Session 31 - Panel Discussion
Steambox Measurement and Performance

Jack Audas, V·I·B
Ankur Gupta, metso
Jack Rumel, Honeywell
Philip Wells, WELLS ENTERPRISES INC.

Timothy Patterson HERCULES ASHLAND.

Steambox Technological Issues

- **Why heat the Sheet**
- **Energy From Steam –**
  - **What type of steam? Superheated vs Saturated**
  - **Where does it go and where should it go?**
  - **How much is needed?**
  - **Is vacuum important? Is it needed, when is it needed?**
- **How do you figure out**
  - **How best to use a steambox**
  - **Where to use it**
  - **Whether or not it is effective**

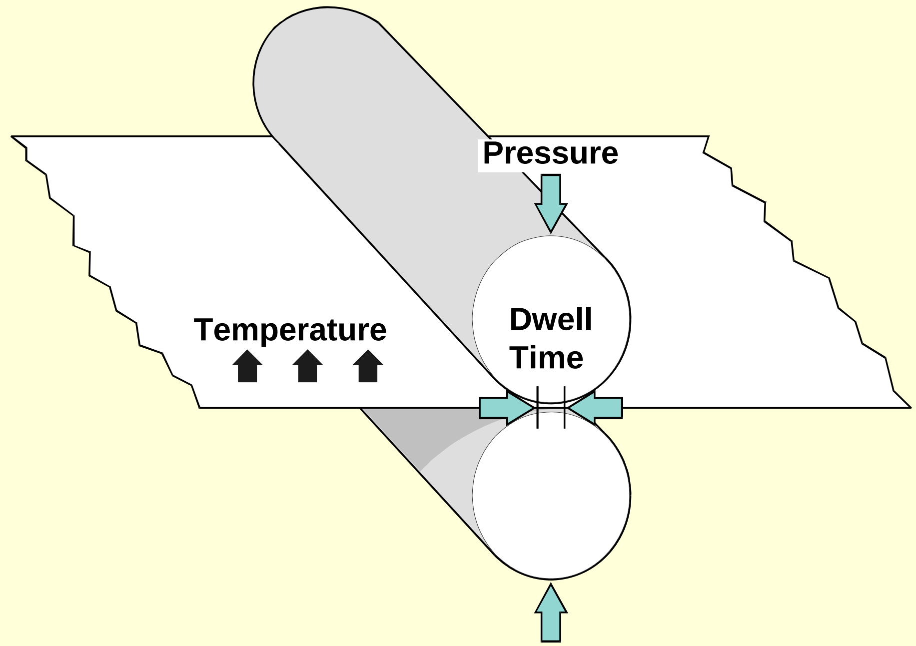
Practical Issues

- Pressing and rewet
  - Consider press loadings and covers BD or plain influence water removal / felt designs
  - Nip Versus Felt Dewatering! (Importance of well designed and maintained save-alls)
  - Rewet issues – overspray from doctors showers.
- Steambox
  - Distance from the sheet
  - Position with respect to vacuum box/zone
  - Old steamboxes require maintenance
  - Dangers of Homemade Steam Shower Designs!
  - Dangers of Welding on or modifying existing steam showers! Thermal expansion
- Performance Measurement
  - Hints for proper use of IR guns
  - Only use the steam shower when required
  - To evaluate performance of steam showers you must be able to measure the changes downstream.
- Maintenance
  - MUST maintain gauges and sensors
  - Cleanliness of the area
  - Trim Squirt splatter impact on couch applications
  - Hay-outs and fiber build up impact on steam showers in press section
  - Dripping issues
- Personnel
  - Needs and capability of the operators
  - The mill knows their machine better than vendor and must share past experience, planned changes

Principles of Pressing

Three hot pressing variables:

