**QUIZ QUESTIONS, ANSWERS, NON-ANSWERS, for Course 3: “Paper’s Appearance”**

Session 1: Tests of paper’s appearance

1A – What is the angle of incidence of light on a sheet of paper for the test that is most commonly used to measure paper brightness in the US?

* 0 degrees
* 90 degrees
* 45 degrees
* 10 degrees

1B – Which of the following is a color coordinate that indicates the degree of yellowness (positive value) or blueness (negative value)?

* b\*
* x
* L\*
* z

1C – What do most people have 3 of so that they are able to perceive multiple shades of color?

* Types of cone cells in the eye.
* Types of rod cells in the eye.
* Types of color filter within the cone cells of the eye.
* Types of sensing organs within cone cells of the eye.

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Session 2: Ways to increase paper’s brightness

2A – Which parameter (from Kubelka and Munk, 1931) indicates the tendency of a material to absorb light?

* S
* k
* R(∞)
* L\*

2B – Which of the following is NOT a good strategy to increase the brightness of paper?

* Bleach the pulp, removing or decolorizing the lignin
* Add bright mineral filler such as calcium carbonate
* Use high-purity additives, such as low-iron alum
* Store the wet pulp for more than 2 days

2C – Why does increased refining generally decrease paper’s brightness?

* More metal gets rubbed off from the refiner plates, and this is converted to rust.
* The resulting paper tends to be denser, with fewer air spaces to scatter light.
* The fibers get shorter, so the light scattering coefficient is increased at lot.
* The fibers become more swollen, creating a bulkier sheet that absorbs more light.

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Session 3: Paper’s opacity and how to change it

3A – How many separate pieces of reflectance data are needed to complete a single test (not replicated yet) of the opacity of paper?

* 1
* 2
* 0
* 3

3B – Which type of mineral has the highest refractive index in this list?

* CaCO3.
* BaSO4.
* SiO2.
* TiO2.

3C - What does the symbol “X(1)” mean in the following equation?

S(paper) = s(1)x(1) + s(2)x(2)

[Note that the quantities in parentheses are often shown as subscripts.]

* The scattering coefficient of component 1.
* “This quantity is to be multiplied by 1.”
* The light absorbance coefficient of component 1.
* The fractional content of component 1.

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Session 4: Paper’s color and the use of dyes

4A - What type of dye is relatively large, planar, highly conjugated, and containing one or more sulfonate groups to render it water-soluble?

* Acid dye
* Basic dye
* Direct dye
* Colored pigment

4B - What is the term to describe the sequence of single and double carbon-carbon bonds such that a longer wavelength of light can be absorbed by an organic chemical compound?

* Conjugation
* Saturation
* Unsaturation
* Isomerization

4C - What do we call a dye that is very effective for absorbance of blue light wavelengths but not green or red wavelengths?

* Blue.
* Yellow.
* Cyan.
* Fluorescent whitener.

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Session 5: Process control of paper’s appearance

5A – Which of the following is a positive displacement pump that is appropriate for precise delivery of dyes to a paper machine system because it delivers a very steady flow?

* Diaphragm pump.
* Centrifugal pump.
* Dynamic or kinetic pump.
* Gear pump.

5B – What is the best way to deal with the fact that online color data are offset due to the higher temperature of the paper during its production?

* Add extra dye to compensate for the effect.
* Reduce the dye addition to compensate for the effect.
* Calibration, using lab tests.
* Cool the web before the sensor.

5C – A key advantage of online monitoring and control of color, compared to manual testing, is which of the following?

* Less costly measuring equipment, since the lab device is not needed.
* No need to calibrate the system due to the self-calibrating principle.
* It is able to take advantage of continuous addition of liquid dyes.
* Higher precision due to more data points and automation.

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Session 6: Two-sidedness and troubleshooting issues

6A – What terms give a good description of the kinds of “fixatives” that are widely used to increase the attachment of typical dyes (especially certain direct dyes having relatively low affinity) to the fiber surfaces?

* Anionic or negatively charged
* Reactive or surface-active
* Monovalent or single-charged
* Cationic or positively charged

6B – So that a higher proportion of a dye will end up on longer fibers, one would choose to add the dye at what point in the paper machine process?

* To the process water (white water).
* To the thick stock (before the fan pump).
* At the accepts of the hydrocyclone cleaners.
* At the size press (to the paper surface).

6C – Three of the following are promising strategies to reduce “graniting” of paper that is being dyed to an intermediate depth of shade. Which of the following is not?

