VOLUME II: Formulation & Production

FOURTH EDITION

BAKING
Science & Technology

E.J. PYLER
AND L.A. GORTON

SOSLAND PUBLISHING COMPANY

Baking Science & Technology

Fourth Edition

By E.J. Pyler
and L.A. Gorton

Volume II

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Foreword

Preparing Volume II in this 2-volume set of "Baking Science & Technology, 4th edition" was equally as challenging as the extraordinary effort put into Volume I. Completeness, timeliness and accuracy were paramount.

Volume I focused on basic food science, crops and raw materials relating to baking. Although these topics remain somewhat timeless, they still required moderate refreshing and updating for the times. On the other hand, ingredients, testing and applications changed or evolved considerably in the past 20 years. All these were reflected with great detail in Volume I.

Time and technology also have redefined the understanding, design and fundamentals of ingredient interaction, equipment and processing and control systems — the heart of Volume II.

As with Volume I, this work updates the 3rd edition, written by E.J. Pyler. As such, the task was to identify the significant changes and advancements in formulating baked foods as well as changes to the equipment and technology related to processing, handling and packaging of standard, artisan and specialty baked items.

This edition also has been reorganized to better reflect the logical progression of the baking process and the understanding and required knowledge of the various technologies having to do with processing ingredients into finished baked foods. We are honored that "Baking Science & Technology" continues to be used as a textbook by the industry's leading baking schools and as a daily reference for thousands of bakers worldwide. This volume continues and completes the scope for which it is intended.

In addition to updating and reorganizing the content of the previous edition, new sections have been added to reflect significant evolutions of the industry. A whole chapter is dedicated to Artisan baking equipment — once limited to small, manual operations, equipment systems are now capable of producing Old World products at industrial speeds with no loss in quality.

Other specialty equipment such as griddle systems, enrobing and robotics feature new or elaborated sections for this edition. In addition, three appendices have been added covering formulation percentages, automation terminology and industry and governmental resources.

As in Volume I, we relied heavily on Laurie Gorton's experience and expertise to tackle a sizable chunk of the assignment, generating the overall outline and progression of the book as well as tackling the first three chapters, dealing with dough processing and product formulation, as well as the final chapter on artisan processing. She also contributed her knowledge and critical editorial eye to the rest of the book as a primary reviewer.

Because of the breadth and depth of the topics included in this volume, we relied on other experts in the industry to take segmented sections of specific chapters, update them based on their own knowledge as well as pertinent industry materials and organize them in a fashion that reflected the new outline.

Each of the contributing writers and reviewers went above and beyond the call of duty. Each spent many more hours than originally anticipated. But the passion they have for this industry helped them press on to uncompromised excellence. Several commented that they learned valuable knowledge from the research conducted to complete and update the content.

To ensure accuracy, comprehensiveness, quality and an independent critique, each section and chapter was reviewed by Sosland Publishing staff as well as other knowledgeable people in the industry.

Volume II starts with the fundamentals of dough and batter processes from mixing to baking. It proceeds into formulation techniques for 20+ subcategories of baked foods and addresses contemporary formulating issues including staling, allergens, etc.

It then delves deep into each process, starting with mixing and forming equipment, heating and cooling systems, auxiliary and specialty equipment, and finishes up with processing aspects of industrial artisan baking technology.

As noted, this book exists because of help from many individuals. For their work appearing in Volume II, thanks goes to authors Laurie Gorton, Mihaelos N. Mihalos, Sigismondo De Tora, Stephen St. Clair Thompson, Rick Stier, Peter Clark, Jim Kline, Hans van der Maarl, Michael Bakhoum, and Charles Rastle and Nigel Hitchings.

For quality assurance provided by reading and critiquing the work in progress, we relied on Bernie Bruinsma, Bruce Campbell, Theresa Cogswell, Michael Eggebrecht, Larry Evans, Roger Faw, Karen B. Foehse, Mike Hall, Bill Hodgson, Bob Horth, Jian Li, Jason Stricker, Jason Tingley, Chuck Walker, Joe Zaleski and Bill Zimmerman.

