

ALUMINUM FOIL CONTAINERS



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INTRODUCTION:

Background:

Aluminum is the most widely used non-ferrous metal and is extensively used in packaging materials. It is an excellent material for creating all types of containers. However, despite the fact that about seven billion aluminum foil containers are produced annually, most packaging engineers and packaging users know very little about the advantages that these containers bring to the packaging and food service industries.

Specifically, aluminum provides an absolute barrier to protect foods, whether on the shelf, in the cooler or in the freezer. It can go from freezer to oven to broiler to microwave oven and result in quality food products whether at home or in central food processing operations. It is lightweight, so that it is easy and economical to transport. It is formable so that it is available in a wide variety of shapes and sizes. It can be printed, coated or embossed. And, it is recyclable which results in a 95% energy savings over that required to produce primary metal.

Objective:

The objective of this CD is to provide a comprehensive overview of aluminum foil containers that will be a suitable educational tool for a wide variety of target audiences.

Target Audiences:

- Current and potential future customers, both industry and consumers
- Packaging professionals and other decision-makers in the packaging and food service industries
- Educators—at the high school, jr. college and university levels
- Students, especially those intending to pursue a career in packaging
- Members of the general public who seek to broaden their knowledge of aluminum packaging products

General Notes to Trainers/Lecturers:

Because of the broad nature of the information included in the CD, those using it can “mix or match” various sections to suit their intended audience. For example, one can cover the general introduction to aluminum and aluminum foil container manufacture in the main body of the disk, or, for more detailed information in aluminum production, click on one of the appendices taken from the TALAT* CD that provide a more in-depth review. Alternatively, a lecture can be made from a single topic, such as Aluminum Foil Containers in Microwave Ovens. Trainers and lecturers are encouraged to utilize those parts of the CD that are suitable to the audience’s level of sophistication and interests. (Note: the European spelling and pronunciation of *aluminium* vs. the U.S. *aluminum* has been left intact for the documents with European origins. This should not be a cause for concern, but may require an explanation for U.S. audiences).

*Training in Aluminum Application Technologies. Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999

Overview of the Aluminum Foil Container Manufacturers Association:

The Aluminum Foil Container Manufacturers Association (AFCMA) represents leading manufacturers of aluminum foil containers in the United States and Canada. The association has worked to promote aluminum foil as a superior packaging material since 1955. www.afcma.org (Figure 1)



Figure 1

History of Aluminum Foil Containers

Formed aluminum foil containers were first produced in the late 1940's for the packaging of bakery products. During the 1950's there were many innovations and many new uses for formed containers. Thus, the industry prospered.

By 1960, nearly 50 million pounds of aluminum were being used to produce formed aluminum containers. In the decade from 1960 to 1970, usage grew to 140 million pounds and by 2002 over 250 million pounds of aluminum were used to manufacture over 7 billion containers in North America. World wide numbers total over 12 billion containers and over 400 million pounds!

The growth of the aluminum foil container is due to its many advantages. The natural qualities of aluminum, its impermeability and barrier properties, provide real benefits for consumers. There simply is not a more versatile material.

Aluminum foil containers are formed by combining mechanical and air pressure to force light-gauge aluminum foil into a shaped die cavity. Esthetically appealing aluminum foil containers are ideal for table-ready service after the container has functioned first as a package and a heating utensil. Foil containers also come in a variety of colors and special purpose coatings.

Aluminum foil containers are used to prepare, freeze, store, transport, cook and serve a variety of foods. Containers made from aluminum foil are the only containers that can be used in all types of ovens: microwave, conventional, convection and broiler. Moreover, its recyclability makes aluminum one of the most environment friendly materials on earth, a key advantage for planet conscious consumers and local governments. Additionally, recycled aluminum saves more than 95% of the energy necessary to produce new primary aluminum.

Most of the major manufacturers of formed aluminum foil containers are members of the Aluminum Foil Container Manufacturers Association. This group is dedicated to producing top quality products and educating the public of the advantages of aluminum foil containers.

The Aluminum foil Container Manufacturers Association (AFCMA) continues to foster the continued growth of this industry with an active education program. This CD-ROM is part of that effort and is intended as a helpful tool for the packaging industry, schools, and consumers.

