PROCEEDINGS
Of National Food Processors Association
Conference

Capitalizing On Aseptic II

April 11-12, 1985 Washington, D.C.

The Food Processors Institute
1401 New York Ave., N.W., Suite 400
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Presented by the National Food Processors Association
in cooperation with the
Juice Products Technical and
Aseptic Processing & Packaging Committees

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OPEN GENERAL SESSION

Welcoming Remarks

Charles J. Carey

Good morning, and welcome to "Capitalizing on Aseptic II." In contrast to "Rocky II" and "Godfather II" which paled somewhat in comparison with the original, we believe that "Capitalizing On Aseptic II" will be part of the story of continuing growth. Aseptic processing and packaging has been a bellwether of resurging technical development which has characterized the 80s in the food industry. Initially, aseptic was a technology imported from abroad—the importation of an already developed technology as our U.S. industry emerged from the dark decade of the 70s when technological development was uncommon. Aseptic was not really a new technology but it did require modification to satisfy U.S. standards. A very important element was added, however, when this technology crossed the Atlantic. The size of the U.S. market was such that it could, and did justify the cost of pursuing opportunities for improving the processing equipment and developing new packaging materials. The results of this stimulus are there to be seen—in the marketplace of end products and in the trade shows which exhibit a new generation of machinery and supplies. We are now on the threshold of another major step forward—the commercial realization of aseptically processed particulates.

Such rapid development in such a short period of time has not always proceeded smoothly. That, however, is to be expected. Not all the products that have been taken to market have succeeded; not everyone who has produced for the market has been equipped to manage distribution; and there is currently talk of overcapacity. Nevertheless, the fact is that a very large and still growing market for liquid aseptic products has been created without any important reverses of a technical nature. That is a monumental achievement when you consider that our food industry must operate against a standard which is one of virtually zero defects.

You who have participated in the technical management of this development— suppliers, processors, and government regulators—can be proud of the record of uninterrupted progress. It is very important that that record be continued as we devote our efforts to seizing the opportunities that lie ahead. It is our hope that this, our second conference on aseptic, will contribute to that goal. We thank you for coming, and we welcome your participation.

Keynote Address: The Pursuit of Aseptic Packaging

Donald D. Rohdy, Ph.D.

During a recent discussion of one of Beatrice's long-tenured aseptic packaging projects, a member of our marketing department commented that the project was similar to the pursuit of world peace—everyone wants it to happen, but it doesn't. For many U.S. food companies, the promise of aseptic packaging has been just that—a promise. But now the promise is starting to become a reality.

In preparing my comments for today, I reviewed the recent literature on aseptic packaging and found it to be mostly technical, and for a good reason. Aseptic packaging is technically complex, but there are also major business issues involved. It is the business side of aseptic packaging that I will emphasize today.

Many of you here today—probably most of you—are in technical professions. However, if I asked each of you to define aseptic packaging, I'm certain I would get a wide range of answers. Again for a good reason, because aseptic packaging means different things to many people.

For the purposes of this morning, let's use this definition of aseptic packaging: "A procedure by which a commercially sterile product is filled into a presterilized container in a commercially sterile environment and the container is hermetically sealed while in the sterile environment."

We really shouldn't make too big of a deal out of the complexity of aseptic packaging, because as Cleve Denny* once said, chickens have been packaging eggs aseptically for years. There may, however, be a question about the shelf-life of this all natural, aseptically-packaged product.

The development of aseptic flexible packaging equipment has occurred primarily in Europe. As a result, the commercialization of this technology started sooner there than in the United States. Since some of you may not be as familiar as others regarding the recent history of aseptic flexible packaging, let's take a few moments for a review.

In 1984, about 28 billion aseptic cartons were filled on Tetra Pak and Combibloc equipment worldwide. At the end of 1984, over 3,000 aseptic Tetra Pak and Combibloc machines were operating around the world. Tetra Pak is the dominant factor in aseptic packaging worldwide, but many other equipment and packaging material firms are getting into the act.

The total number of aseptic flexible packages sold in the U.S. during 1984 is estimated to be about 1.5 billion. This was almost double the quantity sold in 1983, and the 1983 sales were about double the 1982 sales. Most of these packages were the 250 ml size.