- Nip pressure
- Nip dwell time
- Sheet temperature

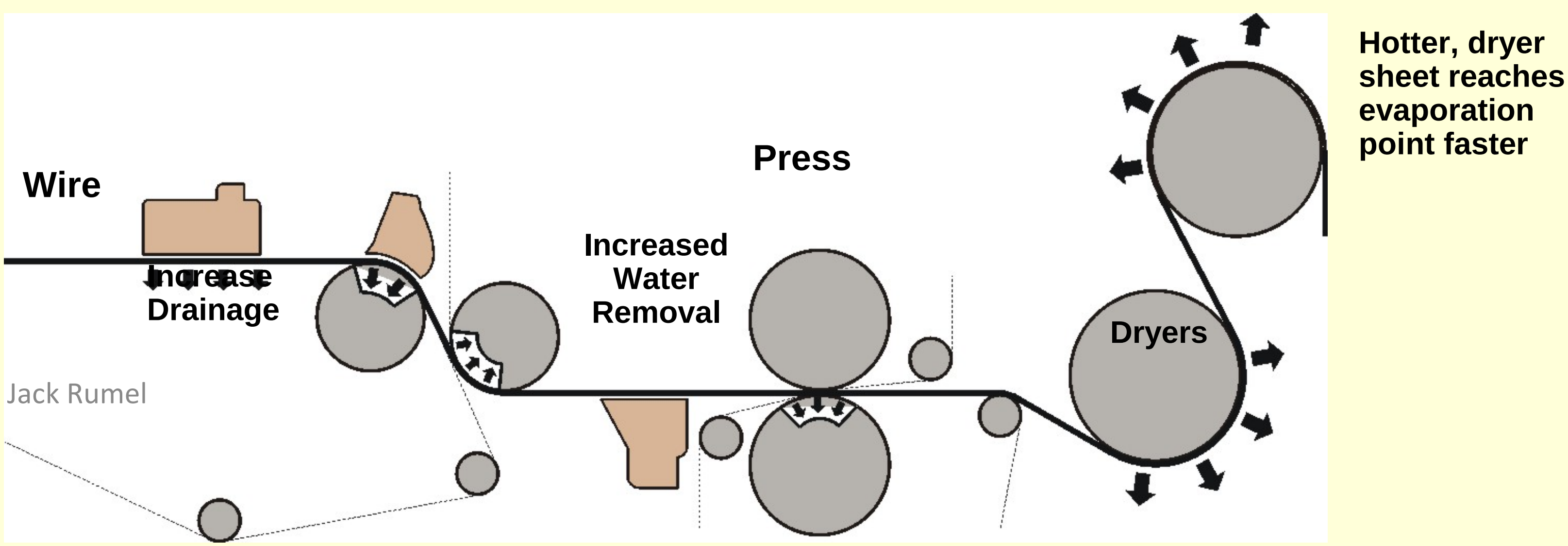


Changing sheet temperature offers the greatest improvements for the least cost

Why heat the sheet?

Increasing sheet temperature at the wet end

- Increases water removal
  - Reduces viscosity and surface tension
  - Increases sheet compressibility
  - Reduced sheet spring back potential
- Increases temperature into dryers



Energy Balance

Energy needed

– Heat water - specific heat water (4.18 kJ/kg- ^{o}C)

1 kilo-calorie heats 1 kg water $\rightarrow$1^{o}C

I kilo-calorie = 4.22 kJ

(OD BW kg/m^{2})(1/solids – 1)(Specific Heat$_{water}$)(ΔT ^{o}C)

= Energy$_{water}$

– Heat fiber - specific heat of fiber (~1.33 kJ/kg)

(OD BW kg/m^{2})(Specific Heat$_{fiber}$)(ΔT^{o}C)

= Energy$_{water}$

– Energy Rate (kJ/hr)

(Energy$_{water}$ + Energy$_{water}$) (machine speed x 60) (sheet width)

= Energy rate$_{total}$

Energy Balance

Energy available

- Steam sensible heat
  - no phase change (amount of super heat)
    - Specific Heat

      0.48 kcal/kg-^{o}C or 2.01 kJ/kg-^{o}C

      (steam flow rate)(Specific Heat$_{water}$)(ΔT ^{o}C)

