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УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ ПО ЧТЕНИЮ АУТЕНТИЧНЫХ ТЕКСТОВ

для студентов специальности
1-36 09 01 – «Машины и аппараты пищевых производств»

Брест 2013

МИНИСТЕРСТВО ОБРАЗОВАНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
«БРЕСТСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ»

КАФЕДРА ИНОСТРАННЫХ ЯЗЫКОВ ПО ТЕХНИЧЕСКИМ СПЕЦИАЛЬНОСТЯМ

УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ ПО ЧТЕНИЮ АУТЕНТИЧНЫХ ТЕКСТОВ НА АНГЛИЙСКОМ ЯЗЫКЕ

для студентов специальности
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Учебно-методическое пособие предназначено для студентов специальности «Машины и аппараты пищевых производств».

Данное учебно-методическое пособие составлено в соответствии с требованиями Программы по иностранным языкам.

Цель пособия - подготовить студентов к чтению и пониманию аутентичной литературы по изучаемой специальности, совершенствовать навыки перевода профессионально-ориентированных текстов, развить коммуникативные способности студентов, расширить их активный и пассивный лексический запас.

Пособие составлено из статей и текстов оригинальной английской и американской технической литературы, содержащих описание устройства и принципов работы различных машин и аппаратов пищевых производств.

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UNIT 1.

Text A. FOOD PROCESSING HISTORY

1. Match the phrases below with the appropriate Russian equivalents.

1. food processing	a) сохранять продукты питания
2. to lose nutrients	b) подвергаться особой обработке
3. food spoilage	c) терять питательные вещества
4. to preserve food	d) пищевая промышленность; технология производства пищевых продуктов
5. to delay deterioration	e) замедлять порчу
6. to undergo special treatment	f) порча продуктов питания
7. to take measures	g) массовое производство
8. smoked meat	h) консервант
9. steaming	i) искусственный заменитель сахара
10. fermenting	j) пастеризация
11. to remove moisture	k) усовершенствованное оборудование
12. to spoil	l) сублимационная сушка
13. canning	m) принимать меры
14. tin can	n) брожение
15. mass-producing	o) удалять жидкость
16. pasteurization	p) консервирование
17. freeze drying	q) портиться
18. refined machinery	r) жестяная банка
19. artificial sweetener	s) обработка паром
20. preservative	t) копченое мясо

2. Read and translate the text.

FOOD PROCESSING HISTORY

Farmers grow fruits and vegetables and fatten livestock. What happens between the time food leaves the farm and the time it is eaten at the table? Like all living things, the plants and animals that become food contain tiny organisms called microorganisms. Living, healthy plants and animals automatically control most of these microorganisms. But when the plants and animals are killed, the organisms begin to multiply, causing the food to lose flavor and change in color and texture. Just as important, food loses the nutrients that are necessary to build and replenish human bodies. All these changes in the food are what people refer to as food spoilage. To keep the food from spoiling, it is preserved.

Raw fruits and vegetables and uncooked meat are preserved by cold storage or refrigeration. The cold temperature inside the cold-storage compartment or refrigerator slows down the microorganisms and delays deterioration. But cold storage and refrigeration will preserve raw foods for a few weeks at most. If foods are to be preserved for longer periods, they must un-

dergo special treatments such as freezing or heating. The science of preserving foods for more than a few days is called food processing.

Human beings have always taken some measures to preserve food. Food processing dates back to the prehistoric age: around 500,000 BC Neanderthals discovered fire and noticed that cooked and smoked meat lasted longer than raw meat. Prehistoric crude processing included various types of cooking, such as over fire, smoking, steaming, fermenting, sun drying and preserving with salt. Ancient people learned to leave animal flesh, fruits and vegetables in the sun and wind to remove moisture. Since microorganisms need water to grow, drying the food slows the rate at which it spoils. Salt-preservation was especially common for foods that constituted warriors' and sailors' diets, until the introduction of canning methods. Evidence for the existence of these methods can be found in the writings of the ancient Greek, Egyptian and Roman civilizations as well as archaeological evidence from Europe, North and South America and Asia.

These crude processing techniques remained essentially the same until the advent of the Industrial Revolution. In 1809 Nicolas Appert developed the canning process to supply food to the French army, which eventually led to canning in tins by Peter Durand in 1810. The United States patented the process in 1815 and began mass-producing tin cans in 1847. In 1861, Louis Pasteur discovered that heating foods before sealing them destroyed harmful microorganisms - the process became known as "pasteurization." Freeze drying techniques were used in the early 1900s in France, followed by the invention of a deep-freezing method by an American, Clarence Birdseye, in 1920.

The mass production of foods through modern processing methods evolved from industrialization, which led to factories, refined machinery, and breakthrough scientific discoveries in biotechnology. Mass transportation and the invention of refrigeration made it possible to deliver processed foods across continents.

In the early 20th century, change in food habits of the consumers furthered the development of food processing with advancements such as spray drying, juice concentrates, freeze drying and the introduction of artificial sweeteners, colourants, and preservatives. In the late 20th century products including dried instant soups, reconstituted fruit juices and "ready-to-eat" products were developed.

There are over 18,000 different food items in today's supermarkets, which are processed to a greater or lesser degree, and thousands of new products are introduced each year. Inventions in food processing and food storage have not only changed what we eat. They have changed how we live. Once there was a world without canned, pasteurized, frozen, and genetically modified food stocked floor to ceiling in supermarkets. Can you imagine that?

3. Find in the text English equivalents to the following word-combinations.

1. выращивать фрукты и овощи
2. кормить домашний скот на убой
3. пополнять запасы тела человека
4. препятствовать порче продуктов питания
5. сохранять с помощью замораживания
6. наука о хранении продуктов питания
7. появляться в первобытные времена
8. грубая обработка

9. составлять чей-либо рацион питания
10. наступление промышленной революции
11. разработать процесс консервирования
12. начать массовое производство консервы
13. разрушать вредные микроорганизмы
14. использовать методы сублимационной сушки
15. изобретение метода глубокой заморозки
16. изменение особенностей питания
17. внедрение искусственных красителей
18. сухой суповой концентрат
19. восстановленный сок
20. готовый к употреблению продукт

4. Fill in the gaps according to the text.

1. All negative changes in the food are what people refer to as ... .
2. To keep the food from spoiling, it ... .
3. The science of preserving foods for more than a few days is called ... .
4. Food processing dates back to ... .
5. Prehistoric crude processing included various types of ... .
6. ... was especially common for foods that constituted warriors' and sailors' diets.
7. In 1809 Nicolas Appert developed .... to supply food to troops in the French army.
8. In 1861, Louis Pasteur discovered that ... foods before sealing them destroyed harmful microorganisms.
9. In 1920 Clarence Birdseye invented ... .
10. ... of foods through modern processing methods evolved from industrialization.

5. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. The science of preserving foods for more than a few days is called food processing.
2. Human beings have quite recently started to take some measures to preserve food.
3. Prehistoric crude processing included various types of cooking, such as over fire, smoking, steaming, fermenting, sun drying and preserving with salt.
4. Since microorganisms don't need any water to grow, drying increases the rate at which food spoils.
5. Salt-preservation wasn't common for foods that constituted warriors' and sailors' diets.
6. Processing techniques remained essentially the same until the advent of the Industrial Revolution.
7. In 1809 Nicolas Appert developed the canning process.
8. The United States began mass-producing instant soups in 1847.
9. Louis Pasteur discovered that heating foods before sealing them destroyed useful micro-organisms.
10. Mass production made it possible to deliver processed foods across continents.
11. Change in food habits of the consumers furthered the development of food processing.

6. Answer the following questions.

1. Why is it necessary to preserve food?
2. What is food processing?
3. When did people start preserving their food?
4. What methods did prehistoric crude food processing include?
5. Why did ancient people leave animal flesh, fruits and vegetables in the sun and wind?
6. Where can the evidence for the existence of crude food processing methods be found?
7. What discoveries were made in the area of food processing in the 19th century?
8. What further advancements were made in the early 20th century?
9. What new products were developed in the late 20th century?

7. Speak on the following points.

1. The necessity of food preservation.
2. Crude food processing methods.
3. The inventions in food processing.

Text B.

1. **Read and translate the text.**

NICOLAS APPERT

Nicolas Appert was born in France in 1749. The son of an inn-keeper, he received no formal education. He had an interest in food preservation and, at an early age, learned how to brew beer and pickle foods. Appert served an apprenticeship as a chef at the Palais Royal Hotel in Chalons, France. In 1780, he moved to Paris, where he excelled as a confectioner, delighting customers with his delicious pastries and candies.

During the late eighteenth century, Napoleon Bonaparte expanded his quest to conquer the world. As French troops invaded neighboring countries, it soon became apparent to the government that world conquest would not be within its grasp without the ability to carry foods for an extended time without spoilage. The executive branch, known as the Directory, offered a prize of 12,000 francs to anyone who could develop a practical means of preserving food for the army during its long forays.

Appert began a fourteen-year quest, determined to win the prize. Chemistry at this time was a little known science and there was virtually no knowledge of bacteriology. Appert's experiments on the preservation of meat and vegetables for winter use was conducted through trial-and-error. He had little reference on which to rely since there was only one published work on food preservation through sterilization, written by Lazzaro Spallanzani (1729-1799). Appert based his process on heating foods to temperatures in excess of 100°C., the temperature at which water boils. To do this, Appert used an autoclave, a device that uses steam under extreme pressure to sterilize foods.

In 1804, Appert opened the world's first canning factory in the French town of Massy, south of Paris. By 1809, he had succeeded in preserving certain foods and presented his findings to the government.

The entire process was time consuming, taking about five hours to complete the sterilization. It involved placing food in glass bottles, loosely stopped with corks and immersing them in hot water. Once the bottles were heated, they were removed and sealed tightly with corks and

sealing wax, then reinforced with wire. Appert demonstrated that this process would keep food from spoiling for extended periods of time, provided the seals were not broken. It was used to preserve soups, meats, vegetables, juices, various dairy products, jams, jellies, and syrups. Although Appert could never explain why his food preservation process succeeded, he is, nevertheless, credited with being the father of canning.

Appert used his winnings to finance his canning factory at Massy, which continued to operate for another 123 years, until 1933. When canned foods were studied in England, it became apparent that glass bottles posed a problem because of breakage. Twelve years later, Appert advanced his process from the use of glass jars to cylindrical tin-plated steel cans. This innovation increased the portability of food for both the British and French military.

In addition to perfecting the autoclave, Appert was responsible for numerous inventions, including the bouillon cube. He also devised a method for extracting gelatin from bones without using acid. Despite his success in the field of food preservation and the recognition he received from his government, Appert died in poverty on June 3, 1841 in Massy, France. He was buried in a common grave.

2. **Answer the following questions.**

1. When was Nicolas Appert born?
2. What education did he receive?
3. Why did it become necessary to develop a practical means of preserving food during the late 18th century?
4. How long did it take Appert to succeed in his quest?
5. On what did he base his process of preserving food?
6. What piece of equipment did Appert use for heating goods?
7. What stages did Appert's food preserving process include?
8. Could Appert explain why his food preservation process succeeded?
9. What did Appert use his winnings for?
10. How long did Appert's canning factory continue to operate?
11. What Appert's innovation increased the portability of food for both the British and French military?
12. What inventions were made by Appert?

UNIT 2.

Text A. FOOD PROCESSING

1. **Before reading the text learn the terms used in the text:**

mechanical transport equipment – оборудование для автоматического перемещения
pump – насос
pipe – труба, трубопровод
valve – клапан, вентиль, задвижка
pallet – паллет, поддон
silo - бункер для хранения
vat – бак, цистерна, чан
vessel - резервуар; сосуд; баллон; камера

tank - бак; резервуар; цистерна; ванна
size reduction equipment –оборудование для измельчения
slicer - ломтерезальная машина
dicer – машина для нарезания (продуктов) в форме кубиков
meat grinder - мясорубка
cutter – резальное устройство, куттер
crushing equipment – дробильное оборудование
grinding equipment – помольное оборудование
crusher – дробилка
mill –мельница, вальцовый станок
pulper - пульпер
grinder – размалывающая машина, волчок шлифовальной машины
disintegrator - дезинтегратор, измельчитель, дробилка
attritor - истиратель, мельница
homogenization equipment – оборудование для гомогенизации
colloid mill – коллоидная мельница
homogenizer - гомогенизатор
mixing equipment – смесительное оборудование
forming equipment - оборудование для формования
agitated tank – чан с мешалкой
extruder – экструдер, пресс
mechanical separation equipment – оборудование для механического разделения пищевых сред
screen –грохот, сито, решето
trommel – барабанный грохот
sifter – рассев
separator – сепаратор
sedimentation tank – бак-отстойник
heat transfer equipment – оборудование для теплопередачи, теплообменное оборудование
heat exchanger-теплообменник
evaporator – эвапоратор, испаритель; выпарной аппарат
dehydration equipment – оборудование для сушки
dryer - сушильная камера, сушильный шкаф
refrigeration and freezing equipment – оборудование для замораживания
freezer – морозильный аппарат, морозильная камера, фризер
mass transfer equipment – оборудование для массообменных процессов
pot still – перегонный куб
distillation column – дистилляционная колонна, перегонная колонна
packaging equipment – оборудование для упаковки
filler –дозатор, наполнительная машина, наполнитель начинок
capper –укупорочная машина, закаточная машина
wrapper – машина для завертывания изделий

2. **Match the phrases below with the appropriate Russian equivalents.**

1. to transform raw ingredients into food	a) разнообразие в питании
2. long shelf-life food products	b) технология сохранения продуктов питания
3. variety in the diet	c) типовой процесс
4. to inhibit changes	d) оборудование пищевых производств
5. preservation technique	e) полный контроль
6. food processing equipment	f) производственные затраты
7. unit operation	g) перерабатывать сырье в продукты питания
8. full scale control	h) продукты длительного срока хранения
9. manufacturing process	i) хранение на складе
10. processing costs	j) замедлять изменения
11. change-over	k) производственный процесс
12. warehousing	l) переналадка (станка), замена

3. **Read and translate the text.**

FOOD PROCESSING

Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans or animals. Food processing typically takes clean, harvested crops or animal products and uses these to produce attractive, marketable and often long shelf-life food products.

The aims of the food processing today, as in the past, are fourfold:

1. To extend the period during which food remains wholesome (the shelf life) by preservation techniques which inhibit microbiological or biochemical changes and thus allow time for distribution, sales and home storage.

2. To increase variety in the diet by providing a range of attractive flavours, colours, aromas and textures in food (collectively known as eating quality). A related aim is to change the form of the food to allow further processing (for example the milling of grains to flour).

