ENERGY EFFICIENT DRYING OF COATED PAPER WITH HIGH INTENSITY AIR DRYING WITH POWERDRY PLUS

Survey of operating data on production machines

Pertti Heikkilä and Nenad Milosavljevic
Metso Paper, Inc., Air Systems
Raisionkaari 60, FI-21200 Raisio FINLAND

metso

Woodfree coated paper (WFC)

Base paper is made of bleached chemical pulp with very little or no mechanical pulp.

WFC paper (coated fine papers) can be single, double or triple-coated.

WFC paper is typically either matt or gloss-calendered.

WFC paper can be printed on sheet-fed or web printing press.

Top-quality coated grades, or art papers, are used to print

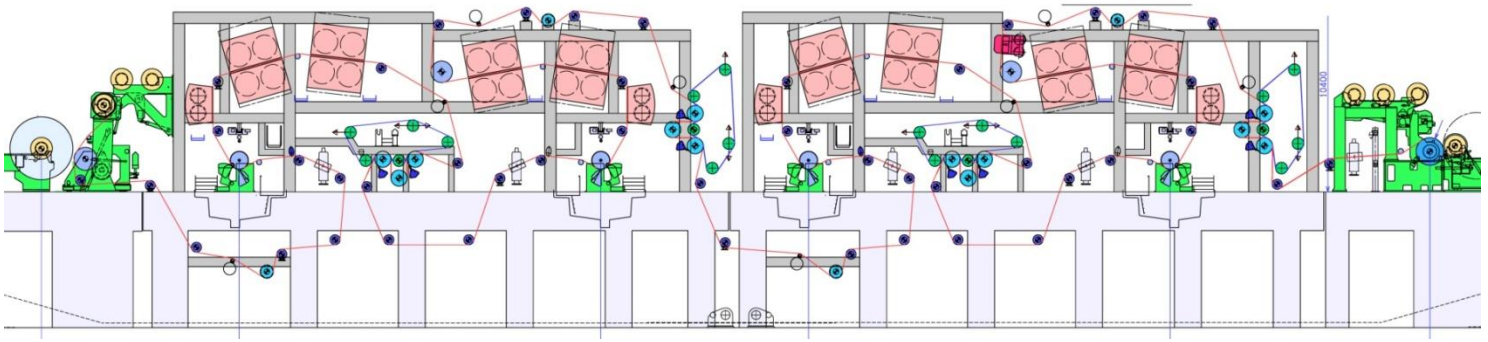
- high-quality art books
- annual reports
- advertising materials

Lighter-coated, woodfree printing papers are used for magazines

- brochures
- books
- catalogs
- posters
- maps

Modern 4-station off-machine coater for double coated woodfree paper

2000 m/min speed
7.5 m sheet width
2 x 13 gsm precoating
2 x 11 gsm top coating



Drying of woodfree coated paper

High quality requirements set certain limitations how the coated paper can be dried in the coating machine, in order to avoid mottling and other quality defects.

It is essential to consider those restrictions in design of a new dryer section, as well as in practical operation with the existing coater dryers.

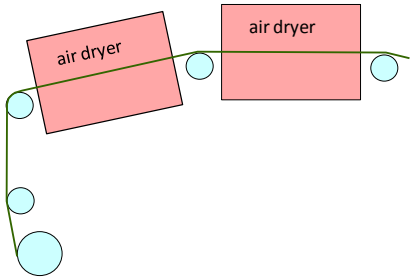
In addition to the quality aspects, there are also other factors that need attention when designing a new coater dryer section, or when operating with an existing one:

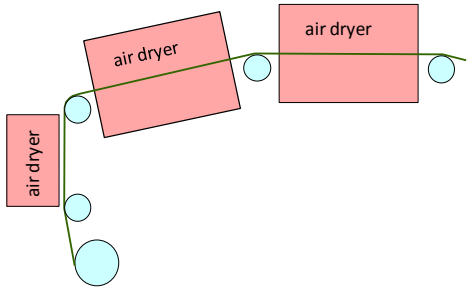
- low operating costs in terms of energy needed for drying
- reasonable investment costs
- easiness of the practical operation with the dryers
- dryer section lay-out aspects especially in the rebuilds.

Various drying concepts used in the industry

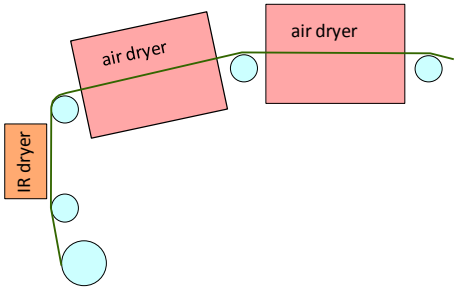
Generally, the drying concepts are based on air drying, infrared drying or combination of both. Cylinder drying can be used in the end phase of drying.

