Energy efficient drying
with an expensive energy

Optimised Infrared Radiation combined with Hot Air

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VNP Technologiekring 20. & 21. November 2024
Apeldoorn

Cost efficient drying with an expensive energy

- Introduction
- Application cases
- Summary

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Introduction

- Drying paper makes up 70% of energy cost of paper mill
- Infrared drying is the most expensive tool
- Infrared drying may be the only and most cost efficient tool

Introduction

- Gas fired infrared should be substituted by hot air
- Electric infrared penetrates deep into matter to be dried
- Enhanced Near Infra Red eNIR has half of energy losses than standard NIR

Introduction

- Drying is a two step process.
  - Energy transfer - **heating** the matter to be dried.
  - Mass transfer - **evaporating** the water from the matter to be dried.
    - Water will move to the cooler side.
    - Steam enthalpy will cool matter to be dried.

Steam Enthalpy at work

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Heating the reverse side before MG

Cooling the top side after MG through improved evaporation

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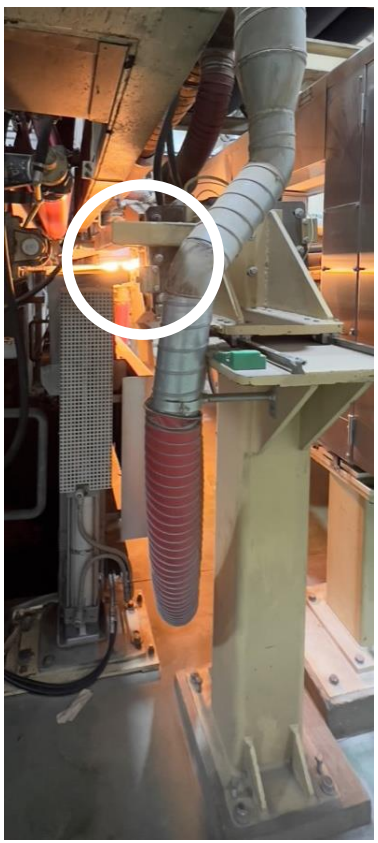
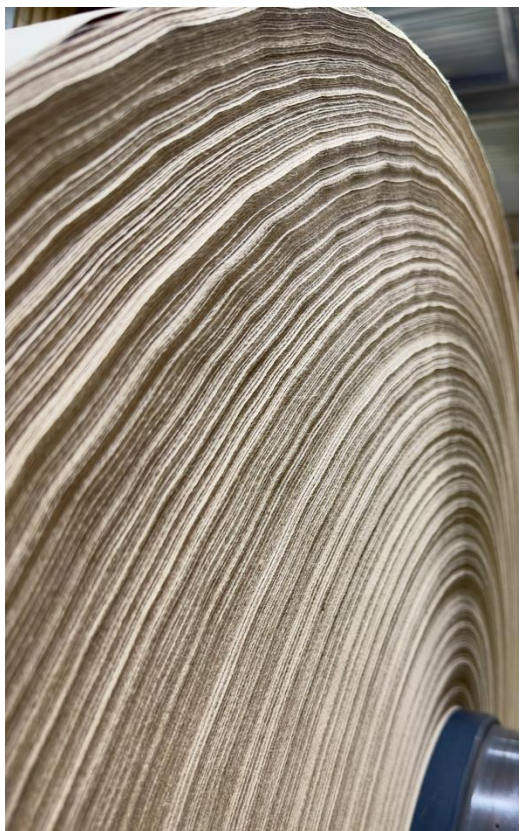
Application Cases

