WHITE PAPER ON TEA MAKING – REVOLUTIONATY DESIGNS FOR CHANGING PARADIGMS

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Abstract

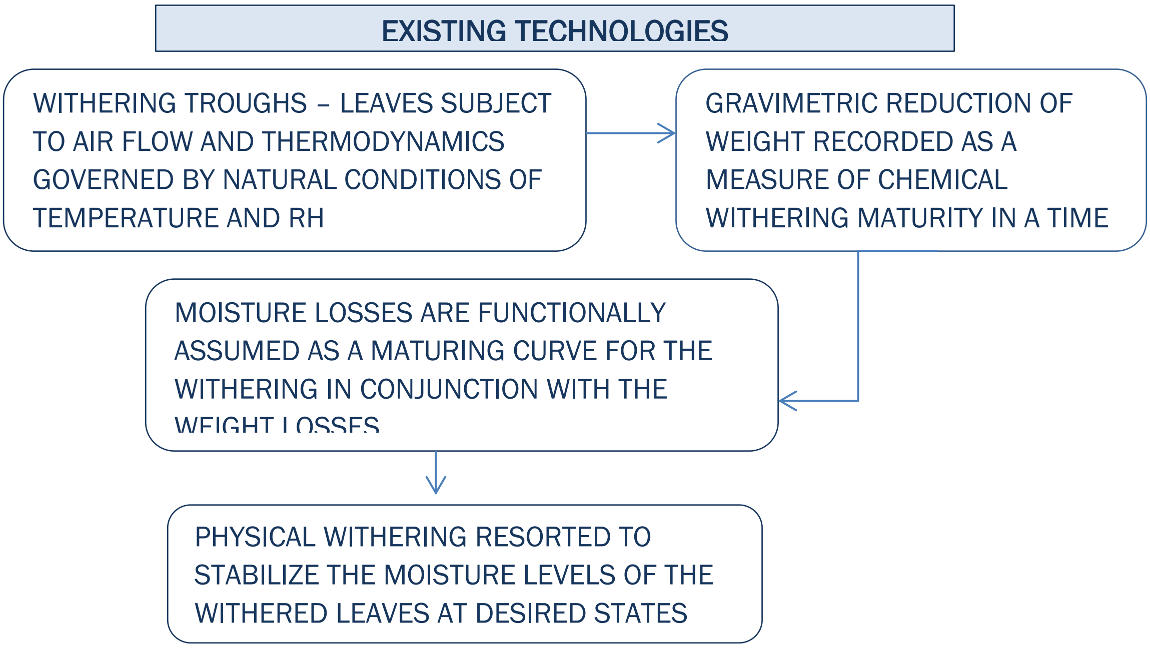
Tea making can be revolutionized for productivity, all important quality in the realm of aroma flavors, keeping properties and diffusion that perpetually drive brands and prices through a concerted focus on the biochemistry and the related kinetics defining the thermodynamics of the processes of withering as well as fermentation, the prerequisites of good tea making in the industry.

This white paper shall serve as a treatise on the technical aspects of the processes in the GL (green leaves) of the tea making process and for discussing the impact on the costs of manufacturing while seeking to change the fortunes of the industry amid weakening macroeconomic scenarios as well as in the wake of numerous challenges in the operations in the present times across the tea world.

The detailing of the road map for implementing the solutions through the cascading effects of scaling up the pilot models to commercial scale in the industry shall serve to bring forth the realm of possibilities with elements of high probability and maximum likelihood of success intrinsically built in. The professional credentials of the author and inventor are factored into the assurances of seamless transition from pilot mode reference frames to the industrial scale of mass manufacturing with the manifestation of envisaged benefits accrued into the tea making processes.

A. Determinants for the transformation models for the tea engineering and manufacturing industry

DETERMINANT – 1: WITHERING TECHNOLOGIES – THE HEART OF TEA – MAKING



EXISTING TECHNOLOGIES

WITHERING TROUGHS – LEAVES SUBJECT TO AIR FLOW AND THERMODYNAMICS GOVERNED BY NATURAL CONDITIONS OF TEMPERATURE AND RH

GRAVIMETRIC REDUCTION OF WEIGHT RECORDED AS A MEASURE OF CHEMICAL WITHERING MATURITY IN A TIME

MOISTURE LOSSES ARE FUNCTIONALLY ASSUMED AS A MATURING CURVE FOR THE WITHERING IN CONJUNCTION WITH THE WEIGHT LOSSES

PHYSICAL WITHERING RESORTED TO STABILIZE THE MOISTURE LEVELS OF THE WITHERED LEAVES AT DESIRED STATES

DEB ALGORITHM – THE CUTTING EDGE WITHERING TECHNOLOGIES

ENGINEERED AIR WITH ENTHALPIES THAT BRING IN THE OPTIMUM ACTIVATION ENERGIES AT A PRECISION LEVEL TO TRIGGER THE EXOTHERMIC REACTIONS AND ESTABLISH THE THERMODYNAMIC EQUILIBRIUM COORDINATES AT FAR EXTREMES ON THE (x,y) PLANE ENABLING THIRD ORDER REACTIONS TO MATURE