Current members of the association include:

General members:

Alcan Foil Products	416-503-6700	www.foil.alcan.com
CM Packaging	800-323-0422	www.cmpackaging.com
Handi-foil of America (HFA)	800-647-1400	www.handi-foil.com
Pactiv Corporation	800-476-4300	www.pactiv.com
Penny Plate, Inc.	800-527-9909	www.pennyplate.com
Reynolds Food Packaging, An Alcoa Business	800-466-3020	www.alcoa.com
Revere Packaging	800-626-2668	www.reverepackaging.com
Wilkinson Manufacturing Co.	800-456-4119	www.wilkimfg.com

Supplier members:

Alcan Rolled Products	800-743-2875	www.lightgauge.alcan.com
Alcoa	800-570-7661	www.alcoafoils.com
Ekco Products	800-645-4644	www.ekcoproducts.com
Norandal USA, Inc.	800-833-6735	www.norandal.com

Please refer to the AFCMA web site for current members
www.afcma.org

Contributors/Acknowledgements:

The following contributed to the preparation of this educational CD:

- Dr. Robert F. Testin, Professor Emeritus, Clemson University
- Training in Aluminum Application Technologies. Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999
- Member companies of AFCMA

BRIEF CONTENT DESCRIPTION:

[SECTION 1: Introduction to Aluminum and Aluminum Foil Container Production](#)

This discussion serves as a basic introduction to aluminum production, aluminum foil production and how aluminum foil containers are made. For a more detailed discussion on aluminum and aluminum foil, the reader is referred to the contents of Supplements 1 and 2 for a more detailed description of aluminum and aluminum foil production and to Supplement 3 for a review of the continuous casting process which is the basis for most aluminum foil production. Supplement 4 is a detailed discussion of the aluminum rolling process.

[SECTION 2: The Perfect Package—Advantages of Aluminum Foil Containers](#)

Aluminum foil containers offer the packaging and food service industries and, ultimately, the consumer many advantages. These include its consumer friendliness, tri-ovenability, recyclability, and a comparison of aluminum foil containers with other packaging choices. The reader is referred to videos that provide more depth on the use of aluminum foil containers in microwave ovens and the container's inherent recyclability.

[SECTION 3: Foil Container Designs and Applications](#)

This section is an overview of the many container designs available in the marketplace. The reader is referred to Supplement 5 for a collage of a number of specific aluminum foil containers currently in the U.S. marketplace.

[SECTION 4: Current Markets for Aluminum Foil Containers](#)

In this section, the dramatic growth of aluminum foil containers over the past ten years is discussed. Current markets and market shares for aluminum foil containers are presented.

[SECTION 5: Future Markets for Aluminum Foil Containers](#)

In this section, the growth potential for aluminum foil containers in the U.S. and worldwide is reviewed. The drive toward consumer convenience and fresh and fresh-like foods in the U.S. and the compatibility of aluminum foil containers for all types of ovens indicates continued strong growth in the U.S. markets. The potential overseas growth of aluminum foil containers in both developed and developing nations is virtually unlimited.

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Section 5: Future Markets for Aluminum Foil Containers

Supplement 1: Introduction to aluminum and light metal— Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999

Supplement 2: Resources and production of aluminum— Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999

Supplement 3: Continuous Casting— Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999

Supplement 4: Rolling: The Process and the Product— Source: TALAT CD-ROM © European Aluminium Association, Brussels, 1999

Supplement 5: Montage of Typical Aluminum Foil Containers in the U.S. Market

Video 1: The Use of Aluminum Foil Containers in Microwave Ovens

Video 2: Recycling of Aluminum Foil Containers

SECTION 1: Basic Introduction to Aluminum and Aluminum Foil Container Production

Introduction:

Aluminum is one of the most abundant metallic elements, accounting for over 8% of the earth's crust on a weight basis (Figure 2). However, economically recoverable aluminum exists in concentrated ore form in only limited locations. The most common, and currently the only commercially utilized aluminum ore, is bauxite. Bauxite may contain 50-60% aluminum oxide (Al_2O_3) on a weight basis. Bauxite is generally found at or near the earth's surface with most deposits located between the Tropic of Capricorn and the Tropic of Cancer. U.S. companies currently mine rich deposits of bauxite in West Africa, Western Australia and in the Central America/Caribbean region.