3. To provide the nutrients required for health (termed nutritional quality of a food).

4. To generate income for the manufacturing company.

Each of these aims exists to a greater or lesser extent in all food production, but the processing of a given product may emphasize some more than others. For example, frozen vegetables are intended to have sensory and nutritional qualities that are as close as possible to the fresh product, but with a shelf life of several months instead of a few days or weeks. The main purpose of freezing is therefore to preserve the food. In contrast, sugar confectionery and snack foods are intended to provide variety in the diet.

Food processing equipment is indispensable component of food processing. It has a role to play in almost all steps in the food processing chain: it is used for slicing, cutting, chopping, stuffing, blending, grinding, crushing, extracting, separating, mixing, freezing, packaging, etc.

All food processing equipment can be classified according to the basic unit operations it performs:

mechanical transport equipment, such as pumps, electric motors, pipes, valves and conveyers

- food storage equipment, such as pallets, bags, bins, silos, vats, vessels, tanks
- mechanical processing and separation equipment:
  - size reduction equipment:
    - cutting equipment, such as slicers /dicers, meat grinders, cutters
    - crushing and grinding equipment, such as crushers, mills, pulpers, grinders, disintegrators, attritors
  - homogenization equipment, such as colloid mills, homogenizers
  - mixing and forming equipment, such as agitated tanks, industrial mixers, extruders
- mechanical separation equipment
  - solid/solid separation equipment, such as screens, trommels, sifters, separators
  - solid/liquid, such as screens, sedimentation tanks, filters, centrifuges, presses, separators
- heat transfer equipment, such as heat exchangers, ovens, fryers, heaters
- evaporation equipment, such as evaporators
- dehydration equipment, such as dryers
- thermal processing equipment, such as sterilizers, heat exchangers
- refrigeration and freezing equipment, such as compressors, condensers, heat exchangers, refrigerators, freezers
- mass transfer equipment, such as pot stills, distillation columns, dryers
- food packaging equipment, such as fillers, cappers, wrappers

Much of today's food processing equipment is versatile and user-friendly. It offers possibility of full scale control over manufacturing process which results in reducing processing costs, enables rapid change-overs and improves product quality. Microprocessors are widely and almost universally used to control food processing equipment. The entire food manufacturing process, from reception of materials, through processing and packaging to warehousing, can be automated.

4. Find in the text English equivalents to the following word-combinations.

1. ряд методов и технологий
2. продлевать период
3. оставаться полезным для здоровья
4. производить продукты с длительным сроком хранения
5. питательные вещества, необходимые для здоровья
6. сенсорные и питательные качества
7. предоставлять разнообразие в питании
8. классифицироваться в соответствии с чем-либо
9. современное оборудование пищевых производств
10. удобный для пользователя
11. полный контроль процесса производства
12. сокращать производственные затраты
13. давать возможность быстрой переналадки
14. улучшать качество товара

5. Here is a list of the food processing aims. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

1. Food processing ... unpalatable or unacceptable raw materials into attractive and desirable products.
2. Food processing ... the period during which food remains wholesome.
3. Food processing ... variety in the diet.
4. Food processing ... a range of attractive flavours, colours, aromas and textures in food.
5. Food processing ... the nutrients required for health.
6. Processing foods ... income for the manufacturing company.

to increase to transform to generate to extend to provide(x2)

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Food processing can transform unpalatable or unacceptable raw materials into attractive and desirable products.
2. The aim of the food processing is to shorten the period during which food remains wholesome.
3. Food processing provides a range of attractive flavours, colours, aromas and textures in food.
4. Food processing equipment is indispensable component of food processing.
5. All food processing equipment can be classified according to its size.
6. Mechanical transport equipment includes such pieces of equipment as crushers, mills, pulpers, grinders, disintegrators, attritors.
7. Heat transfer equipment is made up of such pieces of equipment as heat exchangers, ovens, fryers, heaters.
8. Mechanical processing equipment can be subdivided into three groups: size reduction equipment, homogenization equipment and mixing and forming equipment.
9. Microprocessors are rarely used to control food processing equipment.
10. Full scale control over manufacturing process helps reduce processing costs, enables rapid change-overs and improves product quality.

7. Answer the following questions.

1. What do you understand by the term food processing?
2. What does food processing deal with?
3. What are common food processing techniques?
4. What are the aims of food processing today?
5. Are these aims equally important in all food production?
6. What role does food processing equipment play in food processing?
7. On what basis can food processing equipment be classified?
8. What groups of food processing equipment can be distinguished? Bring the examples of the pieces of equipment constituting each group.

9. Today's food processing equipment offers possibility of full scale control over manufacturing process, doesn't it?

10. Is it possible to automate the entire food manufacturing process?

8. Speak on the following points.

1. Food processing, its necessity and aims.
2. The classification of food processing equipment.

Text B. MATERIAL SELECTION

1. Before reading the text learn the terms used in the text:

carbon steel – углеродистая сталь
stainless steel – нержавеющая сталь
plastics – пластмасса, пластик
acid – кислота
alkali – щёлочь
inhibitor – ингибитор (вещество, замедляющее химические реакции и биологические процессы)
passivity - пассивность (высокая коррозионная стойкость металла)
chromium – хром
alloy – сплав
welding characteristics – сварочные характеристики
grade of stainless steel – марка нержавеющей стали
surface finish – характер поверхности
abrasive wheel – шлифовальный круг
glass bead – стеклянная дробь

2. Read and translate the text.

MATERIAL SELECTION IN THE DESIGN OF FOOD PROCESSING EQUIPMENT

Food processing equipment includes equipment for all types of operations in the processing of foodstuffs (vegetables, fruits, nuts, meats, poultry, fish, dairy products, grains, cereals, bakery and confectionery products, beverages, and animal foods). Machinery and associated systems for most applications are designed of special materials for highly sanitary operation and ease of thorough cleaning.

As you walk through a typical food processing plant you can see equipment of varying ages, constructed of a myriad of materials, including carbon steel, aluminum, stainless steel and plastics.

Aluminum is a material used extensively for processing equipment. It has a very good strength to weight ratio and is highly resistant to corrosion. Aluminum is also resistant to many acids, but contact with alkalis causes corrosion. Although the metal can safely be used in the presence of certain mild alkalis, with the aid of inhibitors, direct contact with alkaline substances should be avoided. Aluminum is readily formed and welded, and due to its relative light weight it is considered more economical than stainless steel.

Steel is the most common material used in manufacturing. However, plain steel has a relatively weak passivity and, unprotected, it will continue to rust and corrode. Plain carbon steel can be augmented by alloying with chromium which has a very high tendency to passivate. When the chromium content of steel reaches 12 to 13 percent the passivity is so good the material will not corrode in ordinary atmospheres or in fresh water. Such alloys are generally called **stainless steel.** However, stainless steel is not stain or rust proof. Some stainless steels being produced have chromium as their sole alloying element but most stainless steels also contain significant amounts of other alloying elements. The purpose of these additives is to improve corrosion resistance of the steel or to increase its strength.

The two most common grades of stainless steel used in processing equipment are:

1. Type 304 - most common and versatile stainless steel. It has excellent forming and welding characteristics. It is readily brake or roll formed into a variety of parts for equipment. Type 304 has outstanding welding characteristics.

2. Type 316 - contains slightly more nickel and has a better resistance to corrosion than type 304, especially in chloride environments that tend to cause pitting. Type 316 is generally more expensive than type 304.

It is these properties that make stainless steel the preferred metal for fabricating processing equipment.

Stainless steels are also identified by their surface finishes which are produced by three basic methods:

1. Rolling between polished or textured rolls
2. Polishing or buffing with abrasive wheels or belts
3. Blasting with glass beads, which produces a uniform surface

Common stainless steel finishes found in food processing equipment are #2B, which is a smooth, dull finish and #4, which is a general purpose polished finish. Both these finishes are considered smooth. Smoothness is important - crevices provide places for bacteria to growth.

3. Answer the following questions according to the text.

1. What pieces of equipment does food processing equipment include?
2. Why is food processing machinery designed of special materials?
3. What equipment can you see as you walk through a typical food processing plant?
4. Is aluminum used extensively for the manufacturing of food processing equipment?
5. What properties does aluminum have?
6. Why is aluminum considered to be more economical than stainless steel?
7. What properties does steel have?
8. What is stainless steel made of?
9. What are the properties of grade 304 stainless steel?
10. What is the difference between grade 304 and grade 316 stainless steel?
11. What methods are used to produce different stainless steel surface finishes?

UNIT 3

Text A. FLOUR MILLING EQUIPMENT

1. **Before reading the text learn the terms used in the text.**

separator – сепаратор
aspirator – аспиратор
disk separator – дисковый триер
scourer – обоечная машинам
colour sorting machine – машина для сортирования по цвету
roller mill – вальцовый станок
sifter – рассев
degerminator – дегерминатор, отделитель зародыша (зерна)
middlings purifier – ситовеечная машина для дунстов и мелких крупок
reduction roller mill – размольный вальцовый станок

2. Match the phrases below with the appropriate Russian equivalents.

1. grading	a) отволаживание
2. purifying	b) помол
3. conditioning	c) сортирование, калибрование
4. grinding	d) посторонняя примесь
5. to pass through	e) помещать, размещать, класть
6. screen	f) высушенный в центрифуге
7. foreign matter	g) очистка
8. indentation	h) удалять, перемещать
9. to remove	i) вращаться
10. to place	j) регулировать, настраивать, подгонять
11. to revolve	k) просеиваться
12. spun dry	l) мяльный валик
13. bran	m) выемка; углубление; зазубрина;
14. to adjust	n) отделять, отсоединять
15. mate	o) парная деталь
16. spiral groove	p) добавлять
17. corrugated roller	q) отруби (твердая оболочка зерна)
18. breaking roller	r) винтовая канавка
19. to detach	s) рифленый валец
20. to add	t) решетка; сито

2. **Read and translate the text.**

FLOUR MILLING EQUIPMENT

Flour is a finely ground powder prepared from grain or other starchy plant foods and used in baking. Although most flour is made from wheat, it can also be made from barley, buckwheat, corn, oats, peanuts, potatoes, soybeans, rice, and rye.

Flour manufacture involves grading the wheat, purifying the wheat, conditioning the wheat, preparing the wheat for grinding, grinding the wheat, processing the flour.

1. Wheat is received at the flour mill and inspected. Samples of wheat are taken for physical and chemical analysis. The wheat is graded based on several factors, the most important of which is the protein content.

2. Before wheat can be ground into flour it must be free of foreign matter. This requires several different cleaning processes.

3. The first device used to purify wheat is known as a separator. This machine passes the wheat over a series of metal screens. The wheat and other small particles pass through the screen while large objects such as sticks and rocks are removed.

4. The wheat next passes through an aspirator. This device works like a vacuum cleaner. The aspirator sucks up foreign matter which is lighter than the wheat and removes it.

5. Other foreign objects are removed in various ways. A disk separator, moves the wheat over a series of disks with indentations that collect objects the size of a grain of wheat. Smaller or larger objects pass over the disks and are removed.

6. Other methods used to purify wheat include magnets to remove small pieces of metal, scourers to scrape off dirt and hair, and electronic colour sorting machines to remove material which is not the same colour as wheat.

7. The purified wheat is washed in warm water and placed in a centrifuge to be spun dry. During this process any remaining foreign matter is washed away.

8. The moisture content of the wheat must now be controlled to allow the outer layer of bran to be removed efficiently during grinding. This process is known as conditioning.

9. Cold conditioning involves soaking the wheat in cold water for one to three days. Warm conditioning involves soaking the wheat in water at a temperature of 46°C for 60-90 minutes and letting it rest for one day. Instead of water, wheat may also be conditioned with steam at various temperatures and pressures for various amounts of time.

10. Wheat of different grades and moistures is blended together to obtain a batch of wheat with the characteristics necessary to make the kind of flour being manufactured.

11. The clean, wetted grain is first ground on a series of roller mills (Fig.1) to remove the bran. A roller mill consists of two or more steel cylinders that revolve in opposite directions. One cylinder revolves at a slower speed than its mate. The grain passes through a space between the cylinders. The space can be adjusted to remove more or less material. Spiral grooves in the face of the cylinder allow the roller mill to act much like a giant shears, or scissors, cutting away the outer bran coat from the endosperm. The endosperm is also cut into chunks in these corrugated, or breaking, rollers. The grain must pass through five or more of these roller mills before the bran is completely removed. If degerminators are not used, the germ is detached by the breaking rolls.

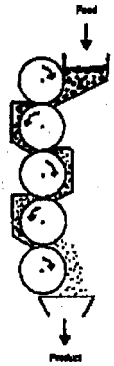


Fig. 1 roller mill

12. Between each roller mill passage, the ground grain is sifted. A sifter is a large rectangular box that rotates in a horizontal circle at high speeds. The sifter separates the ground grain into several products according to their size. The large-size material is sent to the next set of

breaking roller mills for further bran removal. The intermediate-size material, called middlings, is sent to purifiers. Flour is the finest product that is removed.

13. The middlings purifier is another sifter with a shaking motion. It moves the middlings over a vibrating screen. Air is blown up through the screen to remove the lighter pieces of bran. The purified middlings move to the reduction roller mills.

14. The reduction roller mills are similar to the breaking roller mills but have smooth surface cylinders. The reduction roller mills are adjusted to reduce the granular middlings gradually into white flour. After each reduction roller mill, the ground material goes to a sifter that removes the flour produced by that roller mill and sends the larger-size middlings to another set of reduction roller mills. It requires 13 or more separate reduction grinding and sifting operations before the middlings are reduced to flour. These sifters are made of metal wire when the flour is coarse, but are made of nylon or silk when the flour is fine. By separating and regrinding the flour, several different grades of flour are produced at the same time. These are combined as needed to produce the desired final products.

15. Small amounts of bleaching agents and oxidizing agents are usually added to the flour after milling. Vitamins and minerals can be added to produce enriched flour. The flour is matured for one or two months and then it is packed into bags.

4. Find in the text English equivalents to the following word-combinations.

1. сортировать по нескольким признакам
2. размалывать в муку
3. очищать пшеницу
4. просеивать через ряд металлических сит
5. собирать предметы размером с пшеничное зерно
6. помещать в центрифугу
7. смывать оставшиеся примеси
8. эффективно удалять
9. включать замачивание пшеницы
10. пшеница различных сортов
11. партия пшеницы с необходимыми свойствами
12. отделять отруби (наружную оболочку зерна)
13. вращаться в противоположных направлениях
14. пространство может быть отрегулировано
15. размалывать в крупную крупку
16. молотое зерно
17. разделять в соответствии с размером
18. изготавливаться из металлической проволоки
19. добавлять отбеливающее вещество
20. вызревать в течение 1-2 месяцев

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. A separator ... the wheat over a series of metal screens.
2. An aspirator ... foreign matter which is lighter than the wheat and removes it.

