Day 1  Monday, April 15
8:00 – 8:30
Welcome, Introductions, Learning Objectives

8:30 – 12:00
The Corrugating Process (overview & focus on how to improve bonding)

- Double-Wall Corrugator Wet End Summary
  Identify main components of a Corrugated Web:
  - Liner, Medium, Adhesive

- Lay-out of Equipment (Numbering/Stations)
  Single-facer #1
  - Liner Splicer (position 3)
  - Liner roll stand (position 3)
  - Preheater
  - Medium Splicer (position 2)
  - Medium roll stand (position 2)
  - Medium pre-conditioner
  - Bridge Elevator Belt.
  Double-face
  Double-facer Liner Splicer (position 1)
  Double-face Liner rollstand (position 1)

  Triple pre-heater
  a. Function
  b. Wrap-arms

  Glue Unit
  a. Function
  b. Additional preheaters

- Corrugator Terms and Variables
  Corrugated Board
  Web
  - Single Face
  - Single Wall
  - Double Wall
  - Triple Wall

  Paper Grades
  - Basis Weight
  - Standard weights

  Construction of Box
  - Box Blank

  Paper Characteristics
  - Liners (Two sides), Medium
  - Moisture
  - Basis Weight
**Optimizing Bonding in the Corrugator**

The five steps to a strong mechanical bond

a. Application
b. Wetting/ Penetration
c. Gelatinization
d. Green-Bond
e. Drying/Fully Cured

a. **Application step**

Application is the first stage of the adhesive bonding process. The applications differ slightly for the single-face liner and the double-face liner. The application stage relates to the amount of starch applied to the flute tips. Application terms & technology topics to be covered include:

1. Applicator roll surface design
2. Distance from applicator roll to flute tip.
   i. Single-facer
   ii. Double-facer
3. Mechanism for applying starch to DF flute tip
4. Metering roll
5. Glue gap settings
6. Applicator roll to flute tip speed variables
   i. Correct placement on flute tip.
   ii. Starch formula, biorax, Viscosity, Directional bond
   iii. Verification of placement
      a. Light Strobe (best method)
      b. Iodine soak test (acceptable method)

b. **Wetting and Penetration step**

Critical to the strength of the bond. *Several variables can affect this phase.* *(more on this topic in Process Control section)*

1. Both medium and liner papers must have the starch penetrate their surface.
2. Two types of wetting/penetration
   - Single-face Pressure Bond (SF Bond)
   - Double-facer Evaporative Bond (DF Bond)

c. **Gelatinization & Green Bond steps**

This Green Bond holds paper together, but still contains a significant amount of moisture.)

a. Starch is applied
b. Starch absorbs into the medium
c. Flute tip is against corrugating roll Primary Starch begins gelling.
d. In the Pressure roll Corrugator roll nip, the Primary Starch penetrates/wets the liner and medium and initiates Green Bond.
e. Gelling raw starch and wetted paper fibers swell into each other (Cross-linking) as web goes up to bridge.
f. Cross linking (once on the bridge)
d. Evaporative Bond - Wetting/Penetration (DF) steps
   Controlling factors: temperature, pressure, speed
   Evaporative bond mechanisms during the first 2-3 seconds

e. Gelling & Green Bond for Pressure Bond (DF) steps
   Mechanisms during bond formation

f. Drying/Fully Curing step
   Final Evaporative bond formation in the final 1-2 seconds.

12:00 – 12:45    LUNCH

1:00 – 4:00
Linerboard & Medium Performance Properties & Tests
   Sheet Structure & why it’s important, MD/CD Fiber Orientation, Formation, etc.
   Properties & Tests, what they are telling us, and what contributes to their values:
   Stiffness, Ring Crush, Mullen, Concora
   Edgewise Compression Test, STFI
   Tensile, Modulus, Stretch
   Liquid Absorption, Porosity, Adhesion
   Sizing tests, Cobb, Water drop, etc.
   Moisture & Humidity Effects on Performance Properties
   Causes of Curl, Warp, & Wash Boarding
   Viscoelastic Creep Failure of Boxes
   Runnability on the Corrugator
   Smoothness and Printability
   Others, as per survey of participants

5:30   Adjournment
Day 2 Tuesday, April 16
Pulp & Paper Mill Operations
8:00 – 9:30
Fiber Raw Materials, Pulp Mill, Recycling
  * Fiber Properties & Effects on Sheet Structure
  * Pulping Processes for Liner & Medium
  * Recycled Fiber Processing, Problems, Improvement

9:30 – 10:00
Stock Prep Refining
  - Refining mechanism & variables; effects on sheet and properties
  - Improving Refining for Linerboard & Medium
  - Plate pattern, intensity, other variables; Case study

10:00 – 12:00
Chemical Additives & Effects
  - pH control, Alum, Sizing Chemicals, Fillers, Strength Adhesives
  - Formation Aids, Retention
  - Wet End Chemistry

12:00 – 1:00 LUNCH

1:00 – 3:30
Paper Machine Wet End Operations
  - BW control, White water, Cleaning, Screening, effects of Air
  - Headbox & Sheet Forming operations
    - Pressure/Hydraulic Headbox operations
    - Importance of and Variables affecting Formation
    - Microturbulence Strategies
    - Jet/Wire Velocity Strategies
    - Fiber MD/CD orientation strategies, TSI / TSO Analysis
    - Crossflows & BW profile control
    - Forming fabrics
  - Top Sheet Forming; Secondary Headboxes, Top Fourdrinier;
  - Hybrid Formers, Twin Wire Gap Formers

3:30 – 5:00
Pressing, Drying, Calendering, Winding
  - Pressing Mechanism of Water Removal; Effect on Sheet Properties
  - Shoe Pressing & other developments
  - Effects of Drying and Shrinkage & Moisture profile on
    Liner & Medium sheet & properties
  - Variables affecting pick up in Size Press
  - Types of calenders & variables affecting calendering
  - Calender box surface treatments
  - Winding operations

5:00 Course Evaluation & Adjournment