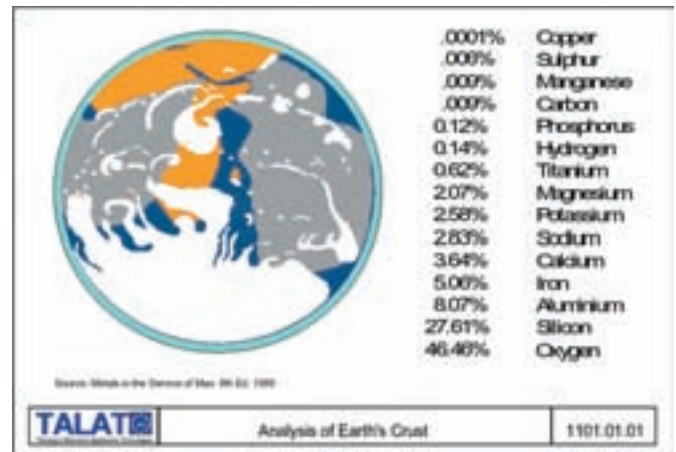


Figure 2

Despite its relative abundance, aluminum was the last of the common metallic elements to be produced on a commercial scale. Because the chemical bond between aluminum and oxygen is higher on the oxidation-reduction scale than other common metals, aluminum cannot be freed from oxygen by typical oxidation-reduction reactions. In 1886, at virtually the same time, American Charles Martin Hall and the French scientist P.L.T. Heroult discovered the electrolytic reduction process that frees aluminum from oxygen.

Aluminum Production:

The basic process is shown in Figure 3 and Figure 4. Purified aluminum oxide is obtained from bauxite by the Bayer Process. Aluminum metal is produced in the Hall/Heroult reduction cell. In this process, Al_2O_3 is dissolved in a molten salt (cryolite— Na_3AlF_6) at temperatures of 900 to 1000 °C. Electric current is passed through the reduction cell which results in oxygen being released at the carbon anodes and molten aluminum being produced at the cathode, underneath the molten salt layer. The aluminum is virtually pure metal, having an aluminum content of 99.5% or more. The molten aluminum is drawn from the reduction cell and cast into billets, direct chill (DC) ingots or continuously cast into sheet.

(Click onto Supplements 1 and 2 for more detailed discussions of the aluminum production process.)

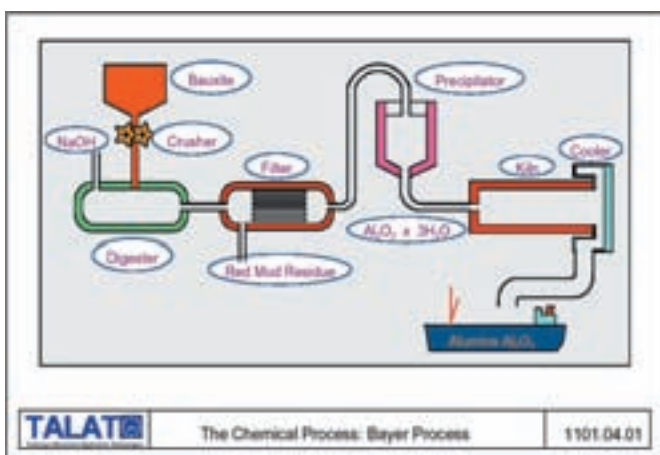


Figure 3

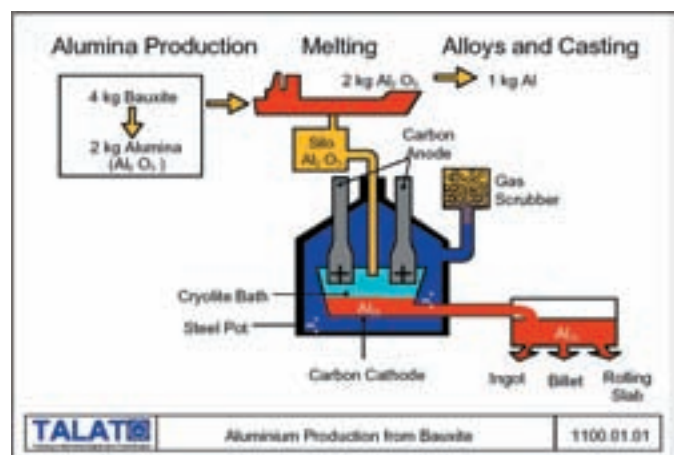


Figure 4

Rolling Aluminum Metal:

Most of the foil and sheet used in aluminum foil containers is produced from continuous cast metal (Figures 5 and 6). However, since most continuous casting operations are not located close enough to reduction facilities to receive hot metal, they receive aluminum in billet form and include melting and holding furnaces that precede the continuous casting operations. When producing foil, the pure metal is alloyed to meet desired foil specifications and cast into sheet metal that may be from 0.2" to 0.4", depending upon the producer.

