the impregnated tobacco and dries the product instantaneously and takes it to the product cyclone, where the solid gas separation takes place.

The hot air duct from the HAG is partially insulated to so that the hot air and the tobacco entering the product cyclone are maintained at 140 to 160oC. The GALT Product discharges out of the product cyclone through an airlock. Process parameters are output moisture content: 4-5 %, Output Fill Value: 85-95 cc/10 g, Throughput: 300 kg/hr. After drying, the GALT product discharge at 4-5% moisture from the Product Cyclone airlock

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will pass through a Two Way Divider chute so that the discharge product is shared on to a Dual Band Conveyor equally. The Dual Band has a Top and Bottom Band; the Top Band is reversible. As the product starts discharging, the Top Band will move in the opposite direction until it gets filled up, which is equal to 50% of the total discharge. The other 50% will be discharged onto the bottom band, which will be feeding the dried tobacco to the Re-Ordering Cylinder (ROC).

Once the top band gets fully filled, it reverses its direction and keeps feeding into the ROC. The band conveyors are controlled by sensors for stopping and conveying depending on the tobacco on the Band Conveyors. In the ROC, the GaLT product gets conditioned to approximately 13% moisture content using air atomized water spray nozzles. The water flow is controlled through a manually operated rot meter, adjusting the water flow reading through a Moisture Meter (TM 710). This is fixed at a suitable elevation on the band receiving conditioned tobacco from ROC. The conditioned tobacco is discharged onto a VOV and then onto a band conveyor. GALT product is packed in a CFC placed on the Roller Conveyor.

Results and Discussion

Determination of tobacco moisture content was carried out as follows. Weigh 10 + 0.01 g of the sample for analysis into tins. Note down the tin numbers pertaining to the sample. Switch on the ovens at least 1 hour before use. Ensure that the oven is empty. Check that the oven fans are operating and that the oven thermometer reads 110 + 0.5oC. Place the tins on the five trays, along with the 5 oven comparison test tobacco sample tins. Switch off the oven. Place the trays in as rapidly as possible. Switch on the oven and leave for 31/2 hours. After 31/2 hours recheck the oven fan and thermometer reading 110 + 0.5oC. Switch 'OFF'. Transfer the trays to the dessicator. Reweigh the tins after 30 minutes one tray at a time.

The percentage moisture for the sample is calculated from the following formula.

$$\text{Percentage Moisture Content} = \frac{\{(w_2 - w_1) - (w_3 - w_1)\} * 100}{(w_2 - w_1)}$$

Where W1 = Weight of the tin, W2 = Weight of the tin + tobacco before moisture test, W3 = Weight of the tin + tobacco after moisture test.

Then tobacco firmness is measured using a Borgwaldt densimeter. The instrument is specifically designed to measure cigarette and tobacco firmness (Fill Value). Remove the sample from the conditioning cabinet. Weigh 20 + 0.1 g of sample and transfer this to the cylinder with minimum handling. Ensure that shorts are evenly distributed with the bulk of the sample. Do not press the sample in the cylinder more than is necessary for the whole sample to be added. Slide the cylinder into place under the piston.

Press the 'Start' button to initiate the test cycle. On completion of the test cycle record the reading on the digital display. This is a direct reading of residual height in mm. The reading will remain displayed until the next test cycle is started. Slide out the cylinder. Remove the sample and transfer to a moisture jar with an identifying ticket. Seal the moisture jar. Clean the cylinder thoroughly before the next sample is introduced. Repeat the above procedures for all samples to be tested. Then the tobacco firmness (Fill Value) can be calculated by using below mathematical expression of the form: The internal radius of the cylinder is 3 cm.

Therefore V, the volume of the sample after testing is: $Px\ 3\ x\ 3\ x\ ((h)/10)\ cm^3$

Where, h = dial reading (mm), Tobacco firmness may be expressed in one of two ways: FV = V x 10/W (cm3/10g sample) and $FV = W\ x\ 10/V\ (mg/cm^3)$ Where, W= weight (g) of sample used. For finding out the accurate cut width and the cuts per inch (cpi), wax bar test is undertaken. Here a wax bar of length of about 2 inch is taken. The wax is let adjacently into the cutter for an operation. The cut wax pieces coming out of the cutter is collected and the cut width of each piece is found out using screw gauge and the corresponding cuts per inch is calculated.

