### Robert Lisy

UW Data Science 420 - Assignment 1

**Problem Statement:** We would like to discover problems in the diaper manufacturing process early so as to minimize potential losses and address manufacturing deficiencies as quickly as possible. The process of diaper manufacturing may be subject to many potential problems. Some of these may be mitigated by collecting data and monitoring these parameters for unusual values. We believe that poor quality diapers are manufactured when consistent quality of the individual components or assembly of the combined materials is inconsistent or poorly monitored.

**Absorbent Pad**

Manufacturing the absorbent pad is a precise process which can have errors in it. The ratio of fiber and hydrogel should be closely monitored, so that the process produces diapers which are sufficiently absorbent but also don’t create a gel block. This can be achieved by keeping the mixture heterogeneous, with a ratio of between 75/25 and 90/10 (fiber to polymer). Absorbent pads should maintain a uniform thickness so that the diapers are not uneven between batches. The fibers which are used in the absorbent pad should have a mass median particle size of approximately 400 microns. Smaller or larger particles will not effectively disperse liquids evenly within the diaper. The pad material should be tested for absorbance under load, which will help insure that the diapers don’t leak.

**Nonwoven Fabric**

The non woven fabric can be broken down into 2 different applications: the back sheet (or outside of the diaper when a child is wearing it) and the top sheet (the part which goes against the wearer’s skin).

The back sheet should be not very permeable to moisture, as a permeable back sheet would encourage leaking. Back sheets could be tested for permeability, as well as other material characteristics (shear and tensile strengths, flexibility).

The top sheet must be semi-permeable - this allows it to admit moisture in towards the absorbent pad but would ideally provide some protection so that moisture remains free from the wearers skin.

**Data Collection**

To monitor the process of producing diapers, we should collect and store the following data:

* Hydrogel ratio (fiber to polymer)
* Fiber size
* Back and sheet tensile strength
* Back and top sheet permeability
* Back and top sheet elastic modulus (stiffness)
* Back and top sheet yield strength
* Roller temperature for non-woven fabric
* Flow rate of fiber / polymer mixers for hydrogel
* Vacuum strength (millibar) of the conveyor belt
* Belt speed for the forming chamber (feet / second)

**Quality Control Sampling**

Even after recording each of these values, we should inspect the end results of our production process. This quality control sampling will help insure we collect information around which diapers may not meet specifications. Some variables we would like to collect during the QC process would be:

* Measurements for consistent size and shape of the assembled diapers
* Time of manufacture of the diaper being inspected
* The line or machines upon which a given diaper was created
* Absorbency under load for a sample set of diapers

Recording the time of manufacture could help us determine if there are issues rooted in *when*  a diaper was manufactured. Do diapers produced at the end or beginning of shifts have different properties than those produced in the middle? Are there staffing issues during the production of diapers which need to be considered?

By recording the line and machine, we could begin to see if a specific setup in the manufacturing process is more error prone than others. For instance there may be a roller for the non woven fabric which is problematic.