      = Energy$_{superheat}$

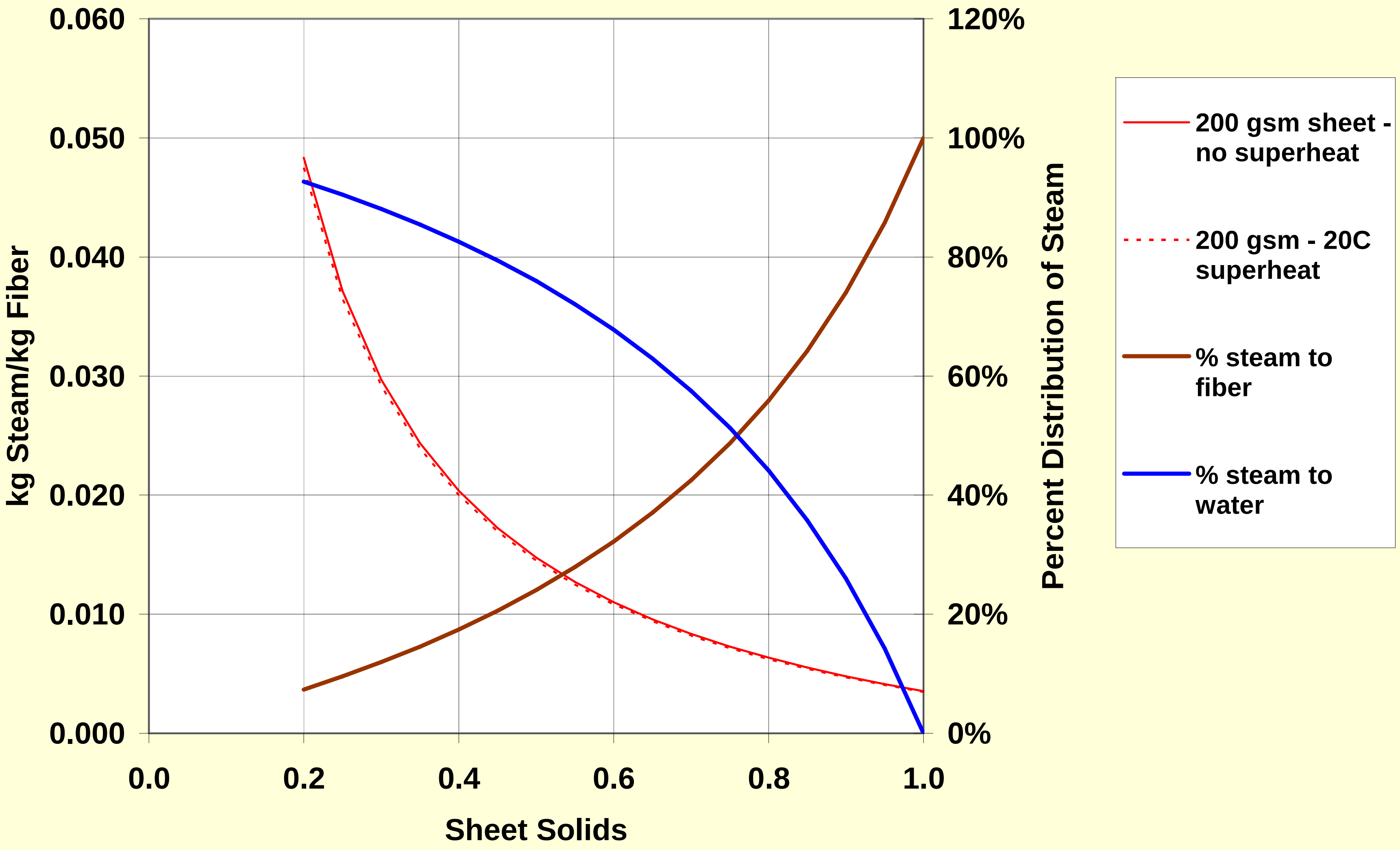
- Steam latent heat
  - phase change
    - Heat of vaporization/condesation = 2257 kJ/kg