(Click onto Supplement 3 for a more detailed discussion of the continuous casting process.)

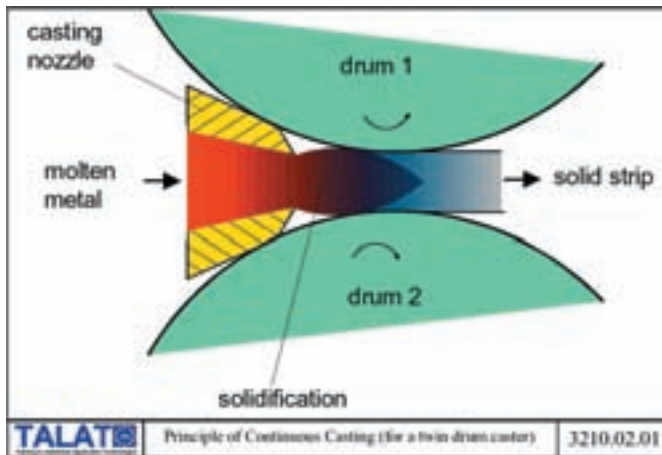


Figure 5

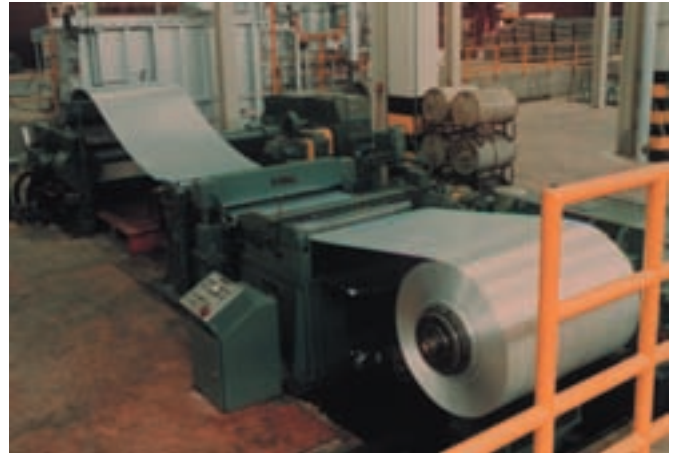


Figure 6

This sheet is cold rolled to the appropriate reroll stock gauge and shipped to a foil plant (Figure 7). At the foil plant, the metal passes through a series of rolling mills with a gauge reduction of 50% or more for each pass through each mill.



Figure 7

Aluminum rolling is not like rolling softer materials such as plastic or paper where a single pair of metal rolls can assure gauge control. In order to correct this problem, foil mills employ a number of means to control the rolling process (Figure 8). The rolls next to the metal are called "work rolls". The rolling mill employs a series of back-up rolls to help ensure appropriate rolling pressure across the web via enhanced rigidity and reduction of roll deflection. This allows higher or variable loads to be absorbed while maintaining a given roll gap profile.

A mill with two back-up rolls is a “four high mill”; one with four back-up rolls is a “six high mill”. Rolls are also shaped (thicker at the middle than at the edges), and back-up rolls may be slightly bent or placed with axes slightly different to help achieve the desired rolling pressures. Rolling fluids, which are employed for cooling, are also used to control the rolling process. Slightly reducing oil spray on a part of a mill roll will cause it to heat slightly at that spot and increase pressure on the metal. Conversely, increasing oil spray can be used to create spot cooling with a resulting lowered pressure at that point. Gauge control is achieved by continuous computer monitoring of gauge at each mill.