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REAL TIME EMASURES OF THE POLYMERIC STATES TO DEFINE THE MATURING PHASES OF THE WITHERING PROCESS

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ESTABLISHING INDEPENDENCE OF WITHERING TIMELINES THROUGH ENGINEERED AIR

KEY NOTES:

1. DIFFERENTIALS

1.1. Analysis of polymerization states

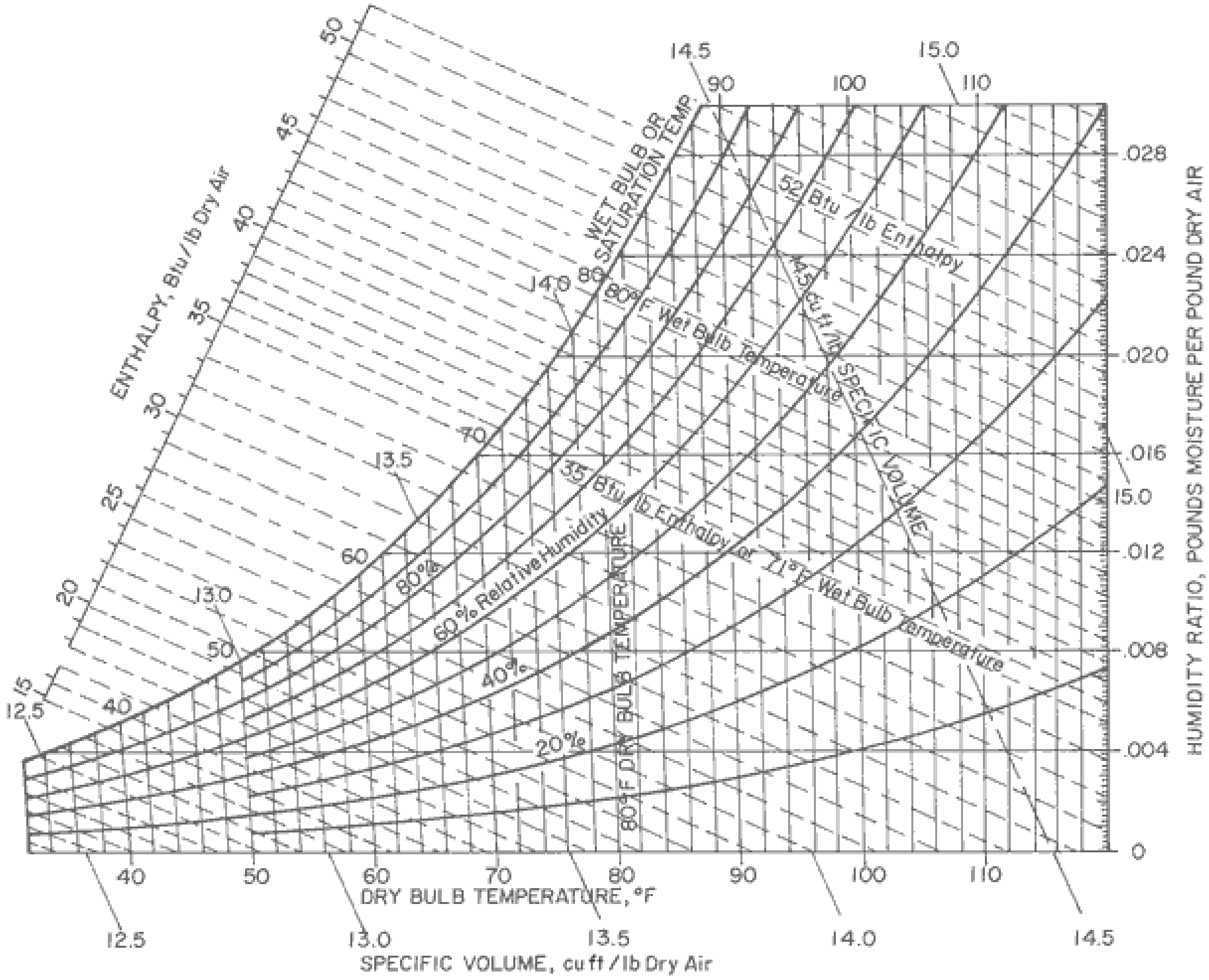
The first order reaction in the withering process is built around the fundamental vying for the activation energies to break free the radicals from the parent compounds in proteins, carbohydrates and the phenols existing in the form of PPO (polyphenol oxidase). The competing compounds are separated by the chiral nature of the bonds in the parent compounds; proteins being the strongest owing to polarity of the free radicals as compared to the carbohydrates and the phenols. Incidentally, the phenols have the lowest free energy states and consequently are subdued in the process of withering. The gradient of temperature as caused by the first state of activation energy is the harbinger for promoting the exothermic reaction. The delta or differential in energy states provides the impetus for the first order reaction states to proceed causing the breaking free of radicals from the parent compounds to form the electrolytes and while this process begins, the moisture gets trapped into the electrolytic concentration and coexists in the form of ionic complex. Thus a dielectric filed is created as a consequence of the first order reaction. However, there are preferential states with the proteins degrading into the amino acids while the caarbohydrates break free to form the simple sugars. The remnant activation energy is far too little in magnitude to trigger the breaking of polyphenols into catcheins and flavonoids. Consequently, the withering process is very often inadequate for the first order reactions to promote the polymerization process to aggressively progress to maturity.

