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Manufacturing Flexible Packaging

Materials, Machinery, and Techniques

Thomas Dunn

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Manufacturing Flexible Packaging

Introduction

Efficient and profitable delivery of quality flexible packaging to the marketplace requires the design and manufacture of products that are both "fit-for-use" and "fit-to-make." The engineering function for a flexible packaging operation must design products and processes that deal with both challenges. The alternative finds the company facing a stalemate in which "Manufacturing can't make what Sales can sell" and "Sales can't sell what Manufacturing can make."

The scope of engineering knowledge inherent in designing "fit-for-use" and "fit-to-make" products is broad:

- Chemical engineering and chemistry: underlying principles of the resins, adhesives, inks, etc., that serve as the raw materials for the industry's products and of the foods, pharmaceuticals, and other products packaged in them;
- Mechanical engineering: basics of both the equipment used to manufacture flexible packaging materials and the machines used by its customers to form and/or fill and/or seal that material;
- Materials science: principles explaining how flexible packaging materials respond to environmental forces during their manufacture and use.

Ideally, the engineering function company of a company takes on the characteristics of a "learning organization"...

> ...organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together [1].

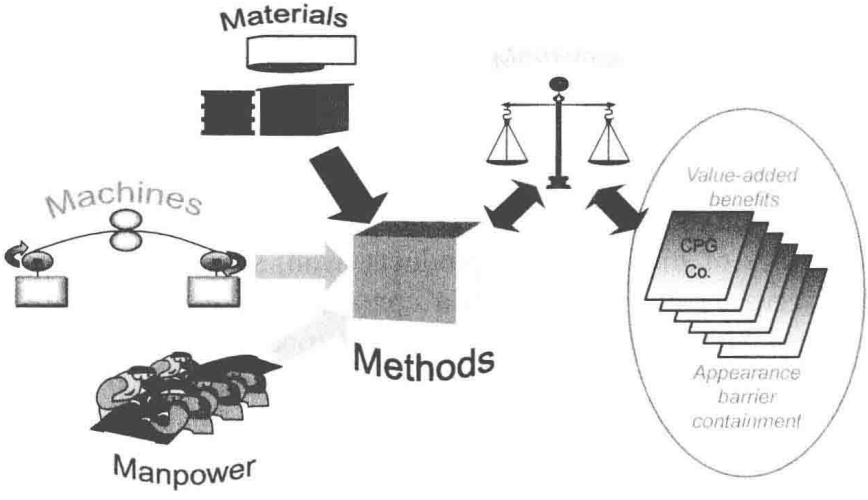
This book attempts to both introduce the engineering student or novice to basic manufacturing steps used to manufacture flexible packaging and suggest how to find and use additional learning resources. Effective participation in the industry requires continual learning. While the pace of change in the industry does not match those based in newer technologies, such as telecommunications and electronics, competitive advantage lies in early recognition and application of material and equipment innovations. Failure to do so leads to professional and organizational stagnation.

The book focuses on "fit-to-make" design challenges of flexible packaging manufacturing. It addresses various manufacturing processes individually, but the reader should appreciate that a great many flexible packages require multiple processes, carried out in sequence, to manufacture a fully functional fit-for-use product. Each process has an input material(s) to which it adds some value. That value-added material may well serve as the input to subsequent processes, and so on until a fit-for-use product is ready for market. The industry uses various "secondary quality characteristics" (Chapter 32) to measure interim and final products. Such test methods attempt to predict the ability of the final product to function successfully for its customer. The methods often provide the basis for contractual "specifications."

Background

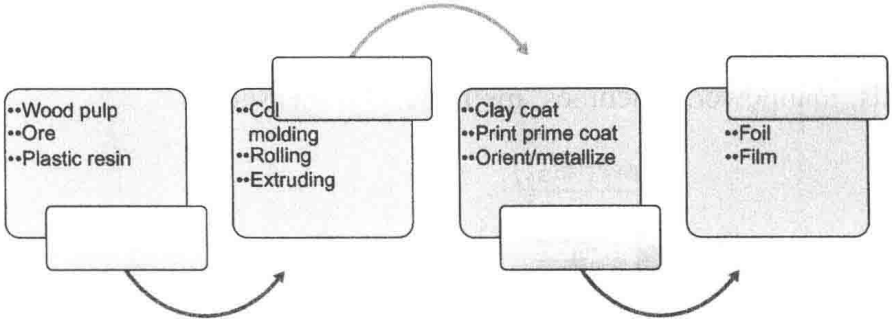
Flexible packaging manufacturing is part of the "converting" industry. The expression comes from the paper industry's use of the term to describe secondary processes associated with a paper mill that "converted" the mill's large rolls of paper into smaller products such as envelops, bags, and sheets for writing or printing. This book approaches the industry as essentially a manufacturing process. Its physical inputs are rolls of paper, plastic film, and aluminum foil, various fluids such as inks and adhesives, and some plastic resins. Its outputs are functional packaging materials ready to contain various products. The

simple input/output model of a process is expanded by the "5Ms" model of manufacturing. Manufacturing requires materials, manpower, machines, methods, and measures.



The book is organized to present "methods" first (Chapters 1–9), then "machines" (Chapters 10–18), "materials" (Chapters 19–29), and finally measures (Chapters 30–32). The subject matter of each chapter could take up an entire academic term of study, but the objective here is to provide enough familiarity with the subject that its relationship to the others is appreciated and a deeper study of its details is possible.

The larger converting industry includes manufacturing processes to produce products other than flexible packaging such as paper and plastic bags, pressure-sensitive tapes and labels, articles fabricated from nonwoven fabrics, and decorative laminates. These all involve "web handling processes," some basics of which Chapter 1 addresses. The book uses the terms "web," "substrate," and "roll stock" interchangeably. The below figure provides a very simplified summary of manufacturing processes for raw material roll stock used in flexible manufacturing. In depth, teaching resources exist for these raw materials processes. This book only considers raw material manufacturing in the context of how the converting industry uses them.



Much of the appeal of flexible packaging comes from the versatility of the industry's products, from simple plastic bags that serve as little more than a container to keep out dust, to complex "retort pouches" in which microbe-susceptible food is sterilized under intense heat and pressure and then preserved for years in a safe and suitable state. The application range of the industry's products results in large part from the ability to combine multiple materials in laminating processes (Chapters 4 and 5).[1] The term "structure" is used to describe the resultant material.

Reference

[1] P. Senge, *The Fifth Discipline*: The Art and Practice of the Learning Organization, second ed., Doubleday, New York, NY, 1990, 413pp.

[1] *Although such composite materials can provide a great deal of package functionality, their nature precludes simple recycling of their components into subsequent use in identical form.*

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