3. A disk separator moves the wheat over a series of disks with indentations that ... objects the size of a wheat grain.
4. Magnets ... small pieces of metal.
5. Scourers ... dirt.
6. A roller mill ... two steel cylinders that revolve in opposite directions.
7. Spiral grooves in the face of the cylinder ... the roller mill to act much like a giant shears.
8. The middlings purifier.... the middlings over a vibrating screen.
9. Middlings ... into flour by pairs of large, smooth metal rollers.
10. Sieves ... of nylon or silk when the flour is fine.

to suck up to consist of to pass to scrap off to collect
to grind to make to allow to move to remove

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Separators and aspirators are the devices used to grade wheat according to its size.
2. Aspirators work like a vacuum cleaner.
3. Electronic colour sorting machines remove material which is not the same colour as wheat.
4. The clean, wetted grain is first ground on a series of separators to remove the bran.
5. A roller mill consists of two or more steel cylinders that revolve in the same directions.
6. The space between roller mill cylinders is rigidly fixed.
7. A sifter is a large oval box that rotates in a horizontal circle at high speeds.
8. Air is blown up through the purifier screen to remove the lighter pieces of bran.
9. The reduction roller mills have corrugated surface cylinders.
10. A sifter removes the produced flour and sends the larger-size middlings to another set of reduction roller mills.

7. Answer the following questions.

1. What devices are used to purify wheat? How do they remove foreign matters from wheat?
2. What is conditioning?
3. What piece of equipment removes the bran?
4. What components does a roller mill consist of?
5. What component allows the roller mill to cut away the outer bran coat?
6. What is a sifter? What function does a sifter perform in flour milling?
7. What is a middling purifier? What tasks does it perform?
8. What device reduces the granular middlings gradually into white flour?
9. What is the design difference between reduction rollers and roller mills?
10. What materials can sifters be made of?

8. Speak on the following points.

1. The removal of foreign matters from wheat.
2. The devices used in flour milling.

Text B. SORTING EQUIPMENT

1. Before reading the text learn the terms used in the text:

sorting – калибрование (разделение на группы по форме и массе), сортирование (разделение на группы по качеству и степени зрелости)
disc sorter – дисковое калибровочное устройство
belt-and-roller sorter – валико-ленточное калибровочное устройство
size sorting – калибрование по размеру, сортирование по размеру
screen, sieve – сито, калибровочная рамка
aperture – отверстие, ячейка
fixed aperture – фиксированное отверстие
variable-aperture – регулируемое отверстие, отверстие переменного сечения
drum screen - барабанные калибрующая машина
mesh cylinder – калибрующий цилиндр с отверстиями
diverging roller – ступенчатый валик
cable – трос
felt-lined conveyor belt – обитый войлоком ленточный транспортер
image processing - обработка изображений
pre-programmed specifications- предварительно запрограммированный параметры
electronic template - электронный образец
programmable logic controller – программируемое логическое управляющее устройство
cell – фотоэлемент
voltage – электрический сигнал
electronically controlled air jet – воздушный эжектор с электронным управлением
chute - питающий лоток
lining material – материал облицовки
blast of compressed air – струя сжатого воздуха
weight sorting – калибровка по весу
slatted conveyor – конвейер с сетчатой лентой
counterbalanced arms - двуплечий рычаг (с чашечкой весов на одном плече и противовесом на другом)

2. Read and translate the text.

SORTING EQUIPMENT

Sorting is carried out on the basis of individual physical properties. It should be employed as early as possible to ensure a uniform product for subsequent processing. The four main physical properties used to sort foods are size, shape, weight and colour.

The shape of some foods is important in determining their suitability for processing. For example, for economical peeling, potatoes should have a uniform oval or round shape without protuberance. Shape sorting is accomplished either manually or mechanically (for example the belt-and-roller sorter, or the disc sorter) or by image processing.

Size sorting (termed *sieving* or *screening*) is the separation of solids into two or more fractions on the basis of differences in size. Screens with either fixed or variable apertures are used for size sorting. The screen may be stationary or, more commonly, rotating or vibrating.

Fixed aperture screens. Two common types of fixed aperture screen are the flat bed screen (or sieve) and the drum screen (rotary screen or reel). The multideck flat bed screen has a number of inclined or horizontal mesh screens, which have aperture sizes from 20 _m to 125 mm, stacked inside a vibrating frame. Food particles that are smaller than the screen apertures pass through under gravity until they reach a screen with an aperture size that retains them. These types of screen are widely used for sorting dry foods, for example, flour, sugar and spices.

Drum screen are used for sorting small-particulate foods (for example nuts, peas or beans) that have sufficient mechanical strength to withstand the tumbling action inside the screen. Drum screens are almost horizontal (5–10° inclination), perforated metal or mesh cylinders. They may be concentric (one inside another), parallel (foods leave one screen and enter the next).

Variable-aperture screens have either a continuously diverging aperture or a stepwise increase in aperture. Both types handle foods more gently than drum screens and are therefore used to sort fruits and other foods that are easily damaged. Continuously variable screens employ pairs of diverging rollers, cables or felt-lined conveyor belts. These may be driven at different speeds to rotate the food and thus to align it. Stepwise increases in aperture are produced by adjusting the gap between rollers and an inclined conveyor belt.

Image processing is used to sort foods on the basis of length, diameter, number of surface defects and orientation of the food on a conveyor as well as colour. It has been used for example with maize cobs, which pass beneath three video cameras, placed 120° apart above a conveyor belt. The images of the surface of the cob are recorded and stored in the memory of a microprocessor. The information is then analysed and compared with pre-programmed specifications for the product, and the cob is either rejected or moved into a group with similar characteristics. In another system a video camera views foods and an operator compares the shapes with an electronic template overlaid on a monitor screen.

Colour sorting. Machine vision sorting systems include monochrome (black and white), bichrome (4100 shades of red and green) and full colour (262 000 shades of red, green and blue, with optional infrared). Each is controlled by a programmable logic controller which has pre-set programs for different products that are easily changeable by operators. They are used for example, to sort potatoes for defects by identifying dark areas on the potato surface. Light sensitive cells in the camera (termed 'pixels') produce a voltage that is proportional to the intensity of light received. An electronic circuit that receives a lower voltage than the pre-set value can thus detect darker objects or areas which reflect less light than normal. The voltage produced in the electronic circuit can be adjusted to alter the sensitivity of detection. Up to 10 tonnes of product per hour pass beneath the cameras on conveyors operating at 150–180 m per min. Defective items are removed by electronically controlled air jets.

Small-particulate foods may be sorted using microprocessor controlled colour sorting equipment. Particles are fed into the chute one at a time. The angle, shape and lining material of the chute are altered to control the velocity of the pieces as they pass a photodetector. Photodetectors measure the reflected colour of each piece and compare it with pre-set standards. Defective foods are separated by a short blast of compressed air. The computer can store 100 named product configurations to enable rapid changeover to different products. Typical applications include peanuts, rice, diced carrot, maize kernels, cereals, snackfoods and small fruits.

Weight sorting is more accurate than other methods and is therefore used for more valuable foods (for example eggs, cut meats and some tropical fruits). Eggs are sorted into six to nine categories with a tolerance of 0.5 g. A weight sorter consists of a slatted conveyor which transports the eggs above a series of counterbalanced arms. The conveyor operates intermittently and while stationary, the arms raise and weigh the eggs. Heavy eggs are discharged into a padded chute and lighter eggs are replaced on the conveyor to travel to the next weigher.

3. Answer the following questions.

1. On what basis is sorting carried out?
2. What types of screens are utilized for size sorting? What is the basic difference between them?
3. What are the elements of image processing system?
4. How are defective items detected by a colour sorting machine?
5. What foods may be sorted using microprocessor controlled colour sorting equipment?
6. What function does a photodetector perform?
7. What components does a weight sorter consist of? How does it operate?

UNIT 4.

Text A. BREAD MAKING EQUIPMENT

1. Before reading the text learn the terms used in the text.

dough mixer – тестомесильная машина
enclosed drum – барабан закрытого типа
arm – лопасть тестомесильной машины
divider – тестоделительная машина
divider hopper – воронка тестоделительной машины
conveyer belt – лента конвейера, транспортерная лента
rounder – округлительная машина
molding machine (molder)– формовочная машина
canvas belt – полотняная лента транспортера
compressed board – прижимная плита
prover – расстойный шкаф
panning device –устройство для укладывания тестовых заготовок в хлебопекарные формы
compressed air-operated device – устройство с пневматическим приводом
tunnel oven – туннельная печь
baking chamber – пекарная камера
vertical serrated blade – вертикальный рифленый нож
slicing machine – ломтерезальная машина
wrapping machine – упаковочная машина; обёрточная машина

4. **Match the phrases below with the appropriate Russian equivalents.**

1. kneading	a) упаковка, завертывание
2. slicing	b) рассчитывать по времени
3. wrapping	c) обороты, вращения
4. to weigh	d) бродить, ферментировать
5. to monitor	e) валок, вращающийся цилиндр
6. to time	f) подавать по трубам
7. to pipe	g) пласт, тестовая лента
8. yeast	h) закатывать (тесто)
9. revolutions	i) раскатывать тесто
10. to ferment	j) контролировать, наблюдать
11. dough	k) дежа (передвижная чаша)
12. rotating blade	l) дрожжи
13. to shape	m) тестовая заготовка размером с буханку хлеб
14. trough	n) спиральный желоб
15. loaf-size piece	o) взвешивать
16. spiral track	p) вращающийся нож
17. to flatten the dough	q) придавать форму
18. sheet	r) нарезание на ломти
19. roller	s) замешивание (теста)
20. to curl (the dough)	t) тесто

5. **Read and translate the text.**

BREAD MAKING EQUIPMENT

Bread is an excellent source of low-fat, complex carbohydrates. Bread is made of three basic ingredients: grain, water, and baker's yeast.

Commercial bakeries have machines that do the work of measuring, mixing, kneading, baking, slicing, and wrapping. Skilled bakers run the machines, and nothing is left to chance. The ingredients are weighed precisely, the temperature and humidity are closely monitored, and the individual steps of the baking process are carefully timed.

After sifting, the flour is fed into a scale that automatically weighs the right amount and pours it into an industrial mixer on the floor below. Temperature-controlled water is piped into the mixer. This mixture is called "gluten" and gives bread its elasticity. A pre-measured amount of yeast is added. Depending on the type of bread to be made, other ingredients are also poured into the mixer.

The usual dough mixer is an enclosed drum that rotates at speeds from 35 to 75 revolutions per minute. Inside the drum, mechanical arms, oriented parallel to the body of the mixer, stretch and knead the dough to the desired consistency in a matter of seconds. The mixing process takes about 12 minutes.

Three methods are used to ferment the dough. In some plants, the high-speed machinery is designed to manipulate the dough at extreme speeds and with great force, which forces the yeast cells to rapidly multiply. Fermentation can also be induced by the addition of chemical additives and vitamin C. Some bread is allowed to ferment naturally. In this instance, the dough is placed in covered metal bowls and stored in a temperature-controlled room until it rises.

After the dough has fermented, the filled trough containing the dough is moved to the divider area or to the floor above the divider. The dough is dropped into the divider hopper, which cuts it into loaf-size pieces with rotating blades. A conveyer belt then moves the pieces of dough to the rounder.

Dough pieces leaving the divider are irregular in shape, with sticky cut surfaces from which the gas can readily diffuse. Their gluten structure is unsuitable for molding. The rounder closes these cut surfaces, giving each dough piece a smooth and dry exterior; shapes the dough into a ball for easier handling in subsequent steps. It performs these functions by rolling the well-floured dough piece around the surface of a drum or cone, moving it upward or downward along this surface by means of a spiral track.

A conveyer belt then moves the pieces of dough to a molding machine. The first function of it is to flatten the dough into a thick sheet, usually by means of two or more consecutive pairs of rollers, each succeeding pair is set more closely together than the preceding pair. The sheeted dough is curled into a loose cylinder by a special set of rolls or by a pair of canvas belts. The dough cylinder is not adherent upon leaving the curling section, and the next operation of the molder is to seal the dough piece. The conventional molder rolls the dough cylinder between a large drum and a smooth-surfaced semicircular compression board. Clearance between the drum and board is gradually reduced, and the dough, constantly in contact with both surfaces, becomes transversely compressed.

The molding machine drops the dough onto a layered conveyer belt that is enclosed in a warm, humid cabinet called a "prover." The dough moves slowly through the prover so that it may "rest," and so that the gas reproduction may progress.

When the dough emerges from the prover, it is conveyed to a second molding machine which re-shapes the dough into loaves and drops them into pans. An automatic panning device is an integral part of most modern molders. As empty pans, carried on a conveyor, pass the end of the machine, the loaves are transferred from the molder and positioned in the pans by a compressed air-operated device.

The pans travel to another prover that is set at a high temperature and with a high level of humidity. Here the dough regains the elasticity lost during fermentation and the resting period.

From the prover, the pans enter a tunnel oven, consisting of a metal belt passing through a connected series of baking chambers open only at the ends. The temperature and speed are carefully calculated so that when the loaves emerge from the tunnel, they are completely baked and partially cooled. While inside the tunnel, the loaves are mechanically dumped from the pans onto shelves. The baking and cooling process lasts approximately 30 minutes.

The bread continues to cool as it moves from the oven to the slicing machine. Here vertical serrated blades move up and down at great speeds, slicing the bread into consistently sized pieces.

Metal plates hold the slices together while picking up each loaf and passing it to the wrapping machine. Pre-printed plastic bags are mechanically slipped over each loaf. At some bakeries, workers close the bags with wire twists. Other plants seal the bags with heat.