The second order reactions begin with the cross linking polymers formed by the realignment of the amino acids and the sugars to form various oligomers (weak polymers) that are essentially the VFC – class I or volatile flavor compounds that are weak and hence are classified into class I. The amino acids are of twenty different kinds with various thresholds of pH values titrating from 2.2 to 9.8 and consequently have strong basic to strong acidic spectrum. Basic amino acids have relatively lower thresholds of free energy states and hence contribute to the formation of the oligomers with weaker polarity and orientation for higher volatility as reflected in the VFC – I.

The stable acidic amino acids having higher threshold peaks migrate to the third order reaction states as promoted by the delta of the gradient or the differential between the activation energies and the free energy states of the compounds. Consequently, the cross linking polymers have dimers forming the bonds thereby lending bond strength to the VFC – II or class II volatile flavor compounds of higher stability.

The progression of the third order reaction states significantly reduces the electrolytic strength thereby releasing the ionic complex of moisture aggressively resulting in significant reduction in both moisture and the weight of the forming cross-linking polymeric chains. The aggregation of the molecular weight gravitates to maturing peak values at the final equilibrium structure of the polymers causing the fundamental termination of the withering process.

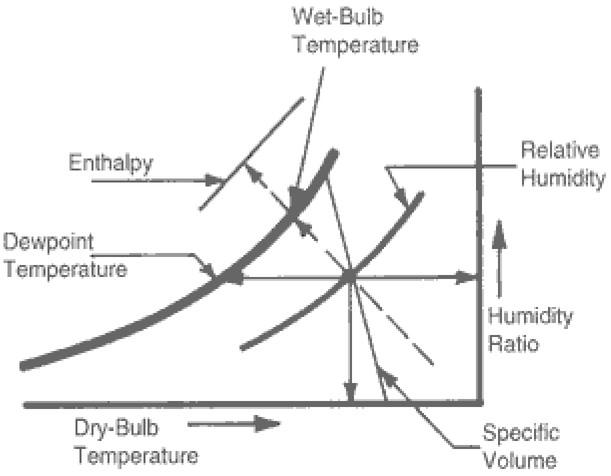
1.2. Coordinates of the thermodynamic equilibrium for the chemical kinetics reference frame and the fundamental independence of time series models

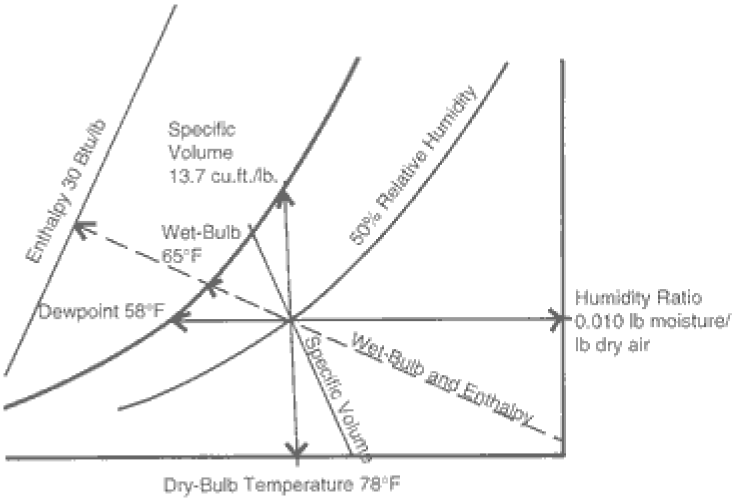


Enthalpy states in the tea leaves are defined by the natural relative humidity and the temperatures built into the system. These define the start of the exothermic reactive states and the conditions for the propagation.

The entropy in the system is between the internal system of the tea leaves and that of the environment in which the exothermic reaction is being conducted. Consequently, the transfer of enthalpy between the two environments shall occur in the milieu of increasing entropy promoted by the large ☐t or the thermodynamic differences.

Higher temperatures with higher relative humidity cause thermodynamic disequilibrium owing to large increases in moisture content and the internal heat in the system that leads to volatility of the moisture particles within the environment. Relatively stable equilibriums are achieved at higher relative humidity but with a correspondingly lower temperature.





Thermodynamically favorable but kinetically unfavorable

Unregulated exothermic reactions in the tea substrates are thermodynamically favorable; yet the kinetics hinder owing to the lack of increases in entropy to desired thresholds. For the kinetics to increase the rate of reaction, the differences between the enthalpies between the internal and external environment need to be large.

Transition State

The thermodynamic hump becomes high at the transition between the enthalpies when the exothermic reaction heat is unquenched as in the transition state, or activated complex, the unstable heat energy is much higher and blocked from propagating.. Breaking bonds *always* requires the input of energy, and there are a *lot* of carbon-carbon bonds in diamond. Hence the height of the hump for the tea withering process is very high in the contemporary processes.