      (steam flow rate)(latent heat)

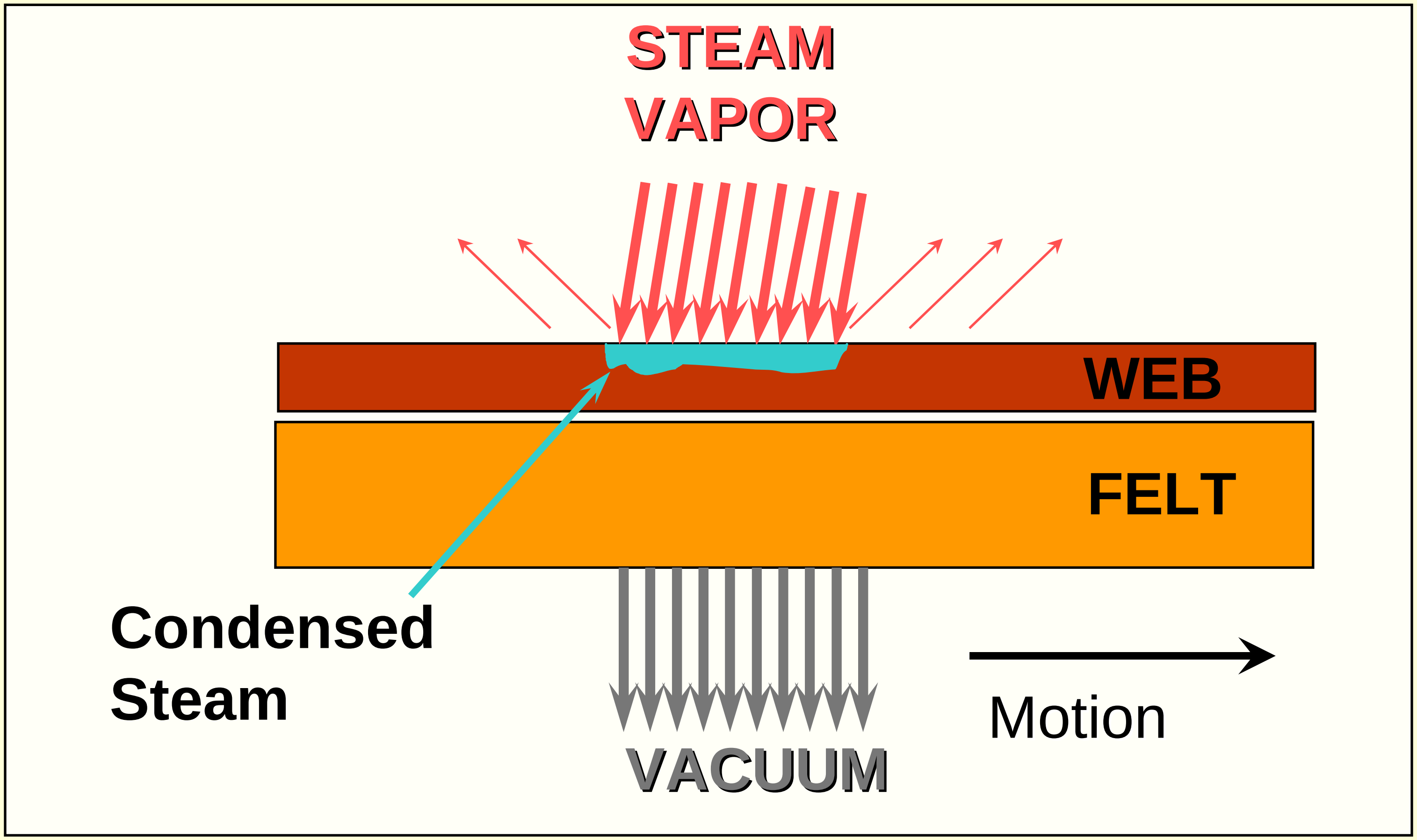
      = Energy$_{condesation}$

Energy Balance