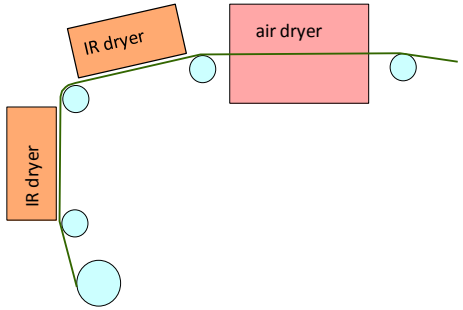
Air drying only



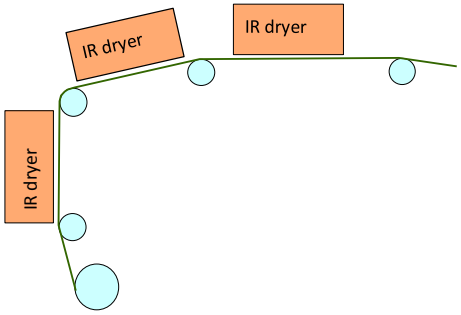


Combined





Infrared only

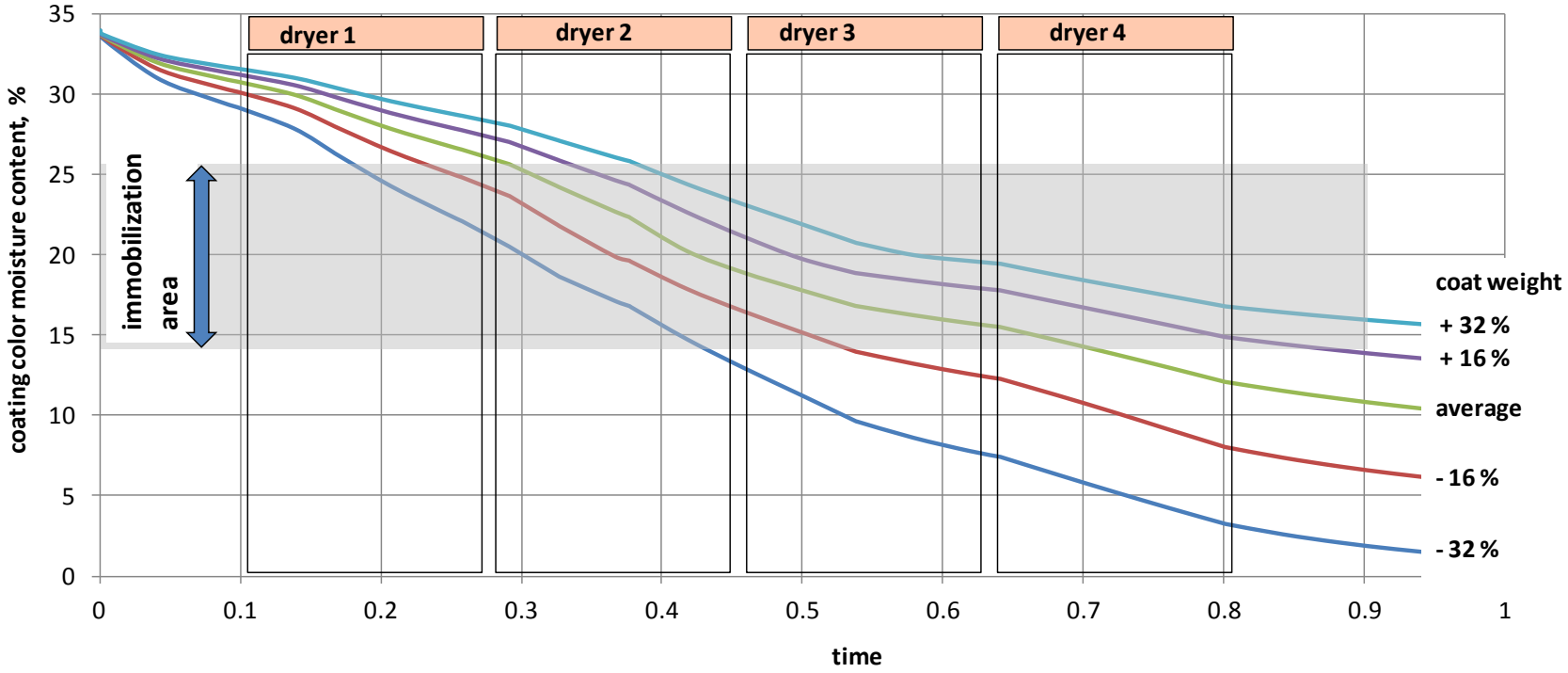


Critical drying phase

Coating immobilization area should be surpassed with invariable drying conditions in order to get uniform surface properties.

Due to coating thickness variations some areas dry faster and some slower.

If dryer type or drying conditions vary within the immobilization area different fractions on the coating surface undergo different kind of drying.