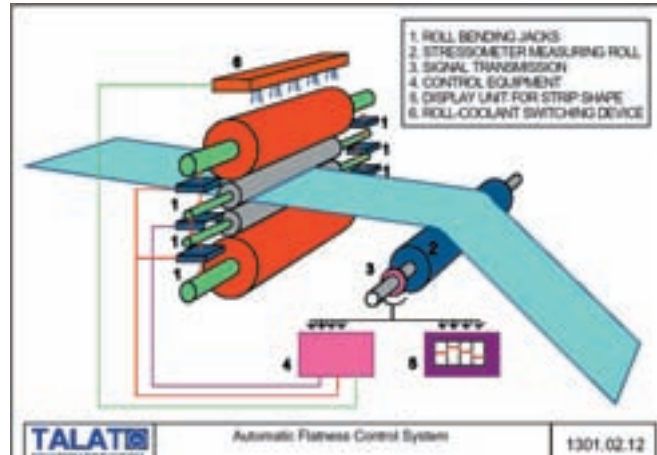


Figure 8

At about a 75% gauge reduction, the aluminum has work hardened as it passed through to rolling mills. At this point, the metal in coil form is annealed in an annealing oven where it is held at 600 – 1,000 °F for eight or more hours (Figure 9). Annealing accomplishes two things: the resulting metal is softened and the rolling oils are removed. Most aluminum foil is also annealed after the finished gauge is reached since soft, oil free metal is usually desirable when the aluminum is converted into final products.

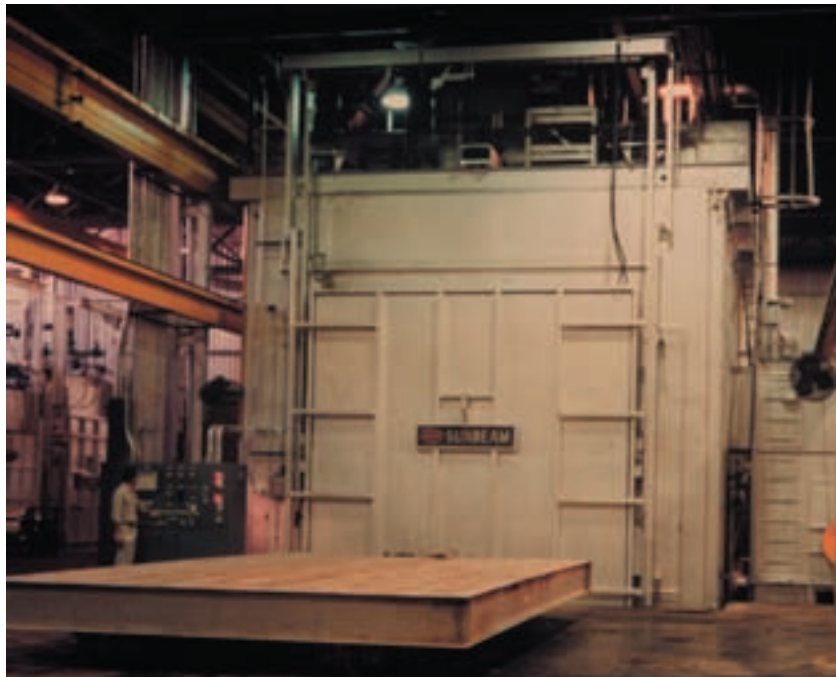


Figure 9

The thickness for aluminum foil containers runs from 0.002” to 0.008”.

[\(Click onto Supplement 4 for a more detailed discussion of the aluminum rolling process.\)](#)

Coating and printing:

Aluminum foil container stock is often coated or printed to protect the container from corrosive food products or add color for both aesthetic and functional purposes (Figure 10).



Figure 10

Slitting:

Since aluminum foil containers vary greatly in size, the coils at the foil plant are slit to the appropriate width prior to transfer to the aluminum foil container manufacturer. The slitting stations also apply a food grade texture to the foil. This texture acts as a lubricant which is required in the forming of a container and remains on finished containers providing a release agent for the food contained within it. The finished product is transferred in coil form to the final forming operation, which may be in-plant or at a separate location or company.

Aluminum Foil Container Formation:

Aluminum foil containers are formed on presses that are fed from coils of feed stock. These presses (Figures 11 – 16) can produce single or multiple containers with a single stroke. The blank is cut and formed into a container with the edges curled in a single operation. Embossing and the formation of metal patterns for functional and decorative reasons are also performed by the presses.



Figure 11



Figure 12



Figure 13



Figure 14



Figure 15



Figure 16

Scrap from the operation is chopped and baled for recycling back into new container feed stock.

Figure 17 is a montage showing a few of the wide variety of aluminum foil containers in today's market. The number of shapes and sizes of aluminum foil containers in today's markets is in the tens of thousands, varying from small trays to pizza dishes to turkey roasters.



Figure 17

SECTION 2: The Perfect Package—Advantages of Aluminum Foil Containers

Aluminum foil containers bring many advantages to the food packaging market. In combination, these advantages position aluminum foil containers uniquely among material choices for the food processing industry, the food service industry and consumer alike. Because of their unique combination of advantages, the aluminum foil container qualifies as the “perfect package” for numerous food packaging applications. Among these advantages are:

Consumer Friendly:

Because foil can withstand wide temperature changes better than other packaging materials, it can go from freezer to oven to the dinner table without changing containers (Figure 18).

