Chemistry Options for Reducing Energy Consumption in Tissue Making

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In this presentation we are using typical data for a modern crescent former machine with gas heated hoods using gas to generate steam

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Agenda

- Focus on energy consumption
- Chemistry options for reducing energy costs
- Case histories
- Conclusions

Why Reduce Energy Consumption?

- There are numerous reasons for reducing energy
  - Cost saving
    - Energy is the second highest cost when producing Tissue so any savings here will have a significant impact on total costs
  - Sustainability
    - Reducing energy consumption will reduce the consumption of fossil fuels, reduce carbon emissions, lower CO_2 emissions and improve your environmental profile
  - Additionally reducing energy consumption should help to insulate you from future increases in energy costs
- Our focus today is on cost reduction

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Energy Costs

- The three main users of energy in Tissue production are
  - Electrical energy for machine drives, refiners, pumps, pulping, fan pump, vacuum system, utilities and so on
  - Steam energy for Yankee
  - Gas energy for Yankee hoods
- Typical breakdown is as follows

Energy Source	Consumption (kWh/mt)
Electricity	900
Gas	1,000
Steam (Gas Generated)	900
Total	**2,800**

- Advances in machine and fabric design have helped reduce energy consumption but there are still opportunities to reduce these values further with the right chemical treatments
- We will focus on energy used for sheet drying but there are possibilities to reduce electrical energy costs

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Reducing Drying Costs

- TAPPI TIP 0404-05 gives the following paper mass balance formula for evaporation rates on the Yankee
- $$R = B \times S \times W \times \left[\frac{L}{E} - 1\right] \times \frac{1}{1000}$$
  - R is the evaporation rate in kg/min
  - B is sheet basis weight in g/m²
  - S is machine speed in m/min
  - W is sheet width in m
  - E is sheet dryness entering the hoods in %
  - L is sheet dryness leaving the hoods in %
  - The values of B, S and W are fixed by operational conditions so the required evaporation rate on the Yankee is controlled by the dryness of the sheet onto the Yankee and leaving the Yankee
    - A 1% increase in post press solids could reduce the evaporation rate by up to 4% which translates to up to a 3% reduction in drying energy
    - A 1% increase in sheet moisture at the creping blade could reduce the evaporation rate by up to 4% leading to up to a 3% reduction in drying energy

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Increasing Post Press Solids

- Retention and drainage aids are commonly used in the production of other paper grades but are not widely used in Tissue production
  - Main issue has been that they are typically high molecular weight polymers which when used in Tissue production lead to formation problems due to over flocculation of the sheet
- New generations of polymers have been developed that have a better balance of molecular weight and structure to give increased drainage without any negative impact on formation
  - These will improve retention and drainage on Tissue machines with no negative effects on formation

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Case History

- Machine Details
  - Crescent former machine
  - 3.0m width
  - Furnish 100% virgin fibre
    - 25% North American softwood 75% Brazilian hardwood
  - Speed 1,850m/min
  - Facial Tissue
- Objectives
  - Reduce gas consumption for cost saving
  - No loss in handfeel or strength
- Solenis Solution
  - Run wet end drainage additive added pre screen to increase post press solids

