



#### The Value of Humidity Measurement in Paper Manufacturing









For every tree cut 3 new trees are planted

Spruce and pine trees are cut every 60-70 years Birches, eucalyptus and acacias are cut every 8-15 years

The forest industry increases the number on trees by about 60% every 50 years





Over 90 % of waste paper is recovered and fully reused to produce new paper

There is a continous request for additional waste paper because of the continuos growth of the packaging paper production



### PAPER PRODUCTION

- Paper machines are running continuosly 24/7 and those can produce all kind of grades within this general parameters:
  - Grammage: from 14 to 400 g/m<sup>2</sup>
  - Speed: from 200 to 2000 m/min
  - Width: from 2 to 11.5 m
  - Tonnage: from 1 to 80 T/h





Inside the paper mills about 99% of the water is clarified and reused

Since 30 years we reduced the quantity of water from 50-70 to 3-10 l/kg of pulp and paper produced

Only 1 l/kg of paper is evaporated



### PAPER HUMIDITY

 The possibility to know the paper humidity in the different phases of the paper production is extremely important because the control of:

- Quality: the paper produced needs to have the same humidity on both, transversal and longitudinal
- Cost: the water used has to be removed with the minumun use of the thermal energy



































## The basics are forming, wet pressing and drying





#### Water removal costs

#### Water Removal kg/kg fibers

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Specific Cost of Water Removal

124	2.25	1.25
		E
Gravity	Mechanical	atic
Fabric Tension	Compression	apor
Vacuum		Ev
\$0.014/ton	\$0.019/ton	\$22.00/ton
Former	Presses	Drvers



#### PAPERMAKING

- The present papermaking technology cannot avoid to use water
- The water used is in the range of 3-10 lt per kg of paper produced
- The water removed via thermal technologies is about the same amount of the paper produced



# Where is important to know the paper humidity

- Immediately after the forming phase:
  - This could allow to manage the drainage curve and vacuum applied
- Immediately after the press section:
  - This will allow to monitor the presses, felts and conditioning activies and to manage any potential setup change
- Immediately after the dryier section:
  - This is the end of the production and the paper quality is defined on base on the measured parameters



#### Paper Web cross profile at reel





## **Today Monitoring**

- Efficient humidity monitoring is normally made at the end of the dryer section.
  - Gamma Rays are used to measure costantly the paper production both, transversal and longitudinal, with a sensor crossing the paper web.
  - The sensor works well on a very closed range of humidity (90-99%)
- In few cases, the same monitoring is applied in between the dryer section before the addition of surface additives



### Humidity measurement trials

- Measurement at high value of humidity (above 50%) are in progress
  - Cristini felt producer use a very high microwave frequency.
    - This requires fixe distance from the paper and it could measure fixed point or transversal
  - Lamort machinery producer use a mathematical measurement of average humidity
    - This requires steam, condensate and water sensor to determine the total amount of water removed on base on the calories used



#### CRISTINI Epic<sup>™</sup> sensors system – On-line smart papermaking technology





#### Humidity measurement trials

- Infrared is normally used to determine the humidity on the paper web.
- Unfortunately this technology is very good but it measures the paper surface without penetrating the high paper thickenesses
- Paper coloured dark brown is also influencing the measure



#### Current method

- Manually the paper is taken from the machine and the samples are tested later measured in the laboratory
  - The measure is reliable if the sample is immediatly tested
  - The samples can be taken only with the paper web broken causing loss of production
  - Any test is effective for the moment of the production and it cannot be repeated frequently



#### What we would need

- Efficient cross humidity measurement tools should be tested on long term basis
- The importance of the humidity measurement is increasing with the energy cost increase
- The reliable measurement will later push the papermaker to produce corrective technology to remove the problems