This entire 4th edition project has taken more than two and a half years from concept to completion. While the planning process and Volume I took nearly 18 months, we pushed hard to get Volume II printed less than one year later. The support of Sosland Publishing Co., including Mark Sabo, president; Paul Lattan, publisher; editorial colleagues Holly Bradley, Kimberlie Clyma, Jennifer Barnett Fox and Shane Whitaker; as well as our design manager, Doni Conarroe and design team assistant Steve Piatt was unfathomable. A huge thank you goes to all involved.

Now that "Baking Science & Technology 4th edition" is complete in print, we foresee the next endeavor — digital formats, updates, online searchability and other advances yet to emerge.

We encourage readers to comment on this edition and its contents as well as to recommend topics and changes for future inclusion.

Steve Berne
Editor, *Baking & Snack*, *Baking & Snack International*, *Snack World*
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Sosland Publishing Co.
December 2009

Preface

On preparing Volume II of the 4th edition of "Baking Science & Technology"

E.J. Pyler
(1913-2003)

The experts who updated these chapters, the reviewers who critiqued their work and the editors who polished this text did their best to represent baking technology in its state-of-the-art condition at the start of the 21st century. Just as R&D departments constantly push the envelope with their new product development projects, it is also the nature of bakery engineers and their counterparts at bakery equipment manufacturing companies to constantly seek improvement in their machines. Thus, a piece of equipment as familiar as the piston divider or the intermediate proofer can suddenly morph into something altogether new or disappear entirely.

As a reporter who has observed and written about the commercial wholesale baking industry for more than 30 years, I would not have it any other way. I experience constant fascination with where the ingenuity of the equipment designer and the creativity of the formulator are taking the industry. Every bakery I visit, every trade show I attend, every phone conversation brings something new to light.

It was the same with Ernie Pyler, who wrote the earlier editions of this book, published in 1952, 1972 and 1988. Although a chemist and teacher by education and training, he eagerly explored "what's new" in equipment, as well. Often he published the very first look at new bakery machines and technology, and he convinced many of the inventors to write in their own words about the developments they were making. As editor, publisher and owner of *Bakers Digest* for all those years, he wore many hats. His son, Dick Pyler, once told me that his father was as happy to get an article about new technology out of a supplier as sell an advertisement for the magazine, probably happier.

Many of the seminal reports that *Bakers Digest* offered its readers remain informative and figure in the chapter references here. But time marches on, and changes continue to be made in bakery processes and technology. For this reason, the authors referred to current articles in *Baking & Snack*, *Baking & Snack International*, the *AIB Technical Bulletin*, the *Proceedings of the American Society of Baking*, *Cereal Chemistry* and *Cereal Foods World*, among other sources, to update this book.

It has been a great honor for me to work on this fourth edition of "Baking Science & Technology." The opportunity was worth all the hard effort it required. I hope you agree that the results live up to their promise.

Laurie Gorton
Executive Editor, *Baking & Snack*
December 2009

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CHAPTER 6

Fundamental Bakery Dough Processes

Complex and varied methods characterize the science and technology of processing yeasted doughs, and each step plays a critical role in overall success.

INTRODUCTION

"The baker's perception of breadmaking … is different from a researcher's view," observed Sluimer (2005). Yet the researcher's view helps illuminate the actions and results the baker gets during preparation of doughs and baking of finished products. For this reason, the scientific examination of the processes of doughmaking and breadmaking warrant attention from bakery students and bakers. What happens chemically and physically when flour, water, yeast and baking's myriad other ingredients are combined? How do chemical reactions change the characteristics of ingredients during the process of doughmaking? What contributions do the physical actions of mixing, kneading, shaping and baking make to the quality of finished products?

The field of experimental baking deals largely with these concerns. At the commercial level, experimental baking comprises a vital part of the company's research

Perfect loaf after perfect loaf — that happens when dough processes come together correctly at bakeries such as Turano Georgia Bread, Villa Rica, GA, shown here.
(*Baking & Snack*)

and development activities. R&D, as pursued in the baking industry, is an applied science. It encompasses product and process development and also gets involved with specifying and testing ingredients, food safety and regulatory and package labeling matters. Experimental baking supports new product development and ingredient testing, as well as optimizing formulation changes and baking technologies (Doerry 1995b).