* Diluting of the dye with water before it is added.
* Waiting until the dye spreads to other fibers.
* Adding the dye at a point of vigorous agitation.
* Switching to a lower-affinity dye.

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Session 7: Fluorescent whitening agents

7A – Which type of fluorescent whitening agent (FWA or OBA) product will have the highest water-solubility, giving it a poor affinity for papermaking fibers and a high suitability for use at the size press?

* Hexasulfonated.
* Tetrasulfonated.
* Disulfonated.
* Unsulfonated.

7B – How does a typical fluorescent whitener product achieve its whitening effect?

* It absorbs red light and emits blue light.
* It absorbs ultraviolet light and emits blue light.
* It absorbs blue light and emits ultraviolet light.
* It absorbs red light and emits yellow light.

7C – Three of the following items will hurt the effectiveness of a fluorescent whitening agent. Which of them will not?

* Titanium dioxide.
* Lignin in the fibers.
* Calcium carbonate filler.
* High-charge cationic polymers.

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Session 8: Cost-optimization of paper’s appearance

8A – What is usually the least expensive way that papermakers can achieve a relatively large increase in opacity of white paper?

* Increase the filler content.
* Add a fluorescent whitening agent.
* Increase the energy input of refining.
* Apply higher pressure at the calenders.

8B – In what situation is it often most effective to add dye only to the surface of the sheet (size-press addition)?

* High opacity
* High-gloss products
* Tissue products
* High basis weight

8C – What paper property can be expected to decrease with an increase of filler content?

* Tensile strength
* Opacity
* Brightness
* a\* value

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ANSWER TO THE QUESTIONS FOR COURSE 3:

1A: What is the angle of incidence of light on a sheet of paper for the test that is most commonly used to measure paper brightness in the US? 45 degrees

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1C: What do most people have 3 of so that they are able to perceive multiple shades of color? Types of sensing organs within cone cells of the eye.

2A: Which parameter (from Kubelka and Munk, 1931) indicates the tendency of a material to absorb light? k

2B: Which of the following is NOT a good strategy to increase the brightness of paper? Store the wet pulp for more than 2 days

2C: Why does increased refining generally decrease paper’s brightness? The resulting paper tends to be denser, with fewer air spaces to scatter light.

3A: How many separate pieces of reflectance data are needed to complete a single test (not replicated yet) of the opacity of paper? 2

3B: Which type of mineral has the highest refractive index in this list? TiO2.

3C: What does the symbol “X(1)” mean in the following equation?

S(paper) = s(1)x(1) + s(2)x(2); The fractional content of component 1.

4A: What type of dye is relatively large, planar, highly conjugated, and containing one or more sulfonate groups to render it water-soluble? Direct dye

4B: What is the term to describe the sequence of single and double carbon-carbon bonds such that a longer wavelength of light can be absorbed by an organic chemical compound? Conjugation

4C: What do we call a dye that is very effective for absorbance of blue light wavelengths but not green or red wavelengths? Yellow

5A: Which of the following is a positive displacement pump that is appropriate for precise delivery of dyes to a paper machine system because it delivers a very steady flow? Gear pump.

5B: What is the best way to deal with the fact that online color data are offset due to the higher temperature of the paper during its production? Calibration, using lab tests.

5C: A key advantage of online monitoring and control of color, compared to manual testing, is which of the following? Higher precision due to more data points and automation.

6A: What terms give a good description of the kinds of “fixatives” that are widely used to increase the attachment of typical dyes (especially certain direct dyes having relatively low affinity) to the fiber surfaces? Cationic or positively charged

6B: So that a higher proportion of a dye will end up on longer fibers, one would choose to add the dye at what point in the paper machine process? To the thick stock (before the fan pump).

6C: Three of the following are promising strategies to reduce “graniting” of paper that is being dyed to an intermediate depth of shade. Which of the following is not? Waiting until the dye spreads to other fibers.

7A: Which type of fluorescent whitening agent (FWA or OBA) product will have the highest water-solubility, giving it a poor affinity for papermaking fibers and a high suitability for use at the size press? Hexasulfonated.

7B: How does a typical fluorescent whitener product achieve its whitening effect? It absorbs ultraviolet light and emits blue light. It absorbs ultraviolet light and emits blue light.

7C: Three of the following items will hurt the effectiveness of a fluorescent whitening agent. Which of them will not? Calcium carbonate filler.

8A: What is usually the least expensive way that papermakers can achieve a relatively large increase in opacity of white paper? Increase the filler content.

8B: In what situation is it often most effective to add dye only to the surface of the sheet (size-press addition)? High basis weight

8C: What paper property can be expected to decrease with an increase of filler content? Tensile strength