- Edge Drying
- Pre Heating
- Surface moisture control before calandering

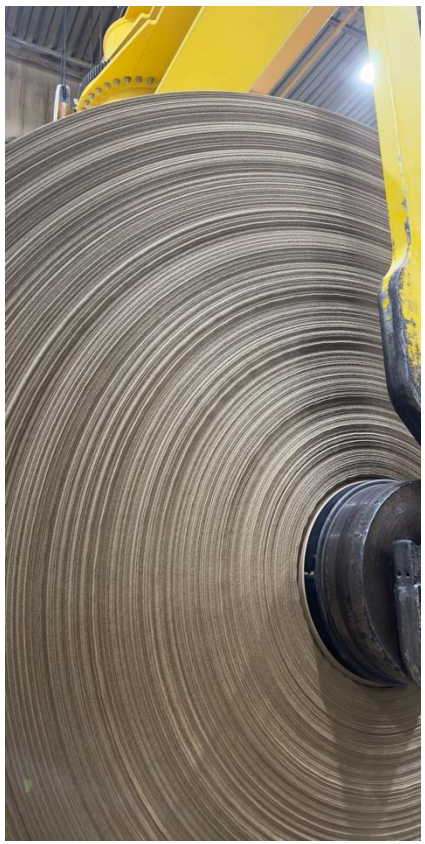
Edge Drying

- Containerboard machine, 90 gsm to 120 gsm
- Wet Edge 7% more moisture
- Reduced production speed
- Middle of sheet overdried down to 1.5% moisture
- **Warp on corrugator due to poor layflat**
- Edge moisture drying before pope





Edge Drying

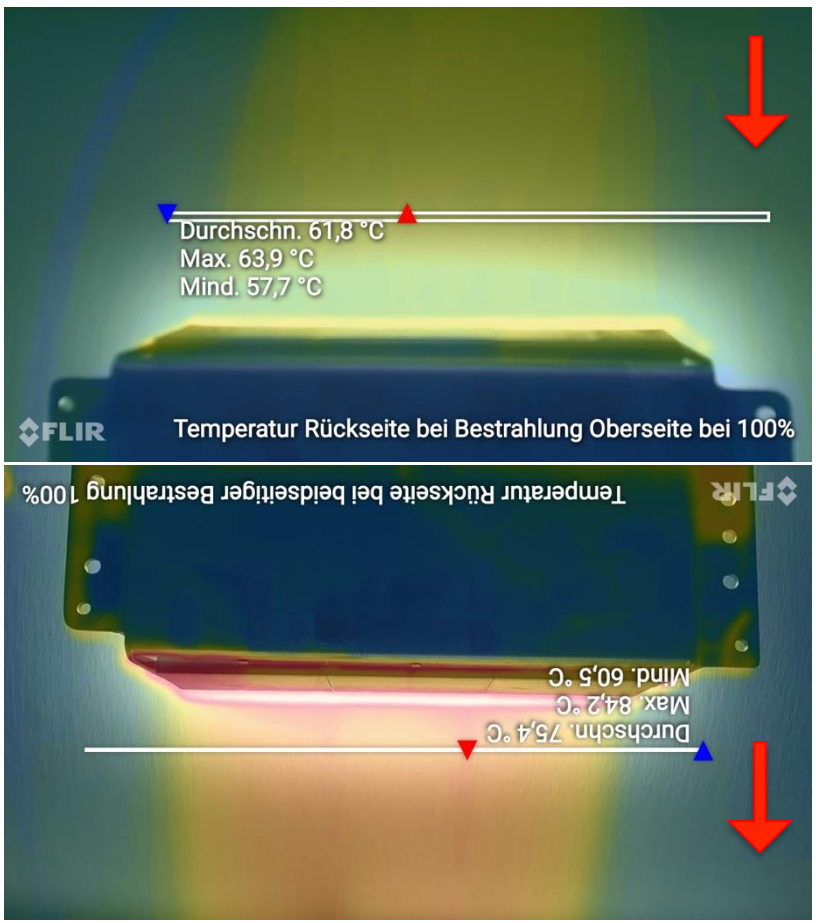


- Edge dryer in main evaporation group before size press
- Drying of edge simultaneous to centre
- Perfect edge
- **No more warp on corrugator**
- specific production: +9.4%
- Specific steam consumption: -5,4%
- Increase average pope speed: +9,9%

Pre Heating

- Folding Box Board 250 to 550 gsm
- Speed 240 to 600 mpm
- Insufficient drying capacity

Pre Heating



- Top Side heated with 320 kW/m or 37.6 kW/t
- Temperature Increase on reverse side by 6°C
- Core temperature ~68°C

- Bottom Side heated with 320 kW/m or 37.6 kW/t so total of 75,3 kW/t
- Temperature Increase on reverse side by 23°C
- Core temperature ~80°C