Experimental bakers set the standards for how proteins, starch and lipids work in baking. This generally unrecognized and vitally important group of people answers basic questions about chemistry, ingredients and baking. In conjunction with wheat breeders, they set the quality of the wheat crops into the next decade by the varieties that are released to be grown.

Experimental baking is also essential to the work done at academic and research laboratory levels. In these settings, it supplies data to the scientists, chemists and engineers exploring the use of cereals for food and feed. For example, it tests the baking potential of new wheat varieties. To evaluate a theory, a series of doughs or batters can be set to test single or multiple variables. The results help the researcher refine the theory and move to the next stage of the experiment.

The breadmaking process is, as Gould (1998) observed, the interaction of raw materials, equipment and people in a particular environment, and he contrasted the breadmaking practices around the world. The baguette of France, the vollkornbrot of Germany, the pita of Lebanon, the steamed buns of China, the chapattis of India — all qualify as bread, yet they differ markedly. While some pastries are leavened by air, most sweet goods are yeast-raised and follow processes common to the manufacture bread products. The factors of ingredients and equipment determine the end products, but consumer requirements and expectations frame the style and character of finished baked foods.

The breadmaking process has several functions, accomplished at different stages in the preparation and baking of dough. Cauvain (1998a) described these as (a) mixing of flour and water, together with yeast, salt and other ingredients in specified ratios to form the dough; (b) developing the gluten structure of hydrated proteins through application of energy during mixing (a stage often termed "kneading"); (c) incorporating air bubbles within the dough during mixing; (d) continuing the development of the gluten structure after kneading to improve its ability to expand when gas pressures increase (a stage termed "ripening" or "maturing"); (e) creating or modifying flavor compounds in the dough; (f) subdividing the dough mass into unit pieces; (g) modifying the shape of the divided dough pieces; (h) resting to allow further modification of the dough pieces' physical and rheological properties; (i) shaping to achieve required configuration; (j) proofing (fermenting and expanding) the dough; and (k) expanding and fixing the dough into its final shape by baking. As with any process or product using naturally variable ingredients, problems will occur. Cauvain and Young (2001) addressed more than 200 such matters in a question-and-answer format.

Dough chemistry involves a series of interactions between carbohydrates, lipids and proteins. Hamer and Hoseney (1998) assembled a comprehensive examination of these connections as described by current scientific research being done worldwide. The principle physical science involved with doughmaking is rheology. Good baking quality depends on several rheological properties such as extensibility exceeding a minimum level, viscosity, strain hardening and optimal resistance to deformation. Several texts that provide insight into the rheology of dough are available

CHAPTER 7

Fundamental Bakery Batter Processes

Success with batter-based, chemically leavened baked foods requires careful management of complex ingredients through closely controlled processes.

INTRODUCTION

If dough processing resembles biochemistry, then batter preparation is more like organic chemistry — no live micro-organisms like yeast to manage, but still plenty of complex ingredients. Flour and sugar comprise the bulk of batter-based products, and flour can vary season-to-season like any other natural-source, minimally processed ingredient.

Many of the stages of fundamental bakery batter processes are nearly the same as those for dough, discussed in Chapter 6. Mixing is responsible for cell creation; baking changes the labile foam-like batter into solid sponge-like crumb; and cooling

Batter-based baked foods range from cakes to muffins to cookies, plus many more, with process requirements that facilitate chemical leavening methods. (i-Stock.com) assures optimum packaging conditions. But one important difference exists: No fermentation is involved. (Yeast-raised doughnuts represent one of the few exceptions.)

Baked products made via batter processes differ considerably from each other. This chapter will examine the basic processes involved in preparation of cake, pie, doughnut and several related products. Cookie and cracker procedures are described here because these items are made with flour milled from soft or low-protein wheat as are cake items. Also, most are leavened chemically or by steam, rather than yeast. Because some products such as muffins, refrigerated biscuits and cheesecakes, among others, employ unique processes, these procedures will be examined in Chapter 8 along with their specific formulating parameters.