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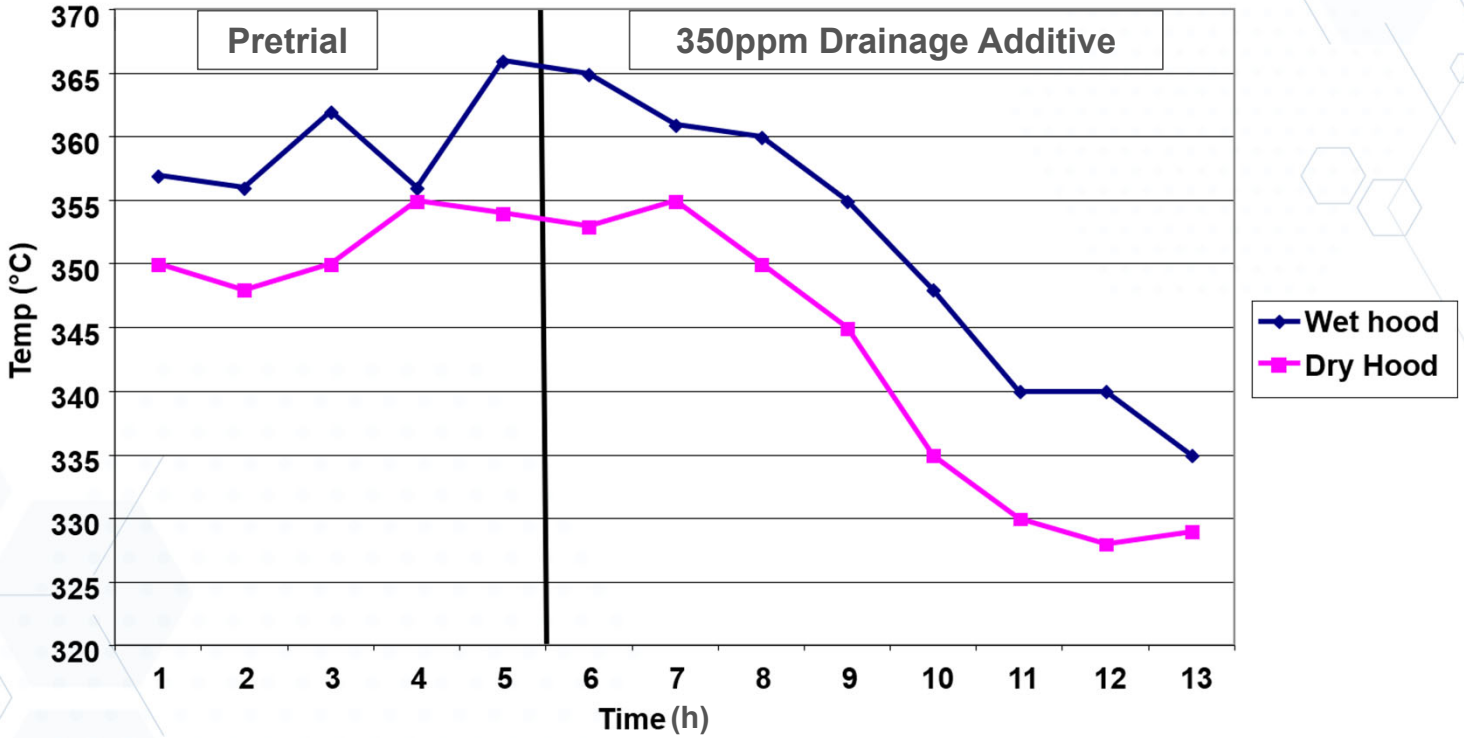
Effect On Hood Temperatures



- Use of a drainage aid increases water removal from the sheet
- This increases sheet solids when transferred onto the Yankee
- This reduces drying load on the Yankee allowing hood temperatures to be reduced with no loss in Tissue quality

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Results

- Hood temperatures reduced by around 40°C
  - Represents a significant gas saving
- In addition
  - Tissue strength increase
    - Allowed 5% reduction in long fibre content
  - Handfeel improved
    - Better control of wet end fines and reduced long fibre content
  - First pass retention also increased
    - Helps to improve fibre utilisation for further cost savings
  - White water solids decreased
    - Helps to reduce dusting
- Drying energy saving estimated to be 5% giving a significant saving inclusive of chemical treatment cost
  - ROI estimated to be over 600% on energy reduction alone

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Creping At Higher Moisture

- The TAPPI TIP 0404-05 paper mass balance calculation shows increasing sheet moisture leaving the Yankee will reduce drying energy consumption
- On a typical crescent former machine the sheet is creped at around 5%
- Creping at a higher sheet moisture will help to reduce energy consumption but there are a number of potential hurdles to this
  - The effect of the higher average moisture on Yankee coating performance
  - The impact of significantly higher peak moisture content on Yankee coating performance
  - This can be a particular problem at an interface between low and high values
- Important to select coating products that will work at high sheet moisture
- Also important to maintain fabric cleanliness to minimise effect on CD moisture profiles

