Federal State Budgetary Educational Institution of Higher Education "Volgograd State Medical University" of the Ministry of Health of the Russian Federation

Department of Management and Economics of Pharmacy, Medical and Pharmaceutical Commodity Science

Methods for manufacturing products from metallic and non-metallic materials

Lecture 4

Discipline: medical and pharmaceutical commodity science

3 course, 5 semester

Volgograd -2022

LECTURE PLAN

1. steelmaking processes.
2. Processes for obtaining copper, aluminum, magnesium.
3. Methods for the production of products from metallic materials.
4. Types of production processes in relation to the product.
5. The main production processes and methods for obtaining blanks from metallic materials.
6. The technological process of manufacturing metal products.
7. Technological processes for obtaining blanks from non-metallic materials.
8. Processes for obtaining powder metallurgy.
9. Processes for obtaining products from polymers (plastics).
10. Processes for obtaining products from rubber, latex.
11. Processes for obtaining products and composite materials.
12. Glass production processes.

Steel smelting methods

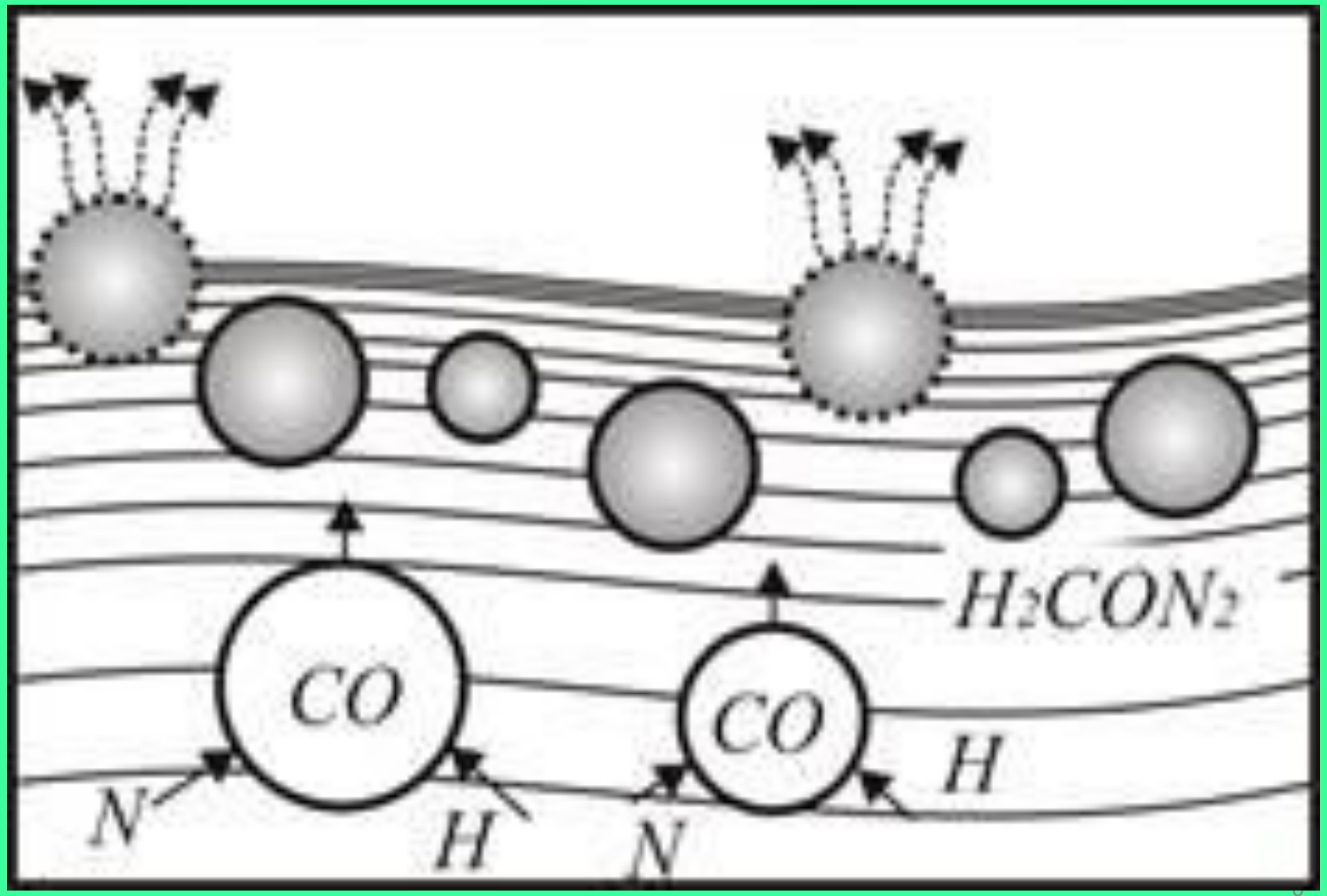
Steelmaking processes are carried out in three stages:

The first stage is the melting of the metal charge and the heating of the liquid metal bath . At this stage, the oxidation of iron and impurities contained in fluxes (silicon, manganese and phosphorus) occurs. The most important task of this stage is the removal of phosphorus by converting it into slag using chemical reactions.

The second stage is the boiling of the metal bath. When iron oxide reacts with carbon, bubbles of carbon monoxide are released from the liquid metal, causing a "bath boil".

During “boiling”, the carbon content in the metal decreases to the required level, the temperature is evened out over the volume of the bath, non-metallic inclusions and gases are partially removed , penetrating *CO bubbles* (Fig.). All this contributes to the improvement of the quality of the metal. This stage is the main one in the steelmaking process.

Bath Boiling and Removal of Hydrogen and Nitrogen Impurities



The third stage is steel deoxidation. The stage consists in the reduction of iron oxide dissolved in liquid metal. Increasing the oxygen content in the metal is necessary for the oxidation of impurities.

Cast iron is converted into steel on various metallurgical equipment in:

- open-hearth furnaces,

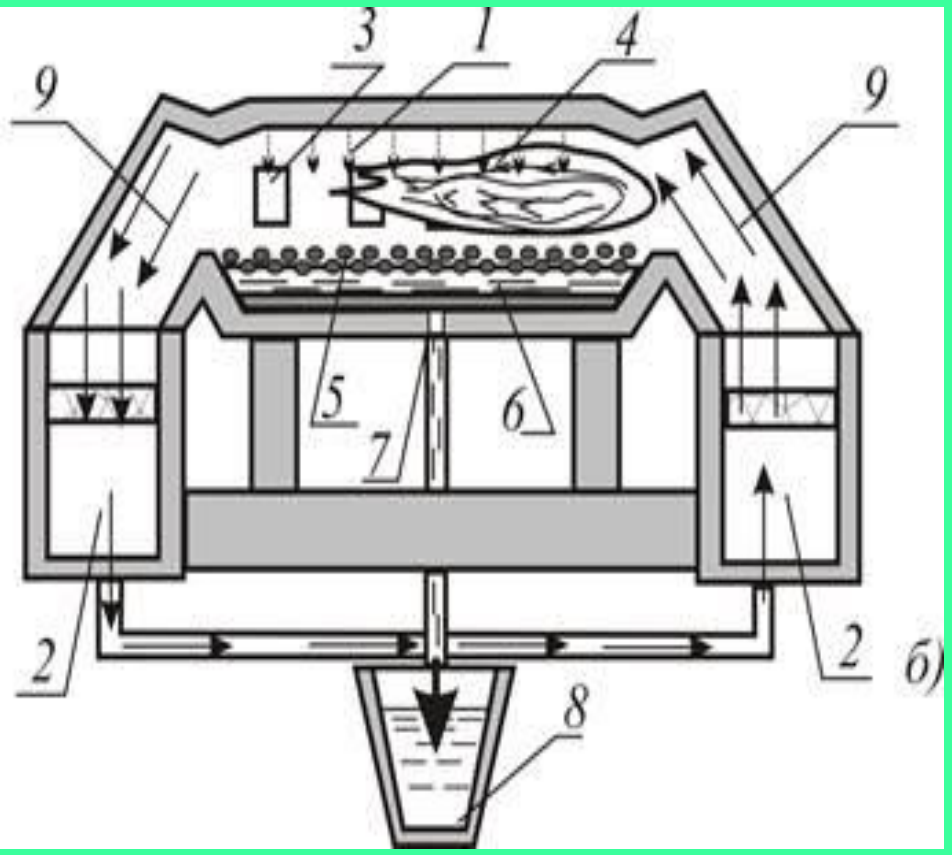
- oxygen converters,

- electric ovens.

A modern open- hearth furnace is a horizontally elongated chamber made of refractory bricks.

- Open-hearth furnace: appearance (*a*), device (*b*): *1* - furnace chamber, *2* - regenerators, *3* - loading windows, *4* - torch, *5* - charge, *6* - steel melt, *7* - steel outlet, *8* - ladle , *9* - furnace heads.

а)



б)

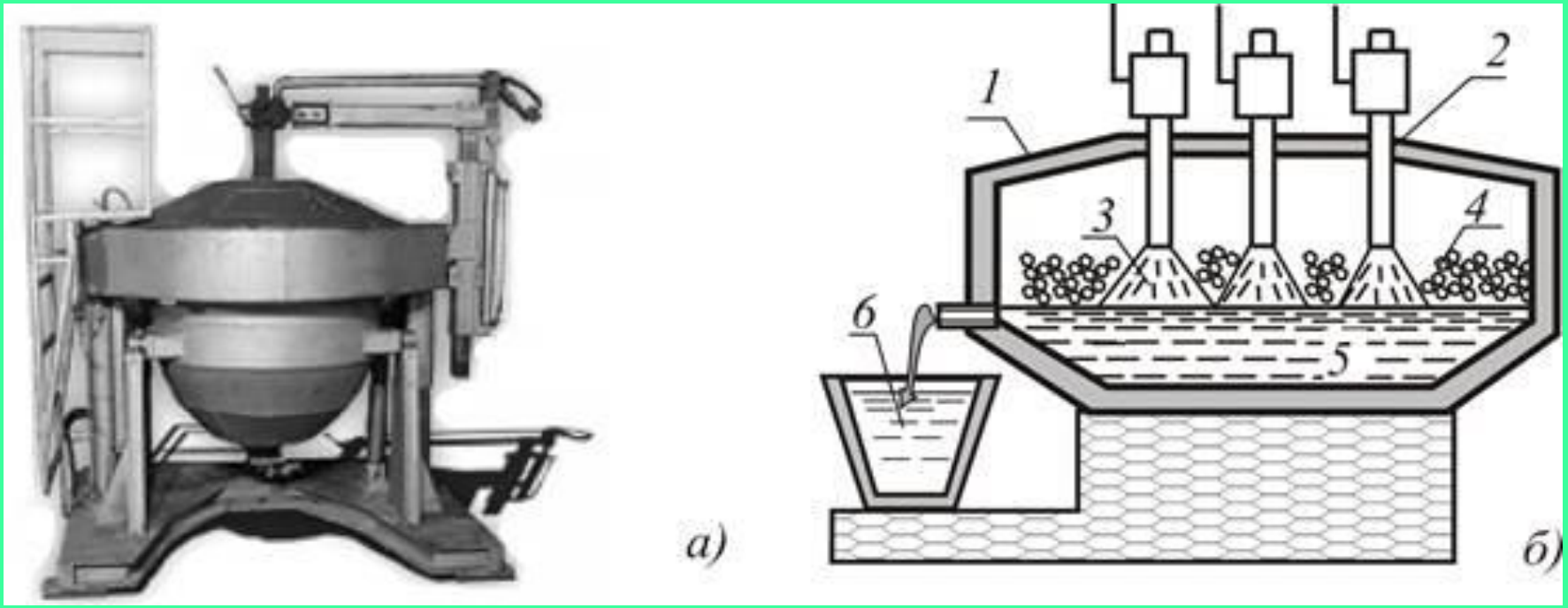
Electric furnaces are used for smelting structural, high-alloy, tool, special alloys and steels.