A multitude of factors including composition and processing affect the final properties of baked batter foods. Many people have attempted to identify these factors, to explain their effects and to use them to maintain consistency and desirable structural and organoleptic qualities in the end products.

Researchers studying the structure of baked foods have long reported that water-soluble pentosans of wheat flours form a gel at room temperature in the presence of oxidants (Neukom et al. 1968). As scientists looked further into this subject, Neukom and Markwalder (1978) suggested that ferulic acid associated with the pentosan forms the necessary cross-links that increase viscosity, later verified by Ciacco and D'Appolonia (1982).

Chlorination of soft wheat flours (commonly used for cakes), as it turns out, enables enhanced oxidative gelation of solvent-accessible arabinoxylans, which Kweon et al. (2009) demonstrated using a Bostwick trough-style consistometer to measure flow.

The unique structure-building effect caused by oxidative gelation, as Bettge and Morris (2007) determined, contributes to soft wheat batter viscosity. Oxidative gelation, thus, impacts cake volume as well as cookie spread, baking time and checking. Although hard wheats have greater potential for oxidative gelation than the soft wheats used for cookies and cakes, such activity is eclipsed in bread doughs by gluten's powerful structuring capacity (Bettge 2009).

7.A. Mixing and Slurrymaking

The primary purpose of mixing is to bring about a complete and uniform dispersion and homogeneous mutual emulsification of the various ingredients, usually with the entrapment and size reduction of air cells and, in the case of most baked products made from soft wheat flour, minimum development of the gluten.

Formation of air cells, discussed in Chapter 6, Part A, is just as important for batters as it is for doughs. Only mixing can create air cells; leavening gases migrate to existing cells and enlarge them. The greater the number of air cells in a batter, the better the chemical leaveners function, resulting in optimized volume. Evenness of size improves the grain as well. Chemical leavening is explained in Volume I, Chapter 2, Part B.

In mixing batters and soft wheat doughs, not only must ingredients be dispersed but certain ones must also be solublized, principally sugar but also salt and bicarbonates. Because sugar readily goes into solution in these products, it actually functions as a liquid, and the presence of sugar syrup as a continuous phase in cookie doughs is essential for optimum finished results. When cookies cool, the sugar crystallizes,

CHAPTER 8

Formulating

By L.A. Gorton (Parts A-E, G-K, O, P and R),
Michael Bakhoum (Part F)
and Hans van der Maarel (Parts L-N and Q)

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Different products require different approaches when formulating.

Careful measurements, repeated throughout testing and into production, will keep product development projects on track.
(*Baking & Snack*, ©2005 David Hills)

INTRODUCTION

Where do bakery formulations come from? Anywhere and everywhere.

Over the years, enterprising individuals founded a good number of commercial bakeries by using their family recipes, and many bakers got their start — and continue to take inspiration — from Old World bread, cake and pastry formulations that immigrated with them and their families. New World concepts such the corn tortillas of the Mesoamericans figure in the rich heritage of bakery formulations, too. Flatbreads from the Middle East, steamed breads from Asia — baked foods are common to every region where cereal grains dominate agriculture. Others such as the meringue-based pavlovas so popular in Australia resulted from the pure artistry of their inventors.

War and politics inspired some baked foods, and food historians credit the origin of both the croissant and the bagel to celebrations of heroism, respectively by Viennese bakers and by the city's Polish allies led by King Jan Sobieski, in the defense of Vienna from attack by the Ottoman Turk army in the 17th century (Balinska 2008). For those interested in baking through the ages, Jacob's extremely readable history of bread, originally published in 1944, has recently been updated and reissued (Jacob and Reinhart 2007).

8.A. Starting Formulations

By L.A. Gorton

Whether working on new products or re-inventing current ones, the formulator needs a starting point, which is the function of starting formulations and the subject of this chapter. Starting formulations are just that: a starting point. Often they give measurements of ingredients in ranges rather than absolute quantities, with the intent of guiding the formulator, but not restricting creativity.

