

Optimised coat drying in a board machine

Retrofitting PM3 at Ningbo Zhonghua Paper, Ningbo, CN

LIN, Zheng, Ningbo Zhonghua Paper, Ningbo

Wolf Heilmann, Augsburg

Tim Klemz, Compact Engineering, Thirsk

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to the Project
- Project Alternatives
- Project Implementation
- Compact Engineering's Drying Technology
- Results
- Outlook

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- Project Implementation
- Compact Drying Technology
- Results
- Outlook

APP and Sinar Mas Overview

- APP is the Chinese branch of Indonesian Sinar Mas Group
- APP is leading Chinese Paper Manufacturer with present annual production of 9 MT p.a. of pulp, paper, board, and tissue, roughly 7 MT p.a. being coated grades
- Main products are Fine Paper, Coated Board, Pulp and Tissue
- APP is presently operating 11 pulp and paper mills in China
- Sinar Mas is a leading producer with present annual production over 20 MT p.a. of pulp, paper and board
- Sinar Mas is the global leader for coated paper and board
- Sinar Mas is presently operating over 20 pulp and paper mills around the world

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- Project Implementation
- Compact Drying Technology
- Results
- Outlook

Mill Overview

- Ningbo Zhonghua Paper belongs to APP Industrial Paper Division
- Ningbo Zhonghua Paper is located in Ningbo, roughly 200 km south of Shanghai
- Mill area: 630,000 sqm.
- Workforce: 1,600
- Total production: 700,000 tpy
- Main grades: double coated board, 200 to 300 gsm
- Own Power plant
- Own Carbonate plant
- Own water treatment plant

Main Paper Machines

- PM2 + PM3

Supplier:

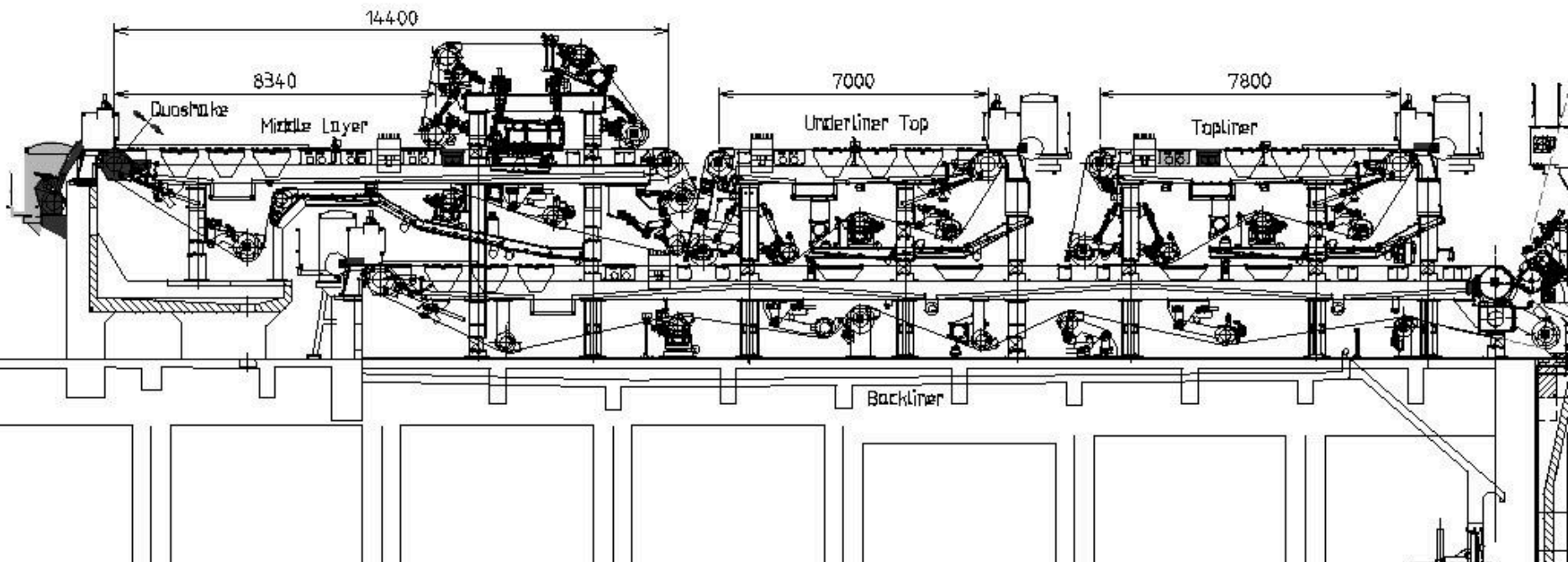
Voith

Start-up:

1996 + 1997

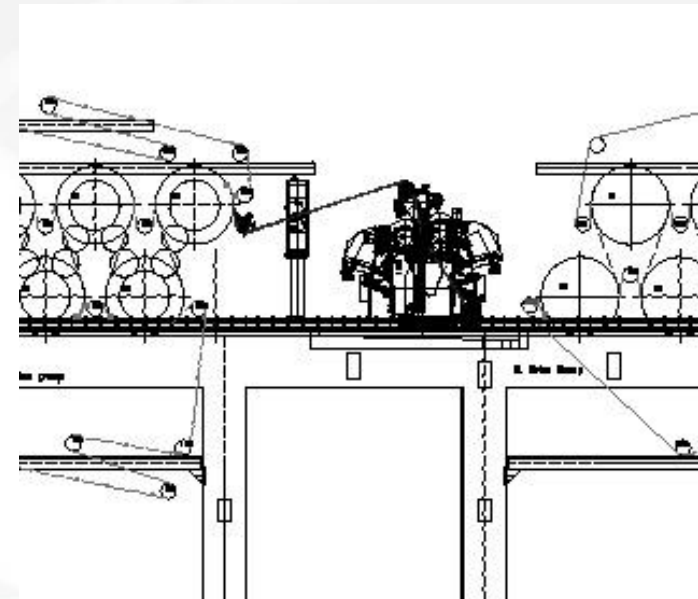
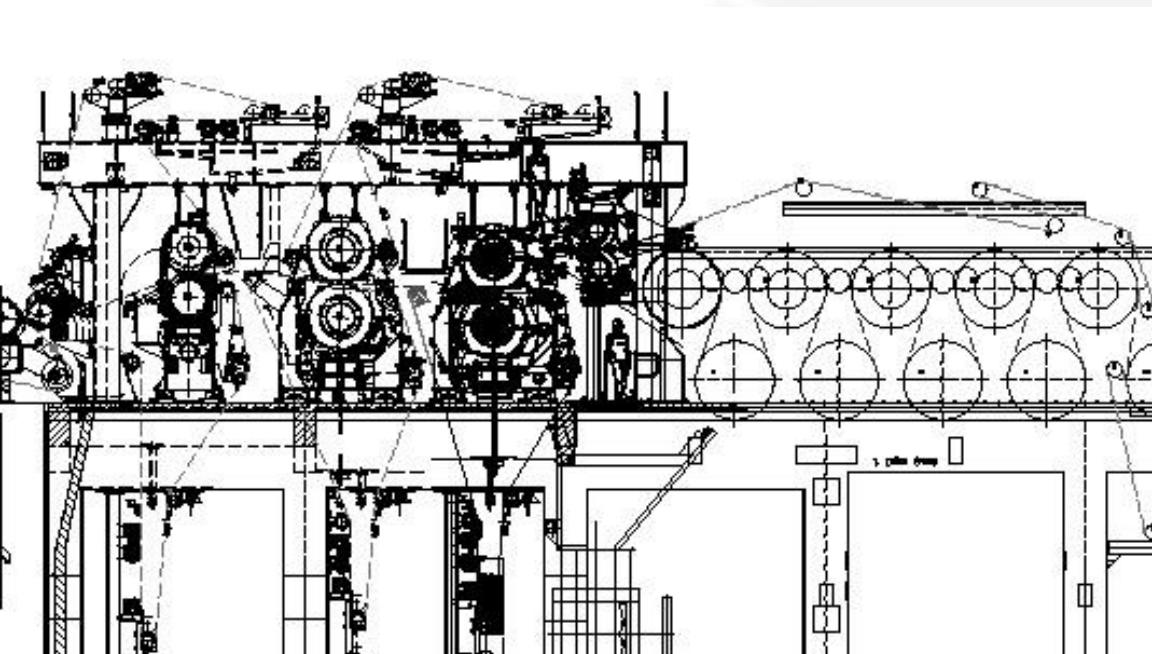
Type:

multi-wire board machine



Main Paper Machines

- width: 4.2 m
- speed: up to 700 mpm
- production: 300,000 tpy each



Main Paper Machines

- Soft calander before coating
- 4 coating heads (2 top side, 2 reverse side)
- Total coat weight 40 to 55 gsm
- Double soft calander after coating