6. Find in the text English equivalents to the following word-combinations.

1. управлять оборудованием
2. засыпать в промышленный миксер
3. вращаться со скоростью 35-75 оборотов в минуту
4. лопасти, размещенные параллельно корпуса миксера
5. занимать 12 минут
6. заквашивать тесто
7. храниться в комнате с регулируемой температурой
8. резать с помощью вращающихся ножей
9. перемещать заготовки к округлительной машине
10. выполнять функцию
11. следующие друг за другом пары валков
12. закатывать в неплотный цилиндр
13. при выходе из закаточной секции
14. обычная формовочная машина
15. зазор между барабаном и (прижимной) плитой
16. перемещать ко второй формовочной машине
17. помещать в хлебопекарные формы с помощью устройства с пневматическим приводом
18. попадать в туннельную печь
19. появляться из туннеля
20. запаивать (пакет) с помощью нагрева

7. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. A scale automatically ... the right amount of flour.
2. Inside the mixer, mechanical arms ... the dough to the desired consistency.
3. The mixing process ... about 12 minutes.
4. The divider ... the dough into loaf-size pieces with rotating blades.
5. A conveyer belt ... the pieces of dough to the rounder.
6. The rounder ... each dough piece a smooth and dry exterior.
7. A molding machine ... the dough into a thick sheet.
8. The sheeted dough ... into a loose cylinder by a special set of rolls.
9. The second molding machine ... the dough into loaves and drops them into pans.
10. A tunnel oven ... a metal belt passing through a connected series of baking chambers.

to weigh	to move	to flatten	to take	to give
to consist of	to cut	to knead	to curl	to re-shape

11. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Bread is made of three basic ingredients: grain, water, and baker's yeast.
2. A molding machine stretches and kneads the dough to the desired consistency.
3. In some plants, the high-speed machinery is used to manipulate the dough at extreme speeds and with great force to make the yeast cells rapidly multiply.

4. After the dough has fermented, the filled trough containing the dough is moved to the divider area.

5. A rounder shapes the dough into a ball using mechanical arms.

6. The dough is flattened into a thick sheet by means of two or more consecutive pairs of rollers.

7. A prover is a humid cabinet where the dough may "rest".

8. A tunnel oven consists of a canvas belt passing through a connected series of baking chambers.

9. A slicing machine cuts the bread into consistently sized pieces.

10. A wrapping machine slips pre-printed plastic bags over each loaf.

12. Answer the following questions.

1. What work is performed by machines in commercial bakeries?
2. What components does the usual dough mixer consist of?
3. What methods are used to ferment the dough?
4. What function does a divider perform?
5. What machine closes sticky cut surfaces of a dough piece?
6. What are the functions of a molding machine?
7. Where does the dough regain its elasticity lost during fermentation and the resting period?
8. What is a tunnel oven?
9. What function does a slicing machine perform?
10. What machine wraps each loaf mechanically?

13. Speak on the following point.

1. The pieces of equipment used in bread manufacturing.

Text B. OVENS

1. Before reading the text learn the terms used in the text:

oven - печь
heat transfer – теплообмен, теплоотдача
mass transfer – массообмен, массопередача
direct heating oven – печь непосредственного нагрева
indirect heating oven – печь косвенного нагрева
infrared oven – электропечь инфракрасного нагрева
pre-programmed control – управление по заданной программе
ribbon burner – ленточная горелка
pressure-relief panel – панель сброса давления
heating plate/ heating bar – нагревательная плита/нагревательный стержень
heater element – нагревательный элемент
oven band - лента пода (конвейерной хлебопекарной печи)
infrared oven – электропечь инфракрасного нагрева
hearth – под (печи)
peel oven - печь с посадкой тестовых заготовок лопатой

multi-deck oven – многоярусная печь
rotary-hearth oven – печь с вращающимся подом
reel oven – конвейерная люлечная печь
multi-cycle tray oven – люлечная печь циклического действия
damper – заслонка, вентиляционное отверстие
exhaust flue – отвод паров

2. **Read and translate the text.**

OVENS

Baking involves simultaneous heat and mass transfer; heat is transferred into the food from hot surfaces and air in the oven and moisture is transferred from the food to air that surrounds it and then removed from the oven. In an oven, heat is supplied to the surface of the food by a combination of infrared radiation from the oven walls, by convection from circulating air and by conduction through the pan or tray on which the food is placed. Infrared radiation is absorbed into the food and converted to heat.

There are four main types of ovens: direct heating, indirect heating, electric and infrared ovens. Nearly all of the oven designs now incorporate advanced energy saving features and microprocessor controls. Pre-programmed baking controls enable operators to select a product code without the need to remember baking settings. Microprocessor control of the sequence, duration, temperature and humidity of baking prevents operator error and the use of incorrect baking conditions.

Direct heating oven. In direct heating ovens, the heaters are inside the baking chamber. Air and the products of combustion are recirculated by natural convection or by fans. The temperature in the oven is controlled automatically, by adjustment of air and fuel flow rates to the burners. Natural gas is commonly used, but propane, butane, fuel oil or solid fuels are also found. Gas is burned in ribbon burners located above and below conveyor belts in continuous ovens, and at the base of the cabinet in batch ovens. Safety features are incorporated to extinguish the burners automatically if abnormal baking conditions arise, and pressure-relief panels are fitted to the top of the ovens to protect personnel should a gas explosion occur.

However, care is necessary to prevent contamination of the food by undesirable products of combustion, and gas burners require regular servicing to maintain combustion efficiency. Microwave and dielectric ovens are another example of direct heating ovens.

Indirect heating oven. In indirect heating ovens, the products of combustion do not enter the baking chamber. The air in the baking chamber is heated via a heat-exchanger, by steam or by burning a fuel. The air is typically recirculated through the baking chamber and the heat-exchanger. Other methods include passing the combustion gases through radiator tubes in the baking chamber, or burning the fuel between a double wall whilst exhausting the combustion gases from the top of the oven.

Electric ovens are heated by induction heating plates or bars. Heater elements are arranged above or below the oven band. Electric ovens are the easiest type of oven to control.

Infrared ovens consist of infrared lamps that put maximum energy in the area where materials are placed. The air temperature in the oven increases from 240 to 350 °C as the product travels through the oven on a conveyor belt. These ovens are designed for high energy efficiency to save power and fuel cost. Infrared ovens allow combining ambient air with the hot air for increased drying speed.

All oven types can be batch or continuous in operation. In batch ovens, the walls and the base are heated. In continuous ovens, radiators are located above, alongside and below the conveyor belt. Most ovens have 25mm thick ceramic tiles fitted to the hearth to promote even heat distribution.

Batch ovens. In the peel oven, food is loaded into a baking chamber, either on trays or singly, by means of a long-handled shovel (a peel) which gives its name to the oven. More recent designs include the multi-deck oven which is widely used for baking goods, meat and confectionery products. Some designs have a 'modular' construction to allow expansion of production by duplication of modules, without having to replace the entire plant. The main disadvantages of batch ovens are higher labour costs and lack of uniformity in baking times, caused by the delay in loading and unloading.

Continuous and semi-continuous ovens. Rotary-hearth ovens, reel ovens and multi-cycle tray ovens all circulate the food through the oven on trays, and loading and unloading take place though the same door. The operation is semi-continuous when the oven must be stopped to remove the food. The movement of food through the oven, with or without fans to circulate the air, ensures more uniform heating.

Tunnel ovens consist of a metal tunnel (up to 120m long and 1.5m wide) through which food is conveyed either on steel plates or on a solid, perforated or woven metal belt. The oven is divided into heating zones and the temperature and humidity are controlled independently in each zone by heaters and dampers. These retain or remove moisture by adjusting the proportions of fresh and recirculated air in the oven. Vapour (and in direct heating ovens, the products of combustion) are extracted separately from each zone. Many designs are equipped with heat recovery systems. Microprocessor control of the belt speed, heater output and position of dampers automatically adjusts the baking conditions in each zone, to produce foods of a predetermined colour or moisture content. Microprocessors also provide management information of production rates, energy efficiency and maintenance requirements. Some ovens are fitted with programmable cycles in which temperature and time of heating, relative humidity, cooling time and air speed are programmed independently for each of 20 or more products. This allows rapid changes to baking conditions and a high degree of flexibility for different types of product.

Tray ovens have a similar design to tunnel ovens but have metal trays permanently fixed to a chain conveyor. Each tray holds several baking pans and is pulled through the oven in one direction, then lowered onto a second rack, returned through the oven and unloaded.

Despite the high capital cost and large floor area, these ovens are widely used for large-scale baking. The main advantages are their high capacity, accuracy of control over baking conditions and low labour costs owing to automatic loading and unloading. In both tunnel and tray ovens, heat exchangers are fitted with the exhaust flues to remove heat from the exhaust gases and to heat fresh or recirculated air.

3. Answer the following questions.

1. How is heat supplied to the surface of the food in an oven?
2. What are the main types of ovens?
3. What is the difference between direct heating ovens and indirect heating ovens?
4. What fuel can be used to heat direct heating ovens?
5. How is an electric oven heated?

6. What is the working principle of an infrared oven?
7. What is the difference between batch and continuous ovens?
8. What parts does a tunnel oven consist of?
9. What are the functions of a microprocessor in a tunnel oven?
10. What is the difference between tunnel ovens and tray ovens?
11. What ovens are widely used for large-scale baking? Why?

UNIT 5.

Text A. PASTA MANUFACTURING EQUIPMENT

1. Before reading the text learn the terms used in the text:

silo – бункер, силос, зерновой элеватор
laminator – машина для слоения теста
vacuum chamber – вакуумная камера
mixing machine – смеситель, миксер
steamer – пропариватель
extruder – экструдер
die – матрица, формующая головка
extrusion screw – прессующий шнек
extrusion barrel – шнековая камера
uniform pitch – постоянный шаг
water cooling jacket – рубашка с водяным охлаждением
Teflon coated insert - вставка с тефлоновым покрытием
continuous drying chamber – камера сушки непрерывного действия
screen conveyer – конвейер с сетчатой лентой
slat conveyer – пластинчатый конвейер
belt – конвейерная лента, настил конвейера
vent with damper – вентиляционное отверстие с задвижкой
hot press – пресс для горячего прессования

2. Match the phrases below with the appropriate Russian equivalents.

1. manufacturing equipment	a) хранить
2. extrusion	b) открывать, выставлять, подвергать воздействию
3. to store	c) перекачивать по трубопроводу
4. to pipe	d) месить, замешивать
5. to equip	e) спрессовывать в ленту
6. to knead	f) производственное оборудование
7. to press into sheet	g) готовый продукт, конечный продукт
8. to remove air bubbles	h) уменьшать трение
9. to feed into an extruder	i) экструзия, выдавливание
10. to expose	j) шнек с острой кромкой витков

11. the rate of production
12. finished product
13. dimensions
14. sharp-edged screw
15. to reduce friction
16. to dissipate the heat
17. to fit a screw into an extrusion barrel
18. to extend the life
19. to manage using sensors
20. packaging station

k) оборудовать, оснащать
l) рассеивать тепло
m) удалять пузырьки воздуха
n) устанавливать шнек в шнековую камеру
o) загружать в экструдер
p) производительность
q) управлять, используя сенсоры
r) размеры
s) упаковочная станция, упаковочный узел
t) увеличивать срок службы

3. Read and translate the text.

PASTA MANUFACTURING EQUIPMENT

Although pasta products were first introduced in Italy in the 13th century, efficient manufacturing equipment and high-quality ingredients have been available only since the 20th century.

Prior to the industrial revolution, most pasta products were made by hand in small shops. Today, most pasta is manufactured by continuous, high capacity extruders, which operate on the screw extrusion principle in which kneading and extrusion are performed in a single operation. The manufacture of pasta includes dry macaroni, noodle, and spaghetti production.

Pasta is made from a mixture of water and semolina flour. Semolina is a coarse-ground flour from the heart of durum wheat, an amber-colored high protein hard wheat that is grown specifically for the manufacture of pasta. With a lower starch content and a higher protein content than all-purpose flours, semolina flour is easily digested.

Pasta manufacture involves mixing and kneading, flavouring and colouring, rolling, pasteurization, cutting, drying, and packaging.

1. The semolina is stored in giant silos that can hold up to 68,100 kg. Pipes move the flour to a mixing machine equipped with rotating blades. Warm water is also piped into the mixing machine. The mixture is kneaded to a lumpy consistency.

2. Eggs are added to the mixture if the product is an egg noodle. If pasta is to be a flavored variety, vegetable juices are added here. A tomato or beet mixture is added for red pasta, spinach for green pasta, carrots for orange pasta. Herbs and spices can also be folded in for additional flavoring.

3. The mixture moves to a laminator where it is pressed into sheets by large cylinders. A vacuum mixer-machine further flattens the dough. Most modern pasta presses are equipped with a vacuum chamber to remove air bubbles from the pasta before extruding. If the air is not removed prior to extruding, small bubbles will form in the pasta which diminish the mechanical strength and give the finished product a white, chalky appearance.

4. The roll of dough moves through a steamer, which heats the dough to 104ºC in order to kill any existing bacteria.

5. Depending on the type of noodle to be produced, the dough is either cut or pushed through dies. Ribbon and string-style pasta are cut by rotating blades. To make tube or shell-shaped pasta, the dough is fed into an extruder.

6. Upon entering the extruder, the dough contacts the extrusion screw first. The screw is exposed so that the dough can be dropped directly from the mixer onto the screw as it turns. Afterwards, the dough is conveyed from the screw into the extrusion barrel to be compacted. The extrusion screw not only forces the dough through the die, but it also kneads the dough into a homogeneous mass, controls the rate of production, and influences the overall quality of the finished product. Although construction and dimension of extrusion screws vary by equipment manufacturers, most modern presses have sharp-edged screws that have a uniform pitch over their entire length. The screw fits into a grooved extrusion barrel, which helps the dough move forward and reduces friction between the screw and the inside of the barrel. Extrusion barrels are equipped with a water cooling jacket to dissipate the heat generated during the extrusion process. The cooling jacket also helps to maintain a constant extrusion temperature, which should be approximately 51°C. If the dough is too hot (above 74°C), the pasta will be damaged.

7. Uniform flow rate of the dough through the extruder is also crucial. Variances in the flow rate of the dough through the die can cause the pasta to be extruded at different rates. Products of non-uniform size must be discarded or reprocessed, which adds to the unit cost of the product.

8. The inside surface of the die also influences the product appearance. Until recently, most dies were made of bronze, which was relatively soft and required repair or periodic replacement. Recently, dies have been improved by fitting the extruding surface of the die with Teflon coated inserts to extend the life of the dies and improve the quality of the pasta.

9. Proper drying is critical in the pasta-making process. Pasta is dried slowly as it travels through a continuous drying chamber for 3 to 10 hours, depending on the pasta shape.

Due to the length of the product, lines employ two different methods for handling pasta. Once extruded, long goods pasta, such as spaghetti, is spread across a horizontally oriented stick so the product hangs vertically. The dryer conveys the stick of pasta through the drying chamber. Short goods pasta, such as penne, is placed on long horizontal conveyors that permit air flow by using, for example, belts with screens or slats.

Air circulation, heat and humidity are critical factors to the pasta drying process. These are carefully managed using sensors and computer controls. Fans circulate air through the dryer and baffles direct air flow.

