

Understanding Business Requirements

- A diaper manufacturer wants to optimize the manufacturing process by detecting any problems that might lead to a bad quality product.
- Prepare a business understanding document, and provide the customer with the data requirements that are needed to help ensure good quality diaper products.

Criteria	Full Credit
Business Understanding Description of business requirements is clear and complete.	2
Data Needs The list of data needs is logical and comprehensive.	2
Format Submission is between 600 and 800 words in length.	1

The manufacturing of disposable diapers is an important sector of the high-tech industry not often considered by the layperson. It was initiated in the 1970's and is now established with an annual market of \$4-billion in the United States alone. When fabricating such a widely accepted and relied upon product many considerations must be integrated in determining how disposable diapers are constructed, from individual material chemical properties to the conjoining of the various parts and constituent layers such as the absorbent pad itself, and even the entire assembly of the layered diaper all-together. In this way, the manufacturing process of disposable diapers must utilize raw materials to establish the resultant product. There are 2 major components that are assembled together: 1) an absorbent pad and, 2) non-woven fabrics such as evident on the outer surface of the diaper, a non-porous polypropylene sheet.

For any diaper, its primary purpose is fluid retention. Thus, the most important component of a disposable diaper is the quality of its absorbent pad. The padding is a mixture made of 2 parts: 1) wood fibers for decentralizing the fluid via a wicking action, and 2) a superabsorbent polymer material that can absorb 15 times its water-weight equivalent. Where an ideal mixture of this type consists of between 75–90 percent wood fiber and a polymer layering requirements that: 1) the diameter of its polymer particles are optimized at approximately 400-microns, and 2) their distributions are evenly applied across both the pads surface and depth. Chemically, the primary absorption characteristics of the polymer are controlled via a property called cross-linking, that is measured as a capacity to absorb via a measure of gel strength. In polymer cross-linking, the degree with which combined polymer chains exist determines the gel strength. If this cross-linking is weak

then the penetrating fluid onto the absorbent pad will quickly block additional absorption at a shallow depth due to the formation of a non-soluble gel network layer. Oppositely, if the degree of polymer cross-linking is too strong then not enough fluid is retained, consequently resulting in uncaptured fluid. Maximized diaper absorption and therefore diaper performance, is thus achieved via wood fibers in order to effectively distribute the containment of fluid within the superabsorbent polymer pad. See Figure 1 below for an illustration of the fabrication process of the absorbent pad.

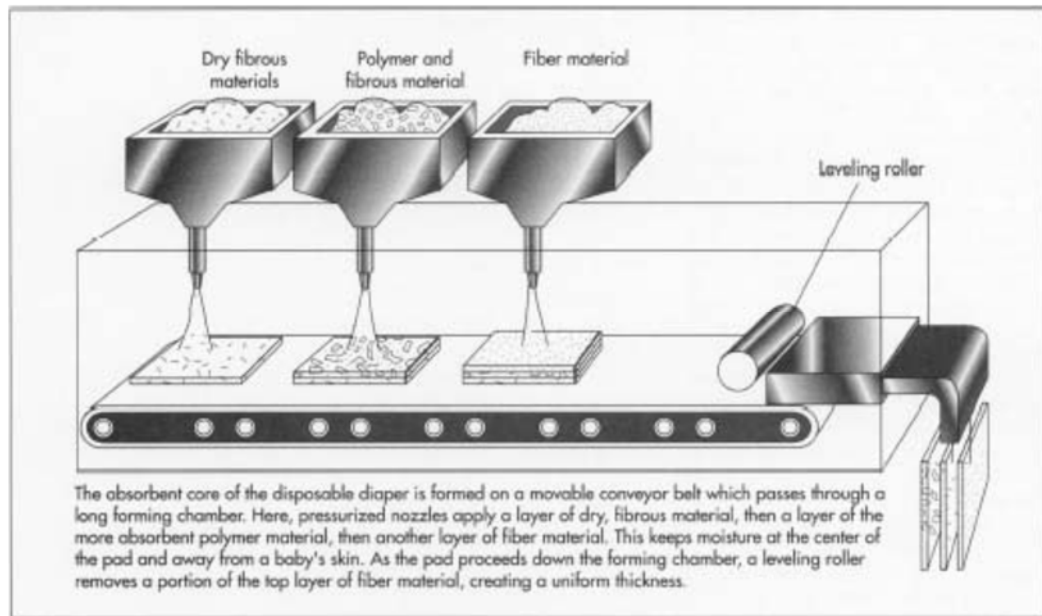


Figure 1 - Illustration of fabrication of the absorbent pad.

Other components that constitute a disposable diaper are primarily non-woven fabrics that are commonly manufactured using a dry (as opposed to wet) process, called the 'meltblown'. This method entails melted plastic resin extracted through tiny holes, via a pressure differential, where the resultant thin plastic strands become vertically oriented before falling in random orientations upon a moving horizontal conveyor belt to form a plasticized sheet. These sheets are then melted and flattened using a heated roller. Depending on the density of these extracted resin fibers, the resultant sheet is either: 1) porous or, 2) non-porous. For example, the exterior surface of a disposable skin diaper is a non-porous non-woven fabric. The layer of non-woven fabric at the interior of the diaper, oppositely interfacing the absorbent pad, is porous. Other materials such as elastic edging, adhesives, inks for coloring, and tape are commonly needed as well.

In the process for constructing a disposable diaper into its final product, the padding and non-woven fabric components must assemble together. This entails the non-porous outer material, the internal padding component previously discussed, and the inner porous fabric to adhere together using adhesives, heat, and a conveyor belt. The typical assembly of these components is shown in Figure 2, below. The image indicates that

the outer non-porous surface is made of polyethylene and that the inner porous fabric is constructed of polypropylene. The padding discussed above is shown placed between these two layers of non-woven fabrics.

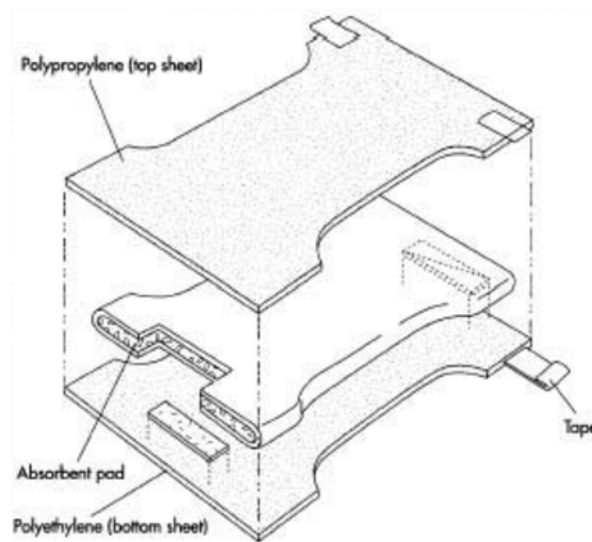


Figure 2 – The final assembly of the components of a disposable diaper.

In order to succeed at executing on a disposable diaper manufacturing business, the aforementioned raw materials and component assemblies must be accounted for within certain quality parameters. In this way, employing the discipline of data science upon product manufacturing practices will facilitate both a higher quality product and increased revenue. An Absorbance Under Load (AUL) test can benchmark the single most important property of diaper performance – that of padding absorption, that returns a capacity of how much fluid absorption while under pressure can be achieved. For this scenario, data required to support the test would require such values as the fluid type and pressure applied. For the padding fabrication, the ratio of the wood fiber to polymer mixture would be important, and for the non-woven fabrics the type of resin and its density might be critical to ensure the correct material properties are achieved.