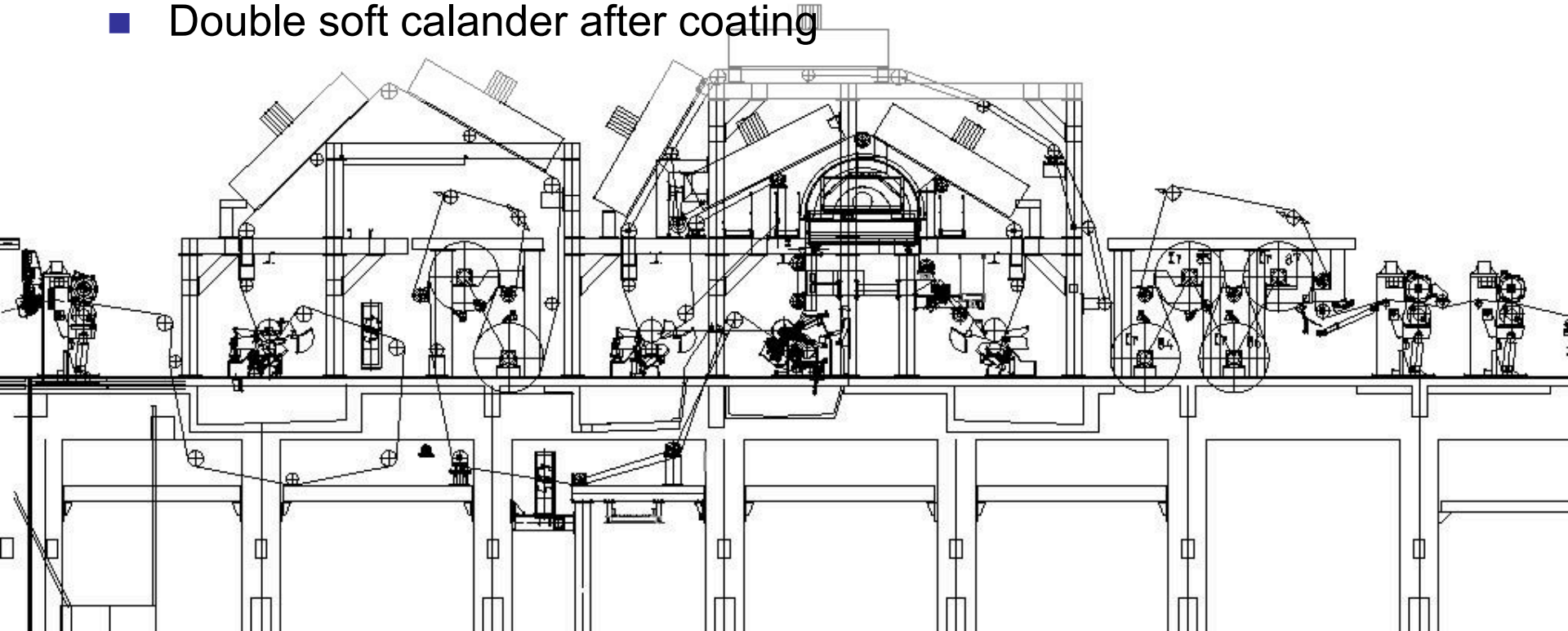


Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- **Introduction to Project**
- Project Alternatives
- Project Implementation
- Compact Drying Technology
- Results
- Outlook

Introduction to Project

- Lamps of existing infrared dryers had to be exchanged two to three times within two years
 - Alternative should avoid the cost of spares and downtime
- Production of paper machines was limited to 700 mpm depending on grammage and coat weight
 - Alternative should allow machine speed of up to 1,000 mpm
- Coat weight was limited by drying capacity
 - Alternative should allow pre coat weight increase of 5 to 10 gsm without limiting furthermore the production speed
 - Higher coat weight allows reducing the overall cost of virgin fibre board
 - Higher coat weight allows reducing the top layer weight on recycled fibre board

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- **Project Alternatives**
- Project Implementation
- Compact Drying Technology
- Results
- Outlook

Project Alternatives

- Alternative 1:
continue replacing lamps as in the past
- Alternative 2:
change electric emitters for gas-fired emitters
- Alternative 3:
keep electric infrared emitters, add additional hot air dryers to the existing ones
- Alternative 4:
replace existing by more effective electric emitters

Project Alternative 1

continue replacing lamps as in the past

- Pros:
 - Cheapest solution
 - Lamps are inexpensive
 - Did work up to now, so why not following doing the same thing we did yesterday or last year

Project Alternative 1

continue replacing lamps as in the past

- Cons:
 - Doesn't allow increasing production
 - Doesn't allow increasing pre coat weight
 - Doesn't allow reducing specific cost per ton
 - Additional sales of board must be allocated to the sister mills – if possible at all
 - It's foreseeable when the machines must be shut down due to inefficiency

Project Alternative 1

continue replacing lamps as in the past

- Not really an alternative

Project Alternative 2

change complete system for gas-fired system

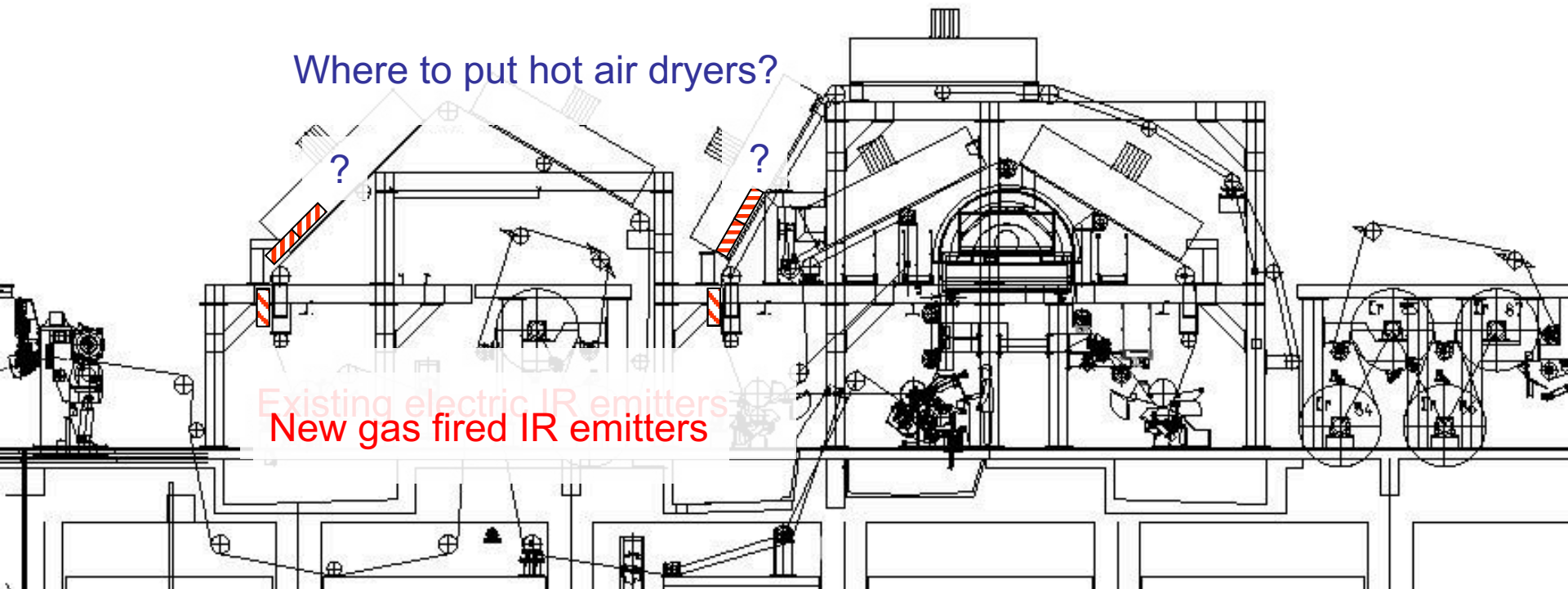
- Pros:
 - Energy apparently less costly