Theoretical Steam Required for 30 ^{o}C Tmeperature Increase



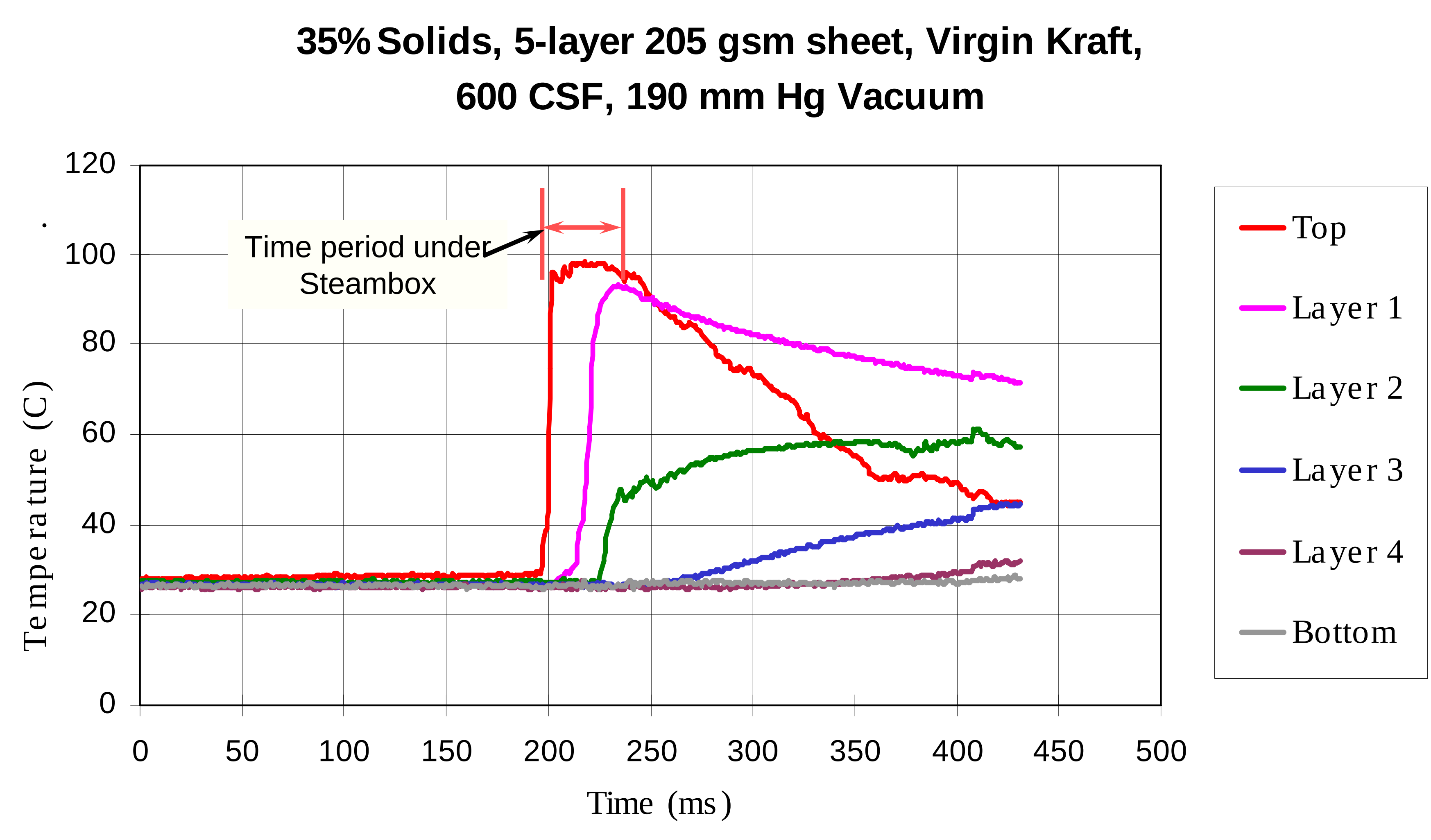
How it is supposed to work.