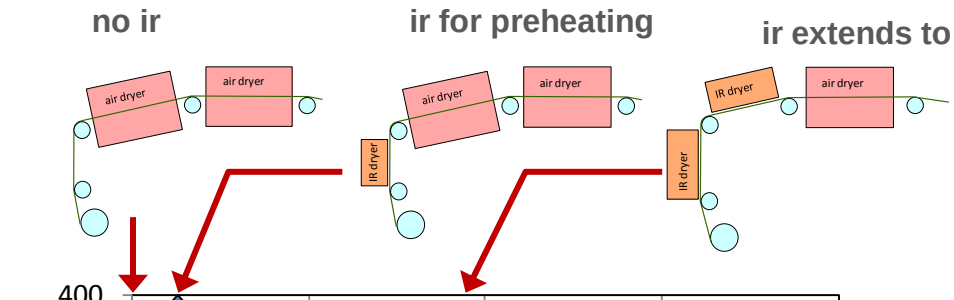


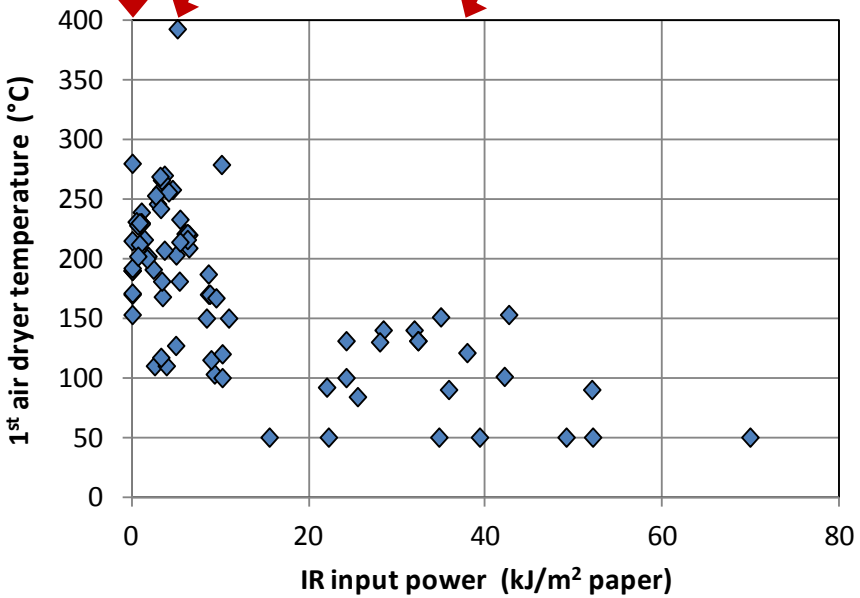
Field study

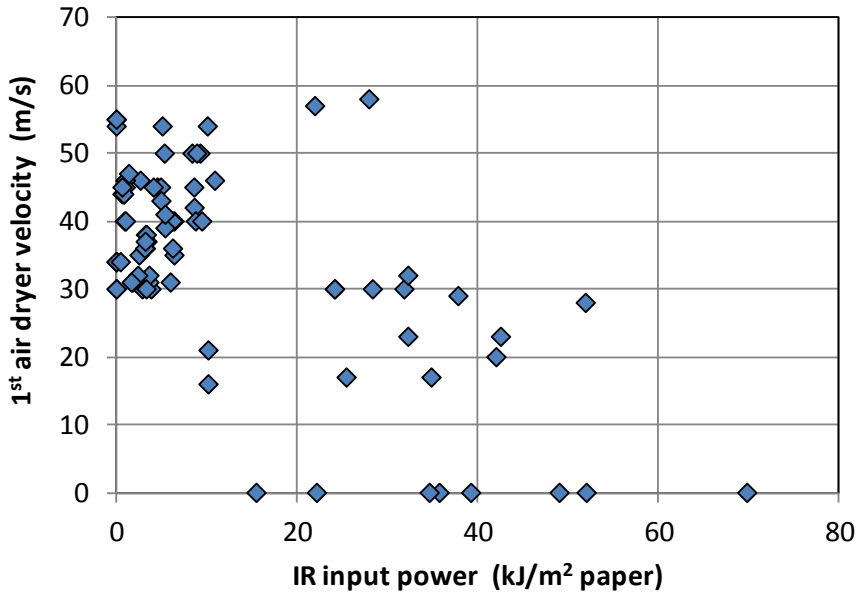
- Dryer operating data has been collected from various coaters producing WFC.
- General observation is that the operating window of dryer settings depend on the drying concept.
- On precoating stations dryer settings can be set more freely without affecting paper quality.
- On topcoating stations paper quality aspects often limit the operating window.
- In case of the air drying only concept, higher blowing air temperatures and velocities can be used, and they are often beneficial for paper quality.
- In case of combined infra + air dryer concepts, small amount of infrared (preheating) doesn't affect on the operating window of the succeeding air dryers.
- In case of combined infra + air dryer concepts, higher amount of infrared drying dramatically affects on the operating window of the succeeding air dryers, allowing only small drying rates to be used.

Operating data from coating machines producing double coated WF paper

The graphs display blowing air temperature and velocity of the 1st air dryer versus used infrared power.
X-axis shows amount of used infrared power in the station / m^2 coated paper ($Q_{IR}/[U_{web} \times B_{web}]$).
Y-axis shows conditions in the first air dryer in the coating station.