(roughly 300 RMB/MWh, resp. 36 EUR/MWh for gas vs.
roughly 600 RMB/MWh, resp. 72 EUR/MWh for electricity)

Project Alternative 2

change complete system for gas-fired system

- Cons:
 - Requirement of bigger space, as evaporation rate per square meter is significantly lower than with the existing system



Project Alternative 2

change complete system for gas-fired system

- Cons:
 - Requirement of bigger space, as evaporation rate per square meter is significantly lower than with the existing system
 - High rebuilt cost through additional framing required
 - High rebuilt cost through relocation of hot air dryers
 - High rebuilt cost through installation of required ancillary equipment of the gas dryers
 - Gas not ideal for drying coatings on board

Project Alternative 2

change complete system for gas-fired system

- Not a feasible alternative despite apparent cost advantage of gas-fired emitters.

Project Alternative 3

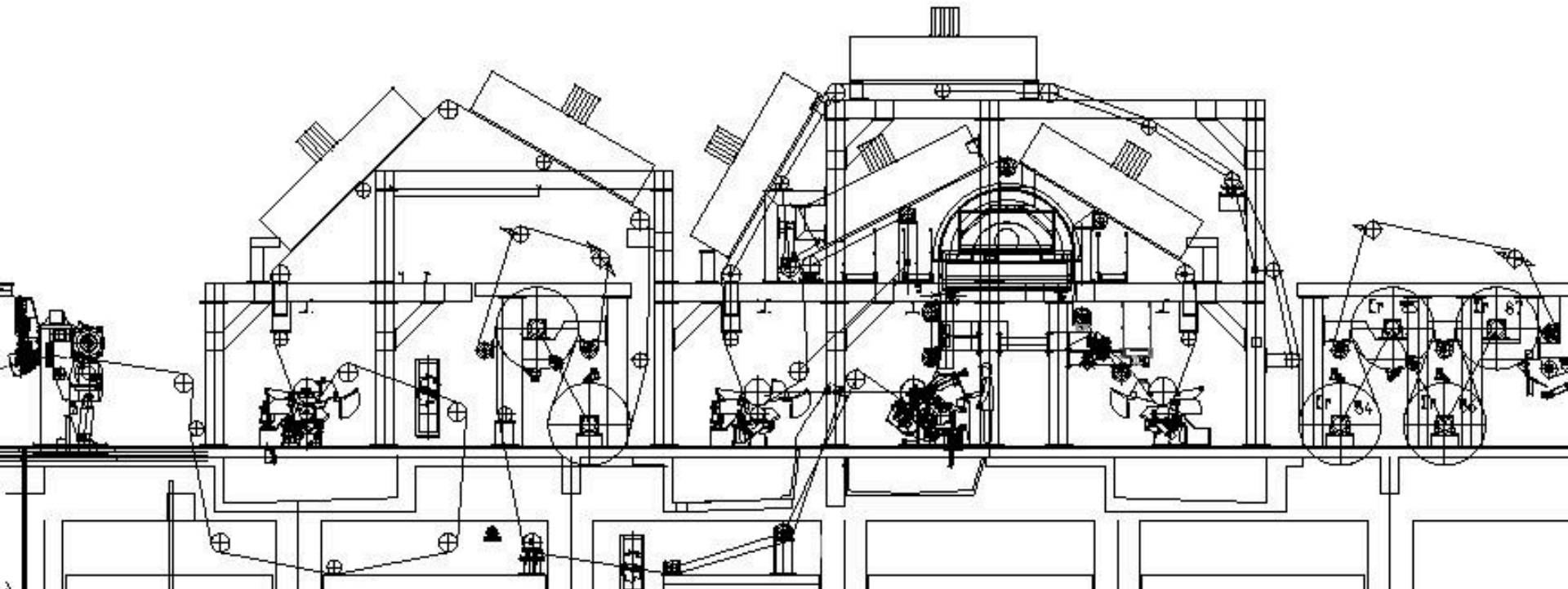
keep electric infrared emitters, add hot air dryers

- Pros:
 - Energy cost of hot air very low
 - No additional maintenance required

Project Alternative 3

keep electric infrared emitters, add hot air dryers

- Cons:
 - Requirement of bigger space, as evaporation rate per square meter is significantly lower than with the existing system



Project Alternative 3

keep electric infrared emitters, add hot air dryers

- Cons:
 - Requirement of bigger space, as evaporation rate per square meter is significantly lower than with the existing system
 - High rebuilt cost through relocation of hot air dryers
 - High rebuilt cost through additional framing required