Kinetics help achieve the rate of the reaction which is fundamentally a thermodynamic determinant and is independent of the time for the reaction. Consequently, withering dynamics is not dependent on the time allowed for the process to mature.

The Equilibrium Constant K

The equilibrium constant, capital K, is a thermodynamic quantity. As such, it depends *only* on the overall reaction. The overall reaction and the degradation of the proteins to the amino acids shall have thermodynamic predominance at equilibrium.

K Depends on Stoichiometry

The equilibrium value shall be defined by the stoichiometric composition of the electrolytes during the breakdown of the proteins and the relative values of the pka and pkb; these in turn being defined by the quantum of shift in the thermodynamic medium while migrating to the external environment from the internal tea substrates.

First Order Reaction equation:

$\ln [A_2] / [A_2]_0 = - k_f t$ wherein the concentration of the reactant reduces exponentially with time in the first phase.

Second Order Reaction equation:

$[x] = \ln ([x]-[B]_0 / [x]-[A]_0 + k_f ([A]_0 - [B]_0)t + \ln ([B]_0 / [A]_0)$

The $[x]$ is the resultant concentration of the mixture of the two groups in the polymerization and is equilibrating as defined by time on a given thermodynamic state as defined by k_f; the specific kinetic constant in the polymeric medium.

Third Order Reaction equation:

Virtually all third order reactions depend upon a third polymer M; in the case of tea substrates the withering can terminate at the formation of the flavor compounds denoted by M. Depending on the kinetic constant k_f as defined by the thermodynamic states, the concentration of M can be increased by allowing the polymerization to proceed to order-2 VFC compounds.

The rate is defined by $d[A_2]/dt = kA^2 [M]$ where $A+A+M = A_2 + M$

Essentially, the activation energy has to provide the right gradient to allow the polymerization to equilibrate at higher concentrations of M; the third and final polymer chain.

1.3. Key postulates of the design

a) Withering is determined by the temperature or enthalpy gradient between the activation energy and the free energy states of the constituent compounds of the bio organic matter of the sap.
b) The activation energy can be designed through engineered air at the right temperature – relative humidity mix.
c) Factors of air velocity, volume, air drift and number of air changes influence the parameters of the activation energy and hence decide the equilibrium coordinates of the chemical kinetics of the thermodynamic reference frame.
d) Withering to maturity is **independent of time series** and is influenced by all of the above postulates.
e) Electrolytic concentration is the fundamental derivative of the relative states of withering maturity as defined by the coordinates of the thermodynamic equilibrium. Typically high electrolytic concentrations can subdue the elimination of moisture that is essentially trapped as ionic complex while promoting the third order reaction states through advanced controls on the activation energy thresholds can reduce the electrolytic concentration significantly.

The residue of electrolytic concentration as functionally determined by the coordinates of the thermodynamic equilibrium in chemical kinetics of the polymerization process define the efficiency of the tea making process with all of the final aspects as enumerated below:

- **Flavors and aroma; the essence of tea**
- **Keeping properties that determine diffusion rates and weight of the liquor**
- **Relative maturing ratios of theaflavins (TF) and thearubigins (TR)**
- **Line productivity as determined bat the CTC and the dryer**
- **Fermentation needs and time to maturity as determined by the relative states of the orders of reaction allowed to be achieved in the process.**

DETERMINANT -2: INFLUENCES OF DIELECTRIC FIELD ON CTC AND ROLLING WHILE CHANGING THE FERMENTATION FUNDAMENTALS

HIGH ELECTROLYTIC RESIDUE CAUSING STRONG DIELETRIC FIELD IN THE SAP – RESULTANT FACTORS OF INFLUENCE CLUSTERS

CLUSTER STATE – 1A: CTC JAM UP – FREQUENT, ABRASION OF CTC ROLLERS, DAMAGES TO WIRE PROFILE, MACERATION QUALITY AFFECTED

CLUSTER STATE – 1B: ROLLING FRICTION INCREASES EXPONENTIALLY CAUSING INCONSISTENT FINES AND UNEQUAL SAP CONCENTRATIONS

CLUSTER STATE – 2: FERMENTATION OFTEN CAUSES SHARP INCREASE IN MOISTURE OWING TO HIGH ELECTROLYTIC CONCENTRATION THAT ATTRACTS THE MOISTURE IN TO THE FIELD TO FORM IONIC COMPLEX

QUICK MATURING OR TERMINATING WITHERING CAUSES THE COORDINATES OF THE THERMODYNAMIC EQUILIBRIUM TO BE OFFSET THEREBY PROMOTING VARYING AND OFTEN ERRATIC TR / TF RATIOS ON EQUIVALENT FERMENTING TIMELINES

LOW ELECTROLYTIC RESIDUE CAUSING VERY LOW FLUX STRENGTH FOR THE DIELECTRIC FIELD ON THE SAP – RESULTANT FACTORS OF INFLUENCE

CLUSTER STATE – 1A: EXCELLENT PERFORMANCE ON THE CTC OWING TO **EXTREMELY LOW FRICTION FIELD** – LOW JAM UP AND HIGHER PRODUCTIVITY ASSURED BY A MINIMUM OF 30-35%