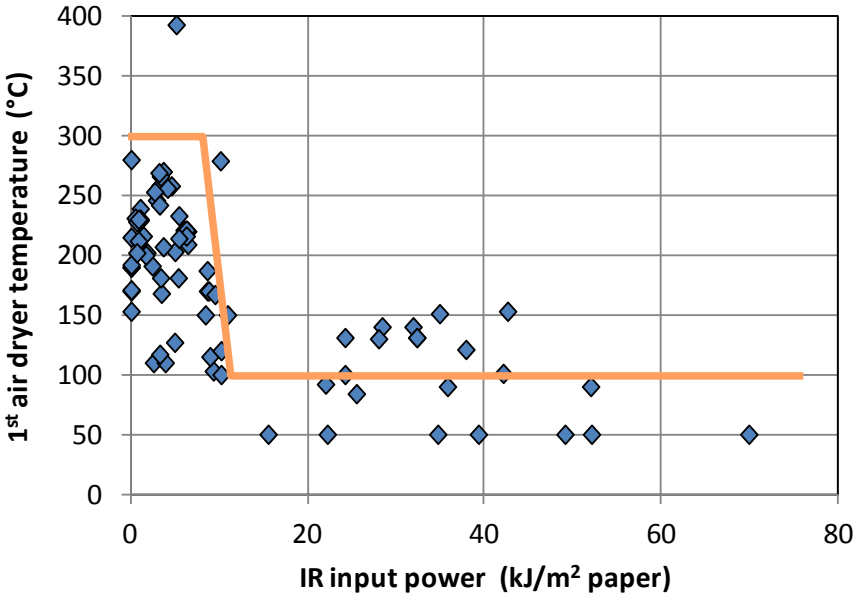


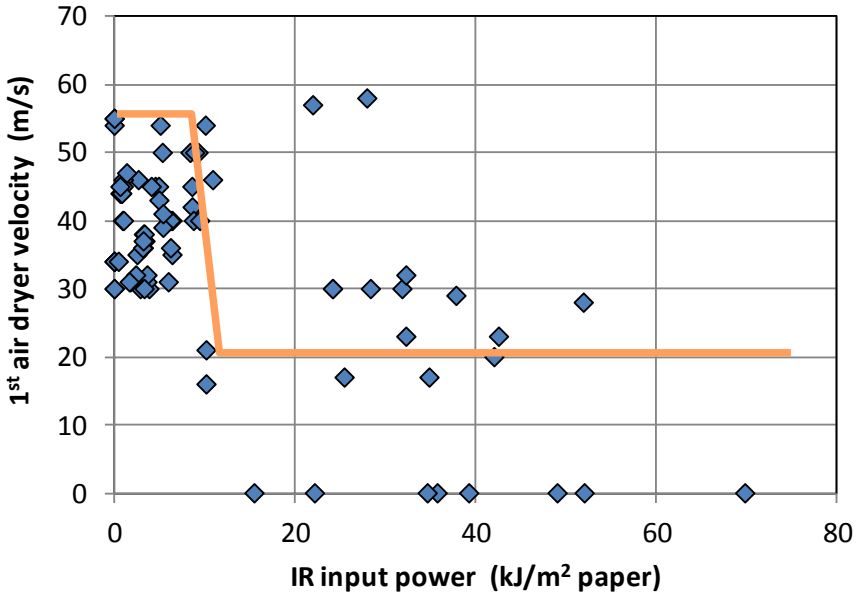
Operating data from coating machines producing double coated WF paper

The data is from the **top coating stations**.

The figures indicate that very low drying rates need to be used if drying is started with infrared and infrared drying extends to the critical area (infrared amount over 10 kJm^2 paper).

If drying is started with air dryers, or the infrared dryers extend only to the preheating phase (infrared amount 0 to 10 kJ/m^2), it is possible to use rather high drying rates in the first air dryer.





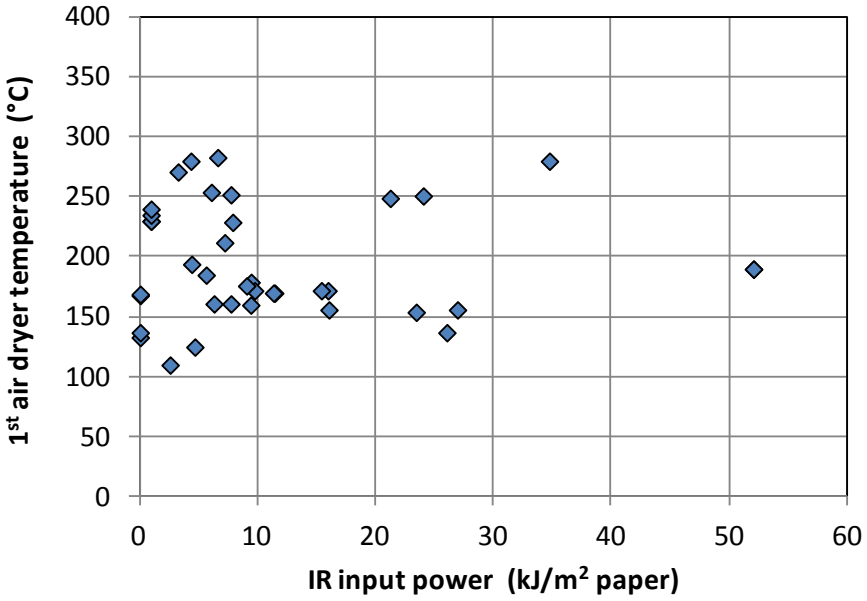
Operating data from coating machines producing double coated WF paper

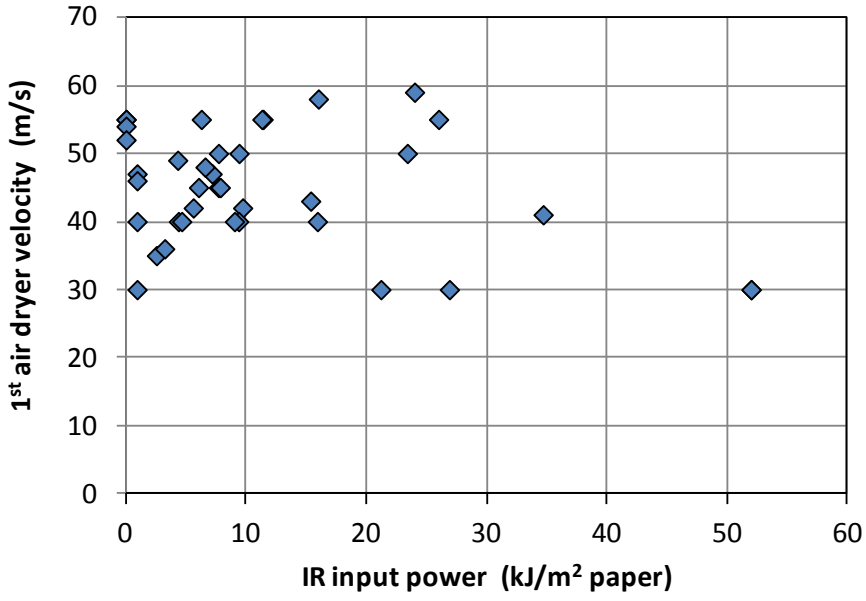
The data is from the **precoating stations**.

