

Manufacturing of Chewing Gum

Self-Selected Homework #1

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This report contains a history of chewing gum which details its invention and the evolution of the product and process to modern times. The modern product will be detailed, and the universal process for manufacturing gum will be described. Various types of specific manufacturing machinery for the process are then detailed. This is followed by a section on the economic aspects of chewing gum manufacturing. Finally, a discussion on the relevance of the topic for beginning and experienced engineers and a discussion of the information learned through the project are included.

Contents

History.....	1
Raw Material.....	2
Manufacturing Process and Equipment.....	2
Economics	4
Relevance.....	5
Learning	5
References	7

History

Chewing gum has been a part of people's lives since A.D. 50, when Ancient Greeks were believed to chew mastiche, tree resin from the Mastic tree⁴. Tree resins proved to be the most popular natural gum, with spruce sap had been a favored chewing substance for centuries in North America even before New England colonists adopted it for their own enjoyment. In the mid-1800s John Curtis and his son formed the first chewing gum company, The Curtis Company, in which they spurred the gum industry and created a manufacturing process which is roughly the same one used to produce chewing gum today. Curtis and his son first boiled the spruce gum and skimmed off impurities such as bark before adding sugar and other fillers. They proceeded by rolling and cooling the gum, cutting it into sticks which they then dipped in cornstarch, wrapped in paper, and placed in small wooden boxes. Curtis's son grew the business by developing a machine to mass produce the gum, and founded the first chewing gum factory⁴.

Modern chewing gum appeared in 1869 when Mexican General, Antonio Lopez de Santa Anna hired inventor Thomas Adams to develop a new form of rubber using chicle. Adams was unsuccessful in developing rubber; however he did succeed in producing Adams New York No. 1 – gum made with the latex chicle. Gum made with similar latexes soon became more popular than spruce gum or paraffin gum. This new latex based chewing gum was smoother, softer and held its flavor better than any previous type of chewing gum⁴.

As the 1900s rolled around, chewing gum was being manufactured in many different shapes, sizes and flavors. The most successful chewing gum company ever was established by William Wrigley, Jr., in 1892. Bubble gum was invented in 1928 by Walter Diemer, a cost analyst for the Fleer Company. Mr. Diemer found the right combination of ingredients and created a gum that was strong enough to stretch when filled with air. During the 1930s and 1940s, the invention of synthetic rubbers assisted chewing gum manufacturers greatly, because they no longer had to rely on irregular supplies of imported natural rubber⁴.

Raw Material

The manufacturing of chewing gum in the United States began with loggers chopping off wads of spruce gum for chewing pleasure and has developed greatly over the years. Traditionally the gum base came from tree resin, today it is synthetic and made of plastics and rubbers. Natural gum bases include latexes such as chicle, jelutong, gutta-percha, and pine rosin¹. Most modern chewing gum bases use either no natural rubber at all, or a minimal amount ranging from ten to twenty percent, with synthetic rubbers such as butadiene-styrene rubber, polyethylene, and polyvinyl acetate making up the rest. These synthetic rubbers are in pellet form.

Along with the gum base is a flavoring and some form of a sweetener. A typical stick contains 79 percent sugar or artificial sweetener. Natural sugars include cane sugar, corn syrup, or dextrose – artificial sweeteners include saccharine or aspartame. Mint flavors are commonly provided by oils extracted from the best, most aromatic plants; fruit flavors are generally derived from artificial flavorings (i.e. apple flavor comes from ethyl acetate,

cherry from benzaldehyde) because the amount of fruit grown cannot meet the demand— these flavorings usually comprise only one percent of the gum's total weight.⁴