HIGH RETENTION OF WIRE PROFILE AND SHARPNESS OF EDGES

CLUSTER STATE – 1B: **ROLLING FRICTION REDUCES RADICALLY** CAUSING DECIDEDLY SUPERIOR FINES AT EVERY ROLL

CONSISTENT AND REPORDUCIBLE SAP CONCENTRATION AS WELL AS BIO ORGANIC CHEMICAL CONFIGURATION ON AN IDENTICAL PRE-FIXED PRESSURE REGIME

CLUSTER STATE – 2: FERMENTATION IS DOMINANTLY ACHIEVED IN THE THIRD ORDER REACTION STATES OF WITHERING CAUSING HIGH FLAVONOIDS IN THE SAP

FERMENTATION TIME IS REDUCED TO LESS THAN 30 MINUTES WITH **REPRODUCIBLE RESULTS AND CONSISTENT MATURING OF TF / TR RATIOS AS FUNCTIONALLY DETERMINED BY THE RELATIVE POLYMERIC STATES**

DETERMINANT – 3: DRYER TECHNOLOGIES

The drying curve of fermented tea is a complex dynamics that has the functional elements drawn in from the characteristics of the tea substrate and the trappings of the moisture in the electrolytic complex of the sap. Consequently, moisture at feed is functionally defined by the properties of the sap on the leaves.

The tea substrates have been researched into for grasping the configurations of the sap in the realms of the strength of the dielectric field, the states of maturity of the polymerization chains in the degradation of the primary organic compounds and the subsequent formation of the secondary and tertiary polymer compounds as reflected in the sap concentrates at the termination of the withering as also the oxidation and fermentation processes prior to the feeding at the dryer. All of these help define the enthalpy of the tea substrate in the dryer; a fundamental pre-requisite to establish the dryer enthalpies.

The dryer enthalpies also require computation by factoring specific heat of the steam at the transfer points into the input air, the number of air changes within the furnace area as designed by the CFM ratings of the impellers at both input and exhaust, the volumes of hot air in circulation at any given point, the velocities of air real time and the refractory capabilities in achieving heat insulation as determined by the instantaneous heat and humidity evaluations of the injecting air.

The Deb Algorithm factors in the computation of the tea substrate enthalpy, evaluates the enthalpy of air in the fluidized chambers real time and finally computes the equilibrating heat levels after the exchange in each of the zones. Steam efficiency and customized drying commensurate with the quality of withering and fermentation are the major derivatives of the Deb algorithm for the dryers.

Fundamental needs in the dryer rivet around the structure of changes in enthalpy that can break in to the electrolytic field of the sap and trigger the physiological changes in the tea while preserving the keeping properties achieved in the process hitherto. The evaluation of primary data has always been the grey area in the industry thereby forming the blind spots for the process technician. Insights within this white paper seek to bring forth the nuances of changes in the dryer that can help decide on the parametric identities in the process. Mathematical precision is designed to found the automation initiatives and unravel the underlying causal linkages to drying tea optimally.

Discussions:

Data coordinates in the enhanced FBD automation

A.1. Enthalpy grid for the tea substrate

a) Measuring the dielectric field on the sap in the moist region through the usage of electrical field maps. The sensors shall be strategically located in the proximity of the tea substrates on the vibratory bed to capture the changes real time and wire in the output signals to a processor for mathematical computation.

b) The tea substrates shall also have temperature sensors of high fidelity to capture the instantaneous changes in substrate temperatures in the moist region. Needless to add, these output signals shall also be wired into the software for calculating the enthalpy.

c) The relative humidity of the substrates shall be computed through the sensors for approximating the conditions in the tea in the moist zone of the FBD.

d) Basic computation of the three variables as outlined in a0, b) and c) above shall help compute the enthalpy in the tea substrate accurately in the software real time and display the values as a scatter in the reference frame.

e) The timeline for the scatter to update shall be around 5 coordinates within 60 seconds. The statistical interpretation of the scatter shall be robust and mathematically accurate riding on the sheer density of the real time data.

A.2. Enthalpy grid of the inlet air

a) All inlet points of the fans shall have the temperature as well as the RH sensors to feed the fundamental data for enthalpy evaluation.

b) The fan drive factors shall also be captured for each inlet to compute the instantaneous air velocity and volumes; an important criteria for correct calculation of the air enthalpy.

c) The gaps in delta (enthalpy differential between the inlet air and the tea substrate) shall be plotted real time and treated to statistical inferences for the process technician to study the variables and plan parametric decisions.

d) The steam dynamics in the boiler for computing the steam pressure within safety levels shall be triggered by the statistical inferences of the delta real time thereby enabling the scatter of the delta to follow a desired curve profile.

e) Specific heat of the transferred steam, the air enthalpy generated at the moist zones and finally the rate of reduction in the field strength for the tea substrates shall help gather vital information on the processing conditions of a given batch with regards to withering and oxidation properties achieved and also help predict the conditions for preserving the original keeping properties of the resultant liquor for each batch.