No clear trend between amount of infrared drying and drying conditions in the first air dryer.

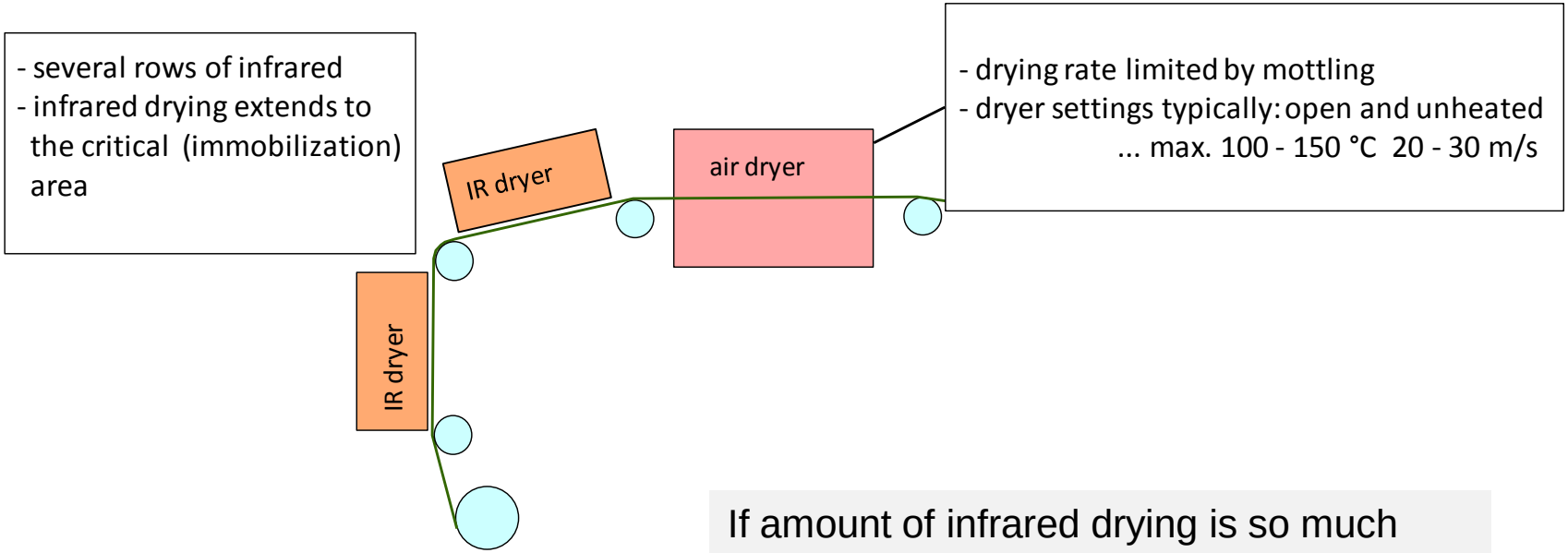
Up to 250 °C and 50 – 60 m/s has been used in the first air dryer regardless of amount of infrared drying.

It is quite commonly accepted among the mill personnel that drying of precoating is not very critical from viewpoint of mottling, and the dryer settings can be adjusted more freely.





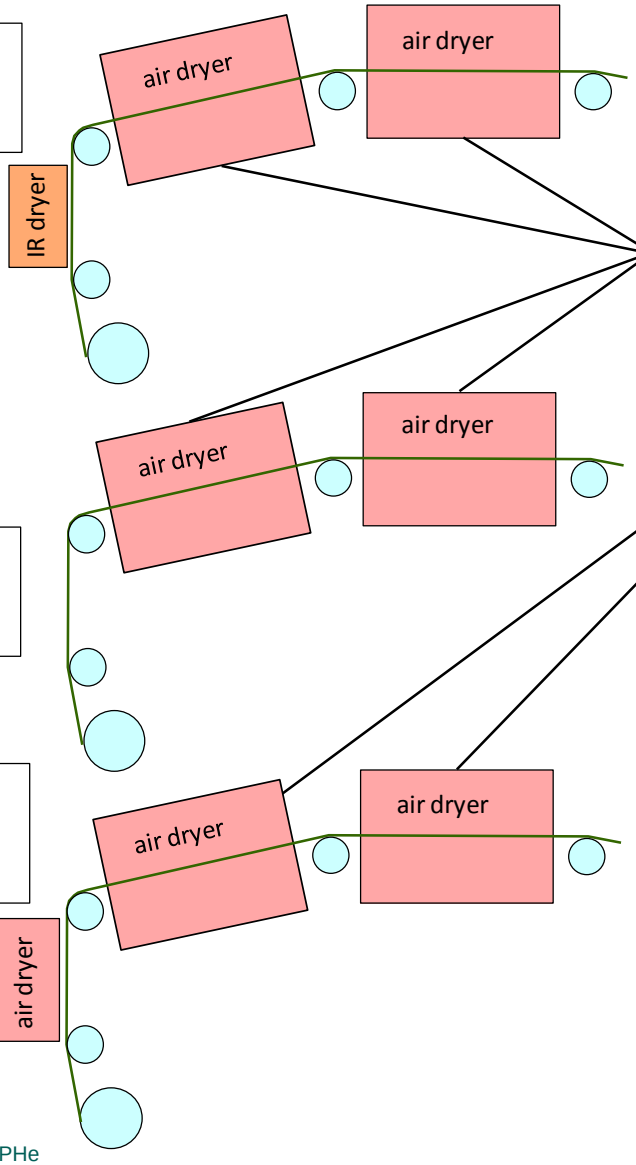
WFC top coating, infrared concept



If amount of infrared drying is so much that the critical phase has already started in the infrared dryers, it is possible to use only very low drying rates in the air dryers. Sometimes the air dryers are switched off.

