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MODIFICATION OF DRYING SECTION IN PAPER RECYCLING PLANT

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***Abstract*— The topic of this Modification of drying section in Paper recycle plant of the last part of the paper machine the drying section. Paper is dried by letting it pass through a series of steam heated cylinders and the evaporation is thus powered by the latent heat of vaporization of the steam. The moisture in the paper is controlled by adjusting the set point of the steam pressure controllers. They are the present system is used for recycle plant. This system is modified drying section with the help of heating coil roller system. It occupies less floor space or easy to portable maintenance cost is low. It also creates opportunity for increased production rate.**

***Index Terms*— Drying Coil, Cylinder, Rollers, Heated.**

I. INTRODUCTION

The most common way to evaporate water from the paper web is to use the latent heat of vaporization in steam. A steam filled dryer is a cost effective method to transfer heat into the sheet. The energy in steam has proven to cost less than a quarter of any other available method. The drying section is the largest energy consumer and the longest part of the paper machine. The dryers of the fastest machines are now being designed as one long single-tier with no alternating sections; thus one side of the sheet is always in contact with the fabric while the other is periodically in contact with the drying cylinders .The paper sheet is heated as it wraps around successive cylinders. Between cylinders the sheet is exposed to the ventilating air which is heated to provide moisture carrying capacity to evacuate the evaporating moisture from the region. The whole section is an enclosed region which operates at conditions which are controlled to maintain a constant sheet moisture content .Modification process for the develop the roller heating system. This system is used for paper recycle machine for drying section. It neglected the steam boilers system. This process is used for heating coil system for drying section .It reduced less floor space less labor cost or maintenance cost.

II. RESEARCH REVIEW

A. George and Hansen (1972)

Were the first comprehensive descriptions of conventional steam-heated cylinder paper drying. Their work is credited with defining the four phases of multi-cylinder drying which is necessary when implementing a numerical solution with representative, varying, and boundary conditions. The solution calculates temperature change only, based Fourier's heat transfer equation, with moisture change measured experimentally in trials on a 1 mm thick sheet .

B. Han (1978)

Examined the hot surface drying of fiber mats. He was the first worker to analyses the internal moisture transfers occurring as paper dries. Han observed a quasi-steady-rate drying period and noted the very large capillary pressure gradients brought about by the very wide pore size distribution Han was no doubt

Frustrated by the intense computational burden that his drying model created, for in summarizing the qualitative work on paper drying by Sherwood.

C. Han published a further paper in conjunction with Matters (1982)

Which concentrated on the vapors diffusion component of paper drying. They obtained correlations for the diffusibility of vapour in a fiber matrix and concluded that normal diffusion accounts for 40% of the total drying rate.

D. Depoy (1988)

Extended Nissan's work by including a calculation for moisture removal based on surface differentials. The model complexity was limited by the use of analog computer solution. Depoy quoted experimental results for both absorbent felts and open weave synthetic fabrics. Use of the latter was shown to allow double the drying rate under dynamic conditions. Such results provided the confidence for industry to make the transition to a different felt philosophy.

E. Hartley and Richards (1992)

Advanced the quest to describe the paper drying process with a diffusion based model. Their paper acknowledged

Corte's work (1957, 1962) which showed the occurrence of capillary flow within the drying sheet, yet chose to construct the model on the basis of both liquid and water vapour diffusion. The model restricted itself to hot surface drying and as such did not address the varying boundary conditions prevalent within a paper machine. It was suggested that shrinkage be considered as a factor in future drying models.

F. Pounder and Ahrens (1997)

Presented a model of high intensity paper drying. This phenomenon occurs when the heated surface of the wet web is at or above the thermodynamic saturation temperature corresponding to the ambient pressure. Their work focused on bulk flow as the dominant mechanism associated with paper drying and was aimed at drying systems operating at temperatures from 175°C to 400°C in tandem with pressures from 7 KPa to 5 MPa. For these reasons their model assumptions and results were not specifically applicable to the current study.

III. DRYING SECTION

Even after passing the paper from entire Press Section, Paper remains still wet hence it requires eliminating remaining water which can only be done through the application of heat. This is carried out by Paper Machine Drying section consists of a series of steam heated cylinders varying in diameter. These Dryers we fabricate in house in Mild Steel material which has top quality and high efficiency. At the end of this operation, the paper will have practically eliminated most of the water it contained, leaving only 5-7% moisture which is necessary in its final composition to maintain elasticity.

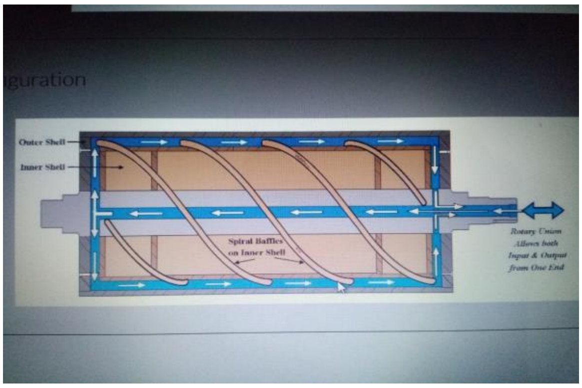

Fig. Heating roller coil

This roller system is heating coil is used Resistive heaters can be made of conducting PTC rubber materials where the resistivity increases exponentially with increasing temperature. Due to the exponentially increasing resistivity,. Above this temperature, the rubber acts as an electrical insulator. The temperature can be chosen during the production of the coil. Typical temperatures are between 0 and 120 °C.

