**OPTIONAL QUIZ QUESTIONS for Course 6: “Water Removal & Productivity on the Paper Machine”**

Scroll way down to the bottom to see answers.

Session 1: Cellulosic fines & drainage additives

1A – When forming a paper handsheet having a relatively high basis weight, what term accurately describes the dependency of drainage time on the content of cellulosic fines?

* Linear
* Nonlinear
* Constant
* Reaching a plateau

1B – The most traditional dewatering-agent programs for paper machines running under acidic papermaking conditions often contain two classes of additives. The first class includes alum, PAC, and poly-ethyleneimine (PEI), among others. What is the second type of additive, which is generally added later to the furnish during papermaking?

* An anionic retention aid (aPAM)
* Colloidal silica or bentonite (micro- or nanoparticles)
* A cationic retention aid (cPAM)
* A high-charge cationic agent

1C – Which of the following chemical substances is NOT expected to contribute to faster dewatering during the formation of paper?

* Aluminum sulfate (papermaker’s alum)
* Cellulase (enzyme)
* Bentonite (or colloidal silica) in sequence with a cationic polymer
* Low-mass poly(acrylic acid-co-acrylamide) (dispersant)

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Session 2: Mechanisms of dewatering enhancement

2A – According to the Kozeny-Carman equation, what three factors are very important in determining the rate of flow through a porous material?

* Elasticity (reciprocal of elastic modulus), particle radius, and temperature
* Fluid viscosity, surface area per unit mass, and volume fraction of the solids
* Sealing tendency, entrapment of fine particles in the mat, and interactive forces
* Canadian standard freeness, first-pass retention, and electrical conductivity

2B – Which of the following mechanisms of retention of fine particles onto fiber surfaces is maximized when surfaces are about half-covered and half-uncovered by cationic polymer?

* Charged patch mechanism
* Polymer bridging mechanism
* Mechanical binding mechanism
* Nanoparticle / cPAM mechanism

2C – Horn and Melzer (1975) found that the fastest dewatering of papermaking stock was achieved when adding an optimum amount of a high-charge cationic polymer (PEI). What else was true at the optimum point?

* It was necessary to add anionic starch to achieve rapid dewatering.
* The zeta potential of fiber surfaces was near to zero
* The fiber suspension was highly uniform and well dispersed.
* The absolute value of zeta potential was near to a maximum.

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Session 3: Paper machine operations & dewatering

3A – What type of equipment on a paper machine forming section can be associated with table activity, microturbulence, and in extreme cases “stock jump”?

* Hydrofoil
* Low-vacuum flatbox
* Headbox slice
* Turbulator bar

3B – What is the expected effect of increased refining on the rate of water removal during the formation of paper?

* Increased refining results in faster dewatering.
* Increased refining results in slower dewatering.
* Increased refining does not affect dewatering.
* More information is needed to answer the question.

3C – Which of the following practices can be expected to minimize the amount of energy needed to remove water from paper at the high-vacuum section of a paper machine?

* Decreasing vacuum from one high-vacuum box to the next
* Increasing vacuum from one high-vacuum box to the next
* Constant vacuum, all at the optimum level established by testing
* All at the maximum levels allowed by design of the equipment

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Session 4: Micro- & nanoparticle systems

4A – About how big is the minimum dimension (thickness or diameter) of a typical particle of bentonite (sodium montmorillonite) or colloidal silica used in papermaking?

* 2 to 20 nm
* 100 to 400 nm
* 1 to 2 micrometers
* 0.1 to 1.5 mm

4B - Which of the following is often true at the point of optimization of a drainage and retention program that involves a high-mass cationic polymer and sequential addition of a micro- or nanoparticles such as bentonite or colloidal silica?

* Minimum value of Canadian Standard Freeness
* A pH value of about 4.2
* Zeta potential near to zero
* A minimum of first-pass retention

4C – Nanoparticles that are longer (higher in structure) tend to provide what advantage, in addition to promoting dewatering when added sequentially with cationic acrylamide copolymer retention aid?

* Brighter and more opaque paper
* More stable zeta potential
* Increased paper strength
* Higher first-pass retention

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Session 5: Water retention value & enzymes

5A – What happens to the water retention value (WRV) as a kraft pulp mixture in water is subjected to increased levels of refining?

* The WRV goes down.
* The WRV goes up.
* The WRV stays the same.
* The WRV goes down then up.

5B – What molecular attribute of a high-charge cationic polymer drainage aid can be expected to make it more effective (bigger increase in drainage rate at lower dosage)?

* Lower molecular mass
* Higher molecular mass
* Linear molecular structure
* A high level of crosslinking

5C – At what point in a typical papermaking process, using kraft pulp, should a cellulase enzyme be applied when the main goal is to achieve faster drainage while keeping paper properties about the same?

* After the refining of the fibers
* Before the refining of the fibers
* Sprayed onto the wet web in the Fourdrinier section
* Just before the headbox to minimize time of contact with the fibers

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Session 6: Troubleshooting of dewatering issues

6A – What kind of response to vacuum dewatering can be expected in the case of papermaking furnish that is strongly flocculated by the addition of an over-effective retention aid treatment?

* Excessive dewatering
* Unsteady dewatering
* No effect on dewatering
* Poor dewatering

6B – What is a practical way to convert an over-flocculated suspension of papermaking fibers into a mixture that would provide favorable dewatering both in the “early” (hydrofoils) part of a Fourdrinier paper machine and “late” (vacuum boxes) dewatering?

* Add nanoparticles to the overflocculated suspension.
* Add a high-charge cationic polymer before the other additives.
* Apply hydrodynamic shear to the overflocculated suspension.
* Use the mixture very quickly before the polymer bridges can form.

6C – Which of the following is NOT a component of a cellulase enzyme mixture, such as are produced by various fungi and bacteria?

* Endoglucanase (attacks randomly)
* Exoglucanase (attacks the ends)
* Neoglucosidase (directs other enzymes)
* Beta-glucosidase (breaks dimers & trimers)

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Session 7: Wet-pressing & productivity

7A – What two main components of pressure have been proposed (e.g. by Wahlström) to oppose the applied pressure at a felted wet-press nip?

* Hydraulic pressure and hydrodynamic pressure
* Mechanical and physical pressure
* Pressure due to the felt and pressure due to the wet web of paper
* Hydraulic pressure and fiber structure pressure

7B – Based on the lecture, why can a high dosage of retention aid sometimes hurt the performance of the pressing and drying processes for the removal of water from a paper sheet?

* The retention aid molecules hold water molecules in the sheet.
* It is harder to remove water from a flocculated sheet.
* The retention aid helps retain minerals, which do not release water easily.
* Too much water is released early in the process, not leaving enough behind for effective wet-press and dryer operations.

7C – What property of water itself can explain why wet-press performance can be improved by use of a steam box or a heated press roll?

* The diffusion rate of water molecules increases with increasing temperature.
* The treatments remove air content from the water, which promotes water release.
* The water becomes supercritical, which dramatically changes its behavior.
* Water’s viscosity decreases when it is heated.

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Session 8: Paper machine dryer section issues

8A – What happens, in general, to the rate of water release from paper in a conventional set of steam-heated dryer cans after there is no longer a film of water that extends out as far as the paper surface?

* The rate of evaporation increases after that point.
* The rate of evaporation stays constant after that point.
* The paper begins its “warm-up period” at that point.
* The rate of evaporation falls after that point.

8B – What is the name of the device that is used to remove condensate from the interior of a dryer can during its operation?

* A turbulator bar
* A cascading rimmer
* A siphon
* A blow box

8C – What type of paper products can be manufactured using either Yankee cylinder dryers or through-air dryers (TAD systems)?

* Tissue paper
* Linerboard or corrugating medium
* Printing papers
* Cement bag paper

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ANSWERS TO QUIZ QUESTIONS, COURSE 6

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3A: What type of equipment on a paper machine forming section can be associated with table activity, microturbulence, and in extreme cases “stock jump”? Hydrofoil

3B: What is the expected effect of increased refining on the rate of water removal during the formation of paper? Increased refining results in slower dewatering.

3C: Which of the following practices can be expected to minimize the amount of energy needed to remove water from paper at the high-vacuum section of a paper machine? Increasing vacuum from one high-vacuum box to the next

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