WFC top coating, airdryer concept

- short infrared dryer for preheating



- dryer settings typically: 150 - 280 °C 40 - 55 m/s
- some machines use similar temperature and velocity in all air dryers
- some machines use lowered temperature and velocity in the dryer that is in the critical (immobilization) area

- no preheating dryers

- high intensity air dryer, PowerDryPlus
- 400 - 500 °C 50 - 60 m/s

If amount of infrared drying is small or none, it is possible to use moderate - high drying rates in the air dryers without risking paper quality.

WFC drying concept with PowerDryPlus

High intensity drying soon after the coating application, and before the critical drying phase, has positive effect on the paper quality.

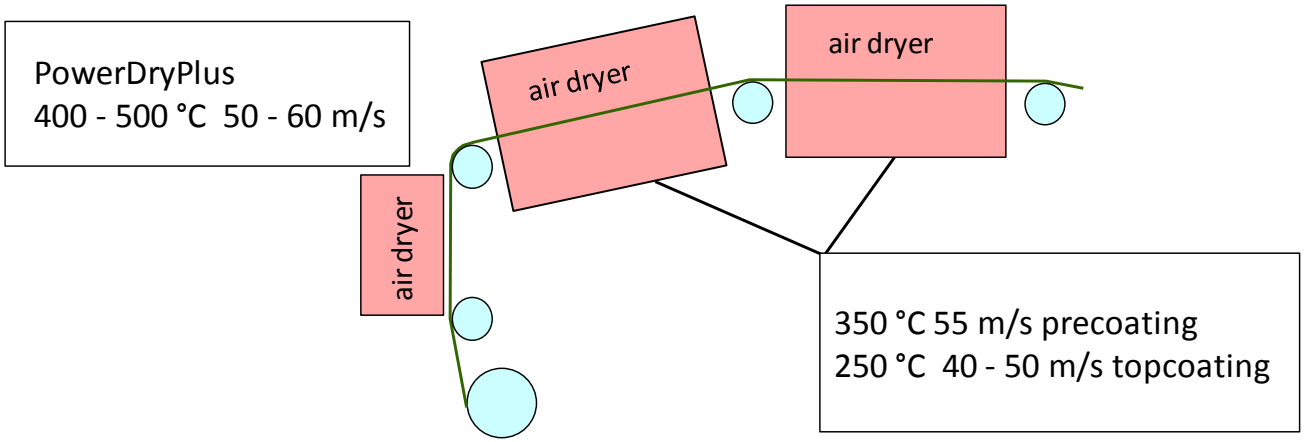
The concept is applicable both for pre- and top coating.

Starting of drying in an early phase reduces water drainage into the base sheet.

Very intensive drying conditions can be used in this position.

Due to layout reasons it is easier to install single sided dryer in this position.

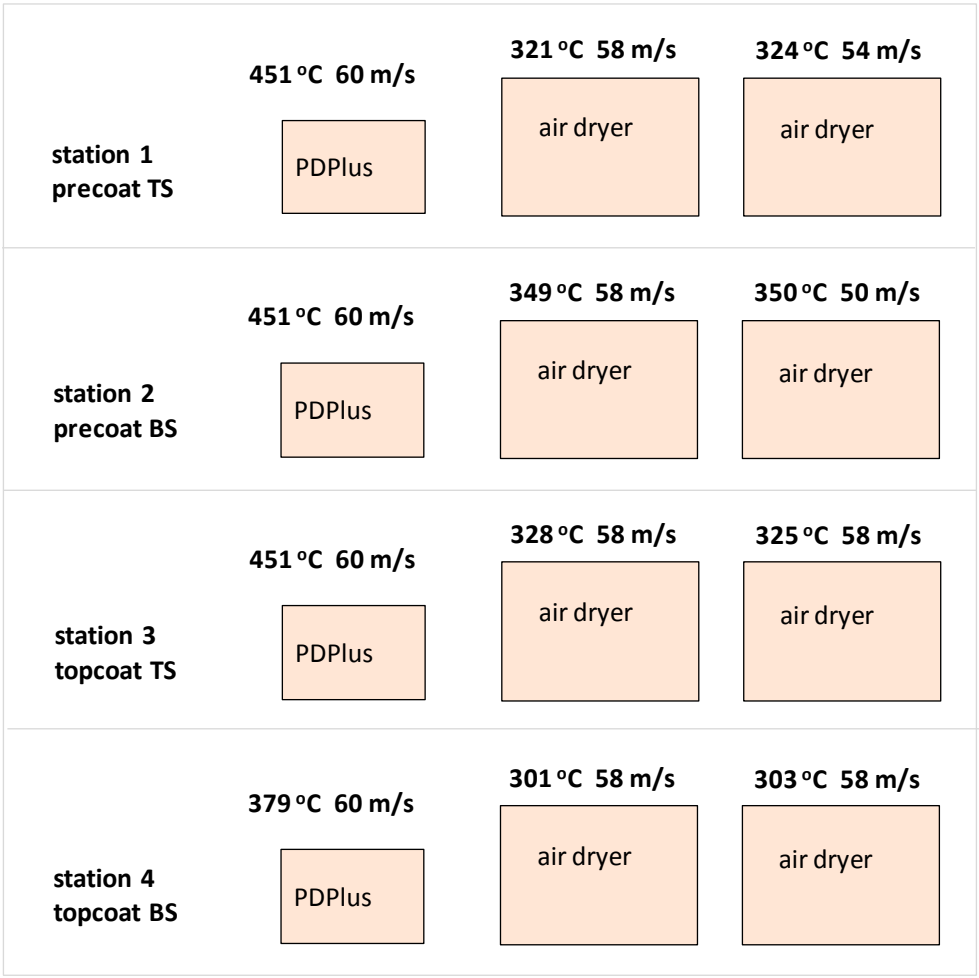
In pilot coater trials with PowerDryPlus, the highest drying intensities (450 – 500 °C, 50 – 60 m/s) have often given the best print quality.