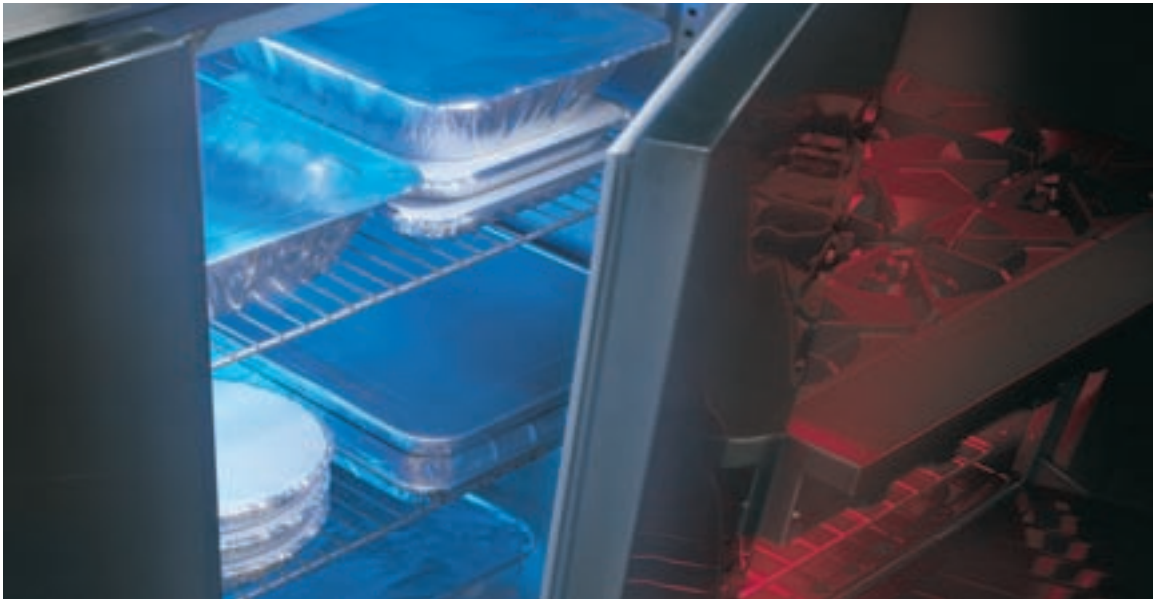


Figure 18

Aluminum foil containers are designed so that they nest very well, taking up little space (Figure 19).



Figure 19

Aluminum foil containers are leak-resistant and keep foods fresher whether in the refrigerator or in the freezer (Figure 20).



Figure 20

Aluminum foil containers are easy to clean up for re-use or for recycling (Figure 21).



Figure 21

Aluminum foil containers are versatile. Consumers can reheat or freeze food products directly in the foil container, dispose of it or recycle it. Foil containers have been selected by Meals on Wheels and by many take-out restaurants and food service companies for their great properties, low cost and convenience (Figures 22 & 23).



Figure 22



Figure 23

Aluminum's conductivity helps speed both baking and freezing and allows faster and better product reconstitution than that of other packaging materials (Figure 24).



Figure 24

Tri-Ovenable:

Only aluminum food containers can be safely used in all ovens—regular ovens (including broiling), toaster ovens and microwave ovens (Figure 25).



Figure 25

Many consumers don't realize that aluminum foil containers can be safely used in today's microwave ovens. In fact, when microwaving with aluminum, microwaves enter from the top, heating food from the center out for more uniform heating or cooking (Figure 26).



When microwaving with aluminum, microwaves enter from the top, heating food from the center out for more uniform cooking.

Figure 26

Microwaving instructions are simple:

- Remove all lids (cover with a paper towel)
- Heat one food container at a time
- Center container in the oven, away from walls
- Microwave in ovens made after 1980

[\(Click here for a video showing microwaving foods in aluminum foil containers.\)](#)

Aluminum's tri-ovenability permits fast and flexible food preparation. Consumers can defrost in the microwave, heat in the oven and brown in the broiler without ever changing containers.

Throughout the heating cycle in whatever oven is used, aluminum retains its bright, attractive appearance, while the food maintains its flavor and appeal (Figure 27).