A.3. Enthalpy grid of the exhaust

a) All the exhaust fans shall have the temperature as well as the RH sensors to compute the air enthalpy accurately.

b) Evaluation of the delta differential between the inlet and the exhaust shall home in on the residence time saturation levels at the designed CFM ratios and shall be the key derivative for an analytical approach to process possibilities for eventually defining the air change parameters that might be suitable for tea substrates of a given growth area and between batches with varying keeping properties.

c) Stagnating heat cycles shall be clarified through graphical interpretation of the inferential statistics in the model. The evaluation of the under pressure building into the system shall also be mathematically possible in the model through the algorithm and shall help give vital insights on the effective rate of evaporation of the moisture as a consequence of the breakdown of the electric field. The drying curve shall be founded on real time data and shall serve the purpose of enabling a knowledge environment to engineer the changes in parameters of the drying curve in higher degrees of process customization.

A. Derivatives of the algorithm

B.1. Enthalpy states of the tea substrate, the inlet air and the exhaust air shall be real time with the scatter density adequately high across the residence time. Statistical inferences shall be drawn to evaluate the equilibrating points in the wet zone, the effective number of air changes during the residence time and the characteristics of the drying curve in absolute terms.

B.2. Changes in the steam pressure as determined by the algorithm, the precision of the specific heat at transfer and finally the delta achieved across the timeline of the residence time. Inferential statistics shall give valuable insights on the CFM imbalances as a consequence of changing heat dynamics, the changes in the states within the tea substrates and finally the properties of the residual air been drawn off from the operating areas of the dryer.

B.3. Tea substrate changes in the strength of the dielectric field, the release of the moisture from the complex and the derivatives of the keeping properties as evaluated from the changes in surfaces described within the substrate during the residence time and the drying curve configuration achieved therein.

B.4. The software yield on important recommendations for the process technician with respect to the batch properties of the tea substrates as derived by the algorithm. The process experts can have the opportunity to validate the algorithm through a rigorous tabulation and logging in of the operating conditions in the process for each batch and the quality results obtained therein. Eventually, long term data shall help refine the algorithm to help create a veritable process control tool that can be used reliably.

B. Commercial benefits envisaged in the long run

C.1. Energy efficiency for the steam consumption per unit weight of made tea shall be the key benefit.

C.2. The consistencies in the drying curve shall be an important derivative of the automation process.

C.3 Differences in properties between the batches of tea shall be chronicled and logged with absolute certainty using the algorithm.

C.4. Historical logging of FBD automation data and the statistical inferences shall help fine tune the process and correlate the quality.

C.5. The properties of a stabilized tea manufacturing process can be documented with validated data like never before to enable the processes to be optimized with higher thresholds of precision.

A. DESIGN OBJECTIVES FOR THE FBD

The fundamental changes in the FBD design are directed to derive a) transfer rate of heat onto the substrate, b) the dwell time for the heat equilibrium to be achieved and the related number of air changes that are required to maintain the said equilibrium and finally c) the trade off for the heat dynamics to establish the maximized conveyor speed for the substrate transfer.

The identification of the elements that can bring in the synergy for establishing the quality paradigms of the FBD and the productivity objectives therein hinge on the comprehension of the following elements of influence:

B. ELEMENTS OF INFLUENCE

Element -1: The CFM balancing between the inlet draft and the exhaust fans
Element -2: Air drift and velocity domain within the chamber
Element -3: Enthalpy quantum in the chamber
Element -4: Transfer rate for the enthalpy computed in the chamber
Element-5: Heat transmission losses within the reference frame

C. ELEMENT DESIGN – THE BLUEPRINT FOR THE INFLUENCE PARAMETERS

Mathematical expression of the CFM calculations of the impeller; either for blowing or suction depending on the configuration; centrifugal and centripetal respectively:

a) Basic influence variables of the impeller:

a.i) Impeller volume per unit rotation: υ
a.ii) Impeller specific mass of the built in material in a dynamic mode: ψ
a.iii) Impeller – the total surface described in one rotational span: ε
a.iv) Impeller specific density (notionally the median of the densities distributed in the reference frame of the impeller): ρ_d
a.v) The specific thermal expansion coefficient for the material of the chamber (γ); essentially a sub-variable impacting the calculations of impeller pressure that gets propagated

b) Nodes for calculation needs:

b.i) Impeller **specific pressure** f(p) imparted over the domain of the reference frame
b.ii) **Quantum of turbulence in the air** f(τ) caused by the reference frame in a unit of rotation
b.iii) **Torque** f(φ) required for generating the **pressure equilibrium of the impeller**

c) Nodes for balancing calculations:

c.i) The **CFM drift** between the induced and the forced draft
c.ii) The **dwell time** between two consequent air changes
c.iii) **Quantum of enthalpy concentrated in the dwell time** within singular **air changes at any random time coordinate**

D. Calculations relevant to the design of the FBD

Derivation -1: Impeller Pressure

$f(p) = g(\tau)^{\nu 1}{}_{0} . (\varphi)$

Impeller pressure is primarily a function of the impacting torque and the domain of turbulence with the boundary decided by the power profile of the motor. This is an important parameter which is often ignored and requires controls over the functional timelines to identify the failing parameters that might lead to ripple effects in the performances of the dryer. Power profile influences the flux strength and the corresponding torque values quite significantly.