Graphical Analysis

The equation of fill value was modified to make out the relations between the fill values (FV), moisture content (MC) and height (H) as follows.

By assuming FV=75cc/10g the relation obtained between but the graph obtained from data. (Figure 1)

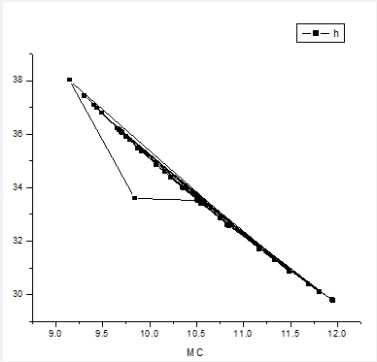

Figure 1: Shows the moisture content in the tobacco by assuming MC=12.2% the relation obtained between FV and H is FV=2.655*H.

By assuming MC=12.2% the relation obtained between FV and H is

FV=2.655*H (Figure 2)

By assuming H=29 the relation obtained between FV and MC is

$$FV = (7092.53 * (MC/13.5)^{0}.8) / (100 - MC)$$

The ideal graph obtained is shown below (Figure 3).

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From the ideal graph graph H vs MC we observed that as Moisture Content (MC) gradually increases height of the tobacco in Borgwaldt digital densimeter decreases, accordingly the fill value of tobacco simultaneously varies as shown in (Figure 1). The ideal graph between FV vs H gives us information about that as height of tobacco increases simultaneously the fill value of tobacco also increases accordingly as indicated in (Figure 2). The ideal graph between FV VS MC shows that as the moisture content increases accordingly the fill value of tobacco also increases. By comparing the ideal graph Vs graph obtained from data we concluded that the fill value of tobacco varies with height & moisture content of tobacco as shown in (Figure 3). We observed from the graphs that to maintain the fill value consistent in the GALT process of tobacco need to maintain the height of tobacco around 29cm & moisture content of tobacco around 13.5%. After maintaining these parameters constant we get the full value of tobacco around 75cc/10g.

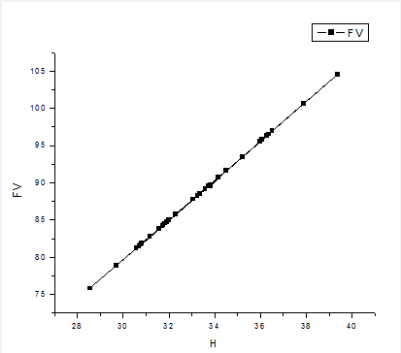

Figure 2: Shows variation of fill value of the tobacco By assuming H=29 the relation obtained between FV and MC is FV=(7092.53*(MC/13.5)^0.8)/(100-MC).

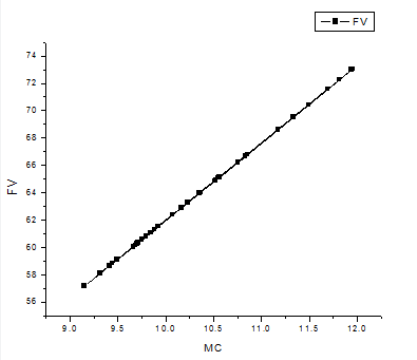

Figure 3: Shows that the variation of fill value against moisture concentration in tobacco.

Conclusion

In this communication, we have concluded that the bulking time should be kept for exactly two hours, because the observed S.D after giving the bulking time of exact two hours has been reduced. The efficiency of the cutter should be kept up to the target, because the cut width must be 0.04 mm whereas after the wax bar test, it has been observed that it is more than the tolerance level (0.06mm) and While filling the CFC box, compression of the product by hand should be avoided. Measures should be considered to make the impregnator fully atomized, according to the tobacco feed, CO_2 inlet and CO_2 holding time. The whole HAG system should be replaced, because the temperature set point of HAG is 290oc, but it is observed that the temperature maintained is 260oc. The moisture level in the EX-ROC should be automated by using the feed forward loop and feedback loop system since the moisture level is not maintained according to the tobacco flow rate and inlet ROC moisture.