The use of aseptic flexible packaging worldwide is estimated to be distributed as shown in *Table 1*.

The all other category includes soy-based products, mineral water, tomato products and wine.

Several aseptic flexible packaging systems have been developed during the past 20 years. These include Tetra Pak, Combibloc, Bosch, Conoffast, and Metal Box for consumer sizes, plus Scholle, and Rossi-Catelli for foodservice and industrial sizes.

These systems are complex and costly to install. In other words, there must be substantial economic reward to justify the capital investment.

This takes us to the main topic of this presentation—why go aseptic? There are several reasons for considering aseptic flexible packaging and some will apply in a specific situation and some in other situations—but only rarely will all of the following reasons apply:

- Cost reduction;
- Consumer preferred package;
- Better tasting product;
- More nutritious product; and
- Longer product shelf-life.

In many cases, the only reason will be cost reduction. This can result from lower cost packaging material, energy conservation or distribution savings—and sometimes all three. From a consumer standpoint, if any one of the other reasons can be added to cost reduction without major negatives there is a strong potential for a winner in the marketplace. It is worth noting that in some cases aseptic packaging can provide a positive change for a specific attribute and in another case the same attribute can be negative—shelf-life for example.

The best way I can describe what I mean is to share with you Beatrice's experience with the "world-peace" aseptic packaging project I mentioned earlier.

In March 1985, we started shipping to the trade Hunt's "Snack Pack" pudding in plastic containers. We introduced this line of products to the marketplace in aseptic aluminum pull-top cans in 1969. The switch to plastic packaging is the culmination of over ten years of technical and market research. The desire to package these products in plastic was there from the beginning, but the technology was not commercially developed.

TABLE 1: Estimated Worldwide Use Of Aseptic Flexible Packaging.

Category	Estimated % of Product Tonnage
Milk-based products	80
Juice-based products	15
All other products	5
	100

*of the National Food Processors Association in Washington, D.C.

We believed aseptic flexible packaging would develop satisfactorily to handle low-acid products. As a result, we continued to do consumer research to make certain the switch from metal to plastic packaging for puddings was a good marketing decision. The first consumer research was a central location test conducted in 1973 with the following results:

TABLE 2: Consumer Survey Results—Package Preferences.

	Adult (%)	Children (%)
Prefer plastic	71	79
Prefer metal	29	21
	100	100

The primary reason for preferring the plastic container was because it is easier to open. The number two reason was the lid is safer and won't cut. The major reason for disliking plastic was the belief the container was not sturdy enough. Because the consumers were concerned the package might puncture, they indicated they would store it differently. However, this negative was not considered a knock-out by the consumers who were tested.

A followup home-use test was done in 1974 and the results were consistent. The same comments regarding easy opening and safe lid were noted, but equally as important, the same pudding in a plastic cup was judged to be at least as good as in a metal can.

Another factor in our decision was the downtrend in the sales of shelf-stable puddings in metal cans. From 1974 to 1983, category sales decreased over 20%. During this same time period, sales of refrigerated puddings in plastic cups increased about 170%. Incidentally, "Swiss Miss" is a Beatrice brand and is number one in the refrigerated puddings category, as is Hunt's "Snack Pack" brand in the shelf-stable puddings category.

The final consumer research was done in 1984 with a laboratory test market. This study was designed to estimate the sales volume potential for shelf-stable puddings in plastic packaging. The positive attitudes about the package indicated in the earlier research were confirmed again.

The next step was to develop TV commercials for shelf-stable pudding in plastic cups. Three alternative test commercials were developed. These three commercials were designed to reach a combination of adults and children, as well as children only. The one that scored the best was the commercial that featured a mother and child combination.

About 85% of pudding purchases are by the mother. However, the consumption is not as heavily oriented toward children as you might think. In fact, usage and attitude studies indicate the consumption is approximately 60% by adults. About 80% of the consumers say they buy shelf-stable pudding because it is portable, but about 70% of the pudding is consumed at home.

The marketing lesson from these data is that consumers perceive the pudding as being portable. But in reality, the heavy usage is at home because it is convenient and shelf-stable. Said another way, the product is available for impulse use, without taking up refrigerator space.