Project Alternative 3

keep electric infrared emitters, add hot air dryers

- Not a feasible alternative despite apparent energy cost advantage of hot air dryers

Project Alternative 4

replace existing by more efficient electric emitters

- Pros:
 - Guaranteed energy reduction of 40% was given, 50% expected
 - Energy input can be halved as specific energy absorption increases
 - Improved Coating hold-out through deep penetration of the specific infrared radiation
 - Less maintenance downtime in future as suggested lamps have guaranteed lifetime of 15,000 operation hours
 - No ancillary equipment required, all existing controls can be used
 - Very short time for implementation between order and start-up

Project Alternative 4

replace existing by more powerful electric emitters

- Cons:
 - Compared to a pure exchange of lamps, the emitters must be replaced once
 - Spare lamps are more costly than standard lamps

Project Alternative 4

replace existing by more powerful electric emitters

- This alternative was selected

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- **Project Implementation**
- Compact Drying Technology
- Results
- Outlook

Project Implementation

- Fall 2012: Project for improving PM2 and PM3 was started
- Week 48/2012: Project for improving coating drying was included
- Week 10/2013: System ordered
- Week 12/2013: Kick-off meeting
- Week 12/2013: Reference measurement of existing infrared dryers
- Week 23/2013: New emitters were installed during an eight hour maintenance shut in both pre coating stations
- Week 24/2013: Performance and guarantee run

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- Project Implementation
- **Compact Drying Technology**
- Results
- Outlook

Compact Drying Technology

- Compact has continuously developed the technology over the past 28 years
- The technology is designed to deliver better heat and mass transfer efficiency
- Improved heat transfer via the Compact lamp
- Lower running temperature so longer wavelengths with no compromise on power output

Compact Drying Technology

- Extended lamp life by design and better lamp cooling
- Improved radiation management from gold-plated reflectors
- Enhanced mass transfer by active management of the boundary layer
- Laminar air removed and replaced with warm turbulent air
- Use of the technology results in greatly reduced running costs and increased productivity

Compact Drying Technology

- Compact Engineering supplies complete systems for:
 - Coating Drying
 - Moisture Profiling
 - Incremental Drying
 - Lamination

