**OPTIONAL QUIZ QUESTIONS for Course 1: “Paper Manufacturing Chemistry”**

Scroll way down to the bottom to see answers.

Session 1: Tour

1A - What is the device for which the incoming flows are called “thick stock” and “white water” and the outgoing flow is called “thin stock”?

* Headbox
* Stuff box
* Cleaner (hydrocyclone)
* Fan pump

1B - What is the approximate percent solids (consistency) of papermaking furnish within the headbox of a typical paper machine system?

* 5%
* 0.5%
* 0.05%
* 0.005%

1C - What general class of pump is most often used to deliver solutions of chemical additives to paper machine systems?

* Centrifugal pumps
* Fan pumps
* Positive displacement pumps
* Dynamic (kinetic) pumps

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Session 2: Water

2A - The two “lone pairs” of electrons, the two covalent bonds between the oxygen and the hydrogen atoms, and the fact that oxygen is more electronegative than hydrogen cause water molecules to have the which of the following properties?

* Polar and capable of forming hydrogen bonds
* Capable of becoming hydrophobic an immobile upon cooling
* Balanced (concentric) in charge, favoring liquid behavior
* Tending to form polymers (polywater) when left to stand

2B - Which of the following ranges of pH corresponds to typical “acidic papermaking”?

* 2.5 to 3.8
* 4 to 5.5
* 5.5 to 7
* 7.5 to 9

2C - The presence of which of the following usually results in an alkaline pH in a typical papermaking system?

* Papermaker’s alum (aluminum sulfate)
* Calcium carbonate
* Sulfuric acid
* Sodium ions (Na+)

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Session 3: Paper strength

3A - Which of the following substances is commonly added to paper furnish for purposes of increasing the paper’s strength?

* Calcium carbonate
* Cationic retention aid
* Colloidal silica
* Cationic starch

3B - Which of the following operations results in internal delamination of the cell walls of fibers, increased swelling of the fiber material, external fibrillation of the fibers, and creation of cellulosic fines?

* Paper forming
* Kraft pulping
* Wet-pressing
* Refining

3C - What type of bonding plays a central role in the development of strength when paper is dried?

* Covalent bonding
* Hydrogen bonding
* Ionic bonding
* Metallic bonding (due to the calcium)

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Session 4: Sizing

4A - Please list at least three types of sizing agent that can be added to papermaking furnish so that the resulting paper will resist water or other fluids.

* Rosin emulsion, polyamine, and alkylketene dimer
* Rosin soap, alkylketene dimer, and alkenylsuccinic anhydride
* Alkenylsuccinic anhydride, alkylketene dimer, and resin
* Alum, poly-aluminum chloride, and polyamines

4B - What are two of the most important characteristics of a chemical compound that needs to function as a sizing agent to make the resulting paper resist water?

* A water-hating portion and a mechanism of anchoring to the fiber surface
* A water-hating portion and a molecular mass of at least 5 million grams per mole
* A water-hating portion and a water-loving portion
* A reactive group and an inert group

4C - Which group of additives can help paper pick up water quicker or a greater amount of water?

* Resin, polyacrylamides, and glyoxylated polyacrylamide
* Alkenylsuccinic anhydride, alkylketene dimer, and polyethyleneimine
* Surfactants (wetting agents), carboxymethylcellulose, super-absorbant polymers
* Alum (aluminum sulfate), polyaluminum chloride, and chlorine dioxide

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Session 5: Charge

5A - What type of charge-related test is analogous to an electricity meter for a house (measuring the amount of charge in a stated amount of process water or suspension)?

* Zeta potential
* Water hardness
* Cationic demand
* Voltage (redox potential)

5B - When running a test to determine the cationic demand of process water in a paper mill system, what kind of solution will be used as the titrant?

* Papermaker’s alum, i.e. a solution of aluminum sulfate
* Sodium hydroxide (or HCl, depending on the initial signal)
* Carboxymethylcellulose (CMC) or other negatively charged polymer
* A high-charge cationic polymer such as poly-DADMAC

5C - Which of the following lists contains only additives that contribute to a positive surface charge when placed in a paper machine system?

* Fibers, wood extractives, direct dyes
* Microparticles, de-inking soaps, most dispersants
* Fiber fines, clay, dry-strength additives
* Polyamines, alum, cationic starch

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Session 6: Fillers and Colorants

6A - What additive can greatly decrease the cost of materials to make a paper sheet as well as to increase the opacity of paper at constant basis weight?

* Mineral particles (filler)
* Cationic starch (corn, potato, tapioca, etc.)
* Papermaker’s alum (aluminum sulfate)
* Air bubbles (surfactant addition)

6B - What happens if calcium carbonate filler encounters acidic pH conditions in a paper machine system?

* Nothing happens.
* Ca(OH)2 (milk of lime) is formed.
* CO2 bubbles are released.
* The system charge becomes more negative.

6C - What type of additive absorbs ultraviolet light, which we cannot see, and re-emits the energy as blue light, making the paper seem less yellow and more fully bleached?

* Direct dyes
* Fluorescent whitening agents (FWAs)
* Invisible dyes
* Subtractive colorants

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Session 7: Retention

7A - If a retention aid molecule were as thin as angel-hair spaghetti, and if it were completely stretched out, it might be about as long as which of the following?

* A mile
* The state of North Carolina
* A football field
* Twice the length of a box of spaghetti

7B - What are the main components of “whitewater” in a paper machine system?

* Fibers and water
* Water and fines
* Shives (fiber bundles) and paper clips
* White dye dissolved in water

7C - Which of the following is the correct equation for the first-pass retention (where “C” means consistency or filterable solids)?

* FPR (%) = 100% \* (Ctray – CHB)/Ctray
* FPR (%) = 100% \* Ctray / (CHB – Ctray)
* FPR (%) = 100% \* CHB / (Ctray – CHB)
* FPR (%) = 100% \* (CHB – Ctray)/CHB

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Session 8: Efficiency

8A - What type of deposit problem in paper machine systems results mainly due to interactions between positively and negatively charged ionic inorganic compounds initially present in the process water?

* Scale
* Pitch
* Slime
* Stickies

8B - The first step in solving a deposit problem in a paper machine system ought to be which of the following?

* Immediately shut down the machine and do a boil-out.
* Double the flow of retention aid to keep the system clean.
* Ignore it and find out if the problem goes away.
* Determine the composition of the deposit.

8C - What general class of additive to paper machine systems tends to be quite sensitive to temperature and the time of contact with the furnish or process water, such that the effects increase with increasing time of contact?

* Microbiocides
* Retention aids
* Defoamers
* Enzymes

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ANSWERS TO QUIZ QUESTIONS, COURSE 1

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