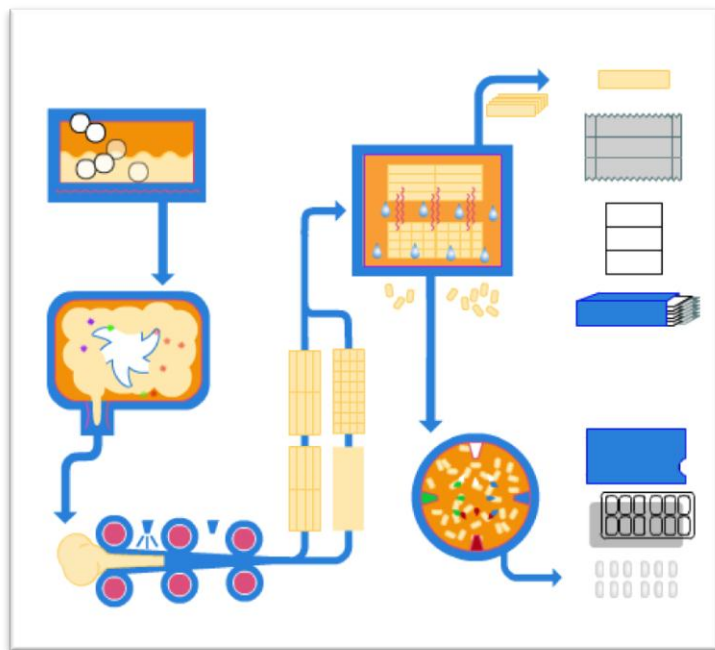


Figure 1 – Processes⁴

Manufacturing Process and Equipment

There are seven basic steps to the manufacturing process of chewing gum: melting, mixing, rolling, scoring, conditioning, coating, and packaging.

Melting

After the materials have been selected and tested, the making of gum begins by melting and purifying the gum base.

Mixing

The melting process is followed by a mixing process where the melted gum base is poured into various mixers, depending on the size of the production run. Sweeteners, flavors, coloring and additives are added in certain portions and at particular timings during the mixing process. As it begins mixing, glucose syrup is often added in syrup form which helps keep the gum soft. Dextrose (a powdered

sweetener) is then added. The materials are blended for approximately twenty minutes – the stirring action of the large steel blades builds up heat which melts all the ingredients together.¹

Rolling

Mixers produce large “loafs” of gum that are further processed depending on what type of gum is being made. For chunk bubble gum products, the gum is sent through an extruder that produces a continuous rope of gum. For gumball products, the gum must be extruded into a pencil shape and then run through a specialized forming machine which creates the shaped balls of gum with hollow cores. For the standard stick, tab, or pellet products, the gum passes through a series of rollers that form it into a thin, wide ribbon. Each pair of these rollers is set closer together than the previous, resulting in a gradual reduction of the gum’s thickness (standard stick gum is rolled to approximately 0.17 inches thick³). During the rolling process a light coating of finely powdered sugar or sugar substitute is added to keep the gum from sticking and to enhance its flavor.

Scoring

After being dusted with powdered sugar, the continuous ribbon or rope of gum is then cut into chunks or into patterns of sticks, short thicker tabs, long rolled strips or small rectangular gum centers, depending on what type of gum is being made⁵. The standard stick product gum is first scored into a pattern of rectangles, each 1.3 inches (3.3 centimeters) long and 0.449 inches (1.14 centimeters) wide³.

Conditioning

Before the chewing gum is wrapped it must be properly cooled and tempered to ensure the finished product will have the right consistency and stay fresh on store shelves.



Figure 3 - Linhandle LC-190 Coating Machine²

Coating

For pellet and gumball gum products, the gum centers are fed to a spray drier that forms a crunchy coating around the gum center. The spray drier tumbles the pieces while a syrup mixture (made of filtered water, sweeteners and coloring) is sprayed onto the gum. This combination of tumbling and spray coating forms a flavorful shell around the soft gum centers.

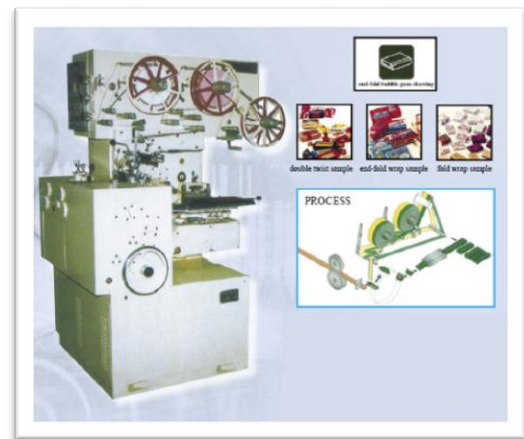


Figure 2 - Linhandle LC-128 Forming, Cutting and Wrapping Machine²

Packaging

For stick, tab and chunk gum a product, the gum is fed into wrapping machines following cooling and tempering. In one continuous process, the wrapping machines receive the gum and wrap it in aluminum foil or wax paper. The gum is then put in a paper wrap and slid into plastic packs that are then sealed, put into boxes or plastic bags and ready to ship. Pellet-style gum products are principally packaged by two methods. The first method is to

place the pellets into the formed plastic compartments of a blister pack. This package is then heat sealed with a foil backing, and inserted into a cardboard sleeve. The second method is to line up ten pellets in a row, wrap in traditional packaging and seal both ends to ensure freshness.