Compact Drying Technology – Titan



Compact Drying Technology – Corona



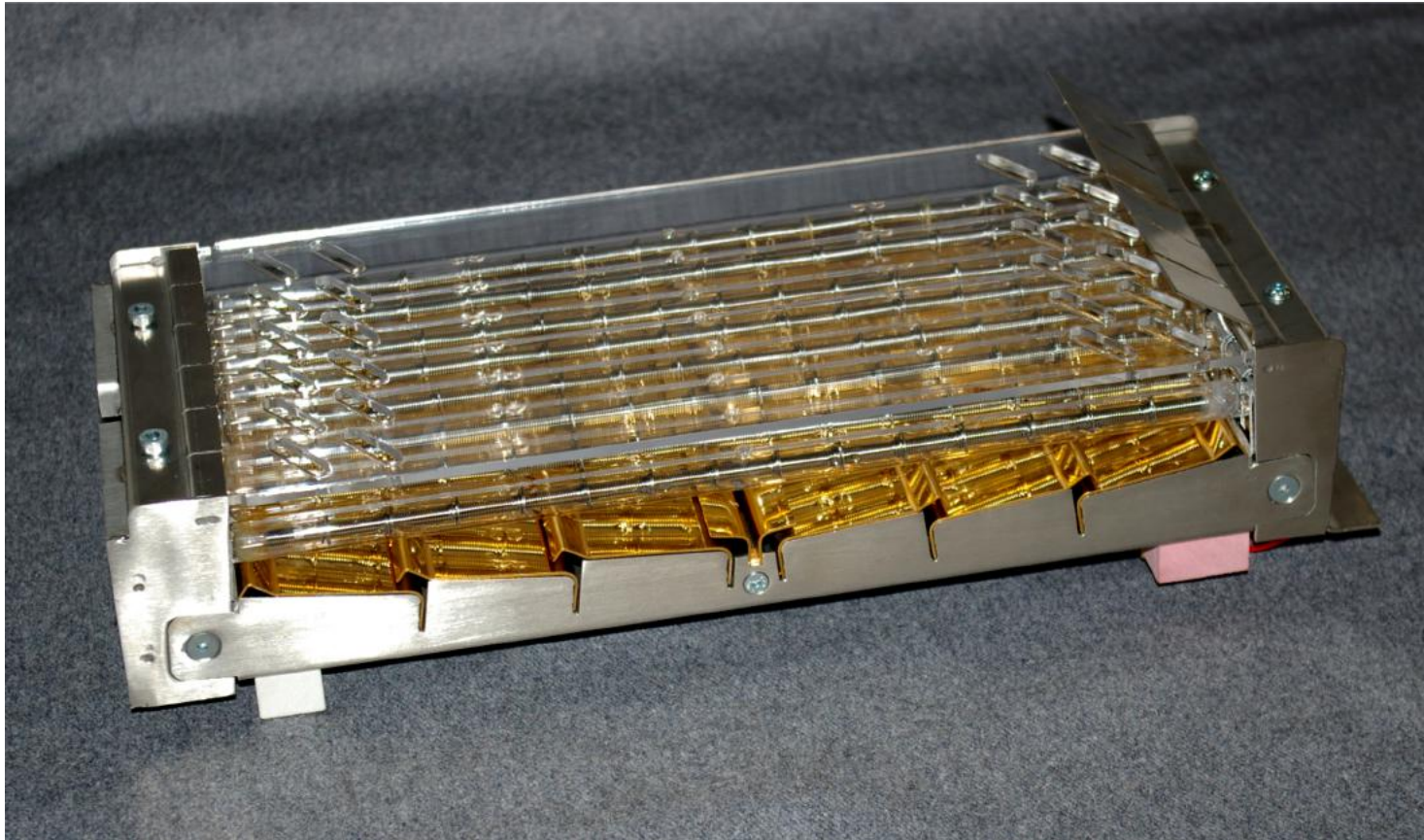
Compact Drying Technology – Apollo



Compact Drying Technology

- In addition to complete systems, Compact manufacture replacement emitters for most existing electrical infrared systems that allow the customer the benefit of modern performance from an old system
- In Ningbo Zhonghua Paper's case, a 20 year old system was transformed into a state-of-the art energy saving system

Compact Drying Technology – The IRE



Compact Drying Technology – The IRE

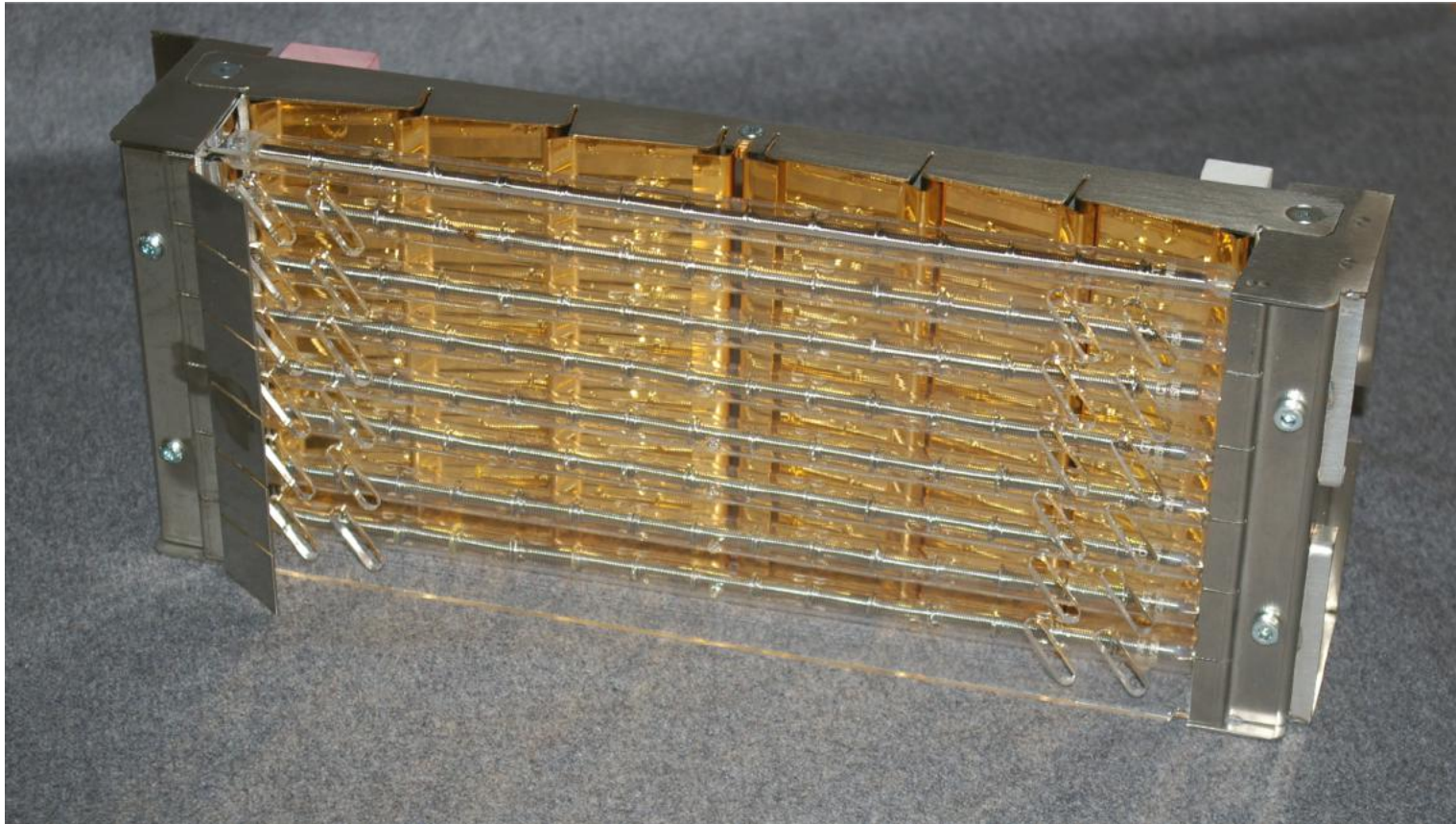


Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- Project Implementation
- Compact Drying Technology
- **Results**
- Outlook