Vents with dampers regulate air flow from inside the dryer to the outside in order to exchange humid air with fresh air. This exchange of air rids the dryer of the moisture removed from the drying pasta.

Once dried, the pasta has 12% moisture content. It's then cooled and is ready to package.

10. Fresh pasta is folded in pre-measured amounts into clear plastic containers. As the containers move along a conveyer belt, a plastic sheet covers each container and is sealed with a hot press. At the same time, a small tube sucks the air of the container and replaces it with a mixture of carbon dioxide and nitrogen to prolong the product's shelf-life. Labels listing the type of noodle, nutritional information, cooking instructions, and expiration date are attached to the top of the containers. Dried pasta is loaded, either manually or by machine, into stainless steel buckets which move along a conveyer belt to the appropriate packaging station.

4. Find in the text English equivalents to the following word-combinations.

1. производить с помощью высокопроизводительных экструдеров непрерывного действия
2. осуществлять замешивание и экструзию за одну операцию
3. миксер, оснащенный вращающимися ножами
4. подавать по трубам в миксер
5. спрессовываться с помощью больших цилиндров
6. уменьшать механическую прочность
7. продавливать через матрицу
8. транспортировать в шнековую камеру
9. контролировать скорость производства
10. поддерживать постоянную температуру
11. влиять на внешний вид продукции
12. требовать периодической замены
13. улучшать качество
14. процесс производства макарон
15. оснащать вставками с тефлоновым покрытием
16. продлевать срок службы матрицы
17. двигаться внутри камеры непрерывной сушки
18. позволять потоку воздуха проникать
19. запечатывать с помощью горячего пресса
20. перемещаться к упаковочному узлу

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. Prior to the industrial revolution, most pasta products ... by hand in small shops.
2. Today, most pasta ... by continuous, high capacity extruders.
3. Extruders ... on the screw extrusion principle.
4. Extruders ... kneading and extrusion in a single operation.
5. Pipes ... the flour to a mixing machine equipped with rotating blades.
6. The mixture ... into sheets by large cylinders.
7. A steamer ... the dough to 104°C in order to kill any existing bacteria.
8. The extrusion screw ... the dough through the die.
9. The dryer ... the stick of pasta through the drying chamber.
10. Pasta ... slowly as it travels through a continuous drying chamber for 3 to 10 hours.

to operate	to press	to move	to manufacture	to force
to heat	to make	to convey	to perform	to dry

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Today, most pasta is manufactured by continuous, high capacity extruders.
2. Warm water is piped into the extruder barrel.
3. Most modern pasta presses are equipped with a vacuum chamber to saturate the dough with air bubbles before extrusion.

4. Upon entering the extruder, the dough contacts the extrusion screw first.
5. Sharp-edged blades force the dough through the die.
6. Most modern presses have sharp-edged screws that have a uniform pitch over their entire length.
7. Grooves in the surface of the extrusion barrel reduce friction between the screw and the inside of the barrel.
8. Air circulation, heat and humidity are thoroughly controlled during the pasta drying process.
9. Short goods pasta is spread across a horizontally oriented stick for drying.
10. Fresh pasta is folded in pre-measured amounts into clear plastic containers.

7. **Answer the following questions.**
1. What pieces of equipment are used nowadays to produce most pasta products?
2. What ingredients is pasta made of?
3. What processes does pasta manufacture include?
4. How do the necessary ingredients get to a mixing machine?
5. What function does a laminator perform?
6. What components does an extruder consist of?
7. How does an extruder operate?
8. What device helps to maintain a constant extrusion temperature?
9. Where does the process of pasta drying take place?
10. How is pasta packed?

8. Speak on the following points.
1. Pasta extrusion.
2. Pasta drying methods.
3. Pasta packing.

Text B. MIXING EQUIPMENT

1. **Before reading the text learn the terms used in the text:**

ribbon blender - ленточный смеситель
trough – месильная емкость, дежа
agitator – месильная лопасть, мешалка, смеситель
charge port – загрузочное отверстие
spray nozzle (= spraying nozzle) – распылительная насадка (сопло)
spray bar – форсуночная стойка
paddle mixer – смеситель с лопастной мешалкой
tip speed – скорость лопасти
shaft – вал, ось, шпиндель
high-shear mixer – смеситель с большими сдвиговыми усилиями
rotor/stator assembly – ротор/статор в сборе
multi-shaft mixer – многовальный смеситель
anchor – якорь (смесителя)
planetary mixer – планетарный миксер

2. **Read and translate the text.**

MIXING EQUIPMENT

At the heart of transforming raw ingredients into food for human consumption is the mixing operation. One of its main tasks is to establish consistency. At-home cooks and process engineers alike know the importance of proper mixing. Even with the right amount of ingredients and flavors, a great recipe will not transform into good food unless the components are well-mixed.

The selection of a correct type and size of mixer depends on the type and amount of food being mixed and the speed of operation needed to achieve the required degree of mixing with minimum energy consumption. There is a large variety of mixers available, due to the large number of mixing applications and the empirical nature of mixer design and development.

The ribbon blender is well-proven equipment popularly used in the food and beverage industries. A ribbon blender consists of a U-shaped horizontal trough and an agitator made up of helical ribbons that are pitched to move material axially in opposite directions, as well as radially. The ribbons rotate up to tip speeds of approximately 300 ft/min.

This blender design is very efficient and cost-effective for mixing dry applications such as cake and muffin mixes, flour, bread improvers, cereals, snack bars, spices, tea (leaves or iced tea powders), coffee (whole or ground beans), and other beverage blends including chocolate drinks, powdered juices, energy drinks, etc.

When dry blending food products, relatively small amounts of liquid may be added to the solids in order to coat or absorb coloring, flavoring, oils or other additive solutions. Liquid ingredients can be added through a charge port on the cover but for critical applications, liquid addition is best accomplished through the use of spray nozzles installed in a spray bar located just above the ribbon agitator.

Paddle mixers are specially designed to scoop, lift and tumble materials in a gentle, but thorough mixing action. While being mixed, the material travels in a three dimensional "figure 8" pattern. The material is constantly being pulled from the ends of the mixer to the middle of the "figure 8" where the most aggressive mixing is taking place. This unique paddle design is ideal for mixing solids or liquids of various particle size, density and viscosity. Paddle mixers work effectively when filled to as little as 20% of rated capacity, thus allowing flexibility of batch sizes. Paddle style agitators allow easier access for cleaning between batches.

Paddle mixer consists of several elements: a centrally mounted horizontal shaft that rotates within a cylindrical container, paddles, and mixing elements that are attached to the centrally mounted shaft, special openings at the top for feeding materials. These mixers are utilized for blending dry material, powdery granular, moist solids and liquids together with pasty substances up to and including highly viscous masses.

High-shear mixers utilize a rotor/stator assembly which generates intense shear necessary to puree solid ingredients in the preparation of dressings, sauces and pastes. This type of device is also used in the food industry for the production of syrup solutions, beverage emulsions and dispersions.

High-shear mixers are comprised of a rotor that turns at high speed within a stationary stator. As the rotating blades pass each opening in the stator, they mechanically shear particles and droplets, and expel material at high velocity into the surrounding mix, creating hydraulic shear. As fast as material is expelled, more is drawn into the rotor/stator generator, which promotes continuous flow and fast mixing.

Multi-shaft Mixers are used in the food industry for batching medium to high viscosity applications such as candy syrups, beverages, sauces, pastes, peanut butter, and other spreads.

This type of mixing system is comprised of two or more independently-driven agitators working in tandem. A low-speed anchor compliments high shear devices. Hence, for higher viscosities, there is a need for a supplemental agitator to improve bulk flow, deliver material to the high-speed devices and constantly remove product from the vessel walls for better heat transfer.

The most common low-speed agitator designs are the two-wing and three-wing anchor. For added efficiency, especially in terms of axial flow, a three-wing anchor can be modified to feature helical flights in between wings.

Planetary mixers are commonly used for high-viscosity liquids mixing in both industrial and domestic applications, and take their name from the path followed by rotating blades.

In a planetary mixer, two or more blades rotate on their own axes while orbiting on a common axis. The agitators continually advance into the batch and contact fresh product all the time.

The classic double planetary mixer is a relatively low speed device; it relies on a product's viscosity to impart shear as two identical blades move through the batch and push materials against the vessel surfaces and between the blades.

3. Use the information given in the text to compete the table.

mixing equipment		
mixer/blender type	parts	application range
ribbon blender		
paddle mixer		
high-shear mixer		
multi-shaft mixer		
planetary mixer		

UNIT 6.

Text A. MILK PASTEURIZATION EQUIPMENT

1. Before reading the text learn the terms used in the text:

HTST system – высокотемпературная кратковременная система
vat pasteurizer – ванна длительной пастеризации
jacketed vat - ванна с теплозащитной рубашкой
heating coil – обогревательный змеевик, нагревательная спираль, нагревательный элемент
tank –бак; цистерна, резервуар
holding period – время выдержки
tubular/plate heater – трубчатый/пластинчатый нагреватель
gasket – прокладка, набивка, уплотнение
plate heat exchanger – пластинчатый теплообменник

heating medium – теплоноситель
storage tank – накопительная емкость, резервуар для хранения
hose – гибкий трубопровод, гибкая труба
clarifier – кларификатор, осветлитель
separator – сепаратор
cone-shaped disc – конусовидный диск
bowl – резервуар
standardizing clarifier – кларификатор для регулирования состава
balance tank - емкость с постоянным уровнем, емкость с поплавком регулятором
float valve – поплавковый клапан
regenerator – регенератор, рекуператор
heat exchange section – секция теплообменника
positive displacement pump – нагнетательный насос, объемный насос
stainless steel plate – пластина из нержавеющей стали
timing pump – синхронизирующий насос
homogenizer – гомогенизатор
piston pump – поршневой насос
adjustable valve – регулируемый клапан
heater – нагреватель
holding tube – трубчатый выдерживатель
regenerative cooler – рекуперативный охладитель
flow diversion valve – клапан возврата, вентиль отвода потока
recorder-controller sensor – датчик регистратора -регулятора
coolant – хладоноситель

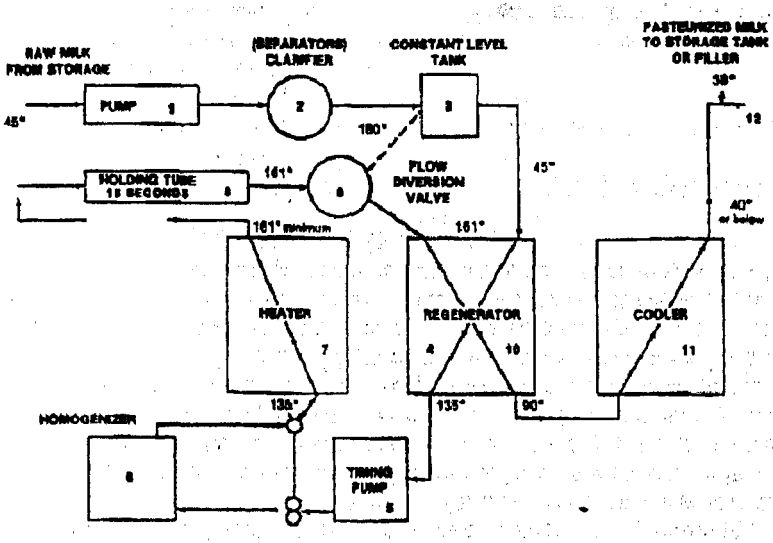


Fig. 1Milk flow through a HTST pasteurizer

2. Match the phrases below with the appropriate Russian equivalents.

1. to pump into raw milk storage tank	a) регулировать поток молока
2. processing step	b) осаждаться на внутренние стенки
3. tank with agitation	c) быть оборудованным чем-либо
4. to have several advantages	d) технологическая операция, технологический этап
5. time and energy saving	e) проходить через кларификатор
6. to pass through a clarifier	f) центробежная сила
7. to remove debris	g) в противоположном направлении
8. centrifugal force	h) закачивать в накопительную емкость для сырого молока
9. discs enclosed within the bowl	i) подогреваться до 57°C
10. to deposit on the inside walls	j) проталкивать через отверстие
11. to separate the heavier milk fat from the lighter milk	k) чан с мешалкой
12. to be equipped with smth	l) диски, помещенные в резервуар
13. to maintain a constant supply	m) удалять мусор
14. to be heated to 57°C	n) поддерживать постоянную подачу
15. in a counter direction	o) обладать несколькими преимуществами
16. to be cooled	p) экономия времени и энергии
17. to regulate the flow of milk	q) уменьшать температуру
18. to force through a passage	r) охлаждаться
19. surface friction	s) отделять более тяжелый молочный жир от более легкого молока
20. to reduce the temperature	t) поверхностное трение

3. Read and translate the text.

MILK PASTEURIZATION EQUIPMENT

1. **Raw Milk Storage.** Raw milk is received at the milk processing plant at a temperature 7°C or less and pumped into raw milk storage tanks through flexible stainless steel or plastic hoses. This raw milk must be maintained at 7°C or less until processed. The steps in processing raw milk will vary at different processing plants and the type of equipment used will also cause a variation in the processing steps. Raw milk that is to be packaged as whole milk is normally clarified, homogenized, pasteurized, and cooled prior to packaging. The sequence of these steps is not always in the same order. If the batch (vat) pasteurizer is used, the raw milk may be clarified and homogenized prior to pasteurization. These steps may also be accomplished after the milk is pasteurized.

2. **Vat pasteurizer.** The batch method uses a vat pasteurizer, which consists of a jacketed vat surrounded by either circulating water, steam, or heating coils of water or steam. The vat is

typically a conical-bottom, enclosed dome-top tank with agitation. In the vat the milk is heated and held throughout the holding period while being agitated. The milk may be cooled in the vat or removed hot after the holding time is completed for every particle. As a modification, the milk may be partially heated in a tubular or plate heater before entering the vat. steam, or heating coils of water or steam

3. **HTST.** The continuous process method has several advantages over the vat method, the most important being time and energy saving. For most continuous processing, a high temperature short time (HTST) plate pasteurizer is used. The heat treatment is accomplished using a plate heat exchanger. This piece of equipment consists of a stack of corrugated (for greater strength, improved fluid flow, and increased surface area) stainless steel plates clamped together in a frame. There are several flow patterns that can be designed. Gaskets are used to define the boundaries of the channels and to prevent leakage. The heating medium is typically hot water, preheated by steam. Modern units can process up to 200,000 L/h.