References

1. RJ Reynolds (1943) Tobacco Company Winston-Salem, North Carolina a Corp of New Jersey Process for Increasing the Filling APC application of Boehme et al. Pp. 304,214.
2. Carlson TN (1982) ed(1991) Modeling stomatal resistance Agric For Meteorol 54: 103-388.
3. Cowan LR (1982) Regulation of water use in relation to carbon gain in higher plants In "Encyclopedia of Plant Physiology" (0L Lange and JD Bewley, eds.) 12(B): 535-562.
4. Avalos JT, Lawlor TE, Fowler KW, Bombick BR, Doolittle DJ (2001) A comparison of the effectiveness of Salmonella strains for detecting mutagenicity of a cigarette smoke condensate. Environ Mol Mutagen 37 (32): 19.
5. Ayres PH, Hayes JR, Higuchi MA, Mosberg AT, Sagartz JW (2001) Subchronic inhalation by rats of mainstream smoke from a cigarette that primarily heats tobacco compared with a cigarette that burns tobacco. Inhal Toxicol 13(2): 149-186.
6. Bernstein L, Kaldor J, McCann J, Pike MC (1982) An empirical approach to the statistical analysis of mutagenesis data from the Salmonella test. Mutat Res 97(4): 267-281.
7. Bombick DW, Bombick BR, Ayres PH, Putnam K, Avalos J, et al. (1997) Evaluation of the genotoxic and cytotoxic potential of mainstream whole smoke and smoke condensate from a cigarette containing a novel carbon filter. Fundam Appl Toxicol 39(1): 11-17.
8. Borgerding MF, Bodnar JA, Chung HL, Mangan PP, Morrison CC, et al. (1997) Chemical and biological studies of a new cigarette that primarily heats tobacco. Part 1 Chemical composition of mainstream smoke. Food Chem Toxicol 36(3): 169-182.
9. Borgerding MF, Perfetti TA, Ralapati S (1999) Determination of nicotine in tobacco, tobacco processing environments and tobacco products. In: Gorrod JW, Jacob PIII (Eds.), Analytical Determination of Nicotine and Related Compounds and Their Metabolites. Elsvier, USA pp. 285-391.
10. Boxman AR (1992) Unveiling the secrets of primary processing. Tobacco Int 194: 16-19.
11. Browne CL (1990) The Design of Cigarettes. Hoechst Celanase Corporation, Charlotte, NC pp. 50-51.
12. Davis DL, Nielsen MT (1999) Tobacco Production, Chemistry and Technology. Blackwell Science, Malden pp. 379-380.
13. deBethizy JD, Bombick BR, Bombick DW, Swauger JE, Doolittle DJ (1998) The use of short-term tests to evaluate progress toward reducing the toxicity of cigarette smoke. Report of Canada's Expert Committee on Cigarette Toxicity Reduction 21-22.
14. Maron DM, Ames BN (1983) Revised methods for the Salmonella mutagenicity test 113(3-4): 173-215.
15. McKee RH, Nicolich MJ, Scala RA, Lewis SC (1990) Estimation of epidermal carcinogenic potency. Fundam Appl Toxicol 15(2): 320-328.

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16. Perry P, Wolff S (1974) New Giemsa method for the differential staining of sister chromatids. Nature 251: 156-158.

17. Pillsbury HC, Bright CC, O'Connor KJ, Irish FW (1969) Tar and nicotine in cigarette smoke. J AOAC 52: 458-462.

18. Steele RH, Payne VM, Fulp CW, Rees DC, Lee CK, et al. (1995) A comparison of the mutagenicity of mainstream cigarette smoke condensates from a representative sample of the US cigarette market with a Kentucky reference cigarette (K1R4F). Mutat Res 342(3-4): 179-190.

19. Swauger JE, Steichen TJ, Murphy PA, Kinsler S (2002) An analysis of the mainstream smoke chemistry of samples of the US cigarette market acquired between 1995 and 2000. Regul Toxicol Pharmacol 35(2): 142-156.

20. Yahagi T, Degawa M, Seino Y, Matsushima T, Nagao M, et al. (1975) Mutagenicity of car- cinogenic azo dyes and their derivatives. Cancer Lett 1(2): 91-96.

21. Gaworski CL, Heck JD, Bennett MB, Wenk ML (1999) Toxicologic evaluation of flavor ingredients added to cigarette tobacco: skin painting bioassay of cigarette smoke condensate in SENCAR mice. Toxicology 139(1-2): 1-17.

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