МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

**САНКТ-ПЕТЕРБУРГСКИЙ НАЦИОНАЛЬНЫЙ
ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ
ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ, МЕХАНИКИ И ОПТИКИ**

ИНСТИТУТ ХОЛОДА И БИОТЕХНОЛОГИЙ

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АНГЛИЙСКИЙ ЯЗЫК

FOOD MANUFACTURING PROCESSES

Учебное пособие

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Учебное пособие подготовлено для обучения английскому языку бакалавров, магистрантов и аспирантов по направлениям 220700 Автоматизация технологических процессов и 151000 Технологические машины и оборудование очной формы обучения.

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В 2009 году Университет стал победителем многоэтапного конкурса, в результате которого определены 12 ведущих университетов России, которым присвоена категория «Национальный исследовательский университет». Министерством образования и науки Российской Федерации была утверждена программа его развития на 2009–2018 годы. В 2011 году Университет получил наименование «Санкт-Петербургский национальный исследовательский университет информационных технологий, механики и оптики».

ВВЕДЕНИЕ

Настоящее учебное пособие предназначено для бакалавров и магистрантов, обучающихся по направлениям 220700 “Автоматизация технологических процессов и производств”, 151000 “Технологические машины и оборудование”.

Цель данного учебного пособия – подготовить студентов к чтению оригинальной литературы по специальности, а также развить и закрепить навыки аудирования, говорения и письма в сфере профессиональной коммуникации.

Настоящее издание предназначено для работы на занятиях с бакалаврами, магистрантами и аспирантами. Пособие состоит из трех разделов, в которых 18 Уроков (Units). Урок включает в себя словарь, текст, лексические и грамматические упражнения. Каждый из трех разделов состоит из шести Уроков и заканчивается контрольным заданием, направленным на выявление остаточных знаний у студентов и закрепление пройденного материала. Контрольное задание содержит три части: Comprehension, Speaking, Writing. Каждая часть предлагает ряд упражнений, отвечающих современным стандартам обучения иностранному языку, и способствует как более глубокому пониманию предмета, так и развитию творческого воображения. Учебное пособие заканчивается приложением, которое включает в себя словарь трудной и специальной лексики, содержащейся в текстах и упражнениях пособия.

Тексты для Уроков подобраны таким образом, чтобы по возможности дать представление об основных механических и физических процессах и операциях, используемых в пищевой промышленности, а также об оборудовании, применяемом на пищевых предприятиях.

Лексические упражнения построены таким образом, чтобы расширить словарный запас студента, активизировать уже имеющиеся знания, а также научить морфологическому членению слов изучаемого языка.

Грамматические упражнения отражают все трудности, необходимые для правильного перевода технических текстов в рамках данного пособия и последующего самостоятельного чтения технической литературы. Целью данных упражнений является активизация полученных ранее знаний и закрепление их на конкретных примерах, содержащих специальную лексику. Необходимо развить у студентов спо-

собность видеть грамматические конструкции в тексте и легко их переводить, а также привлечь внимание студентов к явлению многозначности и многофункциональности отдельных слов, словосочетаний, грамматических категорий, особым образом употребляемых в технической литературе.

Контрольное задание, представленное в конце каждого раздела, состоит из трех заданий, направленных на повторение пройденного материала и активизацию знаний и мышления. Задания носят творческих характер, тем самым способствуют активизации творческого мышления студентов и в то же время закреплению лексики, грамматики и информационного наполнения текстов. Задания развивают навыки и умения, необходимые для полноценного и качественного изучения иностранного языка, а именно говорения, понимания, устной речи и письма.

Каждому Уроку предшествует список лексических единиц, которые являются специфическими для данного раздела и могут вызывать трудности при переводе и общем понимании текста.

Издание заканчивается словарем, в котором студент без труда найдет лексику, необходимую для работы с текстами и упражнениями.

При работе с данным пособием рекомендуется использовать следующие словари:

1. Мюллер В.К. Большой англо-русский словарь: в новой редакции. – М.: Цитадел-Трейд: Рипол классик, 2005.

2. Электронный словарь ABBYY Lingvo 12.

3. Современный англо-русский политехнический словарь/Сост. В.В. Бутник – М.: Вече, 2012.

4. Русско-английский политехнический словарь/Сост. Б.В. Кузнецов. – М.: Руссо, 2001.

UNIT 1

agriculture – сельское хозяйство
animal husbandry – животноводство
article – изделие, товар, предмет торговли
auxiliary – вспомогательный
bakery products – выпечные изделия
composition – состав
confectionary – кондитерские изделия
dehydrated – дегидратированный, обезвоженный
dissolve – растворять(ся), разжижать(ся)
dry – сухой, сушить
drying – сушка
edible – съедобный, годный в пищу
equipment – оборудование
extraction – извлечение, отжим, экстракция
fishery – рыбный промысел
food industry – пищевая промышленность
handling – транспортировка, погрузочно-разгрузочные операции
horticulture – садоводство
hydrate – гидротировать(ся)
market – рынок
marketing form – товарный вид
mix – смешивать, перемешивать
mixer – мешалка, смеситель, миксер
mixture – смесь
moulding – прессование, формование
non-edible – несъедобный
process – обрабатывать, перерабатывать
processing – обработка, переработка, технология
recover – восстанавливать, извлекать
size enlargement – увеличение размеров
size reduction – уменьшение размеров
solid – твердое тело
solution – раствор
sorting – сортировка, классификация
starch – крахмал
suspension – суспензия
winning – выделение

MECHANICAL OPERATIONS IN FOOD INDUSTRY

Food industry came into being a few hundred years ago. This was long before any knowledge was acquired about what happened during food processing which was mainly based on experience and traditions. Only recently science has become involved in foods and thus food science is a young science.

The food industry processes biological materials which are produced by agriculture, horticulture, animal husbandry and fishery. They differ greatly from each other and are of a very complicated structure and composition. That is why food processing should be based on knowledge of the properties of these biological materials and of the changes that take place during processing. But food processing can not be accomplished without mechanical operations and mechanical equipment because they create proper conditions for it.

Mechanical operations are very important in the manufacture of all kinds of products and especially in that of complex articles such as bakery products and confectionery as well as modern products such as canned and dehydrated soups, baby foods, meat products, etc.

Mechanical operations include first of all handling of materials (i.e. transportation and storage methods) which is very important in any plant. The next commonly used operation is mixing which may be used in the production of many complex articles or as an auxiliary operation in reactions where the reacting materials must be brought into close contact with each other; in physical operations such as dissolving and extraction and so on.

Size reduction and size enlargement are exceptionally important in the food industry. In the case of size reduction a distinction can be made between the operation for a purpose (to give the product a certain marketing form and dimension) or as an auxiliary operation in physical operations such as drying, cooling, heating, etc. Size enlargement (moulding) of articles is often applied in confectionery industry, in meat processing, etc.

Finally, many mechanical separation methods are used in the food industry. Solids are separated from liquids. Examples of liquids recovered from mixtures are fruit juices and sugar solutions. The winning of a solid is of prime importance in the separation of starch from suspensions. We know the classification of solids to be also of great importance: in the cleaning and sorting of raw materials; in the separation of edible from non-edible components and in the sorting of final products according to shape and di-

mensions. Other mechanical separations (liquid/liquid, solid/gas and liquid/gas) are also used quite frequently.

The specialized mechanical engineer who works in food industry must be able to select the most suitable equipment for a certain purpose. He also should know the design and construction of this equipment and solve different technical and economical problems.

EXERCISES

I. You are sure to easily guess the meaning of the derivatives:

Verbs:	Nouns:	Adjectives:	Adverbs:
To produce	production productivity product producer	productive producible	productively
To separate	separation	separate	separately
To operate	operation operator	operative	operatively
To react	reaction	reactive	reactively

II. Word formation. Form nouns from the given words according to the pattern:

a) dry – drying
process – ?
manufacture – ?
handle – ?
dissolve – ?

b) accomplish – accomplishment
enlarge – ?
equip – ?

c) store – storage
use – ?
pass – ?

d) machine – machinery
fish – ?
confection – ?
cream – ?
bake – ?
recover – ?

III. Translate into Russian:

food processing, handling of materials, storage methods, size reduction, classification of solids, size enlargement, raw materials, specialized mechanical engineer, moulding, non-edible components, products of different shape and dimensions.

IV. Translate into English:
пищевая промышленность, приводить материалы в тесный контакт друг с другом, товарный вид, вспомогательные операции, быть очень важным, подходящее оборудование, решать технические и экономические проблемы, продукты детского питания, консервированные и обезвоженные супы, методы механического разделения.

V. Translate the following sentences paying attention to the predicates in **the PASSIVE VOICE:**
1. One can use the term «process» when only a single operation is considered. **2.** Many years ago food processes were mainly based on experience and traditions**. 3.** The problem of liquids separation is being studied at our research institute. **4.** The problem of transport and storage methods is dealt with in this article. **5.** Size enlargement of articles is often referred to as moulding. **6.** The hygienic standards of transport equipment are paid great attention to when dealing with perishable products such as milk, meat, fish and eggs. **7.** Sometimes in the extraction of solids, physical separation can be followed by mechanical separation.

VI. Remember the translation of the verbs **TO BE** and **TO HAVE:**
1. The question is whether mechanical or physical separation methods have to be applied. **2.** We know the classification of solids is of great importance in food industry. **3.** We have considered the operation of mixing which may be used for a purpose or as an auxiliary operation. **4.** To choose the equipment for a certain purpose all properties of the material to be processed are to be considered. **5.** This mixer has vertical as well as horizontal material displacement. **6.** In some cases the purpose of mixing is to obtain a good contact between the materials to be mixed.

UNIT 2

beans – бобы, фасоль
blower – воздуходувка, вентилятор
cereal – хлебный злак
convey – транспортировать, перевозить
displace – перемещать
dough – тесто
ejector – эжектор, струйный насос
fan – вентилятор
flour – мука
flow sheet – технологическая схема, последовательность операций
fluid – текучая среда (жидкость или газ), жидкость
flume – желоб
food safety – безвредность пищевых продуктов
fruit pulp – плодовая мякоть, пульпа, пюре
hydrolic – гидравлический
inclined – наклонный
juice – сок
pipe – труба
pneumatic – пневматический
powder – порошок
pump – насос
requirement – требование
settle – оседать, осаждаться, отстаиваться
steam – пар
tank – бак, цистерна, резервуар
vat – бак, чан, ванна
vessel – резервуар
viscous – вязкий

HANDLING OF MATERIALS

Any flow sheet begins with handling. Raw materials pass through the factory from department to department and from one machine to another, transportation often being necessary within the processing equipment itself.

Mechanical transport of food materials may be divided into fluid(gas or liquid) and solids transport. Air, various gases or vapours are displaced by fans, blowers, compressors, vacuum pumps and ejectors. For the transportation of liquids and suspensions pumps are used.

Solid food materials in the form of pieces, granules and powder can be transported by pneumatic or hydraulic conveying. Hydraulic transport method is the displacement of the material by means of a liquid (usually water). Pneumatic transport method is the displacement of materials by means of a gas (usually air). The mechanical transport equipment is often used in combination with other processing equipment designed for heating, cooling, mixing or drying of materials.

Granular food solids, grains and powders can be conveyed through pipes with high velocity air streams. Food materials handled include cereals, flour, beans, coffee, granular sugar and others. Some agricultural raw materials are transported into the processing area by open water channels and flumes.The floating food materials, e.g. tomatoes, carrots, apples, citrus fruit are transported to the juice extractors by mechanical conveyors which may also act as washing equipment. Regarding the transport direction of the products, conveyors can be classified as horizontal, inclined, vertical and combined direction conveyors. Most of them are able to displace products in both directions. The vertical conveyors are called the elevators.

In addition to the mechanical and engineering aspects, the food handling equipment must meet strict hygienic (sanitary) requirements which will ensure food safety.

In food processing and manufacturing storage is of great importance and may be short or long term. Short-term storage may be a preliminary stage of processing or it may be involved in a later stage, as in the case of adding supplementary substances. Long-term storage is used in securing a continuous flow of raw material in manufacturing as in case of grains or in the storage of concentrated juice in tanks. Stored food may be solid, liquid or viscous. Storage equipment of solids includes hoppers, boxes or bags. Storage of liquid or viscous foods such as fruit pulp, concentrated juice or dough may be done in tanks, vats or vessels. The design and construction of food storage equipment is based on practical experience taking into consideration physical and chemical properties of food products and the sensitivity of food quality to environmental conditions.

EXERCISES

I. Find the suffixes in the following words. What parts of speech do they form? Translate the words:
pneumatic, equipment, conveying, ejector, displacement, mechanical, combination, usually, granular, hydraulic, agricultural, suspension, storage, addition, various, blower, shorter.

II. Form the verbs from the given nouns and give their Russian equivalents:
consideration, conveyor, accomplishment, suspension, storage, extractor, blower, enlargement, classification, washer, settlement, division, transportation.

III. Translate into Russian:
flow sheet, processing equipment, pneumatic and hydraulic conveying, heating and cooling of water, granular food solids, mechanical transport equipment, high velocity air stream, floating food materials, product quality, food safety.

IV. Translate into English:
добавление дополнительных веществ, обеспечение непрерывного потока сырья, долгосрочное хранение, удовлетворять строгим санитарным требованиям, концентрированный сок, принимать во внимание условия окружающей среды.

V. Translate the following sentences paying attention to the predicate in the **PASSIVE VOICE:**
1.Vats and vessels are used for temporary storage of relatively small quantities of liquid or highly viscous foods. **2.** Details on conveyors for specific industrial applications are given in catalogs of equipment manufacturers. **3.** Tankers for storage of liquid foods are usually made of stainless steel. **4.** When pipes are not used they should be dried by passing through hot air. **5.** The selection of transport mechanisms is determined by the properties of the product to be transported. **6.** Food safety is paid great attention to. **7.** The temperature and humidity of the room in which boxes are stored must be taken into consideration.

VI. Translate the sentences containing **MODAL VERBS**:
1.A conveyor may be as long as required. **2.** In long-term storage measures must be undertaken to protect the product from spoilage. **3.** Combination of mechanical and pneumatic conveying can be used in moving boxes weighing up to 150 kg. **4.** The surface of vats and vessels should be smooth and corners should be avoided. **5.** Particular care should be taken to prevent fires and explosions of some sensitive food powders. **6.** Pipe insulation is necessary for cold pipes, e.g. in refrigeration systems, in order to prevent moisture condensation which may induce microbial growth. **7.** Short belt conveyors can be part of a continuous weighing system. **8.** It should be noted the ton in the United States is equal to 2000lb, i.e. 908 kg.

VII. Mind the following **NOUN CHAINS**:
product heating control, easily filled plastic bag, quality damage risk, power consumption requirements, effective pipe cleaning, continuous food processing operation, food plant transport mechanisms.

UNIT 3

accomplish – выполнять, осуществлять
assemble – собирать, монтировать
axis – ось
batch mixer – мешалка периодического действия
blend – смесь
bottom – дно, основание
can – консервировать в герметичной таре
consumption – потребление
continuos mixer – мешалка непрерывного действия
cylinder – цилиндр, валок, барабан
dairy product – молочный продукт
drum mixer – мешалка барабанного типа
homogeneous – однородный
immisible – несмешиваемый, несмешивающийся
margarine – маргарин
mayonnaise – майонез
miscible – смешиваемый
mixer – мешалка, смеситель, миксер
mixed feeds – смешанные корма
pipeline – трубопровод
power consumption – потребление энергии
rotating mixer – мешалка с вращающимся барабаном
sampling – взятие проб
scrape – скоблить, скрести
shallow – мелкий
stationary – неподвижный, стационарный
sweet – конфета
whipped cream – взбитые сливки
whirl – завихрение

MIXING OF MATERIALS

Mixing is stated to be the combination of different materials and their distribution until a certain degree of homogeneity is achieved. Mixing proves to be a very frequently used operation.

There are many different problems associated with mixing. Solids may be mixed with solids (most mixed feeds, blends of tea and coffee, dried soup etc.) or liquids (many canned goods, several dairy products, drinks and also chocolate and sweets), liquids may be mixed with liquids (emulsions like mayonnaise, butter and margarine) or gases (ice cream, whipped cream, some sweets and baked goods).

Mixtures may be homogeneous, for example, solutions of solids and liquids, mixtures of miscible liquids and gas mixtures or heterogeneous, for example, liquid/liquid, liquid/gas, solid/gas, etc.

The following properties are found to be important in mixing: the proportions of the materials to be mixed; the particle size of the materials i.e. mixing becomes more difficult, the more the particle sizes differ; density of the materials, i.e. a large difference in density makes mixing more difficult; shape of the particles.

Mixing is accomplished in mixers, which may work batch-wise or continuously. In all mixers the particles are moved and displaced in more than one direction. The simplest mixers working batch-wise are drum-mixers, or rotating mixers. These mixers consist of a cylinder, the rotation axis of which is normal to the axis of symmetry; a small cylindrical tube from which half of the cylinder wall is removed, is mounted on each of the two flat walls of the mixer.

Furthermore it is possible to install stationary or rotating stirring arms. In the latter case the drum is usually rotated in the direction opposite to the stirring arms (Fig.1). Drum mixers with stirring arms are less suitable for materials that can be damaged.

Another mixer consists in principle of a shallow cylindrical slowly rotating vessel in which stirring arms rotate in the opposite direction and scrape the bottom.

There are mixers in which air is the mixing agent. Air is blown through a vessel containing the components to be mixed. The materials whirl around and fast mixing results.

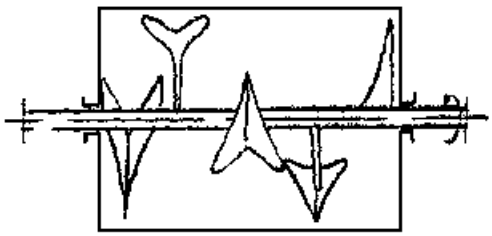

Fig. 1. Drum mixer

Continuous mixing of solids is not often used. The simplest method of continuous mixing is to join together several pipelines in which the materials are transported pneumatically. Another possibility is a continuous mixer assembled from a large number of twin mixers.

It is very difficult to compare and evaluate the efficiency of different mixers. The required mixing time ranges from a few seconds up to 20–30 minutes, depending on the difficulty of the mixing process. Very little can be said about the power consumption. It is obvious that the smaller and heavier the particles to be mixed, the higher the power consumption.

Control of mixing can take place by sampling and analysis, sampling itself being a difficult problem.

EXERCISES

I. What parts of speech are the following words?
place – displace – displacement – placed; state – stated – station – stationary – stationer; differ – different – indifferent – difference – differently; relate – relation – relatively – relative – correlate.

II. Group the words into the families according to their suffixes.Give their Russian equivalents:
perishable, factory, consumer, viscous, carefully, distribution, density, uniformly, mixer, pneumatic, granular, heterogeneous, possibility, consumption, popular, eccentric, obvious, suitable, recovery, combination, hydraulic, homogeneous.

III. Translate into Russian:
several dairy products, rotating stirring arm, shallow cylindrical slowly rotating vessel, carefully dosed quantities, circulation current, small droplets formation, batch drum mixer, whipped cream, immiscible liquids.

IV. Translate into English:
часто используемая операция, размер частиц, ось вращения, непрерывное смешивание твердых веществ, потребление энергии, мешалка периодического действия, пневматическая транспортировка твердых веществ по трубопроводу, смешивание жидкостей, шоколадные конфеты.

V. Mind the forms and functions of the **INFINITIVE**. Translate the following sentences:
1. The components to be mixed are to be placed in the cylinder of a mixer. **2.** The simplest method of continuous mixing is to join together several twin mixers**. 3.** To improve mixing stationary or rotating stirring arms should be installed. **4.** To mix materials means to combine different materials until a certain degree of homogeneity is achieved. **5.** Carrying out this experiment the scientists hoped to obtain a new combination of materials with better properties. **6.** Mixing was necessary to establish a close contact between a liquid and a gas.

VI. Find **INFINITIVE CONSTRUCTIONS** in the following sentences and translate them:
1. It takes 5 minutes for this mixture to be obtained. **2.** This mixer is supposed to be most suitable for solids that contain large amount of water. **3.** The power consumption appears to be taken as a measure of the mixing action**. 4.** We know these two mixers to differ mainly in form and shape of stirring arms. **5.** The following properties are found to be important in mixing. **6.** One should know physical and mechanical operations to be very important in the manufacture of all kinds of products. **7.** Mixing was stated to depend upon density of the materials to be mixed.

VII. Look at Fig.1 and try to describe the process of mixing in drum mixer.

VIII. Your task is to increase the mixer efficiency. How can it be done?

UNIT 4

agitate – мешать, перемешивать
agitator – лопасть, мешалка
agitator tank – резервуар с мешалкой
atomize – распылять
atomizer – распылитель
dispersion – дисперсия, диспергирование, рассеивание
heat transfer – теплопередача, теплообмен
homogenizing – гомогенизация
hydrofoil – гидрокрыло
kneading machine – месильная машина
mass transfer – массопередача, перенос тепла
multiphase – многофазный
paddle – лопасть, лопатка, мешалка
planetary mixer – планетарная мешалка
rheological – реологический
screw – шнек
stirrer – мешалка

MECHANICAL MIXING OPERATIONS

Mechanical mixing operations are widely used in food processing industry to give new physical or rheological properties to food products, to disperse components in multiphase mixtures, to improve heat and mass transfer and to develop new food structures. The design and operation of mixing equipment depends on physical and rheological properties of the initial components and the final products. Food mixtures involve many ingredients including liquid, powder, gases and granular solids. Some important ingradients are present only in small quantities, and they should be dispersed evenly and efficiently in the final mixture. The theory of mixing is more developed in liquid/liquid systems, while solid mixing is accomplished mostly empirically.

The selection of appropriate liquid mixing equipment depend primarily on the viscosity of the liquid and the volume of the mixing vessel. The basic mixing unit is agitator tank, i.e. a vertical cylindrical vessel equipped with one or more stirrers. Various types of stirrers are used de-

pending on the volume of the vessel and the viscosity of the liquid. High speed agitators include propellers, turbines and hydrofoils, paddles and screws being used for low speed agitators.

If one needs to produce stable mixtures of immiscible liquids by fine dispersing of one liquid in the other, very fast agitators can be used. This occurs in the preparation of emulsions. There are two types of emulsions: emulsions of oil in water and emulsions of water in oil. Very fine dispersing is known to be called homogenizing. This operation can be accomplished by means of a high pressure pump that forces the material through very narrow openings and may also be called homogenizer.

Many operations involve the mixing of liquid with gases. For example, the dispersion of liquids in gases is called atomizing and apparatus used for this purpose are called atomizers. The liquid to dispersed is forced through small openings under pressure. To promote the formation of small droplets the liquid is given a rotational movement before it reaches the opening. Small openings and high pressures give very fine droplets, particularly when the liquids are viscous.

The mixing of liquid and solids is used for producing food pastes and dough and is accomplished in specialized equipment. Double planetary mixers are used for highly viscous liquids and pastes. Dough mixing and processing are important operations in the baking, pasta and ceral process industries. Mixers for this purpose are of very heavy construction and they are called kneading machines. Some of them have one or two kneading arms rotating in a special vessel.These arms rotate in opposite directions at equal or different speeds. Most kneading machines work batch-wise although there are at present also continuos machines.

EXERCISES

I.Mind the shift of the stress in the following words:

„progress – to pro'gress	„subject – to sub'ject
„process – to pro'cess	„produce – to pro'duce
„increase – to in'crease	„present – to pre'sent

How does it change the meaning of words?

II. Find the correct form of the word on the left so that can be used on the right:

DIFFER:	A large _____ in density make mixing difficult.
MIX	Mixing takes place in _____.
VISCOSITY	Paddles are used for more _____ materials.
RELATE	The stirring arms are rotating at _____ high speed.

III. Translate into English:
подходящее оборудование для смешивания жидкостей, высокоскоростные мешалки, устойчивая смесь, эмульсия масла в воде, образование мелких капель, гомогенизатор, распыление жидкости в воздухе.

IV. Define the functions of **PARTICIPLES** in the following sentences and translate them:
1.This mixer consists of a shallow cylindrical slowly rotating vessel in which stirring arms rotate in opposite direction. **2.** Having distributed a small amount of liquid uniformly in the solid, we got the necessary mixture. **3.** The required mixing time ranges from 1 to 20 minutes, depending on the difficulty of the mixing process. **4.**Being the mixing agent, air is blown through a vessel containing the materials to be mixed. **5.**When required, rotating stirring arms are installed in mixers. **6.** Being separated, non-edible components are removed. **7.** Unless packed, butter is not allowed to be sold.

V. Translate the following sentences paying attention to **NAPCs:**
1. Air being blown through a vessel containing the components to be mixed, fast mixing takes place. **2.** All the advantages of the methods having been considered, the best method for particular case was chosen. **3.** Separation of heterogeneous mixtures of two liquids is a common operation, the two liquids being of different densities. **4.** Mixing is accomplished in mixers which may work batch-wise or continuously, continuous mixing being seldom used. **5.** Try to describe the mixing of liquid with air by means of atomizing.

UNIT 5

appearance – внешний вид
bar – брусок
break up – разбивать
carrot – морковь
cell – клетка
coarse – крупный, грубый
colloid mill – коллоидная мельница
cutter – режущий аппарат, куттер
cutting – резание, резка, кусок
disintegrator – дробильная машина
fine – мелкий
fragment – часть
grind – измельчать, размалывать, дробить
grinder – дробилка, мельница
grooved – бороздчатый, желобчатый
knead (v) – месить, смешивать, разминать
kneading machine (n) – месильная машина
market – продавать, рынок
mashed vegetables – пюре из овощей
mill – мельница
milling – измельчение, размол
peel – очищать
recovery – восстановление, извлечение
reverse – обратный, противоположный
release – освобождать
sausage – колбаса, сосиска, сарделька
shaping – формовка, придание формы
slice – ломтик
slit – прорезь, щель
smooth – ровный, гладкий

SIZE REDUCTION

The breaking up of materials into smaller fragments is an extraordinarily important operation in the food industry.

Size reduction may be the main objective or an auxiliary operation. Products are marketed in certain forms or sizes, which depend on either the preference by the consumer or historical tradition . For size reduction, a distinction can be made between extreme size reduction (milling) and reduction to relatively large dimensions and often particular shapes (cutting).

Many articles are marketed in cut form: potatoes, vegetables, fruit, meat, fish, bread, cheese, butter, tobacco. The cuttings may have very different shapes, slices, cubes, bars, etc. Other products are manufactured in a form very much reduced in size: examples are mashed vegetables, tomato paste, fruit in jams and lemonade, meats like sausage and all kinds of emulsions. In these cases the object is to obtain products that are homogeneous in appearance and taste. Kneading machines, disintegrators, mills, homogenizers, etc. are used for this purpose. For example the most commonly used type of colloid mill is shown in Fig. 2.

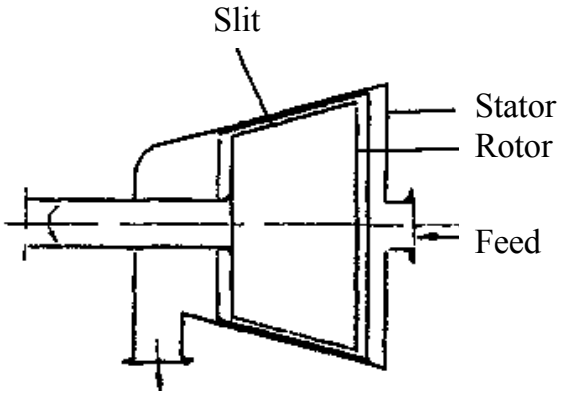

Fig. 2. Colloid Mill

It consists of a conical housing (stator), inside which a conical rotor rotates. The speed is high. The slit between the stator and the rotor is adjustable and can be set very narrow. Its operation is based on the very large shear stress in the slit. Rotor and stator may be smooth or grooved.

Some mixers are better called disintegrators because they disperse as well as mix. A disintegrator consists of a vessel of special shape in which a number of knives rotate at very high speed (up to 170 revolutions per second). They are most suitable for the grinding of solids that contain large amounts of water, such as meat, fruit and vegetables. They produce very finely ground products and work very efficiently.

The purpose of size reduction as an auxiliary operation for other processes is usually to create a large surface area. This is very important in all kinds of physical operations on solids (as in drying, dissolving, cooling and heating), and also for close contact which may be achieved between immiscible liquids and between liquids and gases.

Size reduction may also play a part in mechanical separation. A good example is the recovery of starch from potatoes. The potatoes must be reduced in size to such extent that the cells are opened and the starch granules are released.

Finally size reduction is frequently used in food industry to obtain a separation between edible and inedible components of a raw material. Size reduction is then only an auxiliary operation. Examples are: scraping of potatoes, carrot, etc., peeling of fruits and other operations. Special machines that are often only suitable for one purpose have been developed for all these operations.

EXERCISES

I. Remember the words of the same root. What parts of speech are they?
a) prefer – preference – preferable – preferably
b)mechanics – mechanical – mechanically – mechanization
c) part – partial – particular – particularity – particularly
d) dry – drying – dryer.

II. Find the suffixes in the following words. What parts of speech do they form? Translate the words.
immiscible, sausage, viscosity, shapeless, conical, distridute, peeling, rotor, suitable, hardness,hydraulic, reduction, homogenizer, adjustable.

III. Find the synonyms among the following words:
choose, aim, sorting, adjustment, mount, regulation, proper, select, use, displace, decrease, suitable, apply, assemble, transport, classification, reduce, purpose.

IV. Translate into Russian:
extreme size reduction, marketing form of product, sausage appearance, main objective or an auxiliary operation, relatively large dimensions, final-

ly divided material, small sized pieces, edible and inedible components separation, cuttings, most commonly used type of colloid mill, narrow adjustable slit.

V. Translate into English:
порошкообразный, вспомогательные операции, большая площадь поверхности, томатная паста, механическое разделение, гладкий конический ротор, пюре из овощей, молотый кофе.

VI. Mind the functions of **PARTICIPLE 2.** Translate the sentences:
1. Finely divided or groud material can be produced by disintegrators. **2.** Some products are manufactured in a form of very reduced particles. **3.** When the dispersed phase tends to separate as a result of a density difference, it can be prevented or slowed down by addition of a thickener to the liquid phase or by size reduction of the dispersed particles. **4.** Many articles are marketed in cut form. **5.** Unless cut in pieces tomatoes cannot be transformed into tomato paste.

VII. Translate the sentences having defined the functions of **GERUND:**
1. For size reduction a distinction can be made between milling and cutting. **2.** To create a large surface area is very important in operations of drying, cooling and heating. **3.** The material has to be subjected to a combination of cutting and packing. **4 .** We know of milling having been used as size reduction for a long time. **5.** This machine is suitable for meat grinding. **6**. Control of mixing can take place by sampling and analysis. **7.** Coarse milling is usually best done by pressing or impact.

UNIT 6

axle – ось
axially – аксиально, по направлению оси
blow – удар, толчок
brittle – хрупкий
coarse milling – грубый помол
collide – сталкиваться
friction – трение
hammer mill – молотковая мельница
hard – твердый, крепкий, жесткий
impact – удар, толчок, столкновение
impact mill – молотковая мельница
hinge – прикреплять
pin – палец, штифт, штырь
pin mill – разбивной барабан
radial – радиальный, лучевой
rubbing – растирание, трение
shearing force – срезывающая сила, скалывающее усилие
teeth – зубья, зубцы
tough – жесткий, прочный, плотный, вязкий

MILLING OPERATIONS

Extreme size reduction is called milling. The technical procedure for size reduction is sure to depend greatly on the properties of the material. If little water or oil is present, the materials are relatively hard and brittle. Deformation which leads to breakage may then be obtained by subjecting the material to a blow or to shearing forces(friction).

In general, several mechanisms are acting simultaneously in milling equipment. Thus, the final result is due to pressure, impacts, friction, etc. However, a certain mechanism is often dominant and milling equipment may even be classified on this basis. Thus, in certain mills size reduction takes place mainly by friction while in others the chief mechanism is impact, etc. Coarse milling is usually best done by pressing or impact; for fine milling – rubbing (friction) is in principle the most suitable method. It is clear that brittle materials are more easily reduced in size by beating or subjecting to impacts, while for tougher materials rubbing and pressing are better.

In principle, milling may be carried out batch-wise or continuously. The former is used in only a few types of mills, for example, colloid mill. There are several possible methods of continuous milling. Firstly the material can be passed through the mill only once. This results in a large variety in particle size. The mill must be set in such a way that after one passage the largest particles are smaller than the maximum allowable size. This method is simple and frequently applied, but it is certainly not ideal. The product is not very uniform, the power consumption is relatively high, the output being small. It would be much better to remove the product as quickly as possible after the required size has been reached.

The milling process must therefore be combined with a classification which takes care of the removal of sufficiently small material from the mill, leaving behind the material which is still too coarse. This classification may take place in the mill itself or in separate equipment outside the mill.

Milling equipment can be divided on the basis of the way of operating into two main groups, impact mills and mills with rubbing action.

Impact mill is a milling apparatus with very fast rotating rotors. The mills operate mainly by blow or impact. As the product to be milled falls through the mill, it is hit by one of the rotors and the pieces collide at high speed either with the wall of the mill, with each other or again with the rotors, extreme size reduction taking place.

A hammer mill is the most widely used type of impact mill. A hammer mill has a number of hammers hinged to an axle. It can be used for hard and brittle materials and also for soft materials. A pin mill is also a type of impact mill, which is frequently used in the food industry. In its simplest form it consists of a stationary disk with a rotating disk a short distance away, both disks being set with pins or teeth. The material is supplied axially. Then it passes through the mill radially and is repeatedly reduced in size by impact. It should be noted that all impact mills also can give considerable size reduction for a single passage.

EXERCISE

I. What helps you define the part of speech of the given words?
uniformly, fineness, original, considerable, milling, smaller, stator, required, classify, friction, suitable, relatively, largest, hammer, various.

II. Find the synonyms among the following words:

friction, blow, frequently, hard, grinding, obtain, often, impact, milling, tough, rubbing, reach.

III. Translate into Russian:
relatively hard material, efficient milling equipment, very fine milling, maximum allowable size, continuous milling process, too coarse material, fast rotating rotors.

IV. Translate into English:
срезывающая сила, грубый помол, мельница периодического действия, отдельное оборудование, ударная мельница, мельница с растирающим действием, молотковая мельница, разбивной барабан.

V. Mind the conjunction **THAT** in the following sentences and translate them:
1. In the cases of fruit jams, lemonade, tomato paste production the object is to obtain products that are homogeneous in appearance and taste. **2.** That size reduction is frequently used in food industry is a well known fact. **3.** It is hammer mill that can be used for brittle materials. **4.** In many physical operations size reduction is important for close contact that may be achieved between liquids and gases in order to create a large surface area. **5**. It was reported that special machines were being constructed for mechanical separation. **6.** The main task was that the operations which had originally been carried out by hand had to be mechanized.

VI. Remember the meanings and functions of the words **SINCE** and **AS.** Translate the sentences:
1. Since cutting of products frequently takes place immediately before packing, cutting machines are combined with packing ones. **2.** As there is a danger of dust explosions, milling is carried out at a low temperature. **3.** Since the product is not very uniform, the power consumption is relatively high. **4.** Since the first mixer was designed all the elements of this mechanism have been improved. **5.** As a result, this operation determines the choice of milling apparatus. **6.** As the product to be milled falls through the mill, it is hit by one of the rotors. **7.** The amount of work to be done per unit volume as well as per unit mass is independent of particle size of the material.

LANGUAGE PRACTICE UNITS 1–6

Comprehension:

Revise texts 1 – 6 and answer the following questions:

1. What mechanical operations do you know?
2. How can solids and liquids be transported?
3. What problems are associated with mixing?
4. What does the operation of mixing equipment depend on?
5. When is size reduction used in food industry?
6. Why is milling process often combined with classification?

Speaking

Choose a topic and make a short presentation:

1. Storage and storage equipment in food processing and manufacturing.
2. Mechanical mixing operations.
3. Distinction between milling and cutting.

Speaking tips:

a) Give clear examples.
в) Make your notes as short as possible.
c) Speak from memory – don't read.

Writing

Write a short composition on the topic "Mechanical operations in food industry".

UNIT 7

agglomerate – агломерировать, скапливаться
agglomeration – агломерация, скопление, слипание
bakery – пекарня
briquetting – прозводство брикетов, брикетирование
biscuit – печенье, бисквит
derive – получать, происходить
dip – макать, погружать, окунать
extrude – выдавливать, выталкивать
extrusion – выдавливание, прессование через матрицу
extruder – шприц-машина
flexibility – гибкость, приспособляемость
granulation – грануляция, зернение
instant drinks – растворимые напитки
molten – расплавленный, жидкий
mould – форма, шаблон, матрица
opening – отверстие
packing – упаковка
pellet – шарик, гранула
pelletting – производство гранул, шариков
pharmaceutical – фармацевтический
perforated plate – перфорированная пластина
porosity – пористость
pressing – прессование
roll – валец, ролик
roll press – плющильная машина
sheet – лист
subject – подвергать
tabletting – производство таблеток

SIZE ENLARGEMENT

Any solid can agglomerate if it is in particulate form and the particles are small enough. Agglomeration (size enlargement) is used to produce several foods such as soup cubes, vegetable combinations, spices, instant drinks, chocolate and others.

Many small particles are combined in order to obtain products of a certain shape. A powdery material may be enlarged in size by pressing it into a sheet after which the sheet can be cut into smaller sized pieces. In this case the material has been subjected to a combination of moulding and cutting. Examples of this combination of shaping and cutting are found in bakeries and biscuit factories.

Shaping of materials plays a very important role in the grain and sugar processing industries; the shaping of products is moreover very important in the chocolate industry and in the manufacturing of cattle feed.

Since shaping of products frequently takes place immediately before packing, the shaping machines are combined with the packing machines.

Production methods are nearly always of mechanical-tecnological nature and are simple in principle. The equipment used for this purpose either is derived from equipment applied in other industries or imitate manual methods.

An important continuous method of shaping is extrusion. The product to be moulded is pressed continuously through openings of the required shape. Presses used for this purpose are called extruders. A very good example is the production of macaroni, vermicelli, and spaghetti. Similar methods are also used in the production of several types of confectionery, in chocolate industry, in the manufacture of sausages and in the shaping of plastic materials like butter. The pressure required for shaping is completely determined by the type of product and thus it is very variable.

The production of pellets is very similar to the above method. Pellets are produced by pressing a mixture of materials through perforated surfaces which determine the final shape of the pellets.

Another method is briquetting or tabletting.This process is used in dried soup factories, pharmaceutical industries, feed factories. In tabletting processes the agglomerates are fabricated through pressing of powders or granules in special moulds, until the consistency of the agglomerate is achieved. In roll presses two identical rolls move reversely. Powders or granules fed at the upper side between the rolls are carried along and compressed between the two rolls.

Agglomeration processes may be continuous or batch. The main advantages of continuos processes are high capacity, constant quality and low labour requirements. The advantages of batch process are flexibility in product variations and in often changing of formulas, high precision in mixing of small compounds.

EXERCISES

I. Why are these words placed here together? Translate them into Russian:
Shaping, tabletting, moulding, milling, peeling, cutting, grounding, mixing.

II. Make up missed forms of the words given below:

to operate	–	operation	–	operator
to extrude	–	?	–	?
to rotate	–	?	–	?
to construct	–	?	–	?
to separate	–	?	–	?
to homogenize	–	?	–	?

III. Add the prefixes IM- ,IR- , IN- , UN- to the following adjectives and translate them:
missible, natural, rational, edible, correct, regular, usual, movable, easy.

IV. Translate into Russian:
products of required shape, powdery material, combination of moulding and cutting, packing machines, pressing a mixture of materials through a perforated plate, dried soup factory.

V. Translate into English:
кусочки маленького размера, производственный метод, непрерывный процесс производства таблеток, расплавленный шоколад, подвергаться формовке, фармацевтическая промышленность.

VI. Mind the functions of the **INFINITIVE.** Translate the given sentences:
1. Solids are enlarged in size to form new products. **2.** The product to be moulded is pressed through openings of the required shape. **3.** The principal objective of size enlargement is to produce goods of appropriate size and porosity, which are strong enough to withstand handling. **4.** Coarse milling is known to be done by pressing or impact. **5.** High water content is required to increase the size of granules.

VII. Define the type of **SUBORDINATE CLAUSES** and translate them:
1. Pellets are produced by pressing a mixture of materials through perforated surfaces which determine the final shape of the pellets. **2.** If sub-

stances are not properly mixed, segregation may occur in packaging the material or during transportation or storage. **3.** Since the temperature during grinding is high the materials should be cooled while being processed. **4.** Properties that determine the quality of agglomerates are the size and porosity of powders or granules. **5.** One should not use high speed cutting machines unless safety measures are taken. **6.** Water is added to the mixture until the required consistency of the mixture is achieved. **7.** Powders are mixed with granules before the granules are completely dry.

UNIT 8

advantage – преимущество
aqueous – водный
beet – свекла
cavity – полость, выемка
centrifugation – центрифугирование
centrifuge – центрифуга
clarify – очищать, отделять от примесей
collect – собирать, скапливаться
concern – касаться, иметь отношение
disadvantage – недостаток
filtration – фильтрация
filter – фильтр
porous – пористый
pulp – мякоть, пульпа
screen – решето, сито, грохот
sedimentation – осаждение, оседание
seed – зерно, семя
settle – осаждаться, отстаиваться
sieve – сито, решето, грохот
sifting – просеивание
sorting – сортировка
sugar beet – сахарная свекла
waste – отходы

MECHANICAL SEPARATION

Mechanical separation is used for heterogeneous mixtures of solids, solids and liquids, solids and gases, liquids and gases and also immisible liquids.

The purpose of the solid/liquid separation may be either the recovery of the liquid (in the clarifying of fruit juices and wine), the recovery of the solids (examples are the winning of starch from aqueous suspensions and the pressing of all kinds of products before drying – sugar beet pulp, fish waste, etc.). The processing of oil-containing raw material is an example of a separation in which both the liquid and the solid are important products.

It is obvious, that to obtain a separation of two substances, they must differ in some property. Since there are numerous properties, there are also many different methods of separation. The materials to be separated very seldom differ in only one property, but if so, there is only one possible method of separation. Generally, the substances differ in two or more properties and consequently it is usually possible to choose from several separation methods. To find the best method for a particular case, all advantages and disadvantages of available methods have to be considered.

These methods are commonly divided into two classes: physical methods and mechanical methods. For example, filtration, centrifugation and pressing are mechanical methods and evaporation is a physical method. Combinations of physical and mechanical methods are also applied.

The method and the equipment required also depend on the combination of substances to be separated. If it is necessary to separate solid from liquid, sedimentation, filtration or pressing can be used. Sedimentation is the settling of solid from a solid/liquid mixture, a concentrated suspension of the solid with a clear liquid above it being formed. Filtration is the separation by a porous medium, the liquid passing through this medium and the solid staying on its surface. Pressing is the separation of solid from liquid under pressure.

The separation of solids is usually called sorting or classification, this method being important in the processing of cereals and seeds of different shape (such as oil seeds, coffee and cocoa beans), vegetables, fruits, fish, etc. For separation of cereals and seeds cylindrical separators have been used for over a hundred years. The principle is shown in Fig.4. A rotating slightly sloping cylinder has a wall equipped with cavities of particular sizes and shapes. Sorting usually takes place inside the drum as shown. Round and oblong seeds fill the cavities.

The round seeds are carried further upwards than the oblong ones and collected separately.

Separation of heterogeneous mixtures of two liquids is a fairly common operation, the two liquids being of different densities. In general this concerns the separation of emulsions, for example, the winning of cream from milk. Separation of different materials can be accomplished in filters, centrifuges, presses, separators, etc., the choice of the equipment depending on the nature of the product.

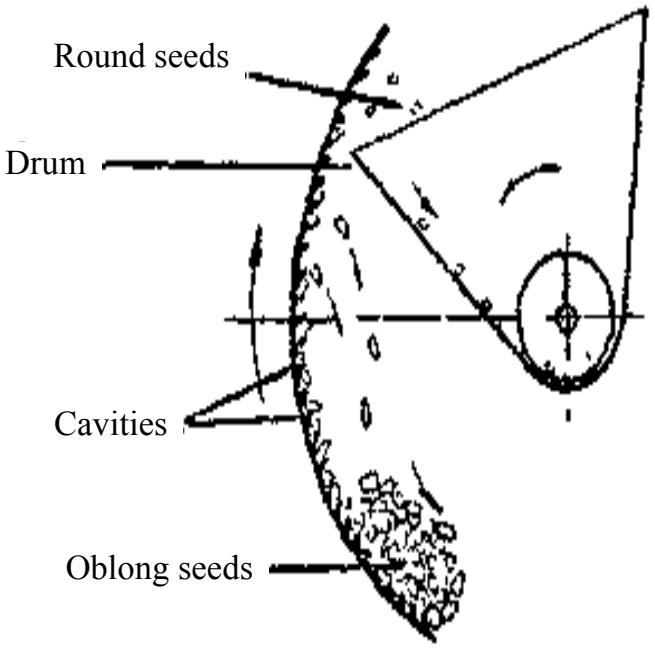

Fig. 4. Cylindrical separator

EXERCISES

I. What are the meanings of the prefixes PRE- and RE-? Translate the words given below:
pretreatment, predrying, predetermine, preheating, predict, precooling, recover, remove, reappear, replace, reproduce, re-equip, remake, rename.

II. Why are these words placed here together?
aqueous, numerous, heterogeneous, porous.
What parts of speech, may they be? Give examples of your own.

III. Form the verbs from the given nouns and give their Russian equivalents:
centrifugation, evaporation, sedimentation, filtration, separation.

IV. Translate into Russian:
fruit juices recovery, low solid/liquid mixture concentration, oil seeds separation, physical and mechanical methods combination, very seldom sepa-

rated materials, cereals classification, fairly common operation, density difference, solid substance sedimentation, high filter efficiency, centrifugation advantages.

V. Translate into English:
несмешивающиеся жидкости, выделение крахмала, недостатки имеющегося метода, требуемое фильтровальное оборудование, пористая среда, концентрированная суспензия, разнородные смеси, сортировка бобов, кофе, какао.

VI. Find all the non-finite forms of the verb (**VERBALS**). Translate the following sentences into Russian:
1. Mixing proved to be a very frequently used operation. **2.** The properties of the materials to be mixed may vary greatly. **3.** An increasing number of complicated articles consisting of different mixtures of two or more components are being manufactured in the food industry. **4.** To find the best method for a particular case all the advantages and disadvantages of available methods have to be considered. **5.** Many small particles are combined in order to obtain products of a certain shape. **6.** Separation of two liquids is a fairly common operation, the two liquids being of different densities. **7.** Control of mixing can take place by sampling and analysis, sampling itself being a difficult problem. **8.** Pressing is the separation of solid from liquid by compressing. **9.** The technical procedure for size reduction is sure to depend greatly on the properties of the material. **10.** Using of different mechanisms enables man to increase the output and to decrease the power consumption of many mechanical operations. **11.** We know pressing to be the separation of solid from liquid by compressing the mixture in such a way that the liquid is released and the solid stays behind. **12.** It is difficult for us to compare all the types and models described above. **13.** Mixtures of lower, but still considerable viscosity are known to be mixed in mixers with stirring arms.

VII. Define the type of **CLAUSES OF CONDITION.** Translate the sentences:
1. If substances differ in two or more properties, it is usually possible to choose from several separation methods. **2.** Too many valuable dissolved materials would be lost, provided products like grass and vegetables were partly dehydrated by pressing. **3.** Unless the potatoes are reduced in size to

such extent that the cells are opened, the starch granules are not released. **4.** But for refrigeration, the problem of food products storage had not been solved. **5.** Were power consumption decreased, the mixer would be put into operation immediately.

VIII. Look at Fig. 4 and try to describe how the cylindrical separator works

UNIT 9

berries – ягоды
blow – дуть, продувать
bounce – подпрыгивать, отскакивать
correlation – соотношение, связь
dirt – грязь
float – плавать
loosen – освобождать, отделять
pea – горох, горошина
ripe – зрелый
ripeness – зрелость
shake – встряхивать, трясти
sink – тонуть
spray – разбрызгивать, распылять
stirring – перемешивание

SEPARATION OF SOLIDS

The separation of solids is usually called sorting or classification. The process can be defined as the separation of mixtures into two or more fractions in such a way that each fraction is more uniform in one particular property than the original mixture. From this definition it follows that in order to obtain fractions that are uniform in more than one property, it may be necessary to apply more than one separation method.

The sorting of raw materials is very important, particularly in the processing of cereals and seeds, vegetables and fruits, potatoes, fish, etc. The prime purpose is to remove foreign matter, defective material or inedible substances, and furthermore to classify according to size, color, ripeness or any other property concerning quality.

For example, disc separator has a horizontal axle on which a large number of circular discs are mounted (Fig. 5). The discs are equipped with cavities on both sides and they rotate through the seed mixture. The seeds that are carried the greatest distance upwards drop on metal strips in between the discs. The advantage of this type of separator is that the active surface is very much larger. It can be used for the separation of round and oblong grains, and also frequently for the separation of wheat grains from whole ones.

Fig. 5. Disk separator

«Foreign matter" is considered to include "dirt". The cleaning of raw materials is very important for hygienic reasons. Large numbers of micro-organisms are also removed with the dirt. . Before the dirt can be removed it must be loosened. This sometimes can be done by shaking or by blowing air through the material; in other cases it is necessary to use washing mashines. Washing can be carried out by vigorous spraying with water, with the aid of shaking and stirring (mechanically or with air) or by other methods.

As a rule it is necessary to find out in which properties the materials differ and, while taking into account the purpose of the separation, which of these properties can best be used to obtain the required sorting. Separation is carried out on the basis of size, shape or density, or sometimes on the basis of color, consistency, friction coefficient, etc.

An example of difficult separation is that based on color. In this case electronic equipment is used. There is sometimes a correlation between color and ripeness, but not always. Therefore, separation according to ripeness, independent of color, is important. For example, ripe and unripe berries are sorted by dropping them on a plate, the unripe ones bouncing further than the ripe ones. Separation is not difficult when there is a correlation between ripeness and size. Still another possibility is that the state of ripeness affects the density. This is the case for peas, because of the conversion of sugars into starch. It is then possible to use a hydraulic classification in a salt solution of such density that the heavy peas sink and the light ones float and then they are removed.

Another purpose of separation is to make final products more uniform. These may be either unprocessed products, such as apples and eggs, which are sorted according to size, or various kinds of dried and ground articles.

EXERCISES

I. What is the pronunciation of the ending -Y in the following words and what parts of speech these words are:
classify, difficulty, generally, vary, quality, dry, uniformly, mostly, apply, greatly, consistency, manually, occupy, very, property, easily, possibility.

II. What helps you define the part of speech of the following words taken from the text?
loosened, clarify, defective, fraction, tremendous, sorting, original, considerably, final, ripeness, lover, mixture, cleaner, hygienic, desirably, lightest, conversion, improvement.

III. Give antonyms to the following words:
shallow – ? repel – ? enlargement – ? edible – ? increase – ? ripe – ? difficult – ? dirt – ? loose – ? desirable – ? miscible – ? outlet – ? homogeneous – ?

IV. Find the correct form of the word on the left so that it can be used on the right:
CLASSIFY: ____ in the food industry is still often done manually.
EASY: Delicate products are ___ damaged during mechanical operations.
SOLUTE: Hydraulic classification takes place in a salt _____ of rather high density.

V. Translate into Russian:
vigorous spraying of water, dirt removal by shaking, foreign matter, frequently applied hydraulic classification, partly dehydrated vegetables, valuable dissolved materials.

VI. Translate into English:
продукт хорошего качества, удаление грязи, продувание воздуха сквозь обрабатываемый материал, высокопроизводительные моющие машины, коэффициент трения, легко повреждаемый хрупкий продукт, превращение сахара в крахмал, сортировка сырья, незрелые ягоды.

VII. Remember the functions of the words IT, ONE, THAT. Translate the sentences:

1. The object of that operation is to obtain products that are homogeneous in appearance and taste. **2.** Physical and mechanical operations are important in the manufacture of all kinds of products and especially in that of complex articles. **3.** From this definition it follows that in order to obtain fractions that are uniform in more than one property it may be necessary to apply more than one separation method. **4.** One should know that the sorting of raw materials is very important in the processing of cereals, vegetables and fruits. **5.** It is pressing that gives the most complete separation of solid and liquid. **6.** A heterogeneous mixture of solid and liquid can be separated by mechanical method or by a physical one .

VIII. Translate the sentences paying attention to the **CLAUSES OF PROPORTION**:
1. The higher the viscosity, the lower the chosen speed and thus, the more expensive the drive. **2.** Separation is known to become more difficult the smaller the differences in properties. **3.** The higher the viscosity, the larger and slower propellers are used. **4.** Mixing becomes more difficult, the more the particle sizes differ. **5.** It is obvious that the smaller and heavier the particles, the higher the power consumption.

IX. Look at Fig.5 and explain the principle of action of the disk separator.

X. Look at Fig.6 and discuss:
How can the skins of the products be loosened?
What kinds of products can be peeled by using this equipment?

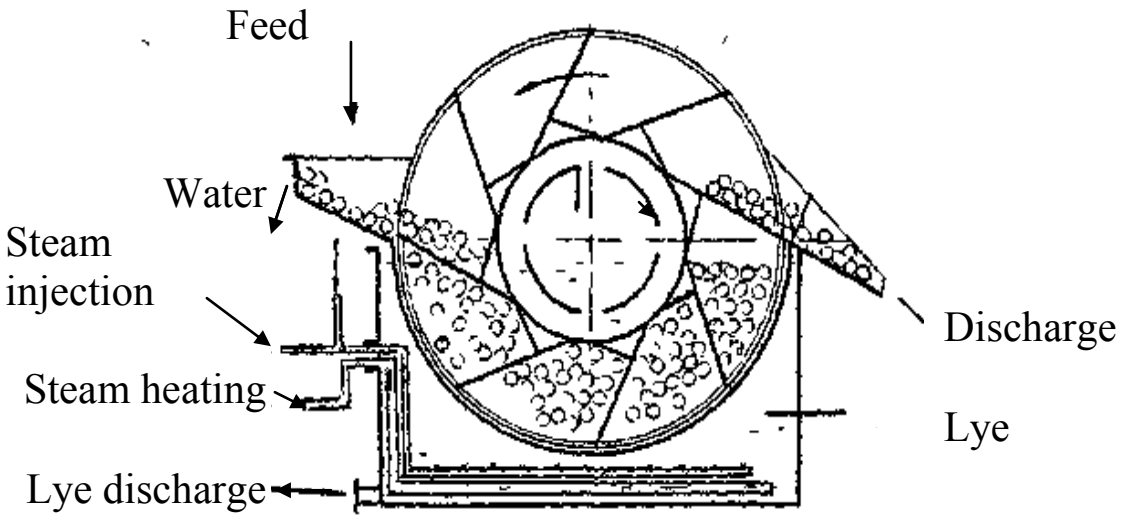

Fig. 6. Continuously working equipment for peeling

UNIT 10

aperture – отверстие
clog – засорять(ся), забивать
cloth – ткань
fracture – разрыв
mesh – сетка, отверстие сита
overflow – перелив; переполняться, переливаться через край
receptacle – приемный сосуд, приемник, резервуар
settling tank – отстойник
sieving – просеивание
size fraction – фракция по размеру
terminal – конечный
woven wire cloth – металлическая ткань, проволочная сетка

CLASSIFICATION OF SOLID PARTICLES

The problem of separating solid particles according to their physical properties arises on a large scale in a number of industries, the food industry including.

Separation depends on the selection of a process in which the behavior of the material is influenced to a very marked degree by some physical property. Thus, if a material is to be separated into various size fractions, a sieving method may be used because this process depends primarily on the size of particles, though other physical properties such as the shape of the particles and their tendency to agglomerate may also be involved. Other methods of separation depend on the differences in the behavior of particles in the moving fluid, and in this case the size and the density of the particles are the most important factors and shape is of secondary importance. Other processes make use of differences in electrical and magnetic properties of the materials or in their surface properties. It is possible to use the method either to separate a mixture of two materials into its constituents or to separate a mixture of particles of the same material into a number of size fractions.

Sieves or screens are made use of industrially on a large scale for separation of particles according to their sizes. Woven wire cloth is generally

used for fine sizes and perforated plates for larger meshes. The mechanically operated screens are vibrated usually by means of an electromagnetic device.

It should be mentioned that sifting is sometimes accompanied by the simultaneous passing of air through the sieve in an upward direction. This combination of sifting and pneumatic classification is applied on a large scale in the milling industry. The purpose is to separate the particles on the basis of shape. Flat particles are concentrated on top of the layer on the screen surface and are either collected or carried off with the airflow, while more spherical particles are concentrated at the screen surface and pass through the screen.

Generally, large particles are separated into size fractions by means of screens and small particles, which would clog in the fine apertures of the screen or for which it would be impracticable to make the openings sufficiently fine, separated in a fluid. Fluid separation is commonly used for separating a mixture of two materials. There exist a number of plants which are used for fluid separation. The simplest of them is a settling tank. The material to be separated is introduced in suspension into a tank containing a relatively large volume of water moving at a low velocity. The particles soon enter the slowly moving water and because the small particles settle at a lower rate, they are carried further forward before they reach the bottom of the tank. The very fine particles are carried away in the liquid overflow. Receptacles at various distances from the inlet collect different grades of particles according to their terminal falling velocities, the particles of high terminal falling velocity collecting near the inlet.

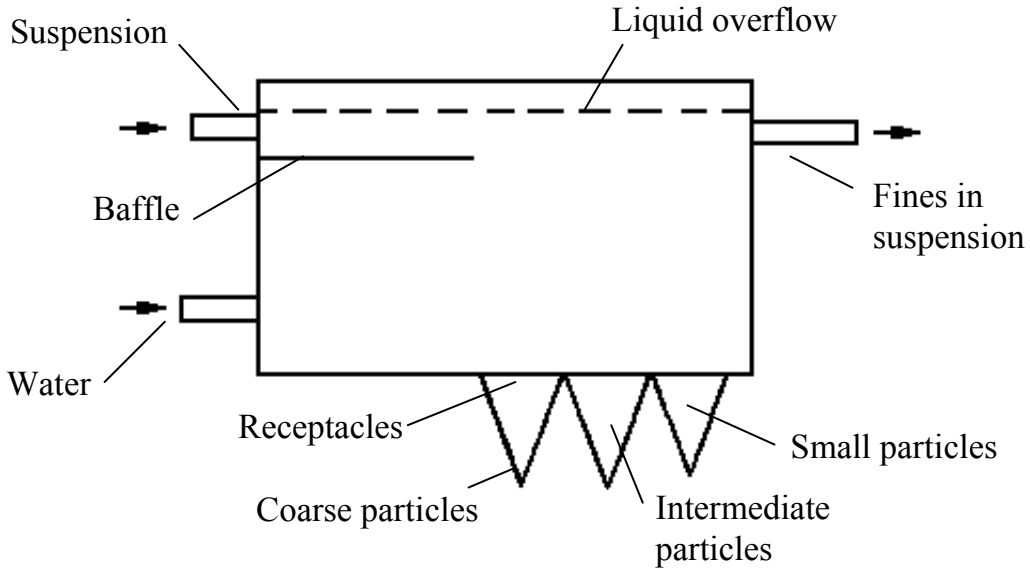

Fig. 7. Gravity settling tank

EXERCISES

I. Remember the pronunciation of the following words:
mixture, aperture, temperature, feature, structure, moisture, fracture.
Translate them. Why are they placed together?

II. Form the missing words from the following verbs and translate them:

Verbs		Nouns:		Adjectives:		Adverbs:
separate	–	separation	–	separative	–	separately
select	–	?	–	?	–	?
relate	–	?	–	?	–	?

III. Find the correct form of the word on the left so that it can be used on the right:
RELATE: A tank contains a ___ large volume of water.
SELECTIVELY: Separator depends on the ___ of a process.
SEPARATELY: Fluid ___ is used for ___ a mixture of two materials.

IV. Vocabulary. Translate the following word combinations from Russian into English:
классификация твердых частиц, фракции различного размера, метод просеивания (грохочения), плотность частиц, электромагнитные свойства материала, поверхностные свойства, дырчатая (перфорированная) пластина.

V. Translate the following word combinations into Russian:
liquid overflow, receptacles, to clog in the apertures of the screen, terminal falling velocity, mesh, woven wire cloth, settling tank.

VI. Pay attention to the proper translation of the words **CAUSE, BECAUSE, BECAUSE OF:**

1. Liquid overflow causes the very fine particles to move forward. **2.** Large particles collect near the inlet of the settling tank because of their high terminal falling velocity. **3.** When separating a material into size fractions a sieving method is used, because this process depends primarily on the size of the particles. **4.** A small force will cause fracture, provided it is maintained for a sufficient time. **5.** Low terminal falling velocity is the

cause that makes small particles to settle far from the inlet of the settling tank. **6.** A great force will cause the particle to fracture. **7.** All particles are separated in a fluid because of the clogging in fine apertures of the screen.

VII. Mind the different words: **VOLUME, VALVE and VALUE:**
1. In a tank there is a relatively large volume of water moving at a low velocity. **2.** The frequency of opening the valves is controlled independently. **3.** The value of gravity is assumed constant.

VIII. Look at Fig.7 and try to describe the process of separating in the settling tank.

UNIT 11

Brownian Movement – броуновское движение
centrifugal – центробежный
cluster – скопление
colloid – коллоид, коллоидный раствор
consolidation – уплотнение
depth – глубина
dilute – разбавленный, разжиженный
draining – осушение
expression – выжимание, отжим
flocculation – образование хлопьев
layer – слой
pure – чистый
sediment – осадок
sedimentation tank – отстойник
solute – растворенное вещество
volumetric concentration – объемная концентрация

SEDIMENTATION

Concentrated suspensions may be obtained by the process which is called sedimentation. Sedimentation is settling of solids from a solid/liquid mixture in such a way that two layers are formed (a concentrated suspension of the solids with a clear liquid above it). After settling the two layers can be separated by filtration or draining. Sedimentation is used in food processing to clean liquid from undesirable particles and to recover useful food particles from water suspensions. It is also applied in the expression of juices and oils from fruits, vegetables and oilseeds.

There are two methods of carrying out sedimentation: the gravitational and the centrifugal techniques. If the particle is settling in the gravitational field, it rapidly reaches its terminal falling velocity. In a centrifugal field the particle may reach a very much higher velocity because the centrifugal force may be many thousands of times greater than the gravitational force.

The rate of sedimentation has been found to depend on the particle diameter and density, the viscosity of the liquid. It also depends on the

depth and diameter of the containing vessel and the volumetric concentration. The depth of the sedimentation tank should be sufficient for settling the smallest solid particles, while the diameter should be such that the upward velocity of the clear water is lower than the settling velocity of the particles.

Although the sedimentation rate tends to increase steadily with the concentration of the suspension, the particles in very dilute suspensions settle rather quickly due to the formation of clusters of particles.

The rate of sedimentation of a suspension of fine particles is difficult to predict because of the large number of factors involved. Thus, for instance, the presence of an ionized solute in the liquid and the nature of the surface of the particles will affect the degree of flocculation, and, hence, the formation of sediment. A further factor influencing the sedimentation rate is the degree of agitation of the suspension. Gentle stirring can produce accelerated settling and prevent consolidation (agglomeration) of the final sediment.

The rate of sedimentation of particles in a fluid will be very much greater in a centrifugal field than in the gravitational field. The use of a centrifuge permits much more rapid sedimentation and also provides the possibility of effecting separation which would be quite impossible under gravitational conditions. For example, a colloid or emulsion may be quite stable under ordinary gravitational conditions where the dispersive forces such as those due to Brownian Movement are very much greater than the gravitational force. However, in a centrifuge the colloid or emulsion may break down completely because the vastly greater centrifugal forces will be able to overcome the effects of the dispersive forces. Similarly, it is possible to obtain a very much drier solid by centrifugal action than by draining under gravity, because the surface tension forces in the fine pores which cause retention of moisture can be overcome by the centrifugal but not the gravitational force.

EXERCISES

I. Give the derivatives of the following words:
centrifuge, gravity, disperse, retain, sediment, suspend, solve.

II. Form the nouns and verbs with the prefix DIS-:
advantage, comfort, charge, solve, cover, integrate, appear, continue.

III. Translate from Russian:
сила гравитации, центробежная сила, осаждение в гравитационном поле, удельная поверхность, объемная концентрация, броуновское движение, фильтрация, осушение, мелкие поры, влага.

IV. Translate from English into Russian:
degree of flocculation, dilute suspension, clusters of particles, degree of agitation, stirring, retention of moisture, flocculation, consolidation, settling, ionized solute, layer, surface tension forces, terminal falling velocity.

V. Remember how **DEGREES OF COMPARISON** are formed. When it is necessary to express the intensity of the quality, intensifiers are used, e.g.: longer – much longer, very much longer, vastly longer – far longer or vice versa – rather longer, somewhat longer.

VI. Translate the following sentences:
1. It is important to know that suspensions of fine particles tend to behave rather differently from coarse suspensions. **2.** In a centrifugal field the particle may reach a very much higher velocity because the centrifugal force may be many thousands of times greater than the gravitational force. **3.** It is possible to obtain a very much drier solid by centrifugal action than by draining under gravity. **4.** The use of centrifuge permits much more rapid sedimentation.

VII. Remember all the possible ways of translating the verbs **SHOULD** and **WOULD** into Russian. Translate the following sentences:
1. The liquid to be dispersed should be forced through an opening under pressure. **2.** If the openings were smaller and if the pressure were constant, the droplets formed would be smaller and more uniform. **3.** Using this mill, the engineer had to suppose that the output of the whole plant would be decreased. **4.** The mechanical engineer should be able to select the most suitable equipment for a certain purpose. **5.** A large difference in density of two substances would make mixing more difficult. **6.** Had these two substances differed in only one property, there would have been only one possible method of separation.

UNIT 12

basket – корзина, ковш
disturbance – возмущение, нарушение покоя
eject – выбрасывать, выталкивать
electrolyte – электролит
fit – устанавливать, монтировать, собирать, подгонять
incorporate – включать
liquor – жидкость, раствор
nozzle – сопло, патрубок, выпускное отверстие
periphery – окружность
precipitation – осаждение
scraper – скрепер, скребок
thickener – концентратор, сгуститель
time of residence – время (длительность) пребывания
throughput – производительность, пропускная способность
yeast – дрожжи

GRAVITATIONAL AND CENTRFUGAL SEDIMENTATION

As it has already been mentioned there are two methods of carrying out sedimentation: the gravitational and the centrifugal techniques. There exists a variety of equipment which is used for sedimentation, some of them being considered below.

The thickener is the industrial plant in which the concentration of a suspension is increased by sedimentation, with the formation of a clear liquid. Thickeners may operate as batch or continuous units and are made of relatively shallow tanks from which the clear liquid is taken off at the top and the thickened liquor at the bottom. In order to obtain the largest possible throughput from the thickener of a given size, the rate of sedimentation should be as high as possible. In many cases, the rate may be artificially increased by the addition of small quantities of electrolyte, which causes precipitation of colloidal particles and the formation of flocs. The suspension is also frequently heated because this lowers the viscosity of the liquid and encourages the larger particles in the suspension to grow in size at the expense of the more soluble small particles. The thickener frequently incorporates a slow stirrer, which causes a reduction in the apparent viscosity of the suspension and also in the consolidation of the sediment.

The batch thickener usually consists of a cylindrical tank with a conical bottom. After sedimentation has proceeded for an adequate time, the thickened liquor is withdrawn from the bottom and the clear liquid is taken off through the pipe from the upper part of the tank.

The continuous thickener consists of a large diameter shallow tank with a flat bottom (Fig. 8). The liquor is fed at the centre with as little disturbance as possible. The thickened liquor is continously removed through an outlet at the bottom and any solids which are deposited on the floor of the tank are directed towards the outlet by means of a slowly rotating mechanism incorporating scrapers. Because of the action of the mechanism, a greater degree of thickening is obtained than with the batch plant. The clarified liquid is continuously removed from an overflow. The thickener has a twofold function. First, it must produce a clarified liquid, the clarifying capacity being determined by the diameter of the tank. Secondly, the thickener is required to produce a given degree of thickening of the suspension. This is controlled by the time of residence of the particles in the tank.

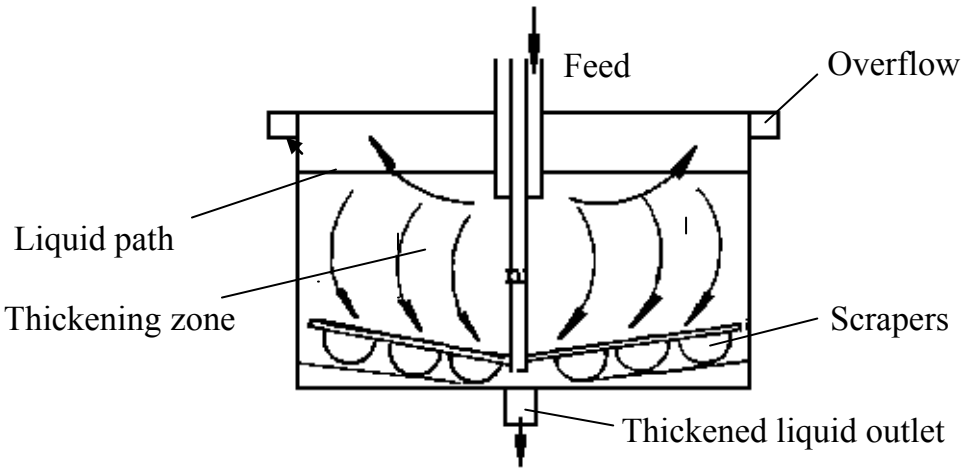

Fig. 8. A flow in a continuous thickener

As to the centrifugal separation equipment, one should certainly know that there exist a great number of centrifuges. Most of them are constructed with the axis of rotation either vertical or horizontal, though in some cases they may be arranged with the axis at an inclined angle in order to facilitate discharge of solids. The continuous removal of solids from the centrifuge basket can be effected by fitting a number of discharge nozzles around the periphery of the basket. The centrifuge is operated in such a way that solids are ejected with sufficient liquid to enable them flow. Centrifug-

es of this type are used in the processing of yeast, starch, meat, fish products and fruit juices.

EXERCISES

I. Translate and remember the words of the same root:
artist – art – artificial – artificially; equal – equality – equilibrium – equation; disturbance – disturb – turbine – turbulent – turbulence; determine – determination – determinable; define – indefinitely – infinite – indefinite; disintegrate – integration – integral – disintegration; viscous – viscosity – viscosimeter.

II. Why are these words placed here together?
classify, unify, satisfy, clarify, signify.

III. Mind the meanings of the prefix EN- and the suffix -EN in the following words:
1. thick – thicken, deep – deepen, fast – fasten;
2. entrain – train, enable – able, enclose – close, entitle – title.

IV. Translate from English into Russian:
to facilitate, to fit, batch thickener, shallow tank, throughput, clarifying capacity, precipitation, to disintegrate, twofold function, time of residence, scrapers, discharge nozzles.

V. Remember the translation of the formal subjects **IT, ONE, THERE** into Russian:
1. As it has already been mentioned there are two methods of carrying out sedimentation. **2.** When one is concerned with the problem of economy, it is necessary to be careful in choosing the equipment. **3.** There are a great number of centrifugal units on the market at present. **4.** There exists the problem of maintaining similarity between the laboratory unit and the industrial plant. **5.** The concentration of suspension will be high for there to be significant interaction between the particles. **6.** One should know that there exist a great number of centrifuges. **7.** If the particle is settling in the gravitational field, it rapidly reaches its terminal falling velocity.

LANGUAGE PRACTICE UNITS 7–12

Comprehension:

Revise texts 7–12 and decide which statements are true or false:

1. The purpose of size enlargement is breaking up of materials into smaller fragments.
2. Filtration and pressing are mechanical methods and evaporation is a physical method.
3. Separation becomes easier, the smaller the differences in properties.
4. The combination of sifting and pneumatic classification is applied in the milling industry.
5. The rate of sedimentation of particles in a fluid is greater in a centrifugal field than in the gravitational one.
6. There is only one type of centrifuges.

Speaking

Choose a topic and discuss it with your partner.

1. Separation methods.
2. Classification equipment.
3. Batch and continuous thickeners.

Speaking tips:

a) Explain things clearly.
в) Use some of your own ideas.
c) Consider your partner opinion.

Helpful phrases

To begin with, I would suggest...
Would you go along with that...
No, I'd rather think that...
Well, you certainly have a point, but...
Don't you think...?
That's absolutely right...
May I just cut in here...

Writing

Revise the texts 11 and 12, collect the information and write an article about gravitational and centrifugal sedimentation.

UNIT 13

build up – нарастать, накапливаться
cake filtration – фильтрация с образованием осадка
filter cake – осадок от фильтрования
filtering medium – фильтрующая среда
funnel – воронка
pore – пора
porous – пористый
support – опора
variable – переменная (величина)

FILTRATION

The separation of solids from a suspension in a liquid by means of a porous medium or screen which retains the solids and allows the liquid to pass is termed filtration. In the chemical laboratory filtration is often carried out in a conical funnel fitted with a filter paper. In the industrial scale filtration is accomplished mechanically by using various types of filters because of much larger quantities of suspension and solids. A thicker layer of solids has to form and, in order to achieve a high rate of passage of liquid through the solids, higher pressures will be needed and it will be necessary to provide a far greater area. A typical filtration operation is illustrated in Fig. 9 which shows the filter medium, in this case a cloth, its support and the layer of solids or filter cake, which has already formed.

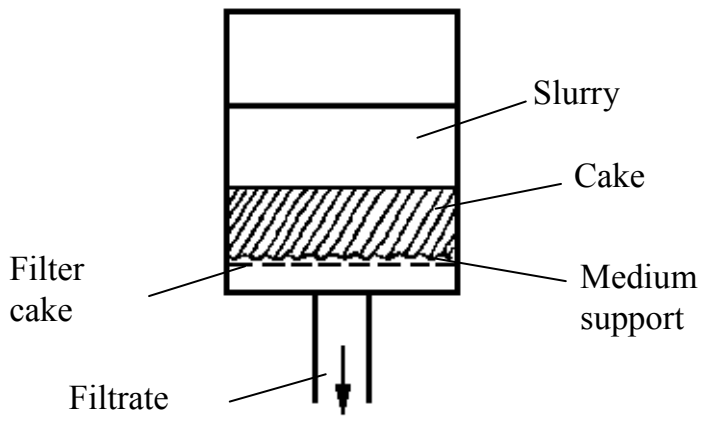

Fig. 9. Filtration operation

The volumes of the suspensions to be handled will vary from the extremely large quantities involved, in water purification, for example, to relatively small quantities in the fine chemical industry where the variety of solids will be considerable. In most instances it is the solids that are wanted and their physical size and properties are of great importance.

Filtration is one of the most important operations for solid/liquid separation, a large variety of filtration methods being used.

In the typical operation shown in Fig. 9 the cake gradually builds up on the medium and the resistance to flow progressively increases. During the initial period of flow particles are deposited in the surface layers of the cloth to form the true filtering medium. The type of filtration described above is usually referred to as cake filtration. The proportion of solids in the suspension is large and most of the particles are collected in the filter cake which can subsequently be separated and removed from the medium.

The mechanical details of the equipment, particularly of the flow channel and the support for the medium, influence the way the cake is built up and the ease with which it may be removed. A uniform structure is very desirable for good washing and cakes formed from particles of very mixed sizes and shapes present special problems.

The initial stages in the build-up of the filter cake are important because they may have a large effect on the flow resistance and may seriously affect the useful life of the cloth. The blocking of the pores of the filter medium by particles is an involved phenomenon, partly because of the very complex nature of the surface structure of the usual types of filter media. One of the most important variables affecting the tendency for blocking is the concentration of particles. The greater the concentration, the smaller will be the average distance between the particles, as a result, suspensions of high concentration generally give rise to cakes of lower resistance than those formed from dilute suspensions.

In the filtration, the resistance of the filter cake progressively increases and consequently, in a constant pressure operation, the rate of filtration falls. If the build-up of solids can be reduced, the effective cake thickness will be less and the rate of flow of filtrate will be increased.

There are many factors to be considered when selecting equipment and operating conditions for filtration.

EXERCISES

I. Form the adjectives having the negative meaning with the prifixes IN -, IM -, IL -, IR -, UN - :
visible, logical, regular, movable, possible, legal, desirable, mobile, dependent, perfect, common.

II. Find the correct form of the word on the left so that it could be used on the right:
FILTER: Particles are deposited on the cloth forming ____ medium.
COLLECT: Most of the particles are ____in the filter cake.
WASH: A uniform structure is very desirable for good ____.

III. Vocabulary. Translate properly into Russian:
filter medium, support, filter cake, water purification, cake filtration, the build-up of filter cake, useful life of the cloth, the tendency for blocking, the rate of filtration, constant pressure operation.

IV. Translate into English:
фильтрация с образованием осадка, фильтрующая среда, коническая воронка, очистка воды, сопротивление потоку, структура поверхности, концентрация частиц, толщина осадка от фильтрования.

V. Remember all the possible meanings of the word **THAT (THOSE).** Translate into Russian the following sentences:
1.The propeller diameter is of about one-third that of the vessel. **2.** In most cases it is the solids that are wanted and their size and properties **3.** The difference between coarse and fine particles is that coarse ones have larger falling velocity. **4.** The chemical reactivity of fine particles is greater than that of coarse ones. **5.** It is only by understanding the mechanisms of the processes that it will be possible for the engineer to design the most economical equipment. **6.** The filter is usually arranged in two sections so that each can be inspected separately. **7.** It is mainly in the details of construction that the differences will occur.

VI. Remember that all the verbs given below correspond to Russian 'называться':
to be called, to be termed, to be referred to as,

to be named, to be known as.

Translate the following, sentences:

1. The separation of solids from a suspension is termed filtration. **2.** This type of filtration is usually referred to as cake filtration. **3.** The discontinuous phase is known as the lean phase. **4.** Concentrated suspensions may be obtained by the process which is called sedimentation. **5.** The continuous phase is often referred to as the dense phase. **6.** The advantages of the centrifugal sedimentation process are named below. **7.** Particles deposited in the surface layer of the cloth can be termed the true filter medium. **8.** Separation of coarse particulate materials is referred to as sedimentation.

UNIT 14

bag filter – мешочный фильтр
consideration – соображение
discharge – разгрузка, опорожнение
drum filter – барабанный фильтр
feed tray – подающий лоток
overall cost – полная стоимость
overall rate – общая производительность
press filter – фильтр-пресс
repulp – повторно превращать в суспензию
resistance – сопротивление
rotary vacuum filter – барабанный вакуумный фильтр
slurry – суспензия
specific resistance – удельное сопротивление
thick – густой, толстый
suction filter – всасывающий фильтр

FILTRATION EQUIPMENT

The most suitable filter for any given operation is the one which fulfils the requirements at the minimum overall cost. Since the cost of the equipment will be closely related to the filtering area, it is normally desirable to obtain a high overall rate of filtration. This involves the use of relatively high pressures but the maximum pressures are often limited by considerations of mechanical design. Although a higher throughput from a given filtering surface is obtained from a continuous filter than from a batch operated filter, it may sometimes be necessary to use a batch filter, particularly if the filter cake has a high resistance, because most continuous filters operate under reduced pressure and the maximum filtration pressure is therefore limited. Other features which are desirable in a filter include ease of discharge of the filter cake in a convenient physical form, and a method of observing the quality of the filtrate obtained from each section of the plant. The most important types are filter presses and continuous rotary filters. In addition, mention should be made of filters for special purposes such as bag filters, and the disc type of filter which is used for the removal of small quantities of solids from a fluid.

The most important factors in filter selection are the specific resistance of the filter cake, the quantity to be filtered, and the solids concentration. For free-filtering materials, a rotary vacuum filter is generally the most satisfactory since it has a very high capacity for its size and does not require much attention. But for large-scale filtration, there are cases where rotary vacuum filters will not be used. If the cake must be washed, the rotary drum is to be preferred. However, if a high degree of washing is required, it is usually desirable to repulp the filter cake and to filter a second time.

Bag filters have now been almost entirely superseded for liquid filtration by other types of filter, but one of the few remaining types is that which has been used in the sugar industry. A number of long thin bags are attached to a horizontal feed tray and the liquid flows under the action of gravity so that the rate of filtration per unit area is very low. The filter is usually arranged in two sections so that each can be inspected separately without interrupting the operation.

The two main types of continuous rotary filters are the rotating drum and the rotating disc filters. These are suction filters in which filtration, washing, partial drying and discharge of the cake all take place automatically. Labor requirements are therefore low, and very economical operation can be obtained, especially if the thick suspension is fed to the filter.

Recent developments in rotary filters include increased size, new materials of construction, and improved methods of cake removal and drying. New construction materials, such as stainless steel, titanium and plastics, all give much improved corrosion resistance for many slurries and hence longer life.

EXERCISES

I. Remember the words of the same root. Translate them into Russian:
pure – impure – purify – purification – impurity; attach – attachment – detach – detachment.

II. Find the synonyms among the following verbs:
arrange, reduce, select, watch, use, form, observe, bring about, decrease, settle, apply, accomplish, shape, chose, precipitate, fit.

III. Vocabulary. Translate the word combinations from Russian:
непрерывный фильтр, фильтр периодического действия, качество фильтрата, фильтр-пресс, дисковый фильтр, удельное сопротивление, на единицу площади, затраты труда.

IV. Translate the word combinations from English into Russian:
minimum overall cost, filtering area, filter cake, discharge of the filter cake, considerations of mechanical design, bag filter, manual attention, drum filter, rotary vacuum filter, filter life.

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V. Remember all the possible ways of translating the verb **SHOULD** into Russian. Translate the following sentences:
1. Gentle stirring should be applied to produce accelerated settling. **2.** It was noted that we should use the rotary drum filters as the most suitable. **3.** If the filter cake had had high resistance we should have used a batch filter. **4.** The material should be of small size so that the distance the solute has to travel is small. **5.** The discharge of the cake should be facilitated by the application of compressed air.

VI. Remember the meanings and functions of the word **SINCE.** Translate the sentences:
1. Since 1909 the film type units have been used for evaporation. **2.** Forced circulation allows to achieve higher degrees of circulation since the heat transfer rate can be kept up. **3.** This type of evaporator has been used since without any change in the design. **4.** Since labor requirements are low very economical operation of the rotating filters can be obtained.

VII. Pay attention to the translation of the words **BEFORE** and **AFTER** in the following sentences:
1. The solvent is heated before it enters the tank. **2.** Before draining the residue, the solvent is sprayed over the solids. **3.** Before being processed vegetables should be washed. **4.**The equipment may be selected only after a detailed analysis of all factors has been made. **5.** Three different filters are placed one after another. **6.** After separating the two phases, the solvent is recovered from each phase. **7**. After the experimental plant proves to be efficient, its commercial production can be started.

UNIT 15

deterioration – порча, ухудшение(качества)
dispatch – отправка
drum dryer – барабанная сушилка
excessive – избыточный
fish meal – рыбная кормовая мука
hardening – затвердевание
mode – метод, способ
overheating – перегрев
pan dryer – лоточная сушилка
particulate – частица, в виде частиц
peel – кожица, корка, шелуха
roller dryer – вальцовая сушилка
rotary dryer – барабанная сушилка
spray dryer – распылительная сушилка
thermal efficiency – тепловой кпд

DRYING

Drying is widely used in many process industries and in food industry in particular.The process of drying consists of the removal of moisture from the products by application of heat usually in the presence of controlled flow of air. It is important in the processing of cereals and seeds, vegetables and fruits, meat, fish, seafood, milk and other food products.

The drying of materials is often the final operation in a manufacturing process and is carried out immediately prior to packaging or dispatch. The operation often follows evaporation, filtration, crystallization, etc. In some cases, drying is an essential part of the manufacturing process, though the majority of process industries apply drying for one or more of the following reasons:

(a) to reduce the cost of transport;

(b) to make a material more suitable for handling;

(c) to prevent the growth of microorganisms resulting in product deterioration;

(d) to avoid the presence of moisture which may lead to corrosion.

There are hundreds of dryer designs available on the market at the present time. The choice of the dryer depends on many factors, the kind of

product to be dried being the most important one. For example, application of rotary dryers to food products is limited to particulate materials, such as granulated sugar or some grains. Large food particles cannot be handled in this type of dryer due to the relatively short residence time, the danger of overheating, and the mechanical damage of the products.. Steam heated rotary dryers are used for drying fish meal and solid food wastes, e.g. citrus peel and pulp. A pan dryer with rotating scrappers is suitable for paste products. Spray dryers are used for drying liquid foods and food suspensions such as milk, coffee and juices which can be dispersed in the form of droplets in a stream of hot air. Drum or roller dryers are used to dehydrate concentrated food liquids, purees and pulp.

Once a group of possible dryers has been selected, the choice can be narrowed by considering the way in which the unit is to be operated – whether batch or continuous. In addition to the nature of the material, a further factor of some importance is the mode of heating, whether by contact with the solid surface or directly by convection and radiation.

Direct heating in which the material is heated primarily by convection from the surrounding air has several advantages. Directly heated dryers are less costly and allow the temperature of the air to be controlled within very fine limits. This is especially important for heat-sensitive materials. Against these advantages, the overall thermal efficiency of directly heated dryers is generally low due to the loss of energy in the exhaust air. This disadvantage may be overcome by modifications to the design, but in some cases, an indirectly heated dryer may prove to be more economical. This is especially the case when thermal efficiency or maximum cleanliness is of paramount importance. One problem with indirectly heated dryers is the danger of overheating the product, as excessive heat may cause hardening where the outside of the food becomes hard and brittle.

EXERCISES

I. Form the nouns from the given verbs using suffixes -TION, -MENT:
a) to separate, to filtrate, to operate, to radiate, to concentrate
b) to accomplish, to require, to develop, to move, to equip.

II. Give the derivatives of the following words:
dry, part, heat, clean, construct, produce, relate, different.

III. Translate into Russian:
removal of moisture, controlled air flow, particulate material, heat-sensitive material, overheating of the product, spray drier, excessive heat, packing, thermal efficiency.

IV. Sentence connection. Remember some of the words often used in scientific literature to connect sentences:
for – /союз/ – ибо, так как (показывает, что сказанное есть причина того, что упомянуто выше);
the former... the latter – первый (из двух упомянутых)..., последний (из двух упомянутых) – средство выделить одну или другую группу существительного в предыдущем предложении;
hence – отсюда, в результате (означает закономерность последующего утверждения);
however – однако, тем не менее (обозначает неожиданный поворот в ходе рассуждений) ;
otherwise – иначе, другими словами (показывает, что то, что было выражено в предыдущем предложении, может быть передано иным способом);
therefore – поэтому, следовательно (указывает, что последующее предложение есть результат того, что сказано выше);
thus – таким образом (обычно указывает на связь между предложениями или членами предложения).
Find these words used in the previous texts and expound their usage.

V. Pay attention to the proper translating of the word **ONCE:**
1. Once the solids are removed with the machine running at full speed, a considerable saving of time and energy is thereby achieved. **2.** If the material is passed only once through the equipment, the operation is known as batch operation. **3.** As soon as the extraction is complete, it is necessary to discharge the residue at once. **4.** Once centrifugal forces are employed, the rate of settling of particles in a gas stream can be greatly increased. **5.** Once there existed lots of operations which have been done manually.

VI. Discussion: Speak on the advantages and disadvantages of direct heating in drying equipment.

UNIT 16

adverse – вредный, неблагоприятный
cabinet – шкаф, отделение
coil – змеевик
countercurrent flow – противоток, встречный поток
flow pattern – тип потока, характер течения
rack – полка, стеллаж
series – набор, комплект, ряд
shell – корпус, кожух
sheet-metal – тонкий листовой металл
stack – укладывать в штабель
tray – лоток, поддон
tray(shelf) drier – полочная сушилка
trolley – тележка, вагонетка
truck – вагонетка, тележка
tunnel drier – сушилка туннельного типа

DRYERS

There are hundreds of dryer designs available on the market at the present time, some of them being considered below in brief.

Tray or shelf dryers are commonly used for granular materials or for individual articles. The material is placed on a series of trays which may be heated from below by steam coils and drying is carried out by the circulation of air over the material. A modern tray dryer consists of a well-insulated cabinet with integral fans and trays which are stacked on racks or are loaded on to trucks which are pushed into the dryer. The capacity of tray dryers depends on many factors such as the nature of material, the loading and external conditions.

In the tunnel dryers, a series of trays or trolleys is moved through a long tunnel and drying takes place in a current of warm air. The tunnel itself may or may not be heated. Tunnel dryers are used for drying trays of some chemicals, foodstuffs, etc. In an alternative system, material is placed on a belt conveyor passing through the tunnel. Typical tunnel arrangements for countercurrent flow of air are shown in Fig. 10. The construction is usually made of sheet-metal and the size varies over a wide range, some dryers being over 30 m long.

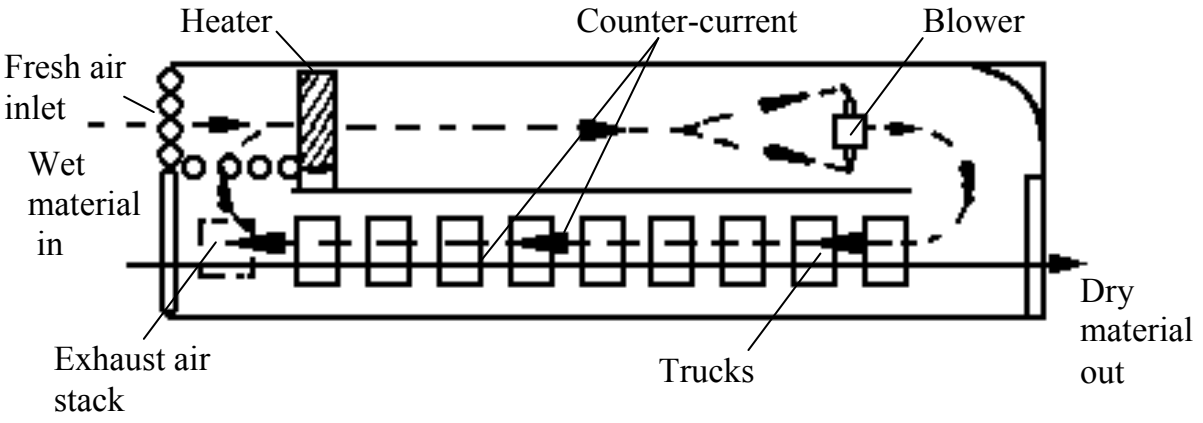

Fig. 10. Tunnel dryer

For the continuous drying of materials on a large scale, the rotary dryer is suitable. This consists of a relatively long cylindrical shell mounted on rollers driven at a low speed. The shell is arranged at a small angle to the horizontal so that material fed in at the higher end travels through the dryer under gravity. The air used as a drying medium is fed in either at the upper end of the dryer to give cocurrent flow, or at the discharge end of the machine to give countercurrent flow.

Spray dryers, otherwise known as atomizers, are used in a variety of industries where fairly high grade product is to be made in granular form. In the drying chamber the gas and liquid streams are brought into contact, and the efficiency of mixing depends upon the flow patterns induced in the chamber. Rotating disc atomizers are most commonly used.Countercurrent dryers give the highest thermal efficiencies but result in high product temperatures. This limits their use to materials which are not affected by overheating. Cocurrent dryers suffer from relatively low efficiency but have the advantage of low product temperatures unless back mixing occurs. In the case of materials which are extremely sensitive to heat great care has to be taken in the design of the chamber to eliminate this. In the preparation of foodstuffs indirectly heated air is used. Maximum temperatures are then normally limited to lower values than those with direct heating. Spray drying has generally been regarded as a relatively expensive process, especially when indirect heating is used. But for handling large volumes of solutions, spray dryers are unsurpassed and it is only at feed rates below 0.1 kg/s that a drum dryer becomes more economic. The jet spray dryer has been used for evaporating milk without adverse effect on flavor and although operating costs are likely to be high the system is well suited to the handling of heat-sensitive materials.

EXERCISES

I. Remember the suffix -WISE forming adjectives and adverbs of manner and viewpoint, e.g.: clockwise, nowise, weather-wise.
Make adverbs from the following words by adding the suffix and translate them into Russian:
other – ? stage – ? length – ? cross – ?

II. What part of speech do the suffixes –NESS, - LESS signify?
roughness, coarseness, hardness, cleanliness, useless, noiseless, helpless, systemless.
Translate the words.

III. Pay attention to proper translation of the terms:
tray or shelf dryers, individual articles, integral fans, to stack, truck, external conditions, tunnel dryer, rotary dryer, spray dryer, atomizer, high grade product, rotating disc atomizer, back mixing, adverse effect.

IV. Mind the translation of the **CLAUSES OF PROPORTION:**
1. The greater the concentration, the smaller will be the average distance between the particles. **2.** The thicker the suspension, the lower is the rate of sedimentation. **3.** The greater the rate at which the load is applied, the less effectively is the energy utilized and the higher is the proportion of fine material which is produced.

V. What grammar phenomena can you find in these sentences? Translate them into Russian:
1. Large food particles cannot be handled in rotary drier due to the danger of overheating and the mechanical damage of the products. **2.** If there is no product between the disks, the machine stops automatically. **3.** With a horizontal centrifuge solids are more readily discharged because they can be allowed to fall directly into the pipe. **4.** The gas is found to move spirally downwards, gradually approaching the central portion of the separator. **5.** The great advantage of this method is that heat-sensitive materials are not damaged. **6.** This principle of separation is little used since the equipment used must be very large in order to reduce gas velocity to a reasonably low value to allow finer particles to settle. **7.** An indirectly heated dryer may prove to be more economical.

VI. Answer the question: What types of driers are discussed in the text?

UNIT 17

conventional – общепринятый, обычного типа
dehydrate – обезвоживать, сушить
freeze drying – сублимационная сушка
helium – гелий
justify – оправдывать
nitrogen – азот
nutritive value – питательная ценность
reconstitute – восстанавливать
sublimation drying – сублимационная сушка

FREEZE DRYING

If contact drying takes place at such a low water vapour pressure that the temperature of the product drops below the freezing point, then it is referred to as freeze drying or sublimation drying. The product then contains ice crystals which change into vapour when provided with the heat of sublimation; this water vapour flows to a condenser where it condenses as ice.

The low water vapour pressure required can be obtained either by drying in a vacuum or by drying in a sufficiently dry gas. The former method, which is the most common, is really vacuum drying. The latter method can take place under atmospheric pressure, the dry gas being usually air or nitrogen.

The freeze drying process consists of freezing and drying. The material is first frozen and then dried in a very high vacuum at a temperature in the range of 240 – 260K. In vacuum freeze drying there are four possible ways of supplying the heat of sublimation: by contact with warm surface, by infrared radiation, by means of microwaves and by admitting a gas that is a good conductor, such as helium.

Freeze drying has a few great advantages which make it very attractive for both solid and liquid foodstuffs. Firstly, the whole process takes place at low temperature. Freezing is usually very rapid, at the end of the freezing process the product being completely dry. The removal of ice takes place at a low temperature and the only part of the product that is exposed to slightly higher temperatures is that which is already dry. The most significant characteristic of freeze-dried products is that they retain their shape and dimensions. They are very light and porous. Consequently they are easily reconstituted and have the additional advantage that they retain their

original appearance which is desirable for pieces of mushrooms, carrots, fruit, chicken and shrimps, for example. Furthermore, the porosity of the products makes it easy to feel them with inert gas such as nitrogen which may be used to break the vacuum at the end of the freeze drying process. Another feature of freeze drying that might be considered an advantage is that very low water contents can easily be obtained. There is also a reasonable retention of aroma with freeze drying.

The porosity of freeze dried products makes packing, storage and transport expensive. To avoid this disadvantage the products can be compressed into tablets after freeze drying. Although the shape is lost, the reconstitution properties deteriorate very little.

Vacuum and freeze driers are the most expensive drying equipment, and they are used to dehydrate sensitive, high-value food products, like coffee, fruit juices, vegetable extracts, mushrooms, dairy products, meat and chicken. The improvement of quality, functional properties and nutritive value of these products justifies the added cost, compared to the conventional drying methods.

Freeze driers are mostly batcn operated installations. They consist basically of a vacuum cabinet, where the product is dried, spread on trays, and a condensing/vacuum system for removing the water vapours and maintaining the vacuum. Semicontinuous and continuous freeze-drying systems have been developed for large industrial operations and are mostly used for drying expensive biotechnological products.

EXERSISES

I. What part of speech do these words belong to?
sufficiently, easily, generally, indirectly, extremely, mostly, relatively, considerably, relatively, continuously, commonly
Translate them into Russian.

II. Form words with the given prefixes and translate them into Russian:
OVER - : heat, flow, estimate, load, weigh, work
UNDER - : do, go, take, line, ground, graduate, estimate, load.

III. What is the meaning of the prefix INTER -? Translate the words:
international, interaction, interdependent, interchange, interconnection.

IV. Translate into Russian:
low water vapour pressure, high liquid content, freeze-dried product reconstitution properties, vacuum freeze drying, poorly conducting material, relatively large heat exchange surface, water-rich products concentration.

V. Translate the following sentences paying attention to **MODAL VERBS** and their equivalents:
1. The condenser has to be cooled to a very low temperature. **2.** All factors should be taken into account when choosing suitable equipment. **3.** This process can take place under high pressure. **4.** While carrying out this operation the reacting materials are to be brought into close contact. **5.** One should be careful while working with infrared radiation. **6.** Another feature that might be considered an advantage is that very low water contents can be obtained. **7.** In vacuum freeze driers large volumes of air and water vapour have to be removed.

UNIT 18

dilute – разбавлять
evaporation – испарение, выпаривание, сгущение
expression – выжимание, отжим
freezing-out – вымораживание
hexane – гексан
liquor – раствор, сироп
microbial spoilage – бактериальная порча
partition – разделение
phase equilibrium – равновесие фаз
powdered milk – сухое молоко
solute – растворенное вещество
solvent – растворитель
sugar cane – сахарный тростник
volatility – летучесть, испаряемость
withdrawal – выведение, извлечение, удаление

CONCENTRATION AND CRYSTALLIZATION

Concentration is the withdrawal of some of the solvent from a solution, and it is thus a partial separation of a homogeneous mixture of solute and solvent. The partial separation results in a more concentrated solution. In the food industry the solvent to be withdrawn is nearly always water.

Concentration is applied to water-rich liquid products which are either directly available in such a state(milk, blood) or are obtained by expression (sugar cane liquor, fruit, vegetables) or extraction (extracts of coffee, tea, meat etc). An axample of the application of the concentration process to a non- aqueous solution is the concentration of a solution of oil in a solvent such as hexane.

Withdrawal of a large portion of the water from a product reduces the storage and transportation costs. Water has to be added to the concentrate again prior to consumption. Concentration is widely used for food preservation. It is known that an increase in the concentration of sugar has a preservation action. When products contain a great deal of sugar by nature, then concentration can be used to lower the water activity to such an extent that they become microbiologically stable. If the amount of sugar present is insufficient then more sugar can be added. In the manufacture of jam, for

example, concentration is used as well as addition of sugar. It is also possible, for example to concentrate a meat extract containing salt to such an extent that there will be no further microbial spoilage.

Concentration is also often used as a treatment prior to a more complete withdrawal of water (drying). An important example is the preparation of powdered milk in which the milk is first concentrated to a solid content of 45 to 50 % and then dried further. In the sugar industry concentration is used as pretreatment in the crystallization of sugar. In the wine industry concentration is sometimes used to raise the alcohol content to a prescribed level.

The process of concentration can be carried out by any one of the following physical methods. It is possible to utilize a difference in partition between two phases, i.e. a phase equilibrium favourable for separation. In evaporation use is made of the difference in volatility between water and solute and thus a favourable liquid-vapour equilibrium. In freezing-out, use is made of the fact that dilute solutions are in equilibrium with ice at their freezing points; thus a favourable liquid-solid equilibrium is utilized. In freezing-out part of the water is crystallized by withdrawal of heat, whereupon the concentrated solution is separated mechanically from the ice crystals.

In crystallization process part of the solute in the homogeneous solution is converted into crystalline state and the crystals are separated mechanically from the remaining solution. The great advantage of this method is that pure solid can be recovered from impure solution. In addition, crystallized products have both an attractive appearance and a convenient shape for packing, transport and storage. In the food industry crystallization of fats in margarine and chocolate, or sugar in sweets is widely used. It is also important in obtaining pure fresh water from sea water and in freezing as method of food preservation.

EXERCISES

I. Form the nouns from the given verbs using proper suffixes:
to act, to convert, to improve, to differ, to spoil, to achieve, to dry, to treat, to concentrate, to appear, to crystallize.

II. How the prefixes PRE -, and COUNTER – change the meaning of the following words?
pretreatment, preheat, predetermine, precool, prefreezing, counterflow, countercurrent.

III. Translate into English:
концентрированный раствор, кристаллы льда, смесь растворителя и растворенного вещества, выжимание фруктов, сухое молоко, испарение жидкости, транспортные расходы, концентрация сахара, кристаллизация жиров.

IV. Remember how **NAPC** is translated into Russian:
1. Separation of heterogeneous mixtures of two liquids is a common operation, the two liquids being of different densities. **2.** All the advantages of the methods available having been considered, the best method was chosen. **3.** The amount of sugar being insufficient, more sugar can be added. **4.** A solution containing several crystallizable substances, more than one substance may crystallize out at the same time. **5.** The most important properties that determine the quality of crystals are purity, the dimensions, shape and uniformity of size, the former being the most important.

V. Pay attention to the proper translation of sentences with **SUBORDINATE CLAUSES:**
1. Freeze drying is applied to valuable products which deteriorate too much in quality when dried by other methods. **2.** It is questionable whether it is possible to find good quality water. **3.** It was mentioned that an increase in the concentration of sugar has a preserving action. **4.** The great advantage of this method is that pure solid can be recovered from impure solution. **5.** That concentration is applied to water-rich liquid products is a wellknown fact. **6.** Freeze-dried products are easily reconstituted provided water is added.

LANGUAGE PRACTICE UNITS 13–18

Comprehension:

Revise texts 13-18 and choose the correct answer:

1. The most suitable filter for any given operation is the one which …
    a) has high labour requirements.
    b) operates under minimum filtration pressure.
    c) fulfils the requirements at the minimum overall cost.
    d) has a low overall rate of filtration.

2. Spray dryers are used for …
    a) concentrated food liquid.
    b) food suspensions.
    c) paste products.
    d) solid food wastes.

3. The most significant characteristic of freeze-dried products is that they …
    a) are easily reconstituted.
    b) lose their original appearance.
    c) are porous and heavy.
    d) have high water content.

4. Concentration can be carried out by …
    a) vacuum drying.
    b) reducing atmospheric pressure.
    c) evaporation.
    d) dilution.

Speaking

Choose a topic and discuss it in a group.

1. Types of filters.
2. Drying and its application.
3. The advantages of crystallization process.

Speaking tips:

a) Take everyone’s point of view into account.
b) Don’t speak about too many things.
c) Choose one or two facts you know well and give examples.
d) Use your own ideas.

Helpful phrases

As far as I know...
Don’t you know...?
I would like to add...
Well, I totally agree with you...
Don’t you think...?
Have you heard...?
May I just cut in here...

Writing

Revise the texts 15–17 and write a report on the topic: “Food dehydration equipment”.

VOCABULARY

A

ADHERE (v) прилипать, сцепляться
ADVANTAGE (v) преимущество
ADVERSE (a) вредный, неблагоприятный
AGGLOMERATE (v) агломерировать, скапливаться
AGGLOMERATION (n) агломерация, спекание, слипание
AGITATE (v) взбалтывать, перемешивать
AGITATOR (n) мешалка, лопасть мешалки
AGITATOR TANK (n) резервуар с мешалкой
AGRICULTURE (n) сельское хозяйство
ANIMAL HUSBANDRY (n) животноводство
APERTURE (n) отверстие
APPEARANCE (n) внешний вид
AQUEOUS (a) водный
ARRANGEMENT (n) расположение, размещение, установка, монтаж, система, устройство, структура
ARTICLE (n) изделие, продукт
ASSEMBLE (v) собирать, монтировать
ATOMIZER (n) распылитель, мельница (для тонкого помола)
AXIAL (a) осевой
AXIALLY (adv) аксиально, по направлению оси
AXIS (n) ось
AUXILIARY (a) вспомогательный, добавочный

B

BAKERY (n) пекарня
BAKERY PRODUCT (n) выпечное изделие
BAR (n) брусок, полоска
BASKET (n) корзина, ковш
BATCH (n) порция, партия,
BEAN (n) боб
BEET (n) свекла
sugar ~ сахарная свекла
BERRY (n) ягода
BISQUIT (n) печенье, бисквит
BLEND (n) смесь

BLOW (n) удар, толчок
BLOW (v) дуть, продувать
BLOWER (n) воздуходувка
BOTTOM (n) дно, основание
BOUNCE (v) подпрыгивать, отскакивать
BREAK UP (v) разбивать
BRIQUETTING (n) производство брикетов, брикетирование
BRITTLE (a) хрупкий

C

CABINET (n) шкаф, отделение
CAKE (n) лепешка, брикет, слежавшийся осадок
filter ~ осадок от фильтрования, фильтровальная лепешка
CAKE FILTRATION (n) фильтрация с образованием осадка
CAN (v) консервировать
CAPACITY (n) мощность, производительность, производительная способность, емкость
CARROT (n) морковь
CAVITY (n) полость, выемка
CELL (n) клетка, ячейка
CENTRIFUGATION (n) центрифугирование
CENTRIFUGE (n) центрифуга
CEREAL (n) хлебный злак
CLARIFY (v) очищать, отделять от примесей
CLASSIFICATION (n) классификация
solid particle ~ разделение твердых тел по размеру
CLOG (v) засорять(ся)
CLOTH (n) ткань
woven wire ~ металлическая ткань(для сит), проволочная сетка
CLUSTER (n) скопление
COARSE (a) грубый
COIL (n) змеевик
COLLECT (v) собирать, скапливаться
COLLIDE (v) сталкиваться
COMPOSITION (n) состав
CONCERN (v) касаться, иметь отношение
CONFECTIONARY (n) кондитерская фабрика, конфета
CONFECTIONERY (n) кондитерские изделия, искусство кондитера

CONSIDERATION (n) соображение, рассмотрение
CONSOLIDATION (n) уплотнение
CONSUMPTION (n) потребление, расход
energy ~ расход энергии
CONTRIBUTION (n) участие, содействие, вклад, доля участия
CONVECTION (n) конвекция
CONVENTIONAL (a) общепринятый, обычного типа
CONVEY (v) транспортировать, перевозить
CONVEYOR (n) транспортер, конвейер
CORRELATION (n) соотношение, связь
COST (n) стоимость; (pl) затраты
overall ~ полная стоимость
COUNTERCURRENT(n) противоток, встречный поток
CREAM (n) сливки
whipped ~ взбитые сливки
CUTTER (n) режущий аппарат, куттер
CUTTING (n) резание, резка, кусок
CYLINDER (n) цилиндр, валок, барабан

D

DAIRY PRODUCT молочный продукт
DAMAGE (n) повреждение, авария, порча, ущерб, убыток;
(v) повреждать, разрушать, наносить ущерб
DEFECTIVE (a) поврежденный, с пороком
DEGREE (n) степень, градус, сорт
DEHYDRATED (a) дегидратированный, обезвоженный
DELUTED (a) жидкий, разбавленный
DENSITY (n) плотность
DEPTH (n) глубина
DESINTEGRATE (v) расщепляться, дробить(ся), размельчать(ся)
DETERIORATION (n) ухудшение качества
DIP (v) погружать, макать, окунать
DIRT (n) грязь
DISADVANTAGE (n) недостаток
DISCHARGE (n) разгрузка, опорожнение
DISINTEGRATOR (n) дробилка, коллоидная мельница, дезинтегратор
DISPATCH (n) отправка
DISPERSION (n) дисперсия

DISPLACE (v) перемещать
DISSOLVE (v) растворять(ся), разжижать
DISTRIBUTION (n) распределение
size ~ распределение частиц по размеру
DISTURBANCE (n) возмущение
DOUGH (n) тесто
DRAINING (n) осушение
DRY (v) сушить
DRYER (n) сушилка, сушильный аппарат
pan ~ лоточная сушилка
roller ~ вальцовая сушилка
rotary ~ барабанная сушилка
spray ~ распылительная сушилка
tray or shelf ~ полочная сушилка
tunnel ~ сушилка туннельного типа
DRYING (n) сушка
freeze ~ сублимационная сушка, сушка вымораживанием

E

EDIBLE (a) съедобный
EFFECT (n) действие, влияние, эффект, результат
EFFICIENCY (n) эффективность, производительность, к.п.д
EJECT (v) выбрасывать, выталкивать
EJECTOR (n) эжектор, струйный насос
ELECTROLYTE (n) электролит
ENLARGEMENT (n) увеличение
size ~ увеличение размеров
EQUIPMENT (n) оборудование
EXPRESSION (n) выжимание, отжим
EXTRACTION (n) извлечение, отжим, экстракция
EXTRUDE (v) выдавливать, выталкивать
EXTRUDER (n) шприц-машина
EXTRUSION (n) выдавливание, прессование (через матрицу)

F

FAN (n) вентилятор
FEED (n) корм

mixed ~ смешанный корм
~ tray подающий лоток
FILTER (n) фильтр
FILTERING MEDIUM (n)
bag ~ мешочный фильтр
batch ~ фильтр периодического действия
continuous ~ фильтр непрерывного действия
drum ~ барабанный фильтр
press ~ фильтр-пресс
rotary vacuum ~ барабанный вакуумный фильтр
FILTRATION (n) фильтрация
FINE (a) мелкий
FISHERY (n) рыбный промысел
FIT (v) устанавливать, монтировать, собирать, подгонять
FLEXIBILITY (n) гибкость, приспособляемость
FLOAT (v) плавать
FLOCCULATION (n) свертывание, выпадение в осадок
FLOTATION (n) флотация
FLOUR (n) мука
FLOW (n) поток, течение
~ pattern тип потока, характер течения
~ sheet
FLUID (n) текучая среда (жидкость или газ), жидкость
FLUIDIZATION (n) ожижение, флюидизация
FLUME (n) желоб
FOOD (n) еда, пища
~ industry пищевая промышленность
~ safety безвредность пищевых продуктов
FORCE (n) сила, усилие
centrifugal ~ центробежная сила
gravitational ~ гравитационная сила
dispersive ~ сила дисперсии
shearing ~ скалывающее усилие
FOREIGN (a) инородный
FORM (n) форма, вид, образ
marketing ~ товарный вид
FRACTION (n) фракция, дробь
size ~ фракция по размеру

FRACTURE (n) разрыв
FRAGMENT (n) часть, кусок
FRICTION (n) трение
FRUIT PULP (n) плодовая мякоть, мезга, пульпа, пюре
FUNNEL (n) воронка

G

GRAIN (n) зерно
GRANULATION (n) зернение, грануляция, дробление
GRIND (v) молоть, дробить, измельчать
GRINDER (n) измельчитель, дробилка, мельница
GRINDING (n) дробление, размалывание
GROOVED (a) бороздчатый, желобчатый (с бороздками, канавками)

H

HANDLING транспортировка; погрузоразгрузочные операции
HARD (a) твердый, жесткий, крепкий
HARDENING затвердевание
HEAT (n) тепло
HEAT TRANSFER теплопередача, теплоотдача
HEXANE (n) гексан
HINGE (N) прикреплять
HOMOGENUOUS (a) однородный
HOMOGENIZER (n) гомогенизатор
HOMOGENIZING гомогенизация
HORTICULTURE (n) садоводство
HYDRATE (v) гидратировать(ся)
HYDRAULIC (a) гидравлический
HYDROFOIL (n) гидрокрыло

I

IMMISCIBLE (a) несмешиваемый, несмешивающийся
IMPACT (n) удар, столкновение
IMPURITY (n) примесь
INCLINED наклонный
INCORPORATE (v) включать

INDUSTRY (n) отрасль промышленности
process ~ обрабатывающая промышленность
INLET (n) вход, впуск, впускное отверстие
INSOLUBLE (a) нерастворимый
INSTANT (a) растворимый

J

JUICE (n) сок
fruit ~ фруктовый сок

K

KNEAD (v) месить, смешивать, разминать
KNEADING arm (n) месильный орган(лопатка)

L

LAYER (n) слой
LIQUOR (n) жидкость, раствор
strong ~ концентрированный раствор (жидкость)
LOADING (n) загрузка, погрузка
LOOSE (a) рыхлый, сыпучий, неплотный
LOOSEN (v) освобождать, отделять

M

MACHINE (n) машина, аппарат
kneading ~ тестомесилка, тестомесильная машина
MARGARINE (n) маргарин
MARKET (v) продавать
MARKETING form (n) товарный вид
MASHED VEGETABLES пюре из овощей
MASS TRANSFER – массоперенос, массопередача
MAYONNAISE (n) майонез
MEDIUM (n) (pl. –a) среда
filter ~ фильтрующая среда
MESH (n) сетка, отверстие сита, меш (число отверстий на дм)
MICROBIAL SPOILAGE бактериальная порча
MILL (v) молоть, измельчать
MILL (n) мельница
colloid ~ коллоидная мельница

hammer ~ молотковая~
impact ~ ударная ~
pin ~ разбивной барабан
roller ~ вальцовая ~
MISCIBLE (a) смешивающийся
MIX (v) смешивать
MIXED FEEDS смешанные корма
MIXER (n) мешалка, смеситель, миксер
batch ~ мешалка периодического действия
continuous ~ мешалка непрерывного действия
drum ~ барабанный смеситель
planetary ~ планетарная мешалка
rotating ~ мешалка с вращающимся барабаном
MIXING (n) образование смеси, смешивание, перемешивание back ~ обратное смешивание
MIXTURE (n) смесь
MOLTEN (a) жидкий, расплавленный
MOLDING (n) прессование, формование
MOUNT (v) монтировать, насаживать, устанавливать

N

NITROGEN (n) азот
NOZZLE (n) сопло, патрубок
NUTRITIVE VALUE питательная ценность

O

OPENING (n) отверстие
OPERATION (n) работа, функционирование, операция, процесс; эксплуатация; режим работы
constant pressure ~ работа при постоянном давлении
unit ~ типовая химико-технологическая операция
OUTLET (n) выход, выходное отверстие
OVERALL (a) полный, общий
OVERFLOW (v) переполняться, переливаться через край
~(n) слив, перелив; продукт, увлекаемый через слив при гидравлической классификации

P

PACK (v) упаковывать
PACKAGIHG (n) упаковка, тара, упакованный продукт,уплотнение
PADDLE (n) лопасть, лопатка
PARTICULATE (n) частица; (a) в виде частиц, частичный
PARTITION (n) разделение
PASTE (n) тесто, макаронное изделие, паста
PEA (n) горошина, горох
PEANUTS (n) арахис, земляной орех
PEEL (n) кожица, корка, шелуха
PEEL (v) очищать
PELLET (n) шарик, гранула
PELLETTING (n) производство гранул, шариков
PHARMACEUTICAL (a) фармацевтический
PHASE (n) фаза
PIN (n) штифт, штырь
PIPELINE (n) трубопровод
PLATE (n) пластина
perforated ~ перфорированная пластина
PNEUMATICALLY (adv) пневматически
PORE (n) пора
POROSITY (n) пористость
POROUS (a) пористый
POWDER (n) порошок, пудра, пыль
POWDERD MILK сухое молоко
POWDERY (a) порошкообразный
PRECIPITATION (n) осаждение
PRESS (n) пресс
screw ~ винтовой пресс
PRESSING (n) прессование
PROCESS (v) обрабатывать
PROCESSING (n) обработка, переработка, технология
PRODUCT (n) продукт
dairy ~ молочный продукт
PROPELLER (n) винт, пропеллер
PULP (n) пульпа, мякоть
sugar beet ~ свекловичный жом (пульпа)
PUMP (n) насос
PURE (a) чистый

R

RADIAL (a) радиальный, лучевой
RATE (n) скорость, степень, коэффициент, класс, сорт
flow ~ объемная скорость потока, расход
RATIO (n) коэффициент, отношение, соотношение, пропорция
reduction ~ степень (коэффициент) измельчения
RECEPTACLE (n) приемый сосуд, приемник, резервуар
RECONSTITUTE (v) восстанавливать
RECOVER (v) восстанавливать, извлекать
RECOVERY (n) восстановление, извлечение, регенерация
REDUCTION (n) (химическое) восстановление, уменьшение, измельчение
size ~ измельчение, размол
RELEASE (v) освобождать
REPULP (v) повторно превращать в суспензию
REQUIREMENT (n) потребность, условие, требование
labor ~ затраты труда
RESIDENCE TIME (n) (время) длительность пребывания
RESIDUE (n) осадок, остаток
RESISTANCE (n) сопротивление
specific ~ удельное сопротивление
RESTRAINT(n) ограничение, ограничитель, условие, требование
RETENTION (n) сохранение, удержание
water ~ удержание влаги
REVERSE (a) обратный, противоположный
RHEOLOGICAL (a) реологический
RIPE (a) зрелый
RIPENESS (n) зрелость, спелость
ROLL (n) валец, вращающийся цилиндр
RUBBING (n) растирание

S

SAMPLING (n) взятие проб
SAUSAGE (n) колбаса, сосиска
SCALE (n) шкала, масштаб, накипь, окалина
SCRAPE (v) скоблить, скрести
SCRAPPER (n) скреппер, скребок
SCREEN (n) решето, сито, грохот

SCREW (n) шнек
SEDIMENT (n) осадок
SEDIMENTATION (n) осаждение
SEED (n) семена, зерно
SETTLE (v) осаждать(ся), отстаиваться
SETTLING (n) осаждение
~ tank отстойник
SHAKE (v) встряхивать, трясти
SHALLOW (a) мелкий. плоский
SHAPE (n) форма, вид, конфигурация
SHAPING (n) придание формы, формование
SHEET (n) лист, пластина
~ metal тонкий листовой металл
SHELL (n) корпус, кожух
SIEVE (n) сито, решето, грохот
SIEVING (n) просеивание, грохочение
SIFT (v) просеивать
SINK (v) тонуть
SLICE (n) ломтик, кусок
SLIT (n) прорезь, щель
SMOOTH (a) гладкий, ровный
SOLID (n) твердое тело
SORTING (n) сортирование, классификация
SOLUBLE (a) растворимый
SOLUTION (n) раствор
SOLVENT (n) растворитель
SPRAY (v) разбрызгивать, распылять
STACK (v) складывать в штабель
STARCH (n) крахмал
STATIONARY (a) стационарный, неподвижный
STAY (v) оставаться
STIR (v) мешать, перемешивать
STIRRER (n) мешалка
paddle ~ лопастная ~
propeller ~ пропеллерная, винтовая
STRESS (n) напряжение
shear ~ касательное напряжение
SUBJECT (TO) (v) подвергать

SUBLIMATION (n) сублимация
SUGAR (n) сахар
~ cane сахарный тростник
SUPPORT (n) опора
SUSPENSION (n) суспензия, взвесь
dilute ~ жидкая суспензия
SWEET (n) конфета; (a) сладкий

T

TABLETTING (n) производство таблеток, таблетирование
TANGENTIAL (a) касательный, тангенциальный
TANK (n) резервуар, хранилище, бак, цистерна, сборник, чан
settling ~ отстойник
TASTE (n) вкус
TEAR (v) рвать, разрывать
TEETH (n pl) зубья, зубцы
TERMINAL (a) конечный
THICKEN (v) сгущать
THICKENER (n) концентратор, сгуститель, отстойник
THROUGHPUT (n) количество материала, пропускаемое через сито; пропускная способность, производительность
TOUGH (a) жесткий, прочный, плотный, вязкий
TRAY (n) желоб, тарелка, противень, лоток, поддон
TRUCK (n) грузовой автомобиль, тележка, железнодорожная платформа, товарный вагон
TWIN (a) двойной, сдвоенный, спаренный

U

UNIT (n) установка, агрегат, блок, узел, единица
size reduction ~ мельница

V

VANE (n) лопасть, лопатка, крыло
VAT (n) чан, бак, ванна
VARIABLE переменная (величина)
VESSEL (n) сосуд, резервуар

VELOCITY (n) скорость
terminal falling ~ конечная скорость падения
VISCOSITY (n) вязкость
aparent ~ кажущаяся вязкость
VOIDAGE (n) пористость, относительный объем пор
VOLUME (n) объем
VOLUMETRIC CONCENTRATION объемная концентрация
VORTEX (n) водоворот, вихрь

W

WASH (v) промывать, мыть
WASTE (n) отходы
WHIRL (v) вертеться, кружиться; (n) вихрь
WINNING (n) выделение
WITHDRAWAL (n) выведение, извлечение, удаление

Y

YEAST (n) дрожжи

СПИСОК ЛИТЕРАТУРЫ

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СОДЕРЖАНИЕ

В 2009 году Университет стал победителем многоэтапного конкурса, в результате которого определены 12 ведущих университетов России, которым присвоена категория «Национальный исследовательский университет». Министерством образования и науки Российской Федерации была утверждена программа его развития на 2009–2018 годы. В 2011 году Университет получил наименование «Санкт-Петербургский национальный исследовательский университет информационных технологий, механики и оптики».

ИНСТИТУТ ХОЛОДА И БИОТЕХНОЛОГИЙ

Институт холода и биотехнологий является преемником Санкт-Петербургского государственного университета низкотемпературных и пищевых технологий (СПбГУНиПТ), который в ходе реорганизации (приказ Министерства образования и науки Российской Федерации № 2209 от 17 августа 2011г.) в январе 2012 года был присоединен к Санкт-Петербургскому национальному исследовательскому университету информационных технологий, механики и оптики.

Созданный 31 мая 1931года институт стал крупнейшим образовательным и научным центром, одним их ведущих вузов страны в области холодильной, криогенной техники, технологий и в экономике пищевых производств.

В институте обучается более 6500 студентов и аспирантов. Коллектив преподавателей и сотрудников составляет около 900 человек, из них 82 доктора наук, профессора; реализуется более 40 образовательных программ.

Действуют 6 факультетов:

- холодильной техники;
- пищевой инженерии и автоматизации;
- пищевых технологий;
- криогенной техники и кондиционирования;
- экономики и экологического менеджмента;
- заочного обучения.

За годы существования вуза сформировались известные во всем мире научные и педагогические школы. В настоящее время фундаментальные и прикладные исследования проводятся по 20 основным научным направлениям: научные основы холодильных машин и термотрансформаторов; повышение эффективности холодильных установок; газодинамика и компрессоростроение; совершенствование процессов, машин и аппаратов криогенной техники; теплофизика; теплофизическое приборостроение; машины, аппараты и системы кондиционирования; хладостойкие стали; проблемы прочности при низких температурах; твердотельные преобразователи энергии; холодильная обработка и хранение пищевых продуктов; тепломассоперенос в пищевой промышленности; технология молока и молочных продуктов; физико-химические, биохимические и микробиологические основы переработки пищевого сырья; пищевая технология продуктов из растительного сырья; физико-химическая механика и тепло-и массообмен; методы управления технологическими процессами; техника пищевых производств и торговли; промышленная экология; от экологической теории к практике инновационного управления предприятием.

В институте создан информационно-технологический комплекс, включающий в себя технопарк, инжиниринговый центр, проектно-конструкторское бюро, центр компетенции «Холодильщик», научно-образовательную лабораторию инновационных технологий. На предприятиях холодильной, пищевых отраслей реализовано около тысячи крупных проектов, разработанных учеными и преподавателями института.

Ежегодно проводятся международные научные конференции, семинары, конференции научно-технического творчества молодежи.

Издаются журнал «Вестник Международной академии холода» и электронные научные журналы «Холодильная техника и кондиционирование», «Процессы и аппараты пищевых производств», «Экономика и экологический менеджмент».

В вузе ведется подготовка кадров высшей квалификации в аспирантуре и докторантуре по 11 специальностям.

Действуют два диссертационных совета, которые принимают к защите докторские и кандидатские диссертации.

Вуз является активным участником мирового рынка образовательных и научных услуг.

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