Fig. Heating rollers

ANSYS

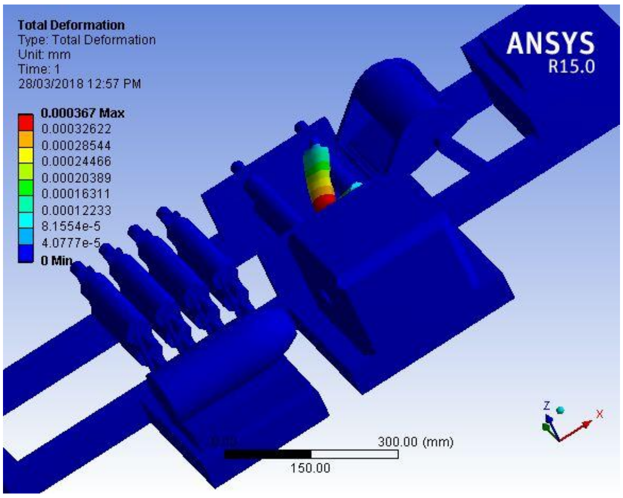

Fig. Total Deformation

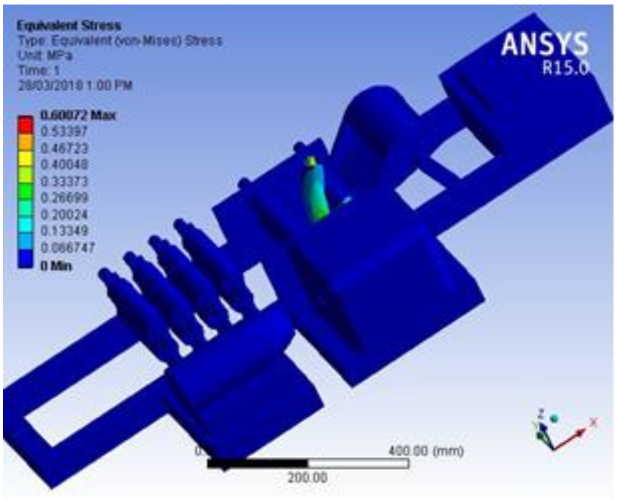

Fig. Equivalent Stress

IV. EXPERIMATION RESULTS

TABLE 1
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Fixed Support 2*	*Force*
State	Fully Defined		
Scope			
Scoping Method	Geometry Selection		
Geometry	3 Faces		2 Faces
Definition			
Type	Fixed Support		Force
Suppressed	No		
Define By			Components
Coordinate System			Global Coordinate System
X Component			-70. N (ramped)
Y Component			0. N (ramped)
Z Component			-100. N (ramped)

TABLE 2
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done

TABLE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Stress*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	Equivalent (von-Mises) Stress
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. mm	0. MPa
Maximum	3.67e-004 mm	0.60072 MPa
Minimum Occurs On	MSBR	
Maximum Occurs On	MSBR	
Minimum Value Over Time		
Minimum	0. mm	0. MPa
Maximum	0. mm	0. MPa
Maximum Value Over Time		
Minimum	3.67e-004 mm	0.60072 MPa
Maximum	3.67e-004 mm	0.60072 MPa
Information		
Time	1. s	
Load Step	1	
Sub step	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

V. Material Data : Mild Steel

TABLE 5
Mild Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

TABLE 6
Mild Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 7
Mild Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250

TABLE 8
Mild Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250

TABLE 9
Mild Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460

TABLE 10
Mild Steel > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22

TABLE 11
Mild Steel > Alternating Stress Mean Stress

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

TABLE 12
Mild Steel > Strain-Life Parameters

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920	-0.106	0.213	-0.47	1000	0.2

TABLE 13
Mild Steel > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2.e+005	0.3	1.6667e+005	76923

TABLE 14
Mild Steel > Isotropic Relative Permeability

Relative Permeability
10000

VI. RESULTS & CONCLUSION

The surface mass transfer coefficient is one of the main first order parameters which control drying rate in the paper machine. A series of laboratory trials were carried out to determine the variation in mass transfer coefficient under changes to test variables. Changes in air speed and dryer fabric permeability provided correlations for mass transfer coefficient against these two variables. The air speed is analogous to paper sheet speed on an actual machine and the dryer fabric permeability is a property which changes in each of dryer sub-sections. To integrate drying trials to form a single curve and then make comparisons between curves produced from different drying conditions, it was necessary to normalize the initial state of the paper sheets. Their ensured that variations in sheet basis weight and initial moisture content were taken

Into account when plotting drying curves. The temperature of the hot plate also varied slightly between tests at the same nominal operating conditions. This occurred as a result of the sharp temperature drop experienced by the hot plate when the cold aluminum backing plate with accompanying wet paper sample was placed in contact with it. This upset the temperature equilibrium of the system in a manner not precisely repeated at each trial.

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