Results

- To evaluate the performance of the system, information had been collected end of march 2013, as well as the day previous to the installation, i.e. June 6th, 2013
- Data were collected again the day after the shut, i.e. June 8th, 2013, as well as during the entire week following the rebuilt
- Data were collected at low power as well as high power. The difference in moisture content achieved can now be related to the power difference
- This delivers the evaporation of water per kW for the old and the new systems
- The hot air dryer settings remain constant to avoid any influence

Results

Existing Impact TAPS[®] Units – Before the Upgrade

Grade ABGW 230gsm 680.1m/min 13.1gsm @71% solids at CS#1 and 13.9gsm @71% solids at CS #2

	10% Power kW/m	Water Removed Kg/m/hr	80% Power kW/m	Water Removed Kg/m/hr	Power Difference kW	Change in Water Removed Kg/m/hr	Av Water Removal Rate kg/kW
CS # 1	9.66	208.93	61.87	209.33	52.21	0.4	0.007
CS # 2	9.66	217.5	61.87	218.31	52.21	0.81	0.0155

Incoming Sheet Moisture %	Sheet Moisture After Coating Drying %	Change in Sheet Moisture Kg/m/hr	Effective Evaporation Rate Kg/kW
5.3	5.4	+ 7.39	- 6.18

Results

Replacement Compact IRE units – After Upgrade

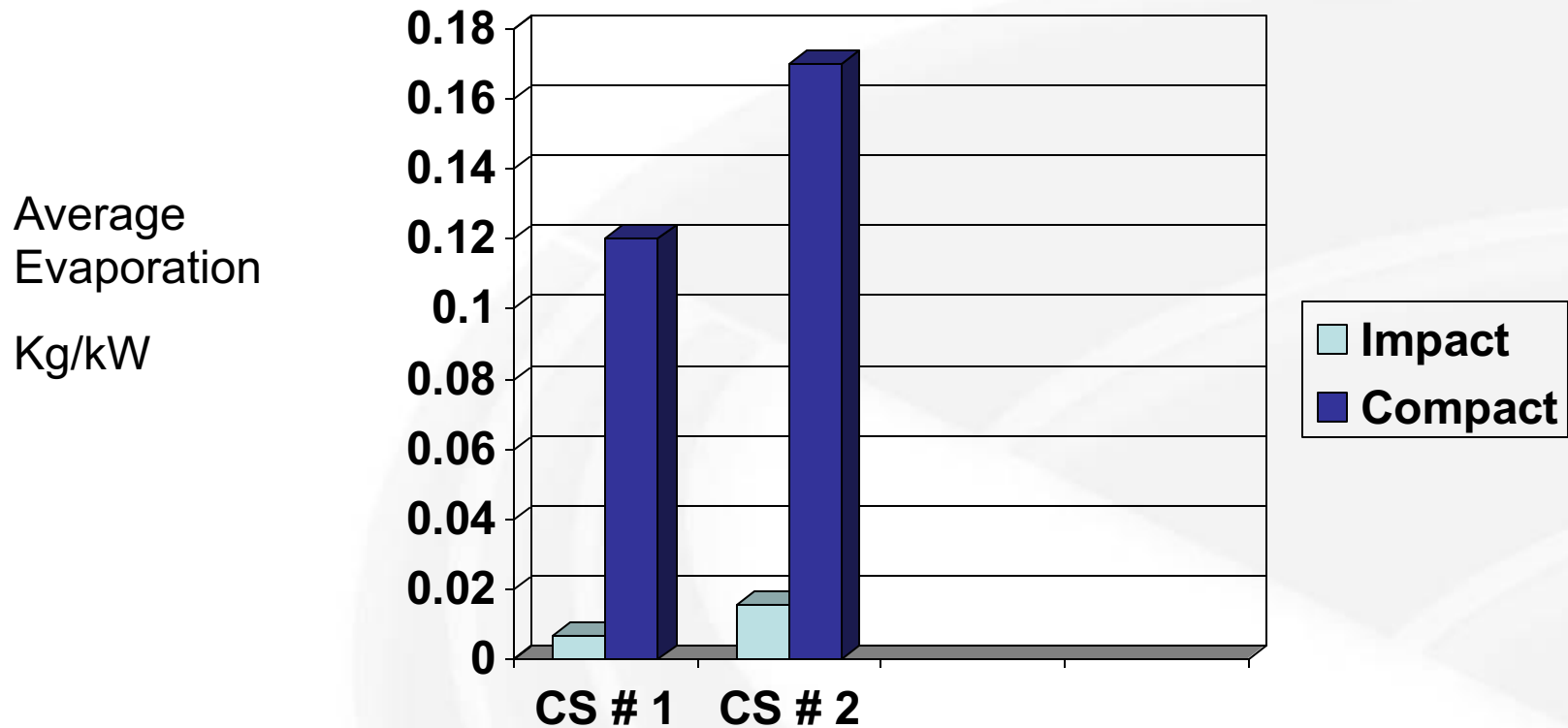
Grade AB2 250gsm 579.8m/min 13.1gsm @ 69% solids at CS #1 and 13.9gsm @ 69% solids at CS # 2

	20% Power kW/m	Water Removed Kg/m/hr	80% Power kW/m	Water Removed Kg/m/hr	Power Difference kW	Change in Water Removed Kg/m/hr	Av Water Removal Rate kg/kW
CS # 1	28.12	185.77	120.58	196.55	92.46	10.78	0.12
CS # 2	28.12	188.20	120.58	203.86	92.46	15.66	0.17