All starting formulations require fine-tuning to meet the exact conditions of the bakery and its equipment platform. Also, ingredients derived from nature vary in the real world from harvest to harvest. Careful specification of purchased ingredients can reduce such variability to a certain extent, but not always. Additionally, marketing imperatives (and corporate financial needs) can impact formula percentages.

8.A.1. Sources

Discussion of formulating necessarily involves reporting of actual formulations, and the reader will find a number offered here; however, these will be of a general nature. A myriad of sources can be tapped for starting formulations.

Of course, the best source for a starting formula is another baker, but many companies consider their formulations to be trade secrets and will not release them to outsiders. Patents protect some formulations, while registered trademarks cover others. Even when a formula can be shared, it often will not work exactly the same way in every bakery or even at other plants operated by the same company.

Many excellent professional textbooks provide commercial formulations and

CHAPTER 9

Mixing and Forming Equipment

Updated by Mihaelos N. Mihalos (Parts A-C and F)
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Best doughs and batters depend on accurate ingredient handling and mixing as well as optimized forming. Equipment choice makes all the difference.

Fully automated ingredient handling interfaces with the company's SCADA system and reduces labor in raw material receiving at this bakery to one person. (Flowers Foods)

INTRODUCTION

This section discusses the machinery and equipment involved in the first stages of dough and batter processing, from ingredient handling and the initial combination or blending of ingredients specified in the formula through fermentation, dividing, makeup and panning. Most concerns bread, buns and other yeast-raised products, but also includes here is the equipment necessary for the ingredient handling and mixing of baked foods made by batter and chemical leavening methods. Added to this discussion is examination of the extrusion, sheeting, lamination and encrusting equipment responsible for a growing amount of bakery output.

Readers will also find coverage of an older technology, that of continuous mixing and the equipment that feeds such systems. Although many commercial bakeries have replaced this technology, it is “alive and well” and operating every day in the plants of at least one major multiple-unit US baker. The legacy of this technology continues to influence the design and operation of today’s preferment and sponge systems.

As purchasers, owners and users of processing equipment, bakers should be aware that the design and construction of these machines affects not only the production of the desired doughs and finished products but also the overall sanitary condition of those doughs and products. In 1949, the baking industry decided to get ahead of sanitation regulations with voluntary standards and formed the Baking Industry Sanitation Standards Committee (BISSC). The cooperative effort between wholesale and retail bakers, bakery equipment manufacturers and public health authorities resulted in publication of voluntary standards for the design and construction of bakery equipment.

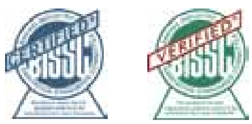

Figure 9.001. Use of BISSC symbols tells bakery equipment buyers that the manufacturer has followed rigorous, industry-established standards for design and construction.

BISSC established its office of certification in 1966, which controls the use of the BISSC Certified and BISSC Verified symbols on bakery equipment (**Figure 9.001**). To display these symbols, the manufacturer must warrant that equipment conforms to the group’s standard (BISSC Certified) and successfully pass a third-party inspection by a BISSC-appointed independent testing agency (BISSC Verified).

During the late 1990s, the group worked with the American Society of Baking’s Z50 Committee to develop an American National Standards Institute (ANSI) standard for the design of bakery equipment. The ANSI/BISSC/Z50.2-2003 standard provides guidance for a variety of manufacturing equipment regarding proper design for sanitation and food safety. BISSC, a not-for-profit corporation, became a wholly-owned subsidiary of AIB International in 2007. The standards can be downloaded from the group’s Web site, www.bissc.org.

9.A. Ingredient Storage and Handling Equipment

Updated by Mihaelos N. Mihalos

Management of ingredients during storage and transfer to processing operations calls for a variety of equipment solutions involving silos, tanks, bins, totes and transfer conveyors as well as weighing and dispensing machines of many different designs. The baker’s inventory of ingredients represents a considerable — and perishable — investment. Equipment for storing and handling bakery ingredients should be capable of containing and maintaining these raw materials in safe wholesome condition. The dosing, weighing and transfer equipment must be configured to deliver ingredients in accurate amounts, no more or no less than required. The equipment must also be sized to fit production needs, neither flooding nor starving downstream processes. An effective ingredient handling system must keep up with demand for ingredients at each usage point. No system operator should wait

Heating and Cooling Equipment

Contributed by Stephen St. Clair-Thompson (Parts A and B)
and updated by L.A. Gorton (Part C),
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and J. Peter Clark (Parts E-H)

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From proofer to cooler, dough pieces turn into finished foods with the help of varied systems and technologies.