One of the cost issues that aseptic flexible packaging equipment must overcome is line speeds. Improvement is being made and more is on the way. For example, the form-fill-seal equipment may appear to be operating at slow line speeds, but that is not the case. If you were to watch the front end of our pudding equipment, everything seems to be in slow motion. But after the sealing unit when the cups are cut apart, a completely different impression is received.

Our equipment forms 24 cups with each stroke, and with 20 strokes per minute that equates to 480 cups per minute. This compares favorably with the aluminum can system it is replacing that runs about 500 cans per minute. With a substantial reduction in packaging material costs for plastic, the total cost for the finished product is less.

So far, the application of aseptic flexible packaging in the U.S. has been almost totally for drink products. Many of these products were already being sold, so only the packaging was new to the consumer. The same is true for our puddings. This makes consumer acceptance much easier and is the logical way for the technology to enter the marketplace.

This was not the situation in Europe. The original application of aseptic flexible packaging was for low-acid, milk-based products, and as noted earlier, this still represents over 80% of the aseptically-packaged food products sold worldwide today. When aseptically-packaged milk was introduced in Germany, there was no big advertising campaign. In fact, TV advertising as we know it in the U.S. does not exist there. What happened was signs were placed in the refrigerator cases that said there was no longer a need to refrigerate milk and stated where shelf-stable milk could be found in the store. A typical, efficient German approach to solving a communications problem!

In the U.S., aseptically packaged milk so far has not been successful. With this item, the consumer is asked to accept a new package and a new product at the same time. Also, fresh, refrigerated milk is available virtually everywhere in the U.S. at relatively low cost.

The point is, it is one thing to convert current products to an aseptic package, but it is more difficult to see a new product in an aseptic package. However, a major business potential exists for the latter because the technology will permit high quality products to be sold shelf-stable. The availability of high oxygen barrier packaging materials also will be a factor. In the past, refrigerated and frozen products usually delivered much higher quality than shelf-stable alternatives, but this will not always be the case in the future.

Almost all of the aseptically-packaged food products in the marketplace worldwide are smooth in texture. The next major advancement in aseptic technology will include particulate products. This will provide almost unlimited opportunities in a wide range of food categories. Some of the equipment already can handle products with small particulates. For example, the system we have chosen can package tapioca and rice puddings.

Along with the particulate technology will come the ability to prepare these new, shelf-stable products in a microwave oven. Over one-third of the U.S. households now have microwave, but the food industry has provided relatively few shelf-stable, high-quality (even good quality) products that can be prepared quickly in a microwave.

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Early in the presentation, I mentioned that aseptic packaging is technically complex. As the food industry starts to produce low-acid foods in aseptic flexible packages, and especially those with particulates, we must be certain not to compromise food safety. Nothing could do more to derail the truly large promise of aseptically-packaged food products than a mistake in this area.

We chose to involve the NFPA during the development of our aseptic puddings in plastic cups. NFPA scientists made major contributions to this program and they were especially sensitive to proprietary issues.

The NFPA has played a major role in the safe processing of food since 1907. This second major conference on aseptic packaging is evidence that the NFPA has led, and will continue to lead, in the safe development of this technology. The large attendance at this conference is proof that the pursuit of aseptic packaging is more than the pursuit of a promise—it is reality.

ASEPTIC PROCESSING AND PACKAGING

Aseptic Processing and Packaging

Dane Bernard*

INTRODUCTION

What we will try to accomplish in this first section of "Capitalizing on Aseptic II" will be to set the stage for what is to follow by reviewing a few of the basic aspects of aseptic technology. We will introduce some of the concepts which will be expanded upon by others and provide a framework for discussions which follow. Since the topic is aseptic processing and packaging, a brief discussion of the term aseptic and a historical perspective will serve as a springboard to the subject.

Aseptic processing is characterized by sterilization of a food product independently from the package or packaging material. The two are then brought together within a sterile or aseptic environment for filling and hermetic sealing.