Case study: dryer operating data of a WFC coater

OMC with 4 coating station
speed 2000 m/min
grade 131 gsm WFC
coat weight 4 x 12 gsm

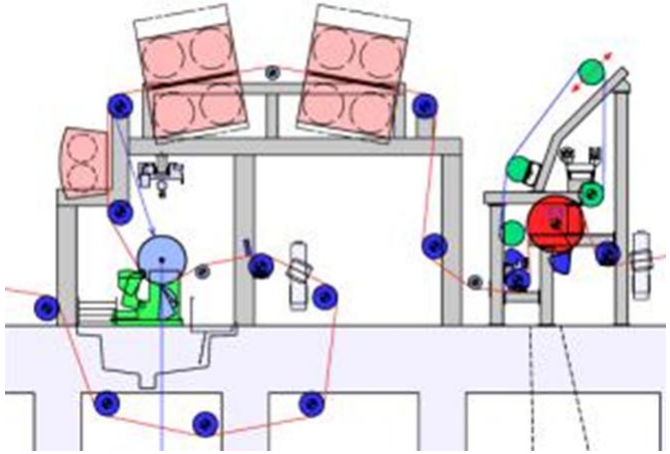
each coating station has
- PowerDryPlus
- two double sided air dryer

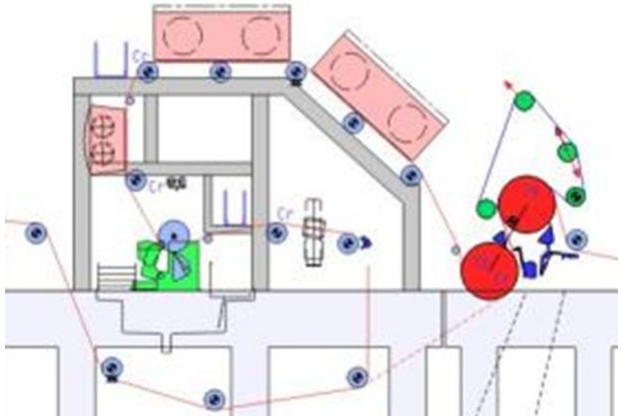


PowerDry Plus

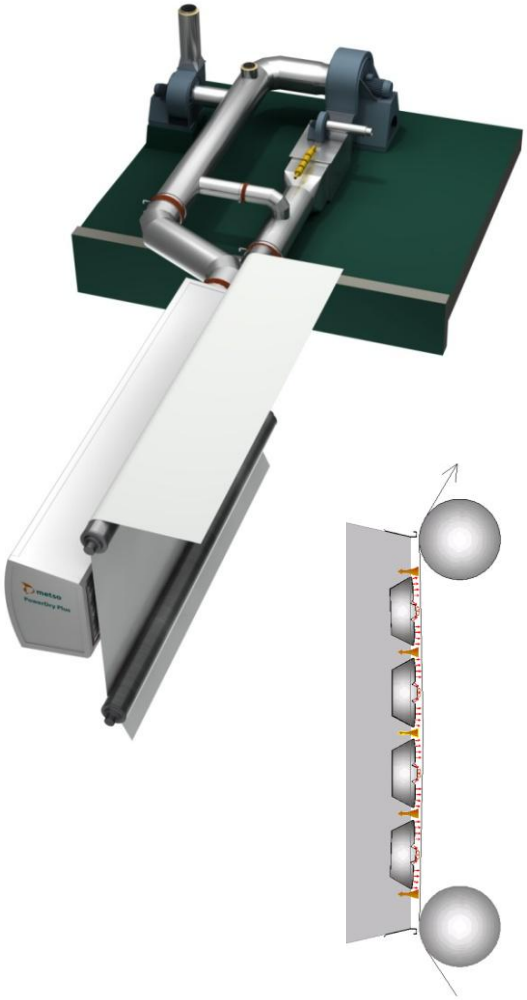
High intensity air dryer

- One-sided air dryer
- For all paper and board grades
- For all web widths
- For new machines and rebuilds
- Utilizes PowerFloat Plus nozzle technology
- Fits well as the first dryer after the coating station
- High drying rate
- Excellent runnability
- Easy to operate