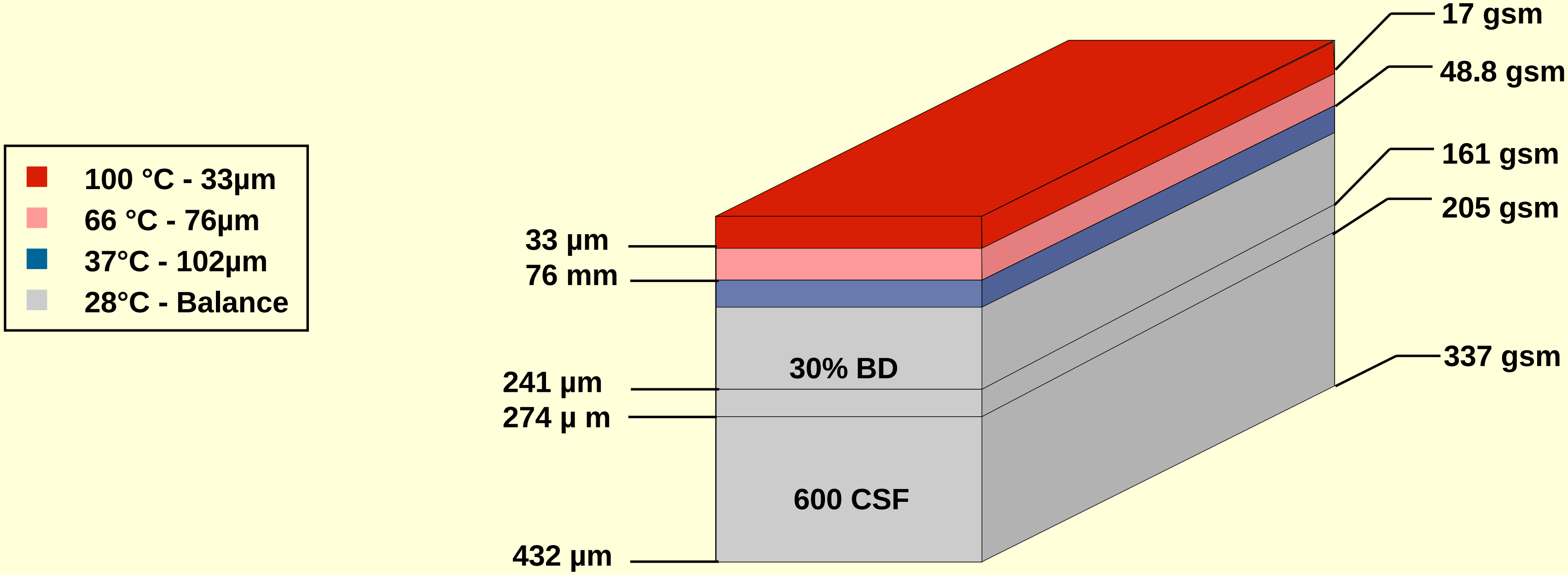
Condensation Transfers Energy

Sheet temperature increase depends on ability to condense steam in the sheet and the amount of water and fibers to be heated