4. **Clarifier.** The cold raw milk passes through either a clarifier or a separator. A clarifier removes debris, some bacteria, and any sediment that may be present in the raw milk. It operates on the principle of centrifugal force. It consists of a bowl and a series of cone-shaped discs enclosed within the bowl. As the bowl revolves at several thousand revolutions per minute, the foreign matter, being heavier than the milk, is deposited on the inside walls of the clarifier bowl in the form of slime. A separator performs the same task, but also separates the heavier milk fat from the lighter milk to produce both cream and skim milk.

5. Some milk plants often use a standardizing clarifier. This piece of equipment can be used as a clarifier, separator and standardizer. Cream may be separated from whole milk, leaving skim milk. When the butterfat percent of milk is higher than desired, the milk may be standardized (the fat percent adjusted by adding skim milk) to the desired fat percent.

6. **Balance or Float Tank.** From the raw milk storage tank, the milk is pumped into a balance or float tank. The balance tank is equipped with a float valve that keeps the milk at a constant level and maintains a constant supply for the pasteurizer, as well as for other steps in processing.

7. **Regenerator (Heat Exchange Section).** From the balance tank, the cold raw milk is drawn into the regenerator section of the HTST by a positive displacement pump. The pump is located at the exit of the regenerator section. In the regenerator section, the cold raw milk is heated to approximately 57°C by hot pasteurized milk flowing in a counter direction on the opposite sides of the thin stainless steel plates. The hot pasteurized milk is also cooled to approximately 32°C by the raw milk. The pressure on the pasteurized side of the regenerator is always greater than the pressure on the raw milk side, which eliminates the possibility of contaminating the pasteurized milk with raw milk if flaws or leaks develop in the plates and gaskets.

8. **Timing Pump.** The positive displacement pump draws the raw milk out of the regenerator section and pumps it under pressure through the rest of the HTST pasteurization system. The timing pump regulates the flow of milk through the final heater, holding tube, regenerative cooler, and final cooler.The pump must be regulated and controlled so that it will take 15 seconds for every particle of milk to flow through the holding tube of the HTST pasteurizer.

9. **Homogenizer.** It is a common practice to connect the homogenizer between the timing pump and the final heating section of the HTST. (The clarifier may also be installed after the homogenizer and prior to the milk being pumped into the final heater.) The homogenizer con-

sists of a three-cylinder positive displacement piston pump and the homogenizing valve. Ca pacities may be in the range of 20,000 L/hr. Operating pressures are approximately 12-16MPa. In the homogenizer, the fat globules of the milk are reduced in size as the milk is forced between small openings under pressure. The breaking up of the fat globules allows them to be evenly distributed throughout the milk and prevents the formation of a cream layer.

10. **Final Heater.** From the homogenizer, the milk is pumped through the heater section of the HTST pasteurizer. The milk, already preheated in the regenerator section, passes over stainless steel plates where it is heated by hot water or steam on the opposite side of the plates to a temperature of at least 72ºC.

11. **Holding Tube.** From the final heater, the milk flows through the holding tube where it is "held" for at least 15 seconds. The "holding time" shall be taken to mean flow time of the fastest particle of milk, at or above 72ºC, throughout the holding tube section. The maximum velocity of the milk through the holding tube is governed by the speed of the timing pump, the diameter and length of the holding tube, and surface friction.

12. **Flow Diversion Valve.** After the milk flows through the holding tube, it passes the recorder-controller sensor. The recorder-controller sensor regulates the forward or diverted flow position of the flow-diversion valve. If milk passing the recorder-controller sensor is 72ºC or higher, the flow-diversion valve assumes a forward-flow position and the milk flows forward into the pasteurized section of the regenerator. If the milk is less than 72ºC when it passes the recorder-controller sensor, the flow-diversion valve assumes a diverted-flow position and the inadequately heated milk is diverted back into the raw milk balance tank.

13. **Regenerator (Cooling Section).** Properly heated milk flows through the flow-diversion valve into the pasteurized side of the regenerator section of the HTST. In the regenerator section, the pasteurized milk is cooled to approximately 32ºC by incoming cold raw milk on the opposite side of the stainless steel plates. The warm pasteurized milk then passes through the cooling section of the HTST, where a coolant, on the opposite side of stainless steel plates, reduces the temperature to 4ºC or below. The cold pasteurized milk then passes to a storage tank to await packaging.

4. **Find in the text English equivalents to the following word-combinations.**

1. закачивать через гибкие трубы из нержавеющей стали
2. резервуар закрытого типа с куполообразной крышкой
3. термообработка
4. пакет гофрированных пластин из нержавеющей стали
5. устанавливать границы канала (для протока жидкости)
6. предотвращать протечку
7. конусообразные диски, помещенные в резервуар
8. несколько тысяч оборотов в минуту
9. поддерживать постоянную подачу (молока)
10. избегать возможности загрязнения
11. трехцилиндровый нагнетательный поршневой насос
12. гомогенизирующий клапан
13. рабочее давление
14. выдерживаться в течение 15 секунд
15. регулироваться скоростью насоса

16. положение клапана на выход/возврат (молока)
17. принимать положение
18. отводить молоко обратно в накопительную емкость для сырого молока
19. дожидаться упаковки

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. Raw milk ... into raw milk storage tanks through flexible stainless steel or plastic hoses.
2. A vat pasteurizer ... a jacketed vat surrounded by either circulating water, steam, or heating coils of water or steam.
3. Gaskets ... the boundaries of the channels and prevent leakage.
4. In a HTST plate pasteurizer, a stack of corrugated stainless steel plates ... together in a frame.
5. Modern HTST plate pasteurizers ... up to 200,000 L/h.
6. A clarifier ... debris, some bacteria, and any sediment that may be present in the raw milk.
7. The bowl of the clarifier ... at several thousand revolutions per minute.
8. The balance tank ... a float valve that keeps the milk at a constant level.
9. In the homogenizer, the milk ... between small openings under pressure.
10. If the milk is less than 72°C, the flow-diversion valve ... a diverted-flow position.

to process	to remove	to consist of	to force	to clamp
to assume	to pump	to revolve	to define	to equip with

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. For most continuous processing, HTST plate pasteurizers are used.
2. In a HTST plate pasteurizer, the heat treatment is accomplished using a clarifier.
3. A clarifier consists of a bowl and a series of cone-shaped discs enclosed within the bowl.
4. In the regenerator section, the cold raw milk is heated by hot pasteurized milk flowing in a counter direction on the opposite sides of the thin stainless steel plates.
5. The pressure on the pasteurized side of the regenerator is always lower than the pressure on the raw milk side.
6. The pump must be regulated so that it will take 45 seconds for every particle of milk to flow through the holding tube of the HTST pasteurizer.
7. The homogenizer consists of a three-cylinder positive displacement piston pump and the homogenizing valve.
8. In a final heater, the milk is heated by hot water or steam on the opposite side of the stainless steel plates.
9. The recorder-controller sensor regulates the speed of a timing pump.
10. In the cooling section of the HTST, a coolant on the opposite side of stainless steel plates reduces the temperature to 4°C or below.

7.Answer the following questions.

1. What processing steps are followed to pasteurize raw milk?
2. What elements does a vat pasteurizer consist of?
3. What pasteurizer is used for most continuous processing? What elements is it made up of?
4. What functions does a clarifier perform?
5. What part of a balance tank keeps the milk at a constant level and maintains a constant supply for the pasteurizer?
6. How is milk heated in the regenerator section of the HTST?
7. What function is performed by a timing pump?
8. What elements does a homogenizer consist of?
9. How does a flow-diversion valve operate?
10. Where is the temperature of the milk reduced to 4°C or below?

8. Speak on the following points.

1. Pasteurization methods.
2. The pieces of equipment used for continuous pasteurization.

Text B. HEAT EXCHANGERS

1. Before reading the text learn the terms used in the text:

tubular heat exchanger – трубчатый теплообменник
continuous flow heat exchanger – теплообменник непрерывного действия
spacing gasket – распорная прокладка
jacketed pan – котел с паровой/водяной рубашкой
agitator – мешалка, лопасть смесителя
cast iron – чугун
scraping blade – скребковое лезвие
swept-surface heat exchanger – скребковый теплообменник

2. Read and translate the text.

HEAT EXCHANGERS

Food and beverages are heat treated for several reasons, among which the most frequent and important is to inactivate microbial population and therefore stabilize and prolong shelf life. Heat transfer has to be rapid and effective, in order to avoid as much as possible any damage to qualities of food, and also to save time and cut down fuelling costs. In a heat exchanger, thermal energy is transferred from one solid or fluid to another solid or fluid.

Tubular heat exchanger. If one or both of the materials that are exchanging heat are fluids, flowing continuously through the equipment and acquiring/giving up heat, the process is very efficient, and these equipments are called "continuous flow heat exchangers". This equipment is often employed to pasteurize milk or other beverages, and the heat exchanging fluid is almost exclusively water or water steam. One of the fluids is usually passed through pipes or tubes, and the other fluid is passed round or across these.

The fluids can flow in the same direction through the equipment (parallel flow) or in opposite directions (counter flow), or they can also flow at right angles to each other (cross flow). Vari-

ous combinations of these directions of flow can occur in different parts of the exchanger. In fact, most heat exchangers of this type have a mixed flow pattern. In parallel flow, the maximal temperature difference between the coldest and the hottest stream is at the entry to the heat exchanger, but at the exit the two streams approach each other's temperature. In a counter flow exchanger, leaving streams can approach the temperatures of the entering stream of the other component and so counter flow exchangers are often preferred. To further improve heat exchange efficiency, the surface of the tubes can be "corrugated", to extend the available surface and also to provoke dynamic turbulence in the fluids, improving thermal exchange up to 90% (especially in the case of low viscosity fluids). These equipments can be used also to cool down beverages.

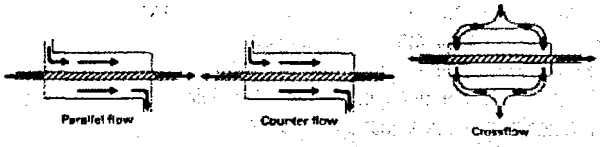


Figure 1 – Examples of fluid flow directions through heat exchangers

Plate heat exchanger. Another popular heat exchanger for fluids of low viscosity, such as milk, is the plate heat exchanger, where heating and cooling fluids flow through alternate tortuous passages between vertical plates as illustrated in figure 2. The plates are clamped together, separated by spacing gaskets, and the heating and cooling fluids are arranged so that they flow between alternate plates. Suitable gaskets and channels control the flow and allow parallel or counter current flow in any desired number of passes. A substantial advantage of this type of heat exchanger is that it offers a large transfer surface that is readily accessible for cleaning: in fact the banks of plates are usually arranged so that they may be taken apart easily.

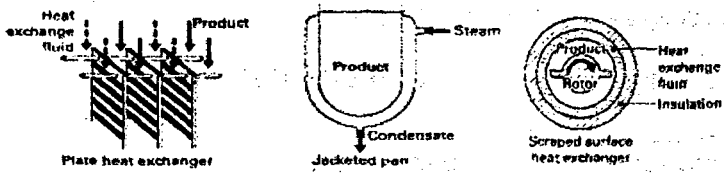


Figure 2 – Different types of heat exchangers

Jacketed pan. In this kind of heat exchanger, the fluid (liquid food up to paste consistence food can be treated with this equipment) to be heated is contained in a vessel, which may also be provided with an agitator to keep the fluid moving across the heat transfer surface, to assure its homogeneous heating. Where there is no agitation, heat transfer coefficients are lower or even halved. The source of heat is commonly steam condensing in the vessel jacket: there must be the minimum of air within the steam in the jacket, because air hinders heat exchange. The pan itself can be made of cast iron, stainless steel, or copper. Heat transfer coefficients are not very high: depending on the pan material and on the viscosity of the fluid to be heated.

Scraped surface heat exchanger. Another kind of heat exchanger consists of a jacketed cylinder with an internal cylinder concentric to the first one, and fitted with scraping blades. The blades rotate, causing the fluid to flow through the space between the cylinders with the outer

heat transfer surface constantly scraped: the scraping blades continuously remove the food from the walls, keeping it mixed and allowing optimal heat exchange. This equipment finds considerable use particularly for products of higher viscosity, and can be also used to drive away heat from the food (e.g. freezing of ice creams and cooling of fats during margarine manufacture). Scraped surface exchangers can also be used to process foods sensitive to heat and/or to mechanical stress.

3. **Answer the following questions.**

1. Why are food and beverages heat treated? What processing equipment is used for this purpose?
2. What are the basic components of a tubular heat exchanger?
3. Where are tubular heat exchangers employed?
4. What are the possible patterns of fluid flow in a tubular heat exchanger?
5. Why is the surface of the tubes "corrugated" in tubular heat exchangers?
6. What is the design of a plate heat exchanger?
7. What is a substantial advantage of plate heat exchangers?
8. Where is the fluid to be heated contained in a jacketed pan? What are the components of a jacketed pan?
9. What materials are used to make jacketed pans?
10. What components does a scraped heat exchanger consist of?
11. What is the function of scraping blades in a scraped heat exchanger?
12. What products are processed using scraped heat exchangers?

UNIT 7.

Text A. ICE CREAM MANUFACTURING EQUIPMENT

1. **Before reading the text learn the terms used in the text:**

unit operation – типовой процесс
mix aging – созревание смеси
metering pump – дозирующий насос, дозатор непрерывного действия для жидкостей
metering tank – порционный резервуар
load cell – датчик загрузки
high-shear blender – смеситель с большими сдвиговыми усилиями
centrifugal pump – центробежный насос
refrigerated storage tank – охлаждаемый резервуар-хранилище
continuous freezer – морозильный аппарат непрерывного действия
refrigerant – хладагент, охлаждающее средство
dasher – взбивающий механизм фризера, било
ingredient feeder – загрузочный дозатор для сырьевых ингредиентов
hopper – загрузочная воронка, приемный желоб
dosing screw – шнек-дозатор
feeding pump – подающий насос, питающий насос
shaker table – вибростенд

blast freezer – скороморозильный аппарат (с интенсивным движением воздуха)
freezing tunnel – туннельный морозильный аппарат
plate freezer – плиточный морозильный аппарат

2. Match the phrases below with the appropriate Russian equivalents.

1. blending of ingredients	1. гомогенизирующий клапан
2. to be equipped with something	2. кристаллизация
3. pumping system	3. снабженный рубашкой, заключенный в кожух
4. high temperature short time heat exchanger	4. питающий резервуар
5. feed tank	5. время созревания
6. solubilization	6. воздушный насос
7. two stage homogenizer	7. закаливание
8. homogenizer valve	8. быть оборудованным чем-либо
9. crystal nucleation	9. система накачки
10. aging time	10. смешение ингредиентов
11. freezing	11. растворение, солюбилизация
12. air incorporation	12. быть заполненным на треть
13. to be filled one-third	13. пастеризатор для высокотемпературной кратковременной пастеризации
14. jacketed	14. двухступенчатый гомогенизатор
15. air pump	15. интенсивность замораживания
16. compressed air	16. насыщение воздухом
17. high-pressure pump	17. сжатый воздух
18. hardening	18. наполнитель в виде кусочков(орехов, печенья и т.д.)
19. freezing rate	19. насос высокого давления
20. particulate ingredient	20. фризерование

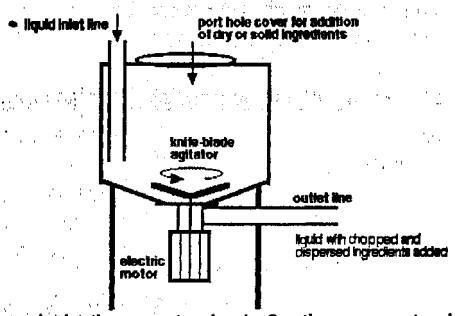
3. Read and translate the text.