Notes on the derivation:

D.i. The enthalpy of the air being blown in by the impeller is the key determinant for the impeller pressure and is governed by

a) the quantum of heat being transferred effectively,
b) the volume of dry air equivalent (technically the CFM) being blown in or within the boundaries of influence of the impeller,
c) the total surface area described by the profile of the impeller,
d) the configuration of the changes in air densities within the area of influence of the impeller,
e) the specific momentum of the impact of the impeller onto the air stream

Derivation -2: Turbulence quantum

The key determinants in establishing the quantum of turbulence that can make an impact in the dryer include the characteristics of the refractory wall. Major realizations of the refractory wall are:

1. Mathematically, the expression shall be $f(\tau) = \gamma(\gamma). \eta(\eta)$ ωηερε $\eta(\eta)$ is the Young's modulus for thermal stress-strain curves for the refractory lining in response to the sustained heat cycles. The expansion and the commensurate strain of the wall can cause major shifts in the quantum of turbulence of the air thereby undermining the effective calculations. The imposition of disproportionate expansion of the refractory wall can weaken the enthalpy changes in the air and consequently reduce the heating configurations significantly.
2. The entropy of the heat system is dependent on the characteristics of the openness or closeness of the system as defined by the systemic power in retaining the heat within the refractory. Fundamentals of predicting the right entropy changes within the timeline of the refractory lining shall define the turbulence quantum of the air. Entropy changes influence the heat quantum and the commensurate transfer to the substrate. Retention of heat by the refractory lining is the kinetic element that either embellishes the performances of the dryer or causes redundancy. Hence the defining elements are:

2.1 Yield Curve on thermal strain: The area described would need to be higher to compensate for a larger number of heats.

2.2 Primary distribution of heat in the furnace area: Enthalpy transfer is influenced strongly by the distribution of heat in the furnace area and the near absence of hot spots and cooler spots as well.

2.3 The specific heat retention on the walls and in the distributed areas would have a significant impact on the performance of the dryer

3. Air turbulence shall define the drift characteristics and the air velocities; two main factors that influence the drying performances in the dryer for a wide variety of substrates.

Derivation -3: Torque

1. Torque is influenced by the flux strength and the features of crest factor defining peak current configuration and the periodicity, the PF and the phase angle for reactance as also the influences of hysteresis.

2. The harmonics in the system shall be the precursors for determining the timelines for the progressive reduction in the power factor and the drive efficiency as also in the reduction in motor efficiency for the drive transmission to the impeller.

3. The quality of air turbulence and the distribution of heat as also the influences on the air changes shall all be defined by the drive efficiency and the concomitant transmission losses.

Mathematically, $f(\varphi) = g\,({}^{n1}(\omega)_{n0}).\ \xi(\delta)$ where φ= phase angle and ω= THD% mapped as functionally the energy curve arising out of the total harmonic distortion within the domain constraints of n_0 and n_1.

Torque is certainly a powerful determinant for efficiently establishing the impact on the impeller and hence by an extension on the distribution of the air within the furnace area.

Essential elements of the Deb Algorithm

1. Enthalpy measurements of the tea substrates is the key defining element in the Deb Algorithm and the data output of the automation process reveals the states of the tea making process.

1.1. The withering quality defines the electrolytic strengths in the sap of the leaves and is an element of measure for the evaluation of the tea substrates at the dryer after the fermentation has been terminated. The main derivatives of the tea enthalpy that get factored in the Deb Algorithm are:

1.2. Processing quality whether at the rolling tables or the cut rollers as the case might be to determine the frictional field that has been overcome to roll or macerate the leaves. This is an important factor that can bring forth the insights of the process in the built-in enthalpy of the processed tea substrates.

1.3. The quality of fermentation shall define the TF and TR ratios as evinced by the polymeric chain formation in the process. The levels of enzymatic activity in the fermentation process effectively define the quantum of moisture trapped in the ionic substrate and consequently determine the final enthalpy of the tea substrates; the key differential of the Deb Algorithm as entailed within the ambit of the research paper.

2. Enthalpy measurement of the hot air in the fluidized chamber

2.1. The air volume imbalances between the inlet and the outlet as determined by design and the combination of steam enthalpy at delivery; otherwise described as the specific heat of steam at transfer.

2.2. The consistencies in distribution of the hot air over the tea substrates are the other factors that are captured as an input element in the Deb Algorithm on a residence timeline.

2.3. The radiator dynamics for abilities to transfer heat and the concomitant factors of heat losses are also built into the Deb Algorithm as qualitative inputs into the system.

3. Final output of the Deb Algorithm can be outlined as follows:

3.1. The equilibrating heat between the air and the tea substrates is the key output.

3.2. Controls on the steam enthalpy are brought in through the Deb Algorithm to overcome various states of enthalpy in the tea substrate as determined by computations of the changes in the flux strength of the dielectric field and consequent release of the moisture from the ionic complex.

3.3. Real time evaluation of moisture reduction from the substrate is obtained asn output and automates the process of optimizing tea drying by altering the steam enthalpies real time thereby significantly improving on the possibilities of steam consumption and related energy fundamentals of the drying process.