Figure 27

Recyclable:

One of aluminum's environmental advantages is its recyclability.

Aluminum has an inherent value. As the leading recycled material in world, aluminum helps pay for many municipal recycling programs, saves billions of dollars annually in energy costs, helps create thousands of jobs and tax dollars in the collecting and processing industries and lowers the cost of aluminum (Figure 28).



Figure 28

The amount of aluminum recycled has doubled in the past ten years and now represents 28% of the scrap value of all recycled materials. It all adds up—recycling aluminum makes sound commercial as well as environmental sense.

Aluminum is the most valuable consumer recycled material. At over \$1,200 per ton, it is more than three times more valuable than the next most valuable material available for recycling (Figure 29).

Aluminum: Most Valuable Consumer Recycled Material at over \$1,200 per ton.

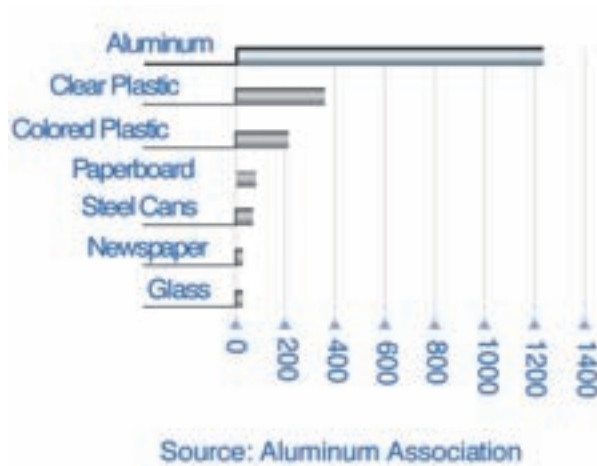


Figure 29

Recycling helps the community—In our schools, homes and streets, recycling has become a daily part of American life. Its impact is especially felt in our communities where less aluminum trash means less litter and helps conserve landfill space. Recycling proceeds also help support community projects like Habitat for Humanity (Figure 30 & 31).



Figure 30



Figure 31

Over 12 billion aluminum foil containers produced world wide on an annual basis. They are almost pure aluminum and are 100% recyclable.

[\(Click here for a European video emphasizing the recyclability of aluminum foil containers.\)](#)

Features and benefits of Aluminum Foil Containers:

As note below (Figure 32), aluminum foil containers offer a host of advantages that cannot be matched by any other material choice.

FEATURES & BENEFITS								
Materials	Aluminum Foil	Ovenable Paperboard	CPET	Molded Fiber	CPET Foam	PP	TFPP	OPS
Tri-ovenable: Conventional, Toaster Oven & Microwave	✓							
Dual-ovenable: Conventional & Microwave	✓	•	•	•	•			
Microwaveable	✓	•	•	•	•	•	•	•
Flash Freezing Compatible	✓	•	•	•				
Film Sealing Compatible	✓	•	•	•	•	•	•	
Printability: Custom Printing of Exterior and Interior	✓	•						
Variety of Shapes and Sizes: Less than One Once to 20 Pound Capacity	✓							
Leakproof, Resealable, Foldover Closures Mate with Variety of Lids	✓		•					•
Rigidity & Hot Handling	✓	•		•	•		•	

Figure 32

SECTION 3: Foil Container Designs and Applications

Aluminum foil containers serve a number of markets (see SECTION 4). A wide range of container designs are available in the retail market. As seen here, (Figure 33) baking pans, roasting pans, muffin pans, pizza pans, cookie sheets, carryout containers, etc., are widely available to the U.S. consumer. Generally, these containers also come in a variety of sizes, depending on the specific consumer needs.



Figure 33

Specialty items such as oven and burner liners are also in widespread use (Figure 34) . An even wider selection of aluminum foil containers is available to other segments of the market, where aluminum foil containers can be focused on a specific market segment needs.



Figure 34

A collage of a number of different aluminum foil container designs and applications is given in Supplement 5.

SECTION 4: Current Markets for Aluminum Foil Containers

Aluminum foil container production continues to grow. As seen in Figure 35, aluminum foil container manufacture in North America has increased from 172 million pounds in 1992 to over 250 million pounds in 2002, an increase of over 45% during that time period.