ICE CREAM MANUFACTURING EQUIPMENT

Ice cream manufacturing process can be divided into two distinct stages, mix manufacture and freezing operations. Ice cream mix manufacture consists of the following unit operations: combination and blending of ingredients, batch or continuous pasteurization, homogenization, and mix aging.

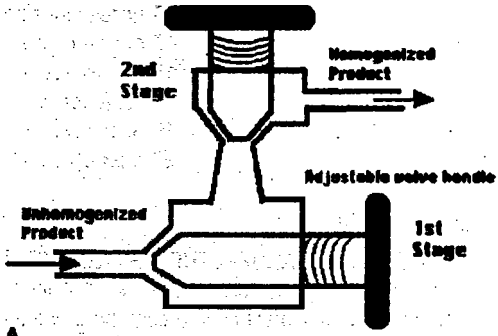
Blending. Ingredients are usually preblended prior to pasteurization, regardless of the type of pasteurization system used. Blending of ingredients is relatively simple if all ingredients are in the liquid form, as automated metering pumps or tanks on load cells can be used. When dry ingredients are used, powders are added through either a pumping system under high velocity or through a high-shear blender (liquifier), a small chamber with rotating knife blades that chop all ingredients as they are mixed with the liquid passing though the chamber via a large centrifugal pump.

High shear blender for incorporating dry ingredients into ice cream mix.



Pasteurization. The mix is then pasteurized. Continuous pasteurization is usually performed in a high temperature short time (HTST) heat exchanger following blending of ingredients in a large, insulated feed tank. Some preheating, to 30°C or 40°C, is necessary for solubilization of the components. The HTST system is equipped with a heating section, a cooling section, and a regeneration section. Cooling sections of ice cream mix HTST presses are usually larger than milk HTST presses.

Homogenization. The mix is also homogenized. Homogenizers of the common type consist of a high-pressure pump that forces the liquid through a narrow opening, the so-called homogenizer valve Two-stage homogenization is usually preferred for ice cream mix. Homogenization of the mix should take place at the pasteurizing temperature. If a two stage homogenizer is used, a pressure of 2000 - 2500psi on the first stage and 500 - 1000psi on the second stage should be satisfactory under most conditions.



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Ageing. The mix is then aged for at least four hours and usually overnight. Aging is performed in insulated or refrigerated storage tanks, silos, etc. Mix temperature should be maintained as low as possible without freezing, at or below 5°C. An aging time of overnight is likely to give best results under average plant conditions.

Freezing. Ice cream freezing also consists of two distinct stages: (1) passing the mix through a swept-surface heat exchanger under high shear conditions to promote extensive ice crystal nucleation and air incorporation; and (2) freezing the packaged ice cream under conditions that promote rapid freezing and small ice crystal sizes.

Ice cream mix can be frozen in batch or continuous freezers and the conditions used will depend on the type of a freezer. Batch freezers consist of a rotating barrel that is usually filled one-third to one-half full with ice cream mix. As the barrel turns, the air in the barrel is incorporated into the Ice cream mix.

Continuous freezers dominate the ice cream industry. Modern freezers are available with capacities up to 4,000 L/h. Continuous freezers consist of a fixed barrel that has blades inside that constantly scrape the surface of freezing barrel. The ice cream mix is drawn from the flavoring tank into a swept surface heat exchanger, which is jacketed with a liquid, boiling refrigerant (usually ammonia in larger scale freezers).

Incorporation of air into ice cream is a necessity to produce desirable body and texture. Modern continuous freezers contain an air-pump, which injects filtered compressed air into the mix during the freezing phase. Rotating knife blades and dashers keep the product agitated and prevent freezing on the side of the barrel.

Flavoring and colouring. Flavoring and colouring can be added to the mix prior to passing through the barrel freezer, and particulate flavoring ingredients, such as nuts, fruits, candy pieces, or sauces can be added to the semi-frozen product at the exit from the barrel freezer prior to packaging and hardening.

Centrifugal pumps are employed to pump sauces through a nozzle into semi-frozen ice cream. Ingredient feeders are designed for controlled injection of a wide range of particulate ingredients into a continuous flow of ice cream. A conventional fruit feeder consists of three main units each separately driven: a hopper with dosing screw and an agitator, a feed pump and in-line mixer. The ingredients are fed into the hopper, where they are kept in constant motion by the agitator. The agitator ensures a constant supply of ingredients to the dosing screw mounted at the bottom of the hopper. Ingredients are moved to the feeding pump that gently incorporates the ingredients into the continuous flow of ice cream. The flow of particulates can be tied automatically to the flow rate of ice cream from the continuous freezer. For larger particulates (e.g., candy or bakery pieces), a shaker table can be used, rather than a hopper with screw configuration, to prevent break-up of the delicate particulate ingredients.

Hardening. After the particulates have been added, the ice cream is packaged and is placed into a blast freezer at -30° to -40°C where most of the remainder of the water is frozen. Freezing rate must still be rapid, so freezing techniques involve low temperature (-40°C) with either enhanced convection (freezing tunnels with forced air fans) or enhanced conduction (plate freezers).

4. **Find in the text English equivalents to the following word-combinations.**

1. технологический процесс производства мороженого
2. состоять из следующих технологических операций
3. дозирующий насос с весовым датчиком
4. цилиндр с вращающимися лезвиями ножей
5. проводить пастеризацию
6. выталкивать жидкость через узкое отверстие
7. температура должна поддерживаться
8. способствовать кристаллизации
9. замораживаться во фризере непрерывного действия
10. вращающийся цилиндр

11. чистить поверхность цилиндра фризера
12. подаваться в скребковый теплообменник
13. теплообменник, снабженный рубашкой с хладагентом
14. впрыскивать очищенный сжатый воздух
15. предотвращать намерзание на стенках цилиндра
16. наполнители подаются в загрузочную воронку
17. обеспечивать постоянную подачу наполнителей
18. шнек-дозатор, установленный на дне загрузочной воронки
19. помещаться в скороморозильный аппарат с интенсивным движением воздуха
20. технология замораживания

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. Ice cream mix manufacture ... the following unit operations: combination and blending of ingredients, batch or continuous pasteurization, homogenization, and mix aging.
2. A high-shear blender (liquifier) ... a small chamber with rotating knife blades that chop all ingredients as they are mixed with the liquid passing though the chamber via a large centrifugal pump.
3. The HTST system ... with a heating section, a cooling section, and a regeneration section.
4. Homogenizers ... the liquid through a narrow opening, the so-called homogenizer valve.
5. Aging ... in insulated or refrigerated storage tanks, silos, etc.
6. Modern continuous freezers ... an air pump, which injects filtered compressed air into the mix.
7. Rotating knife blades and dashers ... freezing on the side of the barrel.
8. Centrifugal pumps .... to pump sauces through a nozzle into semi-frozen ice cream.
9. Ingredient feeders ... for controlled injection of a wide range of particulate ingredients into a continuous flow of ice cream.
10. After the particulates have been added, the ice cream ... into a blast freezer at -30° to -40°C.

to force	to equip	to perform	to be	to prevent
to employ	to design	to consist of	to contain	to place

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. A high-shear blender (liquifier) is a small chamber with rotating knife blades that chop all ingredients as they are mixed with the liquid passing though the chamber via a large centrifugal pump.
2. The HTST system is equipped with a high-shear blender.
3. Homogenizers of the common type are equipped with a high-pressure pump that forces the liquid through a narrow opening, the so-called homogenizer valve.
4. Batch freezers consist of a fixed barrel that is usually filled one-third to one-half full with ice cream mix.
5. Continuous freezers consist of a barrel that has blades inside that constantly scrape the surface of a freezing barrel.

6. In modern continuous freezers, rotating knife blades and dashers keep the product agitated.
7. A conventional fruit feeder is employed to pump sauces into semi-frozen ice cream.
8. A conventional fruit feeder consists of three main units: a hopper, an agitator and an air pump.
9. The feeding pump gently incorporates the ingredients into the continuous flow of ice cream.
10. After the particulates have been added, the ice cream is packaged.

7. Answer the following questions.

1. What stages can ice cream manufacture be divided into?
2. What main components does a high-shear blender consist of?
3. What piece of equipment is used for the pasteurization of ice cream mix?
4. What is a homogenizer? How does it operate?
5. Where is the aging of ice cream mix performed?
6. What pieces of equipment are used to freeze ice cream mix?
7. What piece of equipment pumps sauces into semi-frozen ice cream?
8. What is a conventional fruit feeder? What components does it consist of?
9. Where is ice cream placed after its packaging?
10. What techniques are used for rapid freezing?

8. Speak on the following point.

1. The equipment used in ice cream manufacturing.

Text B. FREEZING EQUIPMENT

1. Before reading the text learn the terms used in the text:

plate freezer – плиточный морозильный аппарат
blast freezer – скороморозильный аппарат
belt freezer – конвейерный морозильный аппарат
fluidized-bed freezer – флюидизационный морозильный аппарат
cryogenic freezer – криогенный морозильный аппарат
spacer – ограничительная пластина, распорная деталь
refrigerant – хладагент
heat transfer rate – интенсивность теплопередачи
scraped surface freezer – скребковый морозильный аппарат
scraper – скребок
mesh conveyor belt – сетчатая конвейерная лента
spray head – головка с распыливающими наконечниками

2. Read and translate the text.

FREEZING EQUIPMENT

Lowering the temperature below the freezing point of the product stops microorganisms from growing and reduces the activity of enzymes. Industrial freezers remove heat from the surface of a food as rapidly as possible. There are several types of industrial freezers, including plate freezers, blast freezers, belt freezers, fluidized-bed freezers, and cryogenic freezers.

Plate Freezer. A plate freezer consists of a vertical or horizontal stack of hollow plates, through which refrigerant is pumped at -40°C. Food blocks are placed between the plates which are then moved together hydraulically and a slight pressure is exerted on the food to be frozen. Spacers, fractionally smaller than the food, may be inserted to prevent the food from being crushed. Plate freezers can be double-plate or multi-plate arrangements. These plates are arranged in an insulated cabinet. The plate freezer is a very efficient method of freezing food with relatively high rates of heat transfer but the technique is inevitably limited to flat foods and packs of relatively shallow dimension.

Blast Freezer. Air blast tunnel freezer consists of an insulated tunnel in which the cooling air is recirculated over food at between -30°C and -40°C. The product to be frozen is placed on trolleys, hooks, or conveyors. The air, cooled by indirect contact with a refrigerant in a heat exchanger, is blown over the food surface by fans or blowers. The simplest form of blast freezer is a batch-operated cabinet freezer in which the food to be frozen is placed on trays which are then wheeled into the cabinet on trolleys. The cabinet is designed to move air evenly at equal velocity over all the surfaces to be frozen and trolleys and trays are designed to offer the same resistance to air flow no matter which path the air takes through the freezer. For this reason the freezer must always be used at full capacity.

In a continuous air blast freezer the food travels on a conveyor belt through a tunnel in which there is a counter-current flow of cold air. The residence time in the freezer is made equal to the required freezing time.

The great advantage of the blast freezer is its ability to accommodate foods of all shapes and sizes; in this respect it is far more versatile than the plate freezer. However, the freezing time will be relatively long.

Belt freezer. These freezers consist of a continuous stainless steel or plastic belt moving in an insulated room. Belt freezers can be straight belt types or spiral belt types. Products either in solid or liquid form can be frozen in this type of freezer. In the case of solid foods, perforated belts are generally used and air can be forced upward through the belt. The upward movement of air can partially lift the product, giving high heat transfer rates and free flowing nature to the frozen product. Air velocities in the range of 1–6 m/s are generally used in these systems.

In a spiral belt freezer, a continuous conveyor belt moves around a cylindrical drum, for up to 50 rounds. These systems require more space when compared to straight belt systems. Air flow can be upward or downward through the spirals. As it accommodates a long conveyor belt, this arrangement gives longer product residence times. This type of arrangement is well suited for products requiring longer freezing times, packaged products, and larger-size products.

Scraped Surface Freezer. This type of freezer is mainly used for liquid and semisolid foods with or without particulates.

It consists of two concentric cylinders, the outer one being insulated to prevent heat gain from the surroundings. The cooling medium flows in the space between the two cylinders, whereas the food is contained in the inner cylinder. A scraper rotates inside the inner cylinder to scrape the frozen product layer from the freezer surface. This keeps the metal surface clean and gives high heat transfer coefficients. Scraped surface freezers can be operated in batch

mode or continuous mode. The product is frozen rapidly and the fast freezing gives a large number of small ice crystals in the product. This type of freezer is extensively used in the ice cream manufacturing industry.

Fluidized-bed freezer. These freezers are used to freeze particulate foods such as peas, cut corn, diced carrots, and strawberries. The foods are placed on a mesh conveyor belt and moved through a freezing zone in which cold air is directed upward through the mesh belt and the food particulates begin to tumble and float. This tumbling exposes all sides of the food to the cold air and minimizes the resistance to heat transfer at the surface of the food.

Cryogenic freezer. Cryogenic freezing came into existence in the 1960s with the introduction of cryogens such as liquid nitrogen and carbon dioxide. A variety of equipment configurations are available. The simplest is the batch cabinet freezer in which liquid nitrogen is injected into a high-velocity gas stream circulating in the insulated cabinet. The food to be frozen is placed in trays which fit onto a trolley rather in the manner of a tray drier.

In a tunnel freezer food is conveyed on a mesh belt through an insulated tunnel. The food passes through a region in which cold nitrogen gas circulates at a high velocity before being conveyed to the spray heads, where liquid nitrogen is sprayed directly onto the food surface. Fish, meat, poultry, fruit, vegetables and bakery products can all be frozen in this way.