Sheet Temperature Change



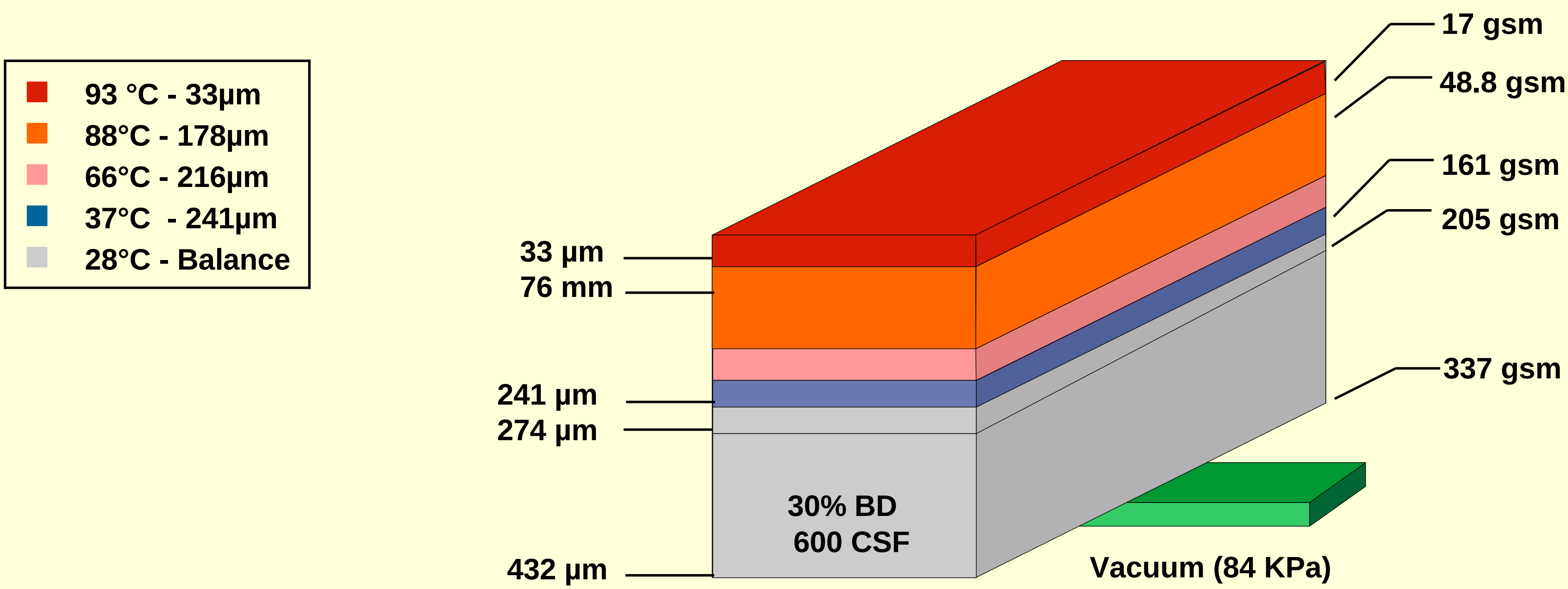
Heating Paper Web with Steam Shower
No Vacuum



PRODUCT	PORTION OF WEB HEATED		
17 gsm Tissue	100%	Speed	610 mpm
48.8 gsm Newsprint	75 - 100%	Dwell time	0.03 Seconds
161 gsm Corrugating	30 - 40%	Steam flow	0.07 kg/kg
205 gsm Linerboard	30 - 40%		
337 gsm Boxboard	15 - 25%		

Jack Rumel

Heating Paper Web with Steam Shower With Vacuum



PRODUCT	PORTION OF WEB HEATED
17 gsm Tissue	100%
48.8 gsm Newsprint	100%
161 gsm Corrugating	90 - 100%
205 gsm Linerboard	80 - 90%
337 gsm Boxboard	50 - 60%