PowerDry Plus



Experience from pilot and production machines

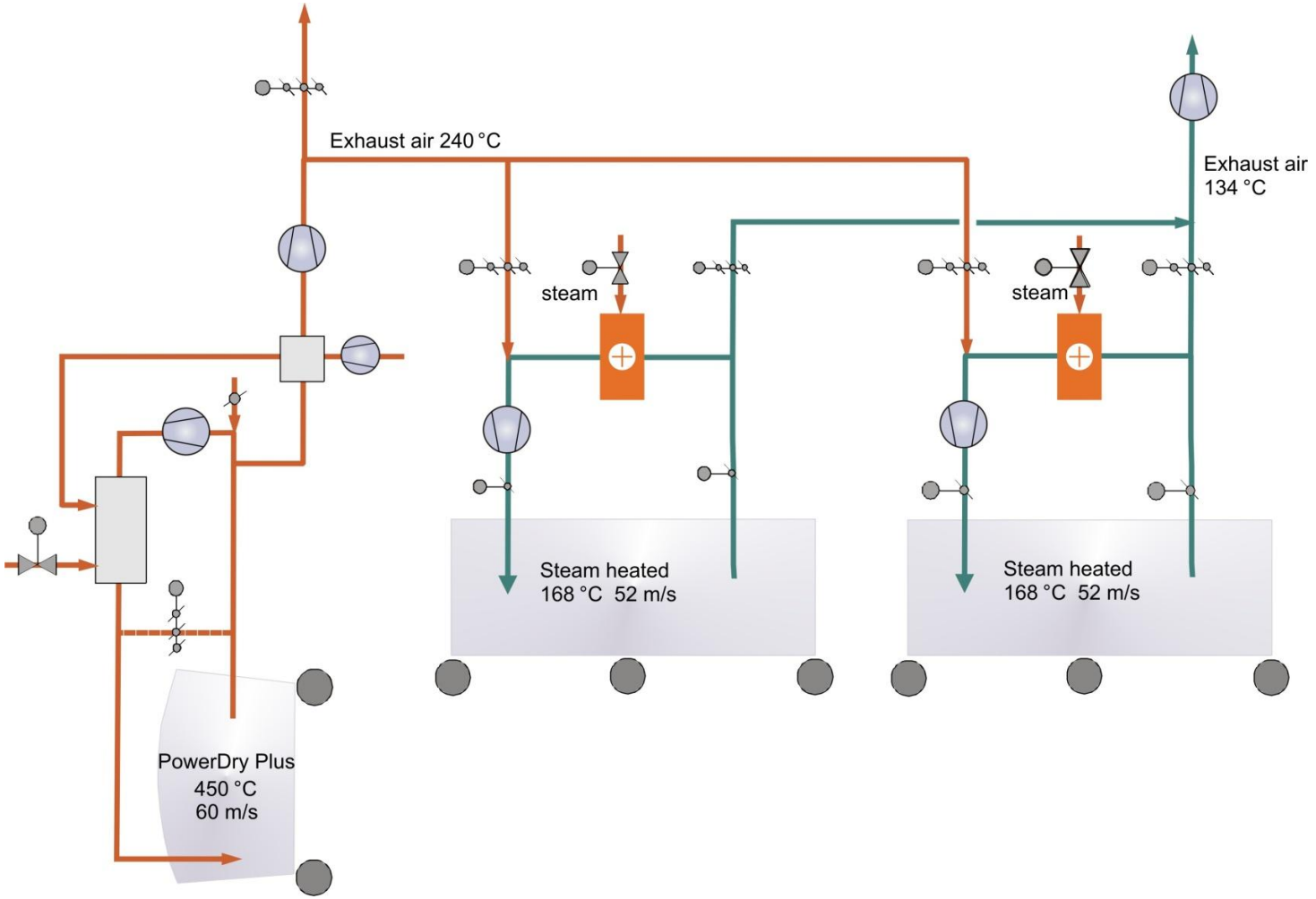
- High intensity air dryer soon after the coating application, and before the critical drying phase, has positive effect on the paper quality.
- Starting the drying in an early phase reduces drainage of water into the base sheet.
- In pilot coater trials highest drying intensities (450 – 550 °C, 50 – 60 m/s) have often given the best quality.

Energy economy

- Energy efficiency of a PowerDryPlus is typically 60 - 80 %.
- Conventional gas or electric infrared dryers having 30 – 40 % energy efficiency would consume 50 – 100 % more heating energy for same drying amount.

Utilizing PowerDry Plus exhaust air in steam heated dryers

Cascading exhaust air into steam heated dryers.
Drying energy efficiency up to 85%.



Conclusions

1. On WFC topcoating stations paper quality aspects often limit dryer operating window.
   - In the air drying only concept, high blowing air temperatures and velocities can be used, and they are often beneficial for paper quality.
   - In the combined infra + air dryer concepts, small amount of infrared (preheating) doesn't affect on the operating window of the succeeding air dryers.
   - In the combined infra + air dryer concepts, higher amount of infrared drying dramatically affects on the operating window of succeeding air dryers, allowing only small drying rates to be used.
2. On WFC precoating stations dryer settings can be set more freely without affecting paper quality.
3. In order to get uniform surface properties, coating solidification should happen in similar drying conditions, related to drying rate and drying method.
4. High intensity drying soon after the coating application, and before the critical drying phase, has positive effect on the paper quality.
5. Huge savings in operating costs can be obtained by efficient utilization of air dryers in the coating machines.