The seven processes involved in chewing gum manufacturing involve a variety of equipment. There are seven machines which are typically utilized in the continuous processing of chewing gum: a grinder, oven, mixer, extruding machine, molding machine, cooling machine, and coating machine.



Figure 4 - KXT-300⁶

In a conventional chewing gum manufacturing process, a double arm Sigma blade mixer is used to mix chewing gum ingredients. Gum base, bulking agents such as sugar or sorbitol for sugarless gum, liquids such as syrup or liquid sorbitol, softeners such as glycerin and lecithin, and flavors are mixed about 5-20 minutes to manufacture the gum. The warm, dough-like gum mass is then removed from the mixer and added to a kneader (extruding machine/molding machine) from which it is forced or sheeted into a ribbon or rope to be formed. The gum then moves to the cooling machine, and is then manually moved into the coating machine or directly into a high speed wrapping machine.

Wrigley has patented a method of continuously manufacturing a chewing gum composition without separate manufacture of a chewing gum base. This new process continuously adds ingredients into a continuous mixer from which they are continuously discharged (while fresh gum ingredients continue to be introduced and mixed within the mixer) and a portion of previously produced chewing gum composition is added to the mixer and mixed with the fresh ingredients (this has been proven to improve the gum base). This procedure maintains the continuity of the process, and increases the quality of the gum base.⁸

Economics

The average American consumes 168 sticks of gum annually and the US gum market has total sales valued at 3.09 billion US dollars. Of the US gum-market, 80 percent is sugar-free gum. The largest

manufacturer of chewing gum is Wrigley's with a market share of 59 percent, followed by Cadbury Schweppes with a market share of 34.5%.⁷

Relevance

The topic of chewing gum manufacturing holds a significance to the amateur engineer as it encapsulates the spectrum of manufacturing processes and equipment, from grinding, melting, mixing, extruding, molding, cooling, coating, and packaging. The experience engineer can gain knowledge that, though the process for manufacturing gum has not changed greatly since its beginning with the Curtis Company, there will always be process improvements which the process engineer can locate and design which can increase the efficiency and quality of the process (as was done by Wrigley in 1999⁸).

Learning

Through this project I learned the manufacturing processes that are implemented in the manufacturing of chewing gum, along with the evolution of materials and process improvements in the system. Having chewed gum since my teeth grew in, I have always been a fan, however never had the opportunity to even consider the process through which the product is made that I so enjoy. I wanted to take this opportunity to implement the knowledge that I have attained about manufacturing thus far through my engineering experience (especially with MEEG453) to learn how the gum that is in my backpack got there in the first place.

Upon thinking of the process, I could only assume that there was a combination of a mixing process followed by an extrusion process, some solidification method (probably cooling), and a wrapping process.

I began my research by watching the *How It's Made* episode on bubble gum to give me a brief visual overview with some fundamental ideas on how the whole process is done. After understanding the basics, I did a variety of web searches and found some very useful articles which detailed the history of chewing gum. These articles gave me a solid understanding of how the process was, how it evolved, what has remained the same, and allowed me to explore further into the modern manufacturing process. I read more and more articles and compared them to see the differences between the processes each described, and was eventually able to attain a solid understanding of the modern manufacturing processes. I then wanted to explore the actual machinery which is used in these processes, and did a number of web searches to locate manufacturers of such equipment – these manufactures gave me a good idea of the standard equipment types that are used in the gum manufacturing process. I was able to relate these machines to those which I have previously learned about in MEEG453 this semester. Finally, I did a search within the most well-known of gum manufactures, Wrigley, to find information on their process – through this search I was able to find patents on developments that they have made within the field, informing me of the ever growing and developing manufacturing world of chewing gum.

I have learned the details of the history of chewing gum, its process line, the factors that are taken into consideration during the processes, and the developments that have been made and are still to be made in the process.

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