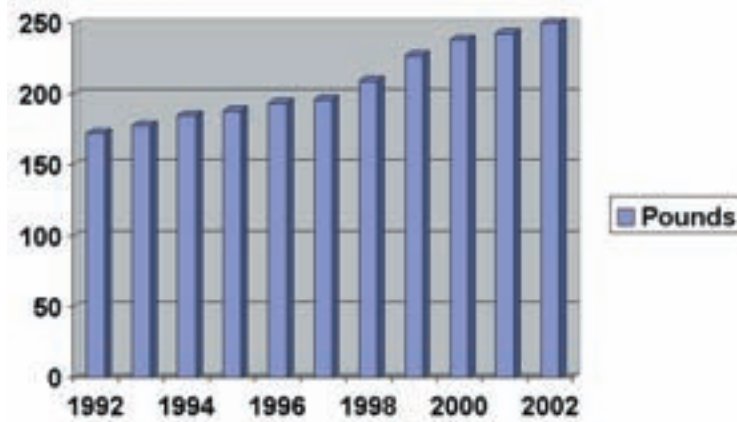


Figure 35

Over **7 billion** aluminum foil containers were manufactured annually in North America.

The estimated markets for aluminum foil containers are as follows:

<u>Market</u>	<u>Market Share (lbs)</u>
---------------	---------------------------

Distribution – Foodservice (Figure 36)	35%
Quick Service Restaurants	
Institutional	
Transportation	
Catering/Vending	

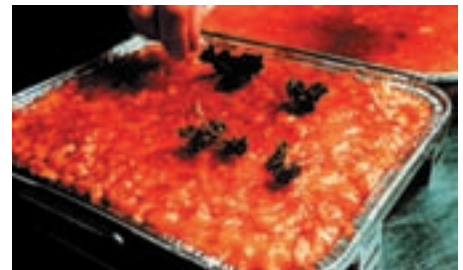


Figure 36

Bakery/Confectionary (Figure 37)	25%
Fresh	
Frozen	



Figure 37

Packer/Processor (Figure 38)	15%
Fresh	
Frozen	



Figure 38

Market

Market Share (lbs)

Retail (Figure 39)

15%



Figure 39

Distribution – Supermarket (Figure 40)

10%

- Bakery – in store
- Deli
- Fish
- Meat
- Produce



Figure 40

Non-Food (Figure 41)

Small %

- Medical
- Electronics
- Outdoor Cooking



Figure 41

SECTION 5: Future Markets for Aluminum Foil Containers

As seen in the previous section, aluminum foil container growth has been over 40% in the past ten years. This rapid growth can be attributed, at least in part, to the U.S. consumer's preference for easy-to-prepare foods, whether in the supermarket freezer or deli or purchasing take home entrees or complete meals from restaurants and other retail outlets. Many mid-line restaurants are beginning to rely on centrally prepared meals and entrees that can be subjected to rigorous quality control and reheated and served at retail outlets. These trends can be expected to continue as the U.S. consumer continues to demand quality food, quickly available, at reasonable prices. So, at a minimum, the current growth rates of aluminum foil containers can be expected to continue. However, what *new* markets are available to manufacturers of these products?

One of the largest, virtually untapped domestic markets for aluminum foil containers is not a new one—microwave heating and cooking. It is unfortunate that early microwave oven technology (pre-1980) was not compatible with metal containers. Today's microwave ovens are compatible with aluminum foil containers and consumer acceptance of this fact would provide a quick boost in foil container sales since microwave ovens are in almost every home and business in the country. To change consumer attitudes about entrenched beliefs is difficult, but not impossible. Information such as contained on this disk, coupled with working with microwave oven manufacturers and the educational community (high school home economics teachers, etc.) may change entrenched consumer attitudes.

Supermarkets (and outlets for consumer foods such as club stores and large, multi-product retailers) are moving toward branded, fresh meat, poultry and fish products, processed and packaged centrally for distribution to consumer outlets. Many of these are now (or will be) packaged in modified atmosphere packages, where the internal atmosphere has been changed to extend shelf life and suppress the growth of harmful microorganisms. Most of these packages require a high barrier to gases and moisture, which is currently being provided by foamed plastic trays or forms of paperboard with some type of barrier lining. **Foil containers have the potential to enter this emerging market by providing barrier properties and a cook-in-the-container feature that most current packages do not provide.**

The greatest overseas potential is in developing nations. These countries, with vast populations and quickly developing technical societies, offer unparalleled opportunities for aluminum foil container manufacturers. Foil containers have the opportunity to move into these markets, not only in existing market areas in the U.S., but also in areas currently occupied by competing materials in the U.S.