Aseptic processing and packaging of foods is not a new processing method. It has been in use since the late 1930s. Recent improvements have been made and new techniques have allowed aseptic processing to achieve great success in the 1980s. This success has been achieved with the recognition that the aseptic processing and packaging of low-acid foods involve a higher degree of complexity than that associated with other types of food processing operations. This complexity greatly increases the number of control points for aseptic processing, often requiring automated control systems to manipulate and monitor numerous mechanical functions. It is of the utmost importance, therefore, that operators of aseptic systems be thoroughly trained in the operation and use of this equipment. In addition, operators should be acquainted with the principles underlying these operational procedures. Following sections of these proceedings will address these training needs as well as recent advances and regulatory considerations for automated control systems.

Definitions

To assist in the discussion of aseptic processing and packaging systems, some definitions are presented below.

Aseptic describes a condition where there is an absence of microorganisms including viable spores. In the food industry, the terms aseptic, sterile and commercially sterile are often used interchangeably.

Critical factors, as applied to aseptic processing, refer to those factors which must be monitored and controlled in order to assure that the product produced is commercially sterile. Remember that the number of critical factors will be greatly increased in aseptic processing as compared to conventional canning. The food processor must consider all aspects of the product, while also monitoring and controlling such factors as chemical sterilant concentration, temperature, contact time, and any other factors which contribute to achieving and maintaining sterility in all parts of the system.

Aseptic system refers to the entire system necessary to produce a commercially sterile product contained in a hermetically sealed container. This includes the product processing system and the packaging unit.

Aseptic processing system refers only to the system that processes the product and delivers it to a packaging system.

Aseptic packaging system refers to any piece of equipment that fills a sterile package or container with sterile product and hermetically seals it under aseptic conditions. These units or systems may also form and sterilize the package.

Basic Aseptic System

Figure 1 is a diagram of a simplified aseptic system. Raw or unprocessed product is heated, sterilized by holding at high temperature for a predetermined amount of time, then cooled and delivered to a packaging unit for packaging. Commercial sterility is maintained throughout the system, from the moment of product heating to the discharge of hermetically sealed containers.

The part of the system up to and including delivery to the packaging unit is considered the aseptic *processing* system, which is the first major component of the aseptic system. The second major component is the aseptic *packaging* unit or system. Different types of processing and packaging systems can be combined to form a complete aseptic system.

Achieving successful aseptic processing of foods requires as a minimum the following conditions:

- Equipment that can be brought to a condition of commercial sterility;
- Commercially sterile product;
- Commercially sterile packages;
- A commercially sterile environment within the packaging machine in which to bring sterile product and packages together and hermetically seal the packages;
- Monitoring and recording of critical factors; and
- Proper handling of finished packages to ensure container integrity.