Pre Heating

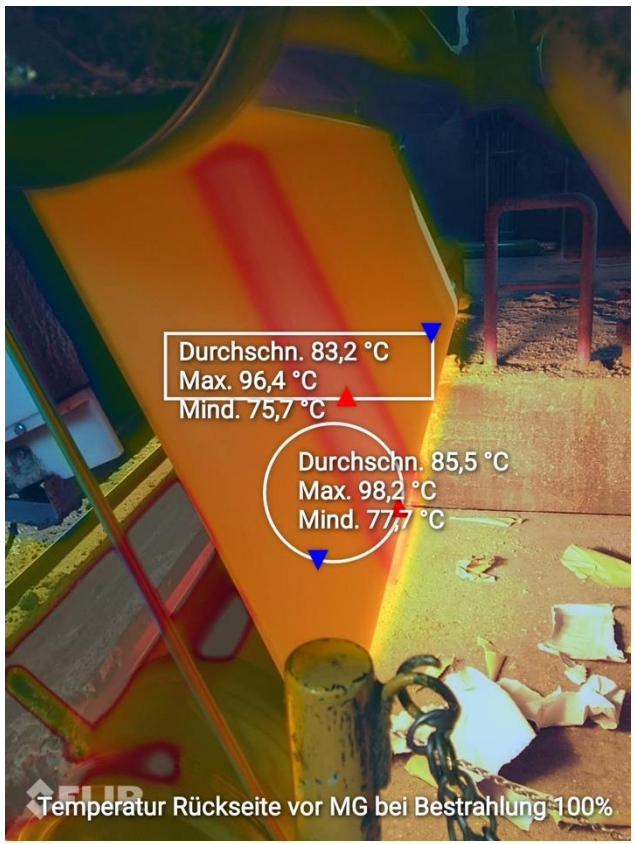
- Energy input was too high: target was 60°C to 65°C core temperature
  - At 65°C just heating, not evaporating
  - At 75°C to 85°C we had strong evaporation

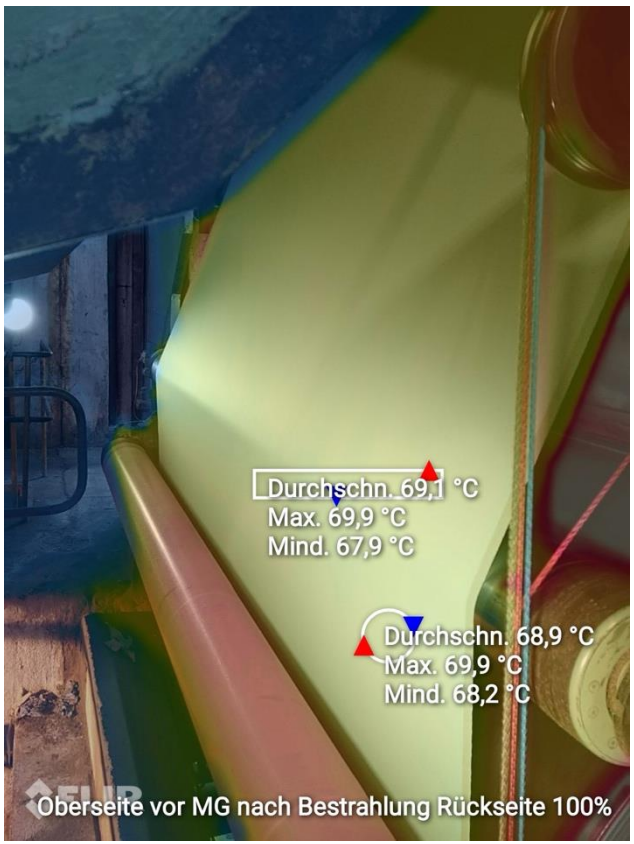
- Moisture at pope: from 7,0% to 5,4%
- 7 cylinders gained for evaporation: 18% production increase expected
- Evaporation rate: 840 g/kW

Moistening surface before calander

- Surface moisture before MG is too low for glazing
- Presently 1.7 gsm of water are sprayed on surface (corresponds to 0.6% of total drying load)

Moistening surface before calander





Moistening surface before calander

- Power 320 kW/m was far too high
- Perfect evaporation as moisture was pushed strongly to the top side
- Very easy job for MG
- For optimum results in this case 120 to 200 kW/m will be needed

- The application on calandar and MG are similar.

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Summary

- Selecting the right wavelength for heating the substrate
  - Longer wavelength than standard NIR at 1.18 µm
  - Shorter wavelength than 2.5 to 3.5µm of gas MIR

- Selecting the right evaporation regime while heating.

- Use infrareds as booster and whenever high energy density is needed.

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- Thank you

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- Questions?