INTRODUCTION

With dough portioned into individual pieces, made up and panned, the baker moves it into the next stages, proofing and baking, followed by cooling. The variety of automated and semi-automated machines involved in these processes allows a wide spectrum of choices. This chapter examines the systems and their technolo-

Loaf after perfect loaf proceeds from oven to cooler to packaging room. (Gardenia Bakeries) gies, including that of another spectrum: the electromagnetic kind.

Proofers, ovens, coolers and freezers represent "big ticket" items in terms of capital investment. When receiving requests for equipment purchases, company managers will usually ask the bakery engineer to estimate payback for the investment. Although the general industry view was to consider 5 years as a common payback period, recent practice shortened this to 3 years and even 1 year or less, depending on the project.

Accountants generally use the following methods to evaluate capital investments: return on investment (ROI), discounted cash flow (DCF) and cash pay back (CPB). In the ROI method, the original investment is divided into the annual return and the result expressed as a percentage. Under DCF, which is the most complicated technique, the evaluation takes into consideration the value of the dollar over an extended period of time, a consideration especially important when evaluating projects encompassing a long period of time. The CPB method is the most practical in that it clearly shows the improved cash flow resulting from investment in new plant and/or machinery.

Tax laws impact return-on-investment calculations because these rules determine the rate at which the cash value of equipment can be depreciated or expensed. For example, a change in US law in 1986 lengthened the depreciation schedule from 5 years to 8. In the years since, the federal government altered its tax rules many times. The latest, the 2009 American Recovery and Reinvestment Act, added a depreciation "bonus" that allows an additional 50% first-year depreciation of the cost for new equipment purchased and put into service in 2009. Depreciation ratios change with nearly every new tax law enacted, and often they reclassify the type of capital investments covered.

10.A. Proofers and Retarders

Contributed by Stephen St. Clair-Thompson

Between the mixer and the oven stand a variety of machines and equipment systems that accommodate the processing stages of intermediate proofing, final proofing and retarding. Each applies time, temperature and humidity to bring out the desired characteristics required for a high-quality finished product.

With regard to the design and use of this equipment, differentiation should be made between proofing and resting functions. Like the relatively short floor time given to doughs held in troughs, intermediate proofing of scaled dough pieces provides rest time that benefits the gluten protein structure of the dough. While taking as long if not longer than bulk fermentation, retarding inhibits, but does not entirely halt, yeast activity and thus supplies both rest for the protein and time for the yeast to develop its flavor compounds and dough conditioning actions. Final proofing functions not only to rest and condition protein but also to foster generation of leavening gases.

The equipment designed and engineered to accomplish these processing stages varies in configuration and size as well as how it employs heat, humidity and time. The chemical and physical processes involved in proofing and retarding are examined in Chapter 6, Parts B and F.

CHAPTER 11

Finishing and Packaging

Updated by Jim Kline

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Appearance plays an important role in the appeal of all baked foods, while automated technology holds down manpower issues and raises output capacity.

Vision systems evaluate product attributes such as count, color, size and/or shape. The inspection system can make adjustments upstream if needed. (Georgia Tech Research Institute, Baking Technology Systems)

INTRODUCTION

We eat with our eyes. How many times have we heard this? However, there is a strong truth behind this. Therefore, going to market requires an appealing appearance. A flawless topping, an attractive coating, an eye-catching package — all and more will be needed to prompt the buying impulse. Not only must a bakery