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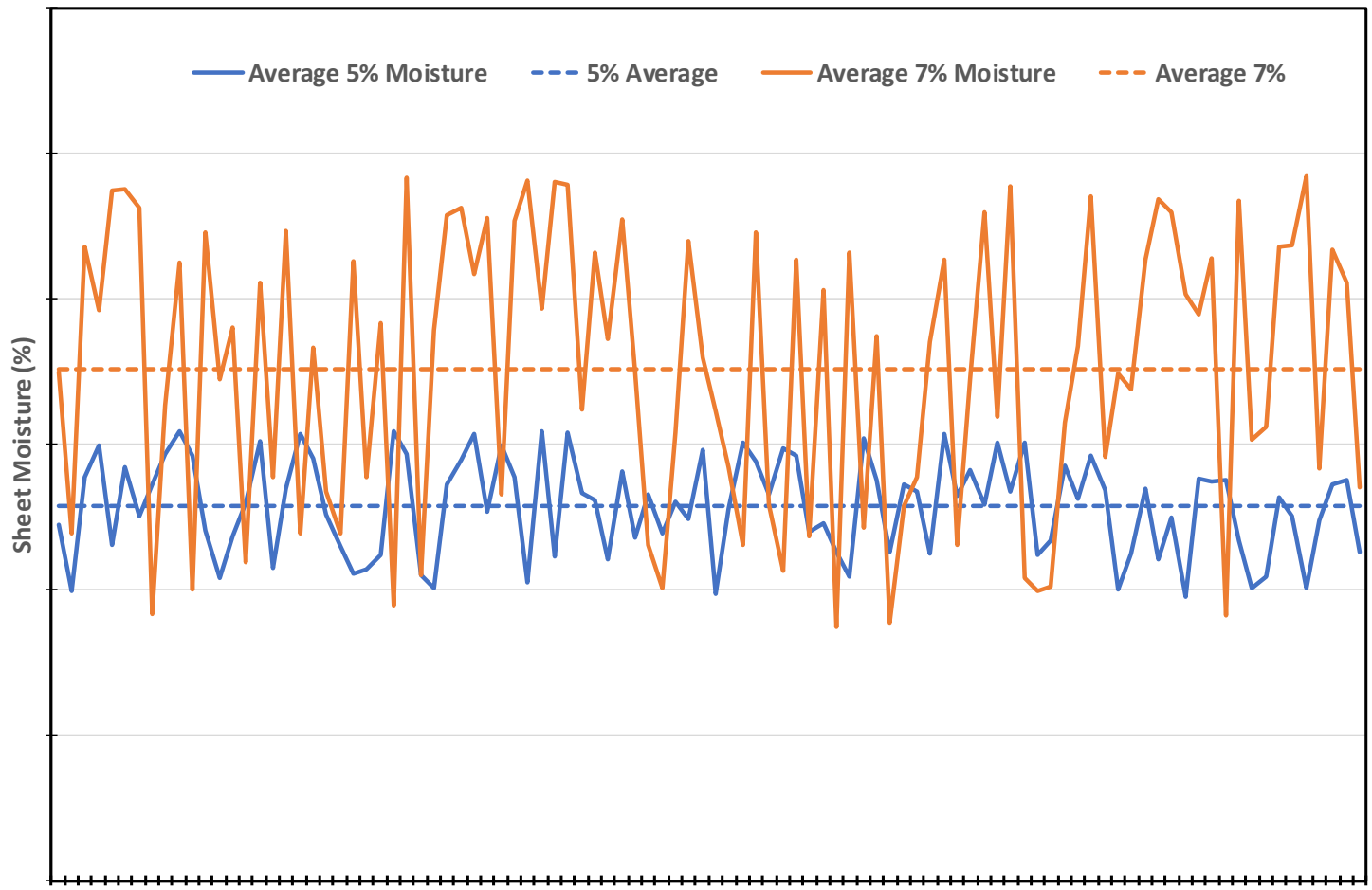
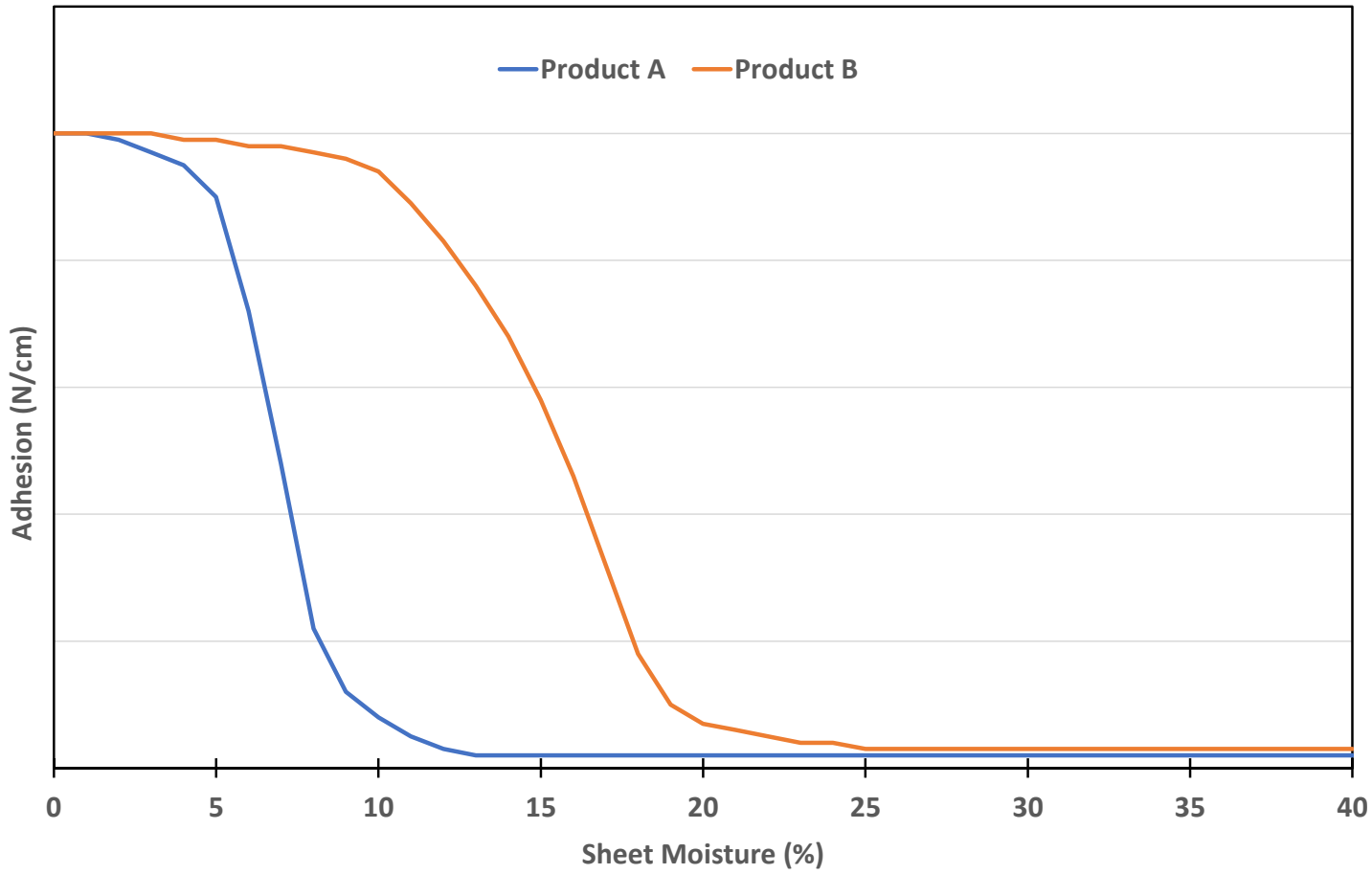
Effect Of Higher Moisture on CD Profile

- Average sheet moisture increased from 5% to 7%
- High to low range increases from 2.2% to 6.0%
- Standard deviation increases from 0.67% to 1.92%
- The higher average and higher range can impact Yankee coating performance depending on product selection



Effect Of Moisture On Creping Adhesives

- Adhesion reduces as sheet moisture increases
- Reduction depends on product selection
- When creping at higher moisture product selection is important



Effect Of CD Moisture Profile

- A new felt will have a high, uniform, permeability
- As it ages it's permeability will reduce and the CD permeability profile will become less uniform
- There are two main impacts of this
  - As a felt ages the sheet moisture content when it transfers onto the Yankee will increase
  - The uneven CD profile will be mirrored on the Yankee resulting in an uneven moisture profile
    - As sheet moisture content at the creping blade increases this will become a bigger problem
- The solution to this is effective felt cleaning
  - Will help to maintain high and uniform permeability

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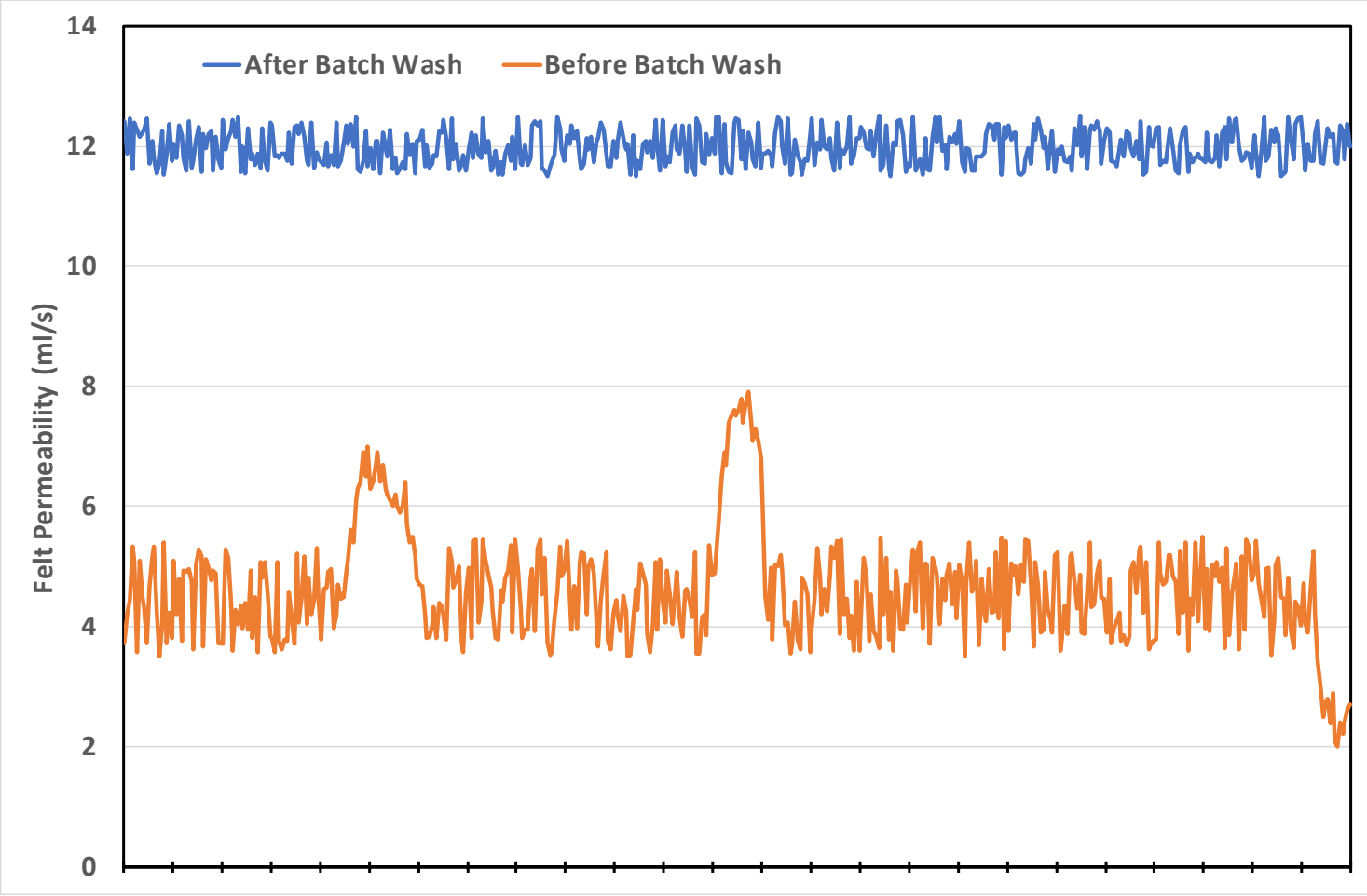
Effect Of Felt Batch Wash On Permeability

- Effective felt cleaning increase felt permeability and also improves profile
- Average permeability increases from 4.6ml/s to 11.9ml/s
- SD decreases from 0.90ml/s to 0.29ml/s
- High to low range decreases from 5.9ml/s to 1.0ml/s



Case History

- Machine Details
  - Crescent former machine
  - 6.0m width
  - Furnish 100% virgin fibre
    - 20% North American softwood 80% Brazilian hardwood
  - Speed 1,600m/min
  - Toilet Tissue
- Objectives
  - Increase sheet moisture from 5% to 7% at creping blade for energy saving
- Solenis Solution
  - Continuous felt conditioning for better moisture profile at higher sheet moisture
    - Using a blended alkaline, surfactant and sequestrant based product
  - New creping adhesive for better performance at high sheet moisture

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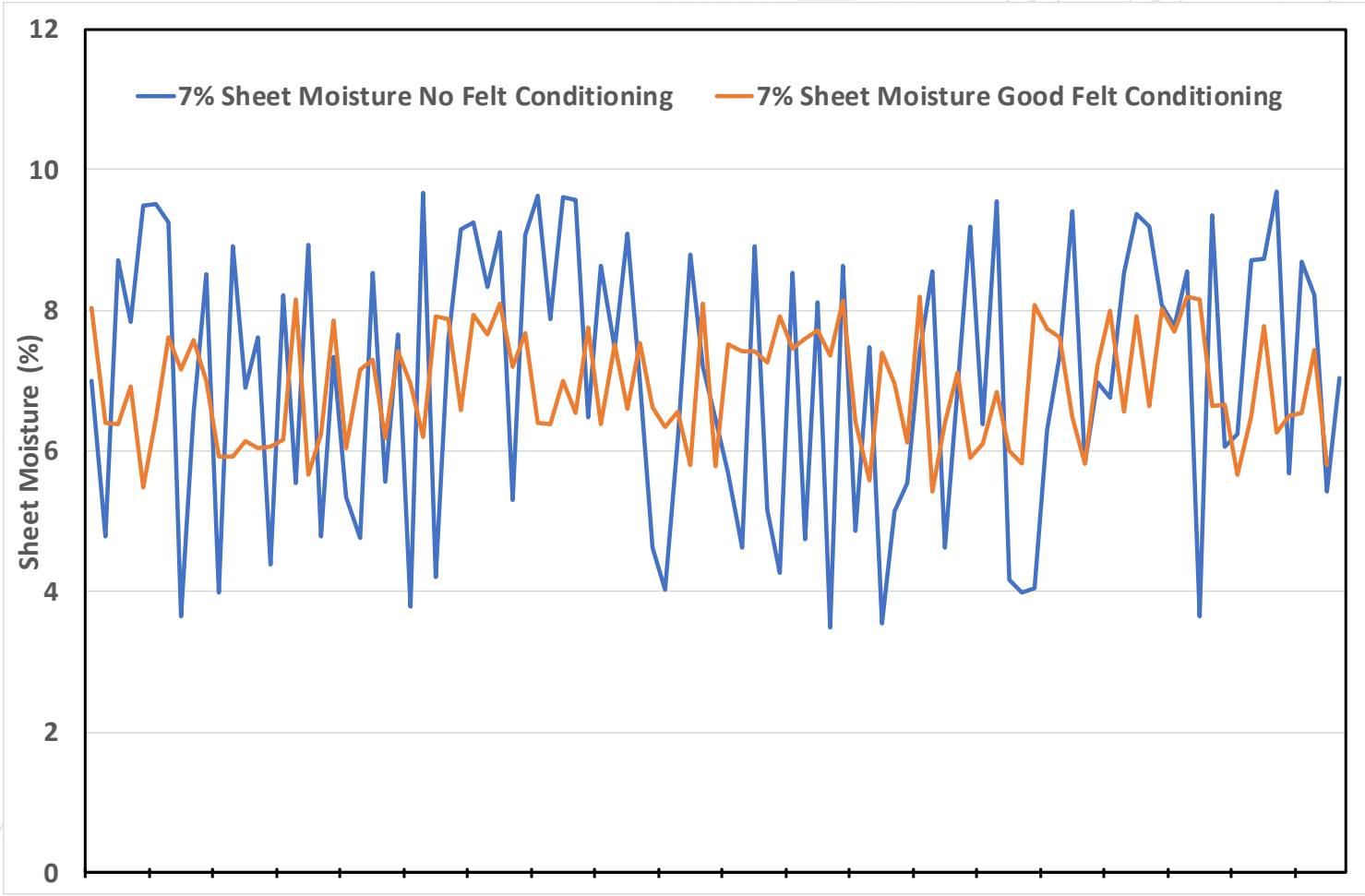
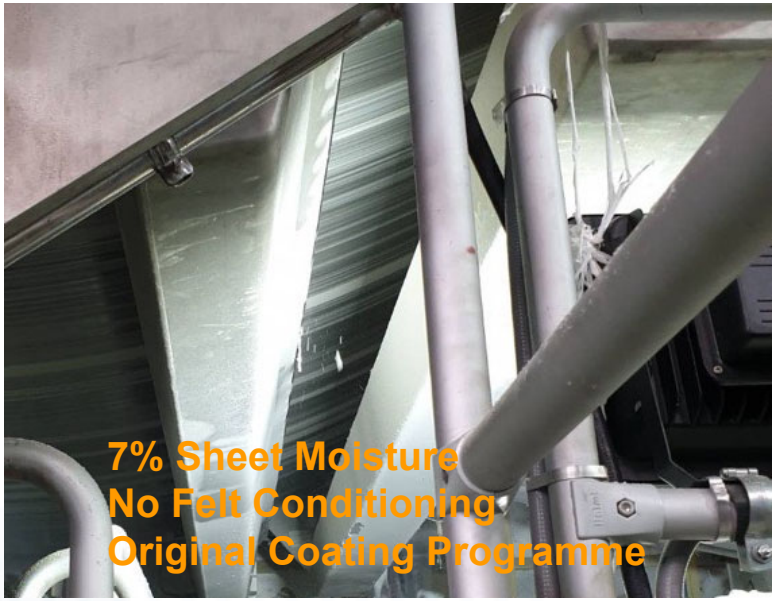
Effect Of Felt Conditioning On Sheet Moisture Profile

- At 7% sheet moisture CD profile was poor and resulted in poor Yankee coating uniformity and performance
- Effective felt cleaning improved CD moisture profile at the same average values
- SD decreases from 1.9% to 0.8%
- High to low range decreases from 6.2% to 2.7%
- This helps to improve coating uniformity



Effect On Yankee Profile



- Updated creping adhesive, used at the same addition rate, was less sensitive to sheet moisture content than original programme
  - Resulted in improved coating uniformity, better reel profile and no loss in Tissue softness at higher moisture

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Results

- As a result of effective felt cleaning CD moisture profile at the creping blade improved which helps to improve coating uniformity
- New creping adhesive was more effective at higher sheet moisture allowing Tissue to be produced at 7% sheet moisture instead of 5% with no loss in quality
  - Higher sheet moisture also resulted in a small fibre saving
- Reduction in drying energy estimated to be 3% giving a significant saving inclusive of chemical treatment cost
  - ROI estimated to be over 400%

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Conclusions

- Advancements in machine design have led to significant reductions in energy consumption during Tissue production but there still opportunities for further reduction
  - By increasing post press solids
  - Creping at higher moisture
- These can be achieved with the right chemical treatments
  - Advanced drainage aids to increase post press solids
  - New creping chemistries combined with an effective felt cleaning programme

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