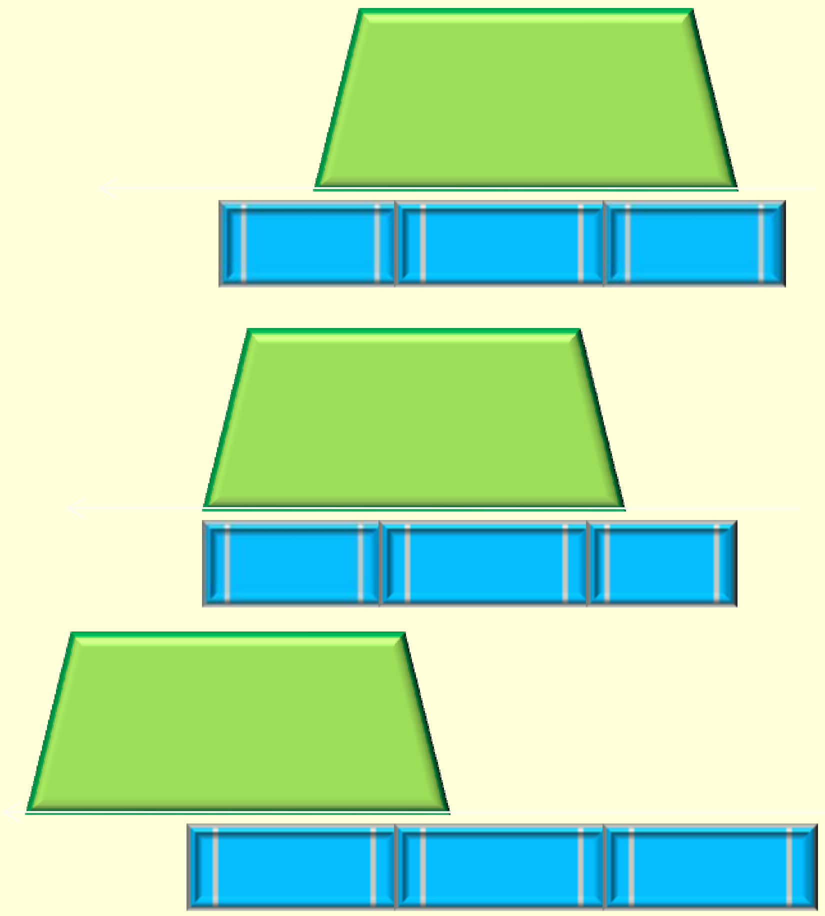
Speed	610 mpm
Dwell time	0.03 Seconds
Steam flow	0.07 kg/kg

Jack Rumel

Steambox position relative to vacuum box

Example: On the Former above Tri-Vac

- Incorrect
- Correct
- Incorrect



Is this the precise amount of steam required?

- Not exactly
  - Steam can only penetrate so far
    - Lighter weights sheets can be heated 100%
    - Heavy weight / closed sheets may only heat the surface
    - Vacuum helps
- Once the surface reaches 100°C, condensation is no longer possible
  - Steam won't penetrate the water layer
  - steam moves sideways to find a place to condense
    - Explains why bump test response width increases with higher steam flows

Typical Steambox Steam Consumption

Typical steam usage *:

- Fourdrinier

  0.10 to 0.18 #steam/#fiber or kg steam/kg fiber

- Press Section

  0.06 to 0.15 #steam/#fiber or kg steam/kg fiber

- Tissue / Pulp

  0.15 to 0.30 #steam/#fiber or kg steam/kg fiber

* If steambox is used exclusively for CD moisture profiling steam consumption may be even lower

MD Sheet Dryness Increase

Typical benefits from increased temperature

Each 10ºC (18ºF) increase in web temperature

- Increases sheet dryness into the dryer section by 1% yielding
  - 5% speed up or…
  - 5% dryer load reduction

Installation Location

Practical Considerations

- Distance from the sheet
- Position with respect to vacuum box/zone
- Doctor Blades
- Press roll covers
- Dry-line on the former

Steambox Evaluation

Considerations for evaluating a steambox

- Solids Increase
- Steam consumption for the above solids increase
- Profile improvement with the above results
- Maintenance requirements
- Effect on sheet properties
- Effect on environment around steambox

Total Life Cycle Benefits vs. Operating Cost

Discussion

– Superheated vs Saturated
– Basis weight considerations
– Vacuum
– Optimum machine location
– Performance evaluation
  - IR Temperature measurement
  - Sheet solids
  - Steam use vs dryer steam use
– Pressing and rewet – roll cover, felt dewatering
– Old Steamboxes
– Maintenance
  - Dripping
  - Gauges
  - Fiber build up
– Personnel – Mill interactions