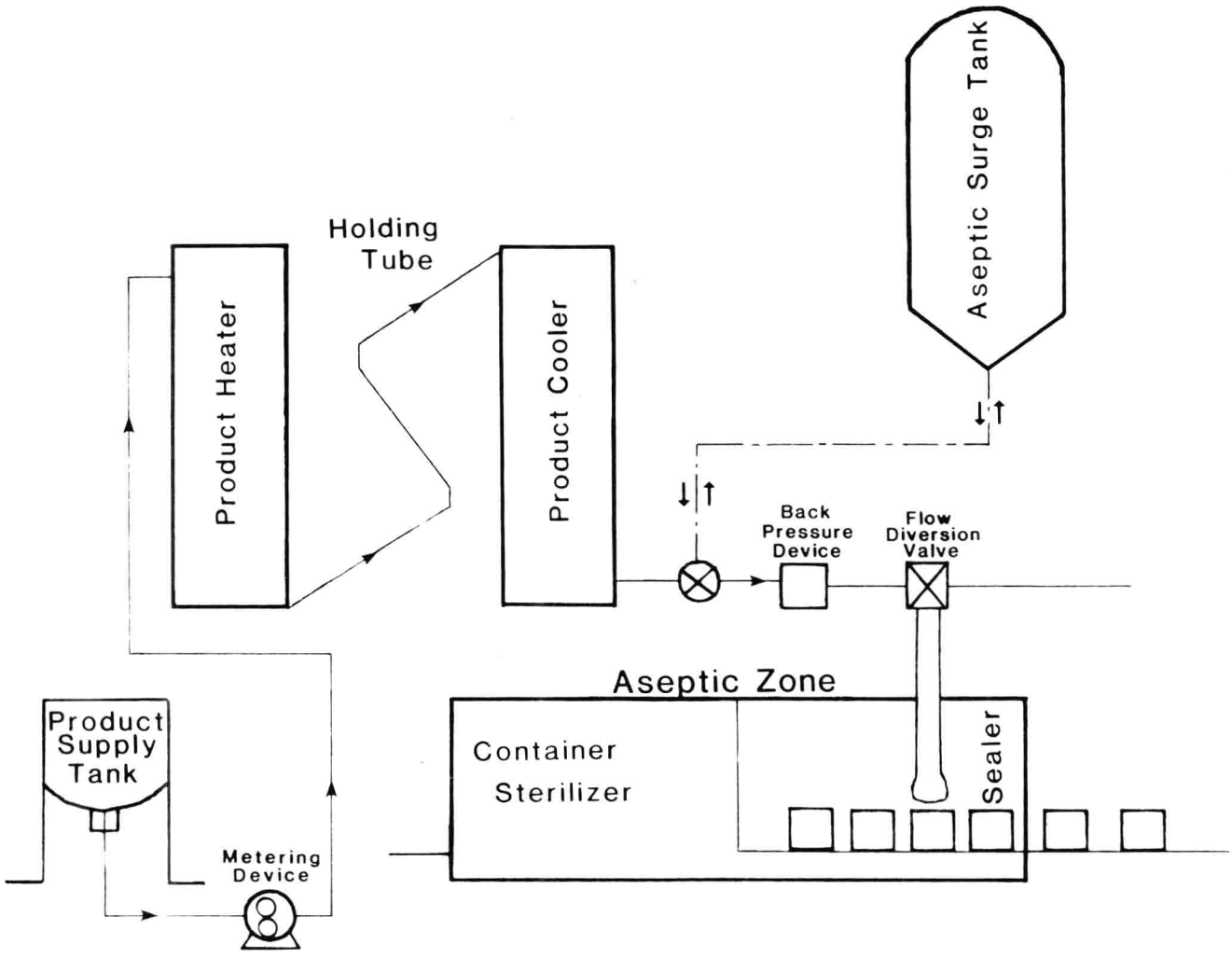
ASEPTIC PROCESSING SYSTEM

Although the equipment for aseptic processing systems varies, all systems have certain common features. They are:

- The nature of the product (pumpable);
- A means to control and document the flow rate of product through the system;
- A method of heating the product to sterilizing temperatures;
- A method of holding product at sterilizing temperatures for a sufficient time to sterilize product;
- A method of cooling product to filling temperature;
- A means to sterilize the system prior to production and to maintain sterility during production; and

*NOTE: Brad Shafer, Austin Gavin, Jenny Scott and Jill Strachan, all of the National Food Processors Association staff, contributed to this paper.

Figure 1: Simplified diagram of an aseptic processing system.



- Adequate safeguards to protect sterility and prevent nonsterile product from reaching the packaging equipment.

Other items such as surge tanks and flow diversion valves may also be incorporated into aseptic systems. These features form the framework for the discussion which follows.

Nature of the Product

Currently, the nature of the product which can be processed aseptically is limited to products which can be transported by pumping. These products are given a scheduled process which is specific for the given product formulation and processing system. This means the product composition should remain relatively uniform as composition may affect flow characteristics or sterilization requirements.

Flow Control

Sterilization time or residence time, as indicated in the scheduled process, is directly related to the rate of flow of the product through the system. This means that product must flow through the system at a uniform and constant rate to ensure that all product receives at least the minimum amount of heat for the minimum time specified. This is generally achieved with a positive displacement pump, called a timing pump or metering pump.

Product Heating

A product heater brings the product temperature to sterilizing levels. There are two major categories of product heaters for aseptic applications: direct and indirect.

Direct heating, as the name implies, involves direct contact between the heating medium (steam) and the product. Direct heating systems can be one of two types: steam injection or steam infusion.

Steam injection introduces steam into the product in an injection chamber as product is pumped through the chamber (*Figure 2*). Steam infusion exposes a free falling film of product to steam within an infusion chamber (*Figure 3*). These systems are currently limited to homogeneous, low viscosity products.

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