Incoming Sheet Moisture %	Sheet Moisture After Coating Drying %	Change in Sheet Moisture Kg/m/hr	Effective Evaporation Rate Kg/kW
5.5	5.0	-65.04	0.34

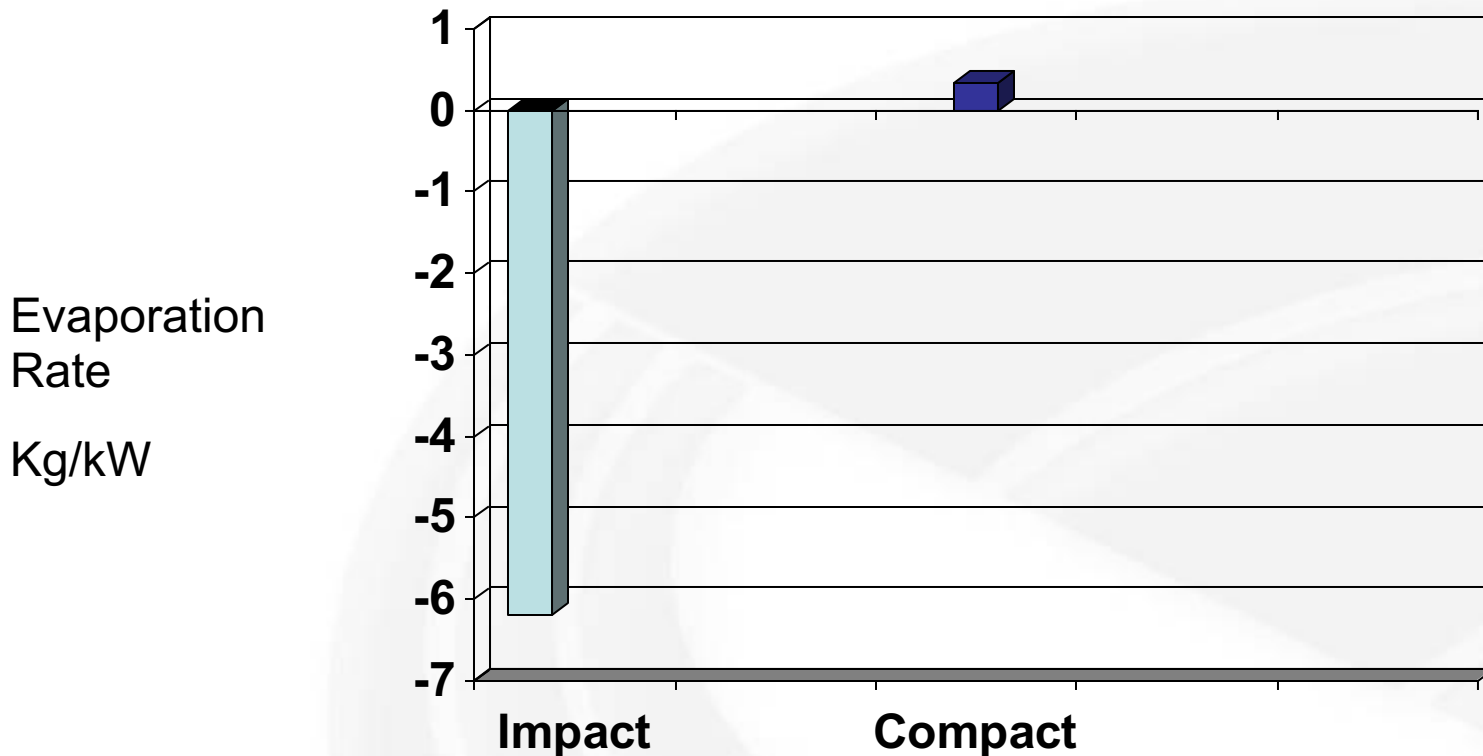
Results

Impact Emitters Vs Compact Emitters – Evaporation/Power Consumed



Results

Impact Emitters Vs Compact Emitters – Overall Evaporation Rate



Compact Drying Technology

- The effects on quality are clear to see:
 - Water migration into the sheet will normally take the fines and binder of the coating colour with it. This happened with the old system, as can be seen on the total moisture increase
 - Removing water from the sheet and coating means the flow is in the right direction, preventing binder and fine losses
 - The coating colour will stay on the surface

Results



Compact Drying Technology

- The payback on investments comes from:
 - Energy saving through the use of innovative, energy efficient technology
 - Possibility for higher machine speeds due to more drying capacity
 - Ability to dry higher coat weights
 - Saving in cellulose fibre costs

Compact Drying Technology

- One negative experience:
 - Due to improved evaporation rate and the hot air dryers being run under positive pressure, excessive amounts of hot, moist air turned down towards the operators
 - Frames in the previous system didn't create so much vapour
 - Deflectors had to be installed to prevent the system blowing warm air down towards the operators

Table of Content

- Introduction to APP and Sinar Mas
- Introduction to Ningbo Zhonghua Paper
- Introduction to Project
- Project Alternatives
- Project Implementation
- Compact Drying Technology
- Results
- Outlook

Outlook

- The high output of Compact Engineering's emitters and their higher efficiency allows us increasing the pre coat weight significantly without speed or weight limitation.
- Production can be increased as soon as the remaining two coating stations will be modified to Compact Engineering's emitters.
- Drying from inside to outside delivers us additional freedom in coating colour development.

We thank you for your attention