Particulate foods such as diced meat or vegetables are best processed in a rotary cryogenic freezer. This consists of a long hollow drum which is inclined horizontally to aid the flow of material through the device. Food falls through a curtain of nitrogen vapour and liquid nitrogen resulting in an IQF (Individual Quick Frozen) product. Such equipment may be up to 1.5 m in diameter and 10 m in length.

3. **Answer the following questions.**

1. What is the working principle of industrial freezers?
2. What types of industrial freezers are described in the text?
3. What piece of freezing equipment typically uses a vertical or horizontal stack of hollow plates, through which refrigerant is pumped at -40°C?
4. What is the role of spacers in plate freezers?
5. The technique used in plate freezers is limited to flat foods and packs of relatively shallow dimension, isn't it?
6. What is a blast freezer? Can you describe the process of freezing in a blast freezer?
7. What is the great advantage of a blast freezer?
8. What is a belt freezer? How does it work?
9. What are the possible types of belt freezers?
10. What components does a scraped surface freezer consist of?
11. What is the application range of fluidized-bed freezers?
12. Can you describe the process of freezing in a tunnel cryogenic freezer?
13. What foods can be frozen in a tunnel cryogenic freezer?
14. What foods are best processed in a rotary cryogenic freezer? What components does it consist of?

UNIT 8.

Text A. BUTTER MANUFACTURING EQUIPMENT

1. Before reading the text learn the terms used in the text:

skim milk – снятое молоко, обезжиренное молоко
disk – тарелка (сепаратора-сливкоотделителя)
distribution hole – распределительное отверстие
churn – маслоизготовитель, маслобойка
plate heat exchanger – пластинчатый теплообменник
rotary agitator – ротационная мешалка
continuous butter-making machine – маслоизготовитель непрерывного действия
beater – лопасть (мешалки), било
variable speed motor – двигатель с переменной частотой вращения
sieve – решето, сито
worker – маслообразователь, рабочая секция (маслоизготовителя)
screw – шнек
perforated plate - перфорированная пластина
strand – непрерывная заготовка
kneading – перемешивание, сбивание (масла)
positive pump – нагнетательный насос

2. Match the phrases below with the appropriate Russian equivalents.

1. churning	a) центробежная сила
2. working	b) ось вращения
3. milk pasteurizer	c) ванна созревания
4. centrifugal force	d) сбивание
5. to move inwards/outwards	e) бак, чан, ванна
6. the axis of rotation	f) масляное зерно
7. storage tank	g) пахта
8. aging tank	h) обработка, текстурирование
9. tub	i) состав масла
10. revolution	j) выдавливать, выпрессовывать
11. butter grain	k) пастеризатор молока
12. buttermilk	l) регулировать, приводить в соответствие
13. to drain off	m) двигаться внутрь/наружу
14. to adjust	n) бак-хранилище, бак-резервуар
15. butter composition	o) оборот, вращение
16. shelf life	p) валец
17. to squeeze	q) мелкая фасовка
18. roller	r) спускать, сливать
19. retail package	s) срок годности

3. **Read and translate the text.**

BUTTER MANUFACTURING EQUIPMENT

Butter is generally made from cream by churning and working. Cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer.

If the cream is separated by the butter manufacturer, the whole milk is preheated to the required temperature in a milk pasteurizer before being passed through a separator. Centrifuges can be used to separate the cream from the skim milk. The centrifuge consists of up to 120 discs stacked together at a 45 to 60 degree angle and separated by a 0.4 to 2.0 mm gap or separation channel. Milk is introduced at the outer edge of the disc stack. The stack of discs has vertically aligned distribution holes into which the milk is introduced. Under the influence of centrifugal force the fat globules (cream), which are less dense than the skim milk, move inwards through the separation channels toward the axis of rotation. The skim milk will move outwards and leaves through a separate outlet.

The cream is cooled and led to a storage tank where the fat content is analyzed and adjusted to the desired value, if necessary.

From the intermediate storage tanks, the cream goes to pasteurization at a temperature of 95oC or more. The high temperature is needed to destroy enzymes and micro-organisms that would impair the keeping quality of the butter.

If *ripening* is desired for the production of cultured butter, mixed cultures of lactic-acid bacteria are used and the cream is ripened to pH 5.5 at 21oC and then pH 4.6 at 13oC. Most flavour development occurs between pH 5.5 - 4.6. The colder the temperature during ripening, the more flavour develops. Ripened butter is usually not washed or salted.

In the aging tank, the cream is subjected to a program of controlled cooling. Cold-aging of cream ensures that the appropriate fat crystalline structure is obtained for optimum churning.

From the aging tank, the cream is pumped to the churn via a plate heat exchanger, which brings it to the required temperature. The *churning* is in most cases achieved by beating in of air. It can be done in a churn, mostly consisting of a large vessel (tub, cylinder, cube, or double-ended cone) with so-called dashboards. The vessel is filled with cream and is rotated at several revolutions per minute (r.p.m.). The churning then takes, say, 20 min. There are also churns with a rotary agitator (for example, 20 r.p.m.).The latter principle is also applied in the frequently used continuous butter-making machine according to Fritz (See Fig.1). In the dairy industry today the majority of the butter is produced on these machines.

In a continuous butter-making machine according to Fritz, the cream enters at (1) and is very intensively churned in the first cylinder fitted with beaters that are driven by a variable speed motor (turning speed of beater, for example, 2000 r.p.m.), yielding very fine butter grains. In the second cylinder (say, 30 r.p.m.), the grains are churned into larger grains, allowing the buttermilk to drain off via a sieve (2). The grains fall in the worker, where they first are kneaded together by the screw, with the residual buttermilk being drained off (3). The mass may be chilled with water (4). The butter is now squeezed through a series of perforated plates and leaves the machine as a strand (6). To adjust the butter composition, additional water, brine, and so forth, can be incorporated during working (5). Some machines are equipped with two worker sections in series. To improve the butter quality, the system is equipped with a vacuum section in which the incorporated air is removed. Removal of air from the butter will improve the texture of the butter and increase the shelf life due to less oxidation and risk of free moisture. A denser product will also improve the efficiency at the packaging machine.

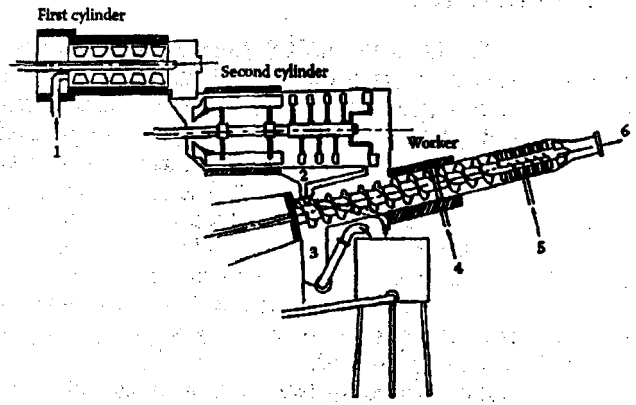

Fig. 1 Continuous butter-making machine according to Fritz

The *working* (kneading) is done to transform the butter grains into a continuous mass; to finely disperse the moisture in the butter; to regulate the water content; and, if desired, to incorporate salt. Working consists of deforming the butter. This can, for instance, be achieved by squeezing the butter through rollers, by allowing it to fall from a height, or by squeezing the butter through perforated plates (in the continuous machines). During the working, the water content is regularly checked and, if needed, additional water is added by injectors to arrive at the accepted standard value.

The finished butter can be immediately packaged in a retail package. After the working, butter is soft enough to be pumped from the churn-and-worker by a suitable positive pump. The packaged butter moves on to cold storage.

4. Find in the text English equivalents to the following word-combinations.

1. изготавливаться из сливок с помощью сбивания
2. предварительно подогреваться до необходимой температуры
3. диски, размещенные последовательно под углом от 45^0 до 60^0
4. разделенные (межтарелочным) зазором от 0.4 до 2.0 мм
5. внешняя кромка пакета тарелок
6. под влиянием центробежной силы
7. программа регулируемого охлаждения
8. перемешиваться с помощью шнека
9. сливки закачиваются в маслоизготовитель
10. состоящий из большого сосуда
11. вращаться со скоростью несколько оборотов в минуту
12. цилиндр, оснащенный лопастями (для сбивания)
13. приводимый в действие двигателем с переменной частотой вращения
14. охлаждаться водой
15. ряд перфорированных пластин
16. быть оборудованным двумя последовательно установленными рабочими секциями

17. быть оборудованным вакуум-камерой
18. увеличивать срок хранения
19. продавливать масло через вальцы
20. быть упакованным

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

1. Centrifuges .... to separate the cream from the skim milk.
2. The centrifuge .... up to 120 discs separated by a 0.4 to 2.0 mm gap.
3. The stack of discs ... vertically aligned distribution holes into which the milk is introduced.
4. Under the influence of centrifugal force the cream ... inwards through the separation channels toward the axis of rotation.
5. A plate heat exchanger ... the cream to the required temperature.
6. The churn vessel ... at several revolutions per minute (r.p.m.).
7. The first cylinder fitted with beaters ... by a variable speed motor.
8. In the second cylinder, the grains ... into larger grains.
9. The butter ... through a series of perforated plate.
10. To improve the butter quality, the system ... a vacuum section.

to rotate	to drive	to consist of	to squeeze	to move
to churn	to used	to equip	to have	to bring

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Centrifuges are used to separate the cream from the whole milk.
2. Centrifuges consist of discs stacked together at a 90 degree angle and separated by a gap or separation channel.
3. A plate heat exchanger brings the cream to the required temperature.
4. A churn consists of a large vessel with so-called dashboards.
5. In a continuous butter-making machine according to Fritz, the first cylinder is fitted with beaters driven by a positive pump.
6. In a continuous butter-making machine according to Fritz, the worker is equipped with a screw, kneading the butter grains together.
7. To improve the butter quality, a continuous butter-making machine can be equipped with an auxiliary worker section in which the incorporated air is removed.
8. During the working, the butter is squeezed through rollers or perforated plates (in the continuous machines), or can fall from a height.
9. After the working, butter is soft enough to be pumped from the churn-and-worker by a suitable positive pump.
10. The packaged butter moves on to an aging tank.

7. Answer the following questions.

1. What piece of equipment is used to separate the cream from the whole milk?
2. What elements does a centrifuge consist of?
3. Why is the cream subjected to pasteurization?

4. What piece of equipment is used to churn the cream?
5. What process takes place inside the first cylinder of a continuous butter-machine? What elements is the first cylinder fitted with?
6. What process takes place inside the second cylinder of a continuous butter-machine?
7. What is a worker? What components does it consist of?
8. What section helps remove the incorporated air from the butter?
9. What are the ways to achieve butter working?
10. What pieces of equipment are used to add, if needed, additional water to the butter?

8. Speak on the following points.

1. The equipment used in butter production.
2. The working principle of a continuous butter-making machine.

Text B. FILLING MACHINES

1. Before reading the text learn the terms used in the text:

filler – дозатор, наполнительная машина
volumetric filler – объёмный дозатор, наполнительная машина
piston filler – поршневой дозатор
intake stroke - ход всасывания (насоса)
supply tank – питательный бак, питающий бак
directional valve – направляющий клапан
measuring chamber – измерительная камера
auger filler – шнековый дозатор
hopper – загрузочная воронка
bridging – *закупоривание, засорение*
net weight filler – весовой дозатор, определяющий массу нетто
gross weight filler - весовой дозатор, определяющий массу брутто
feeder – питатель, подающий механизм, дозатор
funnel – воронка, раструб

2. Read and translate the text.

FILLING MACHINES

The filling machine is usually the most important machine in a food packaging line. The filler performs two critical functions. It measures out a specific quantity of a food product and it places that metered quantity of the food product into a package. The machine may also perform other functions, such as making the package and closing the package. Most fillers can be set up to work on many different products.

Filling machines used in food systems measure out a quantity of product by volume or weight.

Volumetric fillers deliver a measured volume of product into each container. Volumetric systems are flexible and can be adapted to a wide variety of products, ranging from water to thick pastes or powders and other dry products.

Piston filler. *Piston fillers are the most common type of volumetric filler.* Piston fillers measure and deliver the product by the action of a single piston. On the intake stroke, the pis-

ton draws product out of the supply tank, through a directional valve and into the measuring chamber, which houses the piston. Then, on the following delivery stroke, the valve leading to the container is opened and the valve leading to the supply chamber is closed, causing the product to flow out of the chamber and into the container. The filled container is then conveyed away and replaced by another empty container and the process cycle repeats.

Auger filler. Auger fillers are a widely used type of volumetric filling equipment used for many types of dry products and thick pastes. The product is held temporarily in a conical shaped bin and metered and conveyed out through an opening at the bottom by an auger. The auger must be specially designed and manufactured to suit the product. The volume of product delivered is directly related to the number of degrees that the auger rotates. The control can be based on time, which requires that the speed of rotation be constant, or it can be based on the degrees of rotation. To change the volume of product delivered, the time that the auger rotates can be increased or decreased.

Some powders tend to bridge in the hopper and not flow into the auger. To prevent bridging, manufacturers make various types of agitators that rotate together with the auger. The agitator breaks up the bridged product and keeps the product flowing smoothly to the auger. If the density of the product is constant, metering a specific volume of product also specifies a particular weight. Volumetric filling is a good choice for products of this type.

Weight filling is used for products that do not have uniform density and for products that require more accurate metering. There are two type of weight filling, gross weight and net weight.

Net weight fillers. Net weight fillers measure out the desired weight of product and convey the measured product to the container.

The metering step is done inside the machine, before the product is introduced into the container. The scale measures only the weight of the product. When the weight of the product in the hopper reaches the preset value, the feeder stops and the hopper opens to discharge the product into a funnel, which guides the product into the container. After the product has been placed into the container, the container is moved away and an empty container is moved into position.

Gross weight filler. A gross weight filler measures the combined weight of the product and the package. Before the filling operation begins, a sample of packages is weighed individually and the average is calculated. The metering scale is then preset with sum of the desired product weight and the average weight of a container. The product is metered directly into a container until the scale determines that the proper (combined) weight has been reached. At that time, the product flow is terminated, the filled container is moved out and an empty container is moved into position to be filled.

3. **Answer the following questions.**

1. What functions does a filler perform?
2. How do filling machines measure out a quantity of product?
3. What measures the product in a piston filler?
4. What function do valves perform is a piston filler?
5. What is the design difference between a piston filler and an auger filler?
6. Why are auger fillers equipped with various types of agitators?
7. How does a net weight filler operate?
8. What is the difference between a net weight filler and a gross weight filler?
9. What function does a metering scale perform in a gross weight filler?

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