**OPTIONAL QUIZ QUESTIONS for Course 9, “Retention & Retention Aids in Papermaking”**

Scroll way down to the bottom to see answers.

Session 1: Fine particles and their retention

1A – What part of the papermaking system has the highest ratio of fines to fibers?

* Thick stock before the fan pump
* Thin stock after the fan pump
* The paper web after the forming section
* None – equal ratio throughout the process

1B – What mechanism contributes to a higher proportion of fines near to a forming fabric?

* Thickening
* Washing
* Hydrofoil action
* Filtration

1C – What is the name of the device that collects fines from excess process water so that the fines can be returned to the paper machine system?

* Pulper
* Saveall
* Hydrofoil
* Hydrocyclone

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Session 2: Retention aid chemistry

2A – Which of the following aluminum species is the most effective as a coagulant, meaning that it can cause the agglomeration and deposition of negatively charged fine particles when added at a very low dosage?

* Trivalent
* Neutral floc
* Aluminate
* Oligomeric

2B – What type of additive for papermaking ordinarily has a very high molecular mass (typically 5 to 20 million grams per mole)?

* High-charge polyamine (scavenger)
* Poly-ethylene imine (PEI, branched type)
* Polyvinylamine (after hydrolysis of amide groups)
* Acrylamide copolymer retention aid

2C – Which of the following retention aids has little effect when added to a papermaking system where there is no alum or cationic starch, *etc*.?

* Cationic acrylamide copolymer
* Poly(dimethylamine epichlorohydrin)
* Anionic acrylamide copolymer
* Cationic starch

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Session 3: Mechanisms of retention aid action

3A – Of the following, which unit operation on a paper machine is expected to have the highest hydrodynamic shear, based on published estimates (Tam Doo *et al.* 1984)?

* Rectifier roll
* Pressure screen
* Headbox slice
* Hydrofoils

3B – What mechanism, achieved by medium-high cationic polymers, can lead to attachments that are quite strong, and are able to form again strongly after being disrupted by shear?

* Charged patches
* Polymer bridges
* Neutralization of surface charges
* Network sieving

3C – What unit operation on a typical paper machine causes essentially all of the fibers to be dispersed from each other, but some fine particles may remain attached by fibers (due to the retention aids)?

* Headbox (including slice)
* Hydrofoils
* Separator
* Pressure screen

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Session 4: Makedown & feeding of retention aids

4A – What is the most common form of retention aid concentrate that is shipped to paper mills in the US?

* Oil-in-water emulsion
* Water-in-oil emulsion
* Hybridized emulsion
* Emulsion in saline solution

4B – What can be done to minimize the amount of low- to medium-mass cationic polymer that diffuses into the cell walls of kraft fibers?

* Addition relatively late in the process, *e.g.* before or after the fan pump
* Addition in highly diluted form so that the water helps to resist the diffusion
* Addition at low temperature, to increase the viscosity and slow diffusion
* Injection using a venturi system (an educator)

4C – Flash mixing injection systems, which use the recirculation of thin stock to dilute the chemical additive before injection, are able to achieve what benefit?

* Injection of the additive in the essential absence of hydrodynamic shear
* Reduced consistency (filterable solids) of the headbox stock, due to the extra dilution
* Increased usage of fresh water (push water), giving a better balance for flows in the mill
* More uniform distribution of the additive at points downstream of the injection point

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Session 5: Lab tests related to retention aid usage

5A – What can users of lab tests, such as the Britt jar, do in order to “calibrate” the results with a paper machine system?

* Adjust the length of time of shearing in the lab test to match the results obtained on the paper machine.
* Adjust the stock consistency of the lab test to match the results obtained on the paper machine.
* Adjust the hydrodynamic shear of the lab test to match the results obtained on the paper machine.
* Adjust the polymer dosage of the lab test to match the results obtained on the paper machine.

5B – Pulsation effects during the formation of a paper sheet on a typical Fourdrinier paper machine are caused by which of the following devices?

* Forming boards and dandy rolls
* Jet-to-wire speed adjusters
* Intermittent suction boxes
* Hydrofoils and vacuum flat-boxes

5C – Tests with the moving belt drainage test device, simulating the effects of high-vacuum dewatering, showed that WHAT increased with increasing frequency of vacuum pulsation?

* Reduction of filler content near the felt side of the sheet
* Reduction of filler content near the wire side of the sheet
* Reduction of apparent density in the center of the sheet
* Reduction of apparent density near the felt side of the sheet

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Session 6: Micro- & nanoparticle systems

6A – Which type of micro- or nano-particle, useful in retention and drainage additive programs, has a highly platy shape with a thickness in the nano-scale?

* Colloidal silica (sol type)
* Colloidal silica (gel type)
* Bentonite (montmorillonite)
* Micropolymer (crosslinked)

6B – What type of colloidal silica, in combination with a cationic retention aid (acrylamide copolymer), can be expected to be most effective for increasing fine-particle retention?

* High-structure (sol-type)
* High-structure (gel-type)
* Low-structure (gel-type)
* Low-structure (sol-type)

6C – What is the explanation for the “wringing” effect of a micro- or nano-particle retention aid system?

* Osmotic forces cause polymer chains to become coiled.
* After breakage of the very-high-mass copolymer chains, they are less effective for bridging.
* Thermal motions of polymer segments being about a transformation from straight to wavy.
* Cationic polymer chains wrap themselves around negatively charged particles.

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Session 7: Interfering substances

7A – In what way did the addition of extractives to papermaking furnish affect the performance of a retention system with cationic starch and colloidal silica?

* Excessive flocculation, leading to poor uniformity of the resulting paper
* Foaming occurred due to the surface-active nature of the extractives, in combination with the starch and silica
* Lack of increase of fines retention, especially at low cationic starch levels
* High retention efficiency due to a synergic interaction between the colloidal silica and the extractives

7B – What happens to a cationic acrylamide retention aid if the papermaking furnish contains an excess of negatively charged dissolved and colloidal substances?

* No effect, since the polymer has the same charge.
* The polymer becomes more effective due to a kind of crosslinking.
* The polymer becomes neutralized and less extended.
* The polymer becomes vulnerable to breakage by hydrodynamic shear.

7C – What kind of retention aid system is tolerant of a combination of negatively charged dissolved and colloidal substances plus high salt (electrical conductivity) levels?

* Cationic acrylamide copolymer (cPAM)
* Anionic acrylamide copolymer (aPAM)
* Poly(ethylene oxide) (PEO)
* Poly(vinylamine) (PVAm)

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Session 8: Control and optimization of retention aids

8A – During routine running of a paper machine, which of the following variables is changed, and in what way, to control the process if the observed efficiency of fine-particle retention is low?

* Increased flow of the retention aid
* Decreased flow of the retention aid
* Movement of the addition point closer to the headbox
* Earlier addition of the retention aid

8B – For effective online control of the retention efficiency, what quantity is monitored, usually by use of calibrated optical tests?

* Tray-water consistency
* Headbox consistency
* Calculated first-pass retention
* Flow of the retention aid

8C – Why is an increased proportion of coated broke often highly correlated with changes in charge demand and in the required dosage of retention aid needed to maintain a steady level of fine-particle retention?

* The broke contains high levels of wood extractives from the coating.
* The broke contains high levels of oxidized hemicellulose from bleaching.
* The broke contains high levels of silicates and fatty acid soaps.
* The broke contains negatively charged latex and pigment dispersants.

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ANSWERS TO QUIZ QUESTIONS, COURSE 9

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