KEY POSTULATES OF THE DRYER DESIGN:

1. **Energy efficiency through optimized enthalpy controls.**

2. **Drying parameters are linked to the states of tea making thereby bringing in reproducibility and quality consistency between batches.**

3. **The algorithm factors in and is built on real time measures for reproducing the tea quality to facilitate the user to comprehend the process in a deepened state of learning.**

ANALYSIS OF WITHERING SOLUTIONS WITH ADVANCED DEB ALGORITHM

PARAMETER	BILL OF MATERIAL	BILL OF QUANTITIES	UNIT PRICE	TOTAL MATERIAL COST	KEY ADVANTAGES
WITHERING - ACTIVATION ENERGY CONTROLS	CHUTE FOR PACKING GL WITH IN-BUILT SUCTION AND EXHAUST FANS WITH CFM AND AIR CHANGE RATIO AS DEFINED BY THE DEB ALGORITHM	1 for 20,000 Kg GL/ BATCH OF 4 HOURS OF 100,000 / WORKING DAY OF 20 HOURS	25000	25000	WITHERING TIME - 4 HOURS
	PRESSURE TRANSDUCER	5	2000	10000	FERMENTATION TIME IN UPSTREAM PROCESSING - < 30 MINUTES
	ONLINE MOISTURE ANALYZER	2	14000	28000	CTC PRODUCTIVITY ENHANCEMENT - 30% / ROLLING TABLE PRODUCTIVITY ENHANCEMENT - 40%
	ONLINE DIELECTRIC FIELD STRENGTH ANALYZER	2	30000	60000	FBD PRODUCTIVITY ENHANCEMENT - 35%
	CHILLING PLANT	1	10000	10000	FLAVORS - REPRODUCIBLE AND INSULATED FROM THE INFLUENCES OF GROWTH AREAS AND CLIMATE PARAMETERS
	VACUUM PLATE DRYER	1	12000	12000	
	AUTOMATION - HARDWARE AND SOFTWARE DEVELOPMENT	1 LOT	30000	30000	ENGINEERED PROCESS
	INSTALLATION, COMMISSIONING AND TEST RUN FOR PROCESS STABILIZATION	1 LOT	25000	25000	
	TOTAL COSTS			200000	

PERFORMANCE GUARANTEES - WITHIN 3% DEVIATION FROM CLAIMED DERIVATIVES

ANALYSIS OF DRYER PERFORMANCES WITH THE ADVANCED DEB ALGORITHM

PARAMETER	BILL OF MATERIAL	BILL OF QUANTITIES	UNIT PRICE	TOTAL MATERIAL COSTS	KEY ADVANTAGES
DRYER AUTOMATION WITH ADVANCED DEB ALGORITHM	CHUTE WITH 3 PRESSURE TRANSDUCERS FOR REGULATED FLUIDIZING OF TEA PARTICLES	1 LOT	35000	35000	ENERGY REDUCTION - 30% OF STEAM CONSUMPTION / KG OF MADE TEA
	ONLINE MOISTURE ANALYZER	2	14000	28000	RESIDENCE TIME - 12 - 13 MINUTES
	ONLIE DIELECTRIC FIELD STRENGTH ANALYZER	2	30000	60000	MOISTURE IN MADE TEA - 2%
	VSD FOR INLET AND EXHAUST FANS	6	2000	12000	GRADES DIFFERENTIATION IN OUTPUT - HIGH RESOLUTION WITH 30% IMPROVEMENT IN FIDELITY OF GRADES AND RADICAL REDUCTION OF STALKS
	AUTOMATION - HARDWARE AND SOFTWARE DEVELOPMENT	1 LOT	30000	30000	
	INSTALLATION, COMMISSIONING AND TEST RUN FOR PROCESS STABILIZATION	1 LOT	25000	25000	
	TOTAL COSTS			**190000**	ENGINEERED PROCESS

PERFORMANCE GUARANTEES - WITHIN 3% DEVIATION FROM CLAIMED DERIVATIVES

DETERMINANT -4: CONCLUDING EXECUTIVE SUMMARY

1. **Payback at depressed market conditions with the depressed tea prices of US $ 1.5 / Kg for BP-1 and 1.8 $ / Kg for PF -1 grades shall be 45 days.**
2. **Auction prices for radically improved quality shall in all probability be hitting > US $ 4 / Kg even with current market sentiments.**
3. **Fundamental consistency of grades and productivity in the processes shall bring in massive improvements of the financials in the tea factories.**

B: EXECUTION PLANS

1. Debasish should be **heading operations for a period of 2 years at the baseline with the following accountability:**

a) **Design and development** of new products

b) **Converting an existing plant as a pilot with retrofitting and organic transformation models in place to showcase developments and possibilities real time.**

c) **Drive revenues and sales** through the product validations and revolutionizing the tea industry as well as achieving brand penetration, leadership and sustainable growth.

2. **Training of engineers** for abstract thinking, research aptitude and quality of engineering workmanship on the shop floor.

3. **Financial turnaround of the operations** to sustained levels of profitability and aggressive liquidation of debt to boost organic profitability