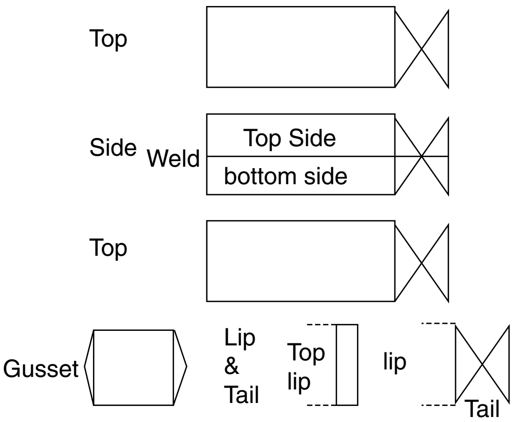
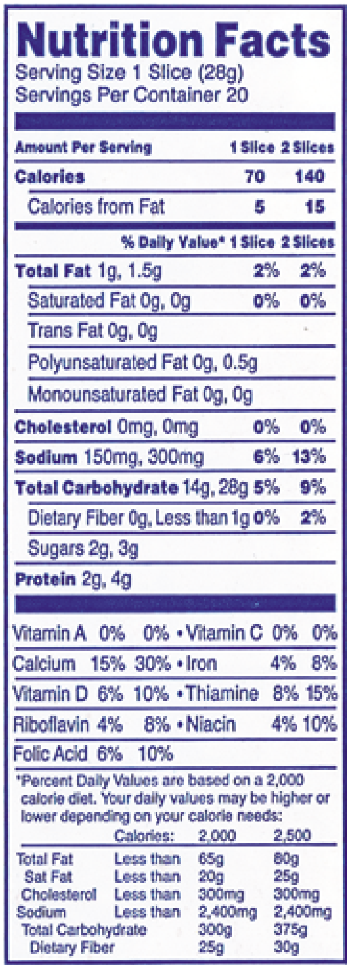


Figure 11.001. The top, sides, bottom, lip and tail of a bread bag each provide a distinct area of display for package graphics.
(Self et al. 1984)

package be made of a material that can run efficiently on packaging machines, but it must also be able to contain, preserve and communicate. The need to hold and protect the food are self-evident, but what about communication?

Packaging serves as a billboard, advertising its contents, and that function is determined by its graphic design. Product names, brands, images and text comprise the look of a package. Bread bags offer five distinct areas (**Figure 11.001**), each capable of relating information.

Some of the information printed on packaging is discretionary; some is mandatory. In the US, consumer food packages must carry information mandated by the Nutritional Labeling and Education Act of 1990 (NLEA) or the Dietary Supplement Health and Education Act of 1994 (DSHEA). For example, the Nutrition Facts panel (**Figure 11.002**) must be prominently displayed on back or side panels of packaging for consumer foods that travel in interstate commerce. The US Food and Drug Administration (FDA) wrote regulations that carry out NLEA and DSHEA and published them in the Code of Federal Regulation (21 CFR 100 to 199). These rules set forth the specific type fonts and sizes for some label components, while also spelling out the wording for health claims. FDA continues to publish guidance documents concerning labeling issues under NLEA, DSHEA and other laws. Canada and Mexico have similar rules, and the EU is in the final stages of codifying food labeling rules.



Nutrition Facts
Serving Size 1 Slice (28g)
Servings Per Container 20

Amount Per Serving	1 Slice	2 Slices
Calories	70	140
Calories from Fat	5	15
	% Daily Value* 1 Slice	**2 Slices**
Total Fat 1g, 1.5g	2%	2%
Saturated Fat 0g, 0g	0%	0%
Trans Fat 0g, 0g		
Polyunsaturated Fat 0g, 0.5g		
Monounsaturated Fat 0g, 0g		
Cholesterol 0mg, 0mg	0%	0%
Sodium 150mg, 300mg	6%	13%
Total Carbohydrate 14g, 28g	5%	9%
Dietary Fiber 0g, Less than 1g	0%	2%
Sugars 2g, 3g		
Protein 2g, 4g		

Vitamin A 0% 0% • Vitamin C 0% 0%
Calcium 15% 30% • Iron 4% 8%
Vitamin D 6% 10% • Thiamine 8% 15%
Riboflavin 4% 8% • Niacin 4% 10%
Folic Acid 6% 10%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories: 2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Figure 11.002. The Nutrition Facts panel for a loaf of white bread reports the nutrients provided. The nutrients listed, the type size and font, and the design of the panel are stipulated by FDA regulations.

Graphic design determines how all these elements fit together. Bakery marketing departments can consult many resources for assistance with the graphic design of a bakery package including advertising and promotion agencies, bakery cooperatives and packaging convertors. Designs may be evaluated by focus groups and consumer intercept methods, while the packaging materials under consideration should be tested to make sure they provide the right barriers, appearance and machining characteristics. Of course, regulatory requirements regarding placement of some elements must be followed.

The flexographic process for printing bakery packaging films can use as many as 8, and recently 10, different inks (referred to as "fountains" in the printing trade) per run (**Figure 11.003**). Limits are based on the number of colors a converter's press holds. Ink choices cover the full spectrum of colors, not just the cyan-magenta-yellow-black (CMYK) protocol of 4-color process printing like that used to prepare this book.

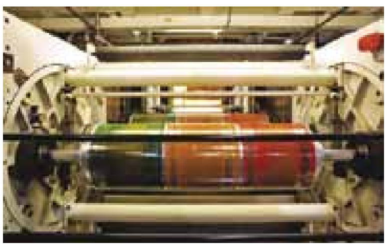


Figure 11.003. Flexographic printing can now be done on presses offering up to 10 color fountains.
(Bryce)

CHAPTER 12

Specialty Equipment

Updated by Hans van der Maarel (Parts A-D and G),
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Machinery to make cakes, cookies, crackers, pies, sweet goods, flatbreads, muffins, bagels, sugar wafers, ice cream cones and more brings considerable ingenuity onto the bakery shop floor.

Wire-cut chocolate chip cookies slot into lanes leading to the packaging line. (*Baking & Snack*)

INTRODUCTION

If the baking industry produced nothing more than bread and rolls, it could certainly feed the world's consumers adequately and with sufficient variety to satisfy most desires. But the existence of sweet goods in the baker's repertoire makes life all the more pleasurable, while griddled items provide a wakeup that jumpstarts the consumer's morning. Equipment to produce such specialty products can "push the envelope" in terms of engineering creativity.

How can the baker and bakery engineer keep up with all this innovation? By using peer-based communication methods. First, individual membership in organizations such as AACC International, the American Society of Baking and the Institute of Food Technologists gives access to annual technical meetings, short courses and scientific papers, many of which have been used to prepare this book. Corporate membership in the Biscuit & Cracker Manufacturers' Association and the Tortilla Industry Association also enables attendance at annual technical conferences. AIB International not only offers intensive resident education in baking science, technology and maintenance engineering but also short courses and seminars about topics of current concern. These groups and other industry organizations provide networking opportunities as well, and a list of such resources appears in Appendix 4.

Of course, the industry's suppliers intensely track what their bakery customers want in terms of technology and communicate closely about opportunities. These vendors also participate in several large trade fairs that mount enormous exhibitions for the benefit of the baking industry. Currently on a staggered schedule of every 3 years, the International Baking Industry Exposition in the US and the iba World Market for Baking in Germany bring together equipment, ingredient and supplies manufacturers. Packaging is the focus of both Pack Expo in the US and interpack in Germany. These and the many regional and local events throughout the world allow bakers and food processors to get hands-on experience with new systems and to look ahead at trends in equipment and processes.

A number of tightly focused business periodicals, now provided in print and digital formats, serve the industry. *Baking & Snack, Milling & Baking News, Food Business News* and *World Grain* are prepared by Sosland Publishing Co. with the news and technical information needs of industry readers in mind. AIB International produces its *AIB Technical Bulletin*, which gives detailed insight into many technical and formulating trends. The editors and contributing writers of these publications and more report in depth about baking's many technical developments to help readers improve their business operations.

Some of these organizations are even experimenting with Web-based social media on the Internet such as Twitter, LinkedIn and Facebook to network with industry managers and spread the word about trends and new thinking in the grain-based foods industry.

12.A. Pastry and Pie Equipment

Updated by Hans van der Maarel

If only dough sheeting was as simple as what happens in the Saturday morning cartoons: When another attempt to snare the Road Runner fails, the steam roller