There are electric furnaces:

- arc

- induction.

- **Arc furnace: appearance (*a*), device (*b*):** *1* - furnace chamber, *2* - electrodes, *3* - electric arc, *4* - charge, *5* - melt, *6* - ladle.



- - The arc furnace is powered by three-phase alternating current. It has three cylindrical electrodes (*2*), to which electric current is supplied through cables. Between the electrode and the metal charge (*4*) there is an electric arc - a source of high temperature for the melt (*5*).

- Electric induction furnaces have advantages over other melting units. They allow:

- it is easy to regulate the thermal process by changing the current parameters;

- get high metal temperature ,

- create an oxidizing, reducing, neutral atmosphere and vacuum, which allows deoxidizing the metal with the formation of a minimum amount of non-metallic inclusions.

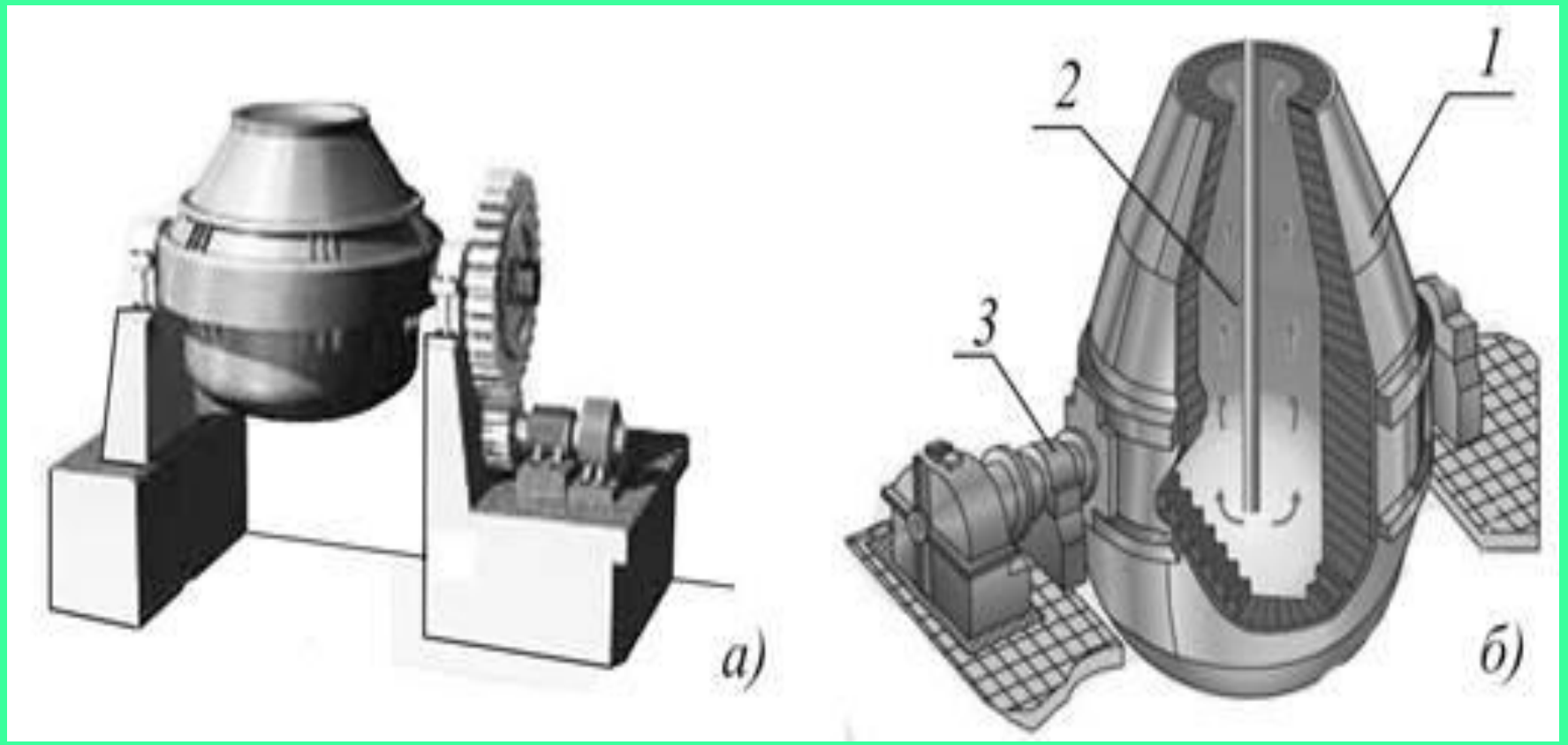
Converter - oxygen method of steel production

A converter furnace is a large steel retort lined with refractory (Fig. *a*).

The converter -oxygen method of obtaining steel proceeds as follows:

Oxygen (*2*) (Fig. *b*) is blown into the converter through its neck, and it enters the charge surface. Oxygen penetrates the metal, causes it to circulate in the converter and mix with the slag. The metal is heated by the heat released during oxidation. The process is carried out at a high temperature, which makes it possible to process cast iron with various impurity contents in the converter, as well as to introduce not only liquid metal into the converter, but also add iron ore to it.

- **Converter furnace: appearance (*a*), device (*b*):**
- ***1* – furnace chamber, *2* – injected oxygen, *3* – overturning device**



In modern metallurgical production, to improve the quality of steel, methods are used that are based on:

- at a more complete removal of gases and harmful non-metallic inclusions from steels;

- on changing the chemical composition of steels due to the introduction of special alloying elements into them, which improve various properties of steels.

COPPER PRODUCTION PROCESSES

Copper in nature is found in the composition of sulfide ores and native metallic copper. The main ways to obtain copper include:

- hydrometallurgical method,

- pyrometallurgical method.

The hydrometallurgical method is based on the principle of its leaching with a weak solution of sulfuric acid and the subsequent separation of metallic copper from the solution.

Obtaining copper by the pyrometallurgical method consists of enrichment, roasting, melting to matte, blowing in a converter, and refining. Matte is an alloy containing copper and iron sulfides. The matte is blown with compressed air in horizontal converters. Thus, blister copper is obtained in the converter. This copper is poured into a ladle and poured into steel molds or on a pouring machine. Blister copper is refined. The essence of refining blister copper is to remove impurities.

ALUMINUM PROCESSES

Aluminum ranks first among metals in terms of distribution in nature. Its content in the earth's crust is 7.45%. Aluminum ores are: bauxites, nephelines, alunites and kaolins.

Aluminum production consists of two main processes:

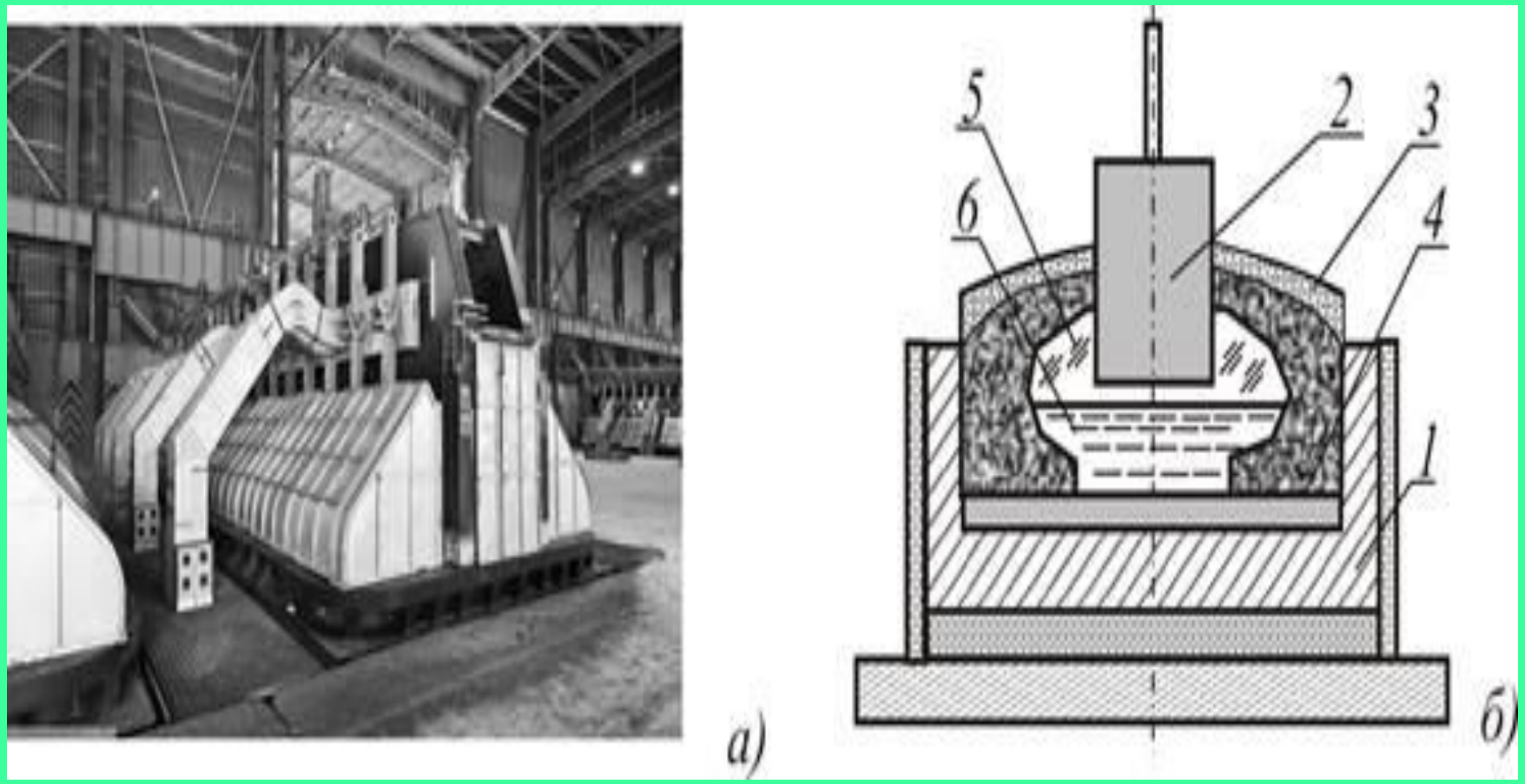
- extraction of alumina from ore,

- electrolysis of alumina.

- **electrolysis of alumina is carried out in a solution of cryolite (Na_3AlF_6) in special electrolysis baths (electrolyzers) (Fig. *a and b*).**

- **Aluminum electrolyzer: appearance (*a*), device (*b*):**

1 **- casing,** ***2*** **- anode,** ***3*** **- alumina,** ***4*** **- cathode,** ***5*** **- electrolyte**



MAGNESIUM PRODUCTION PROCESSES

To obtain magnesium , the most widely used electrolytic method, the essence of which is to obtain pure anhydrous magnesium salts, electrolysis of these salts in the molten state and refining metallic magnesium.

The electrolysis is carried out in an electrolyzer lined with fireclay bricks. Graphite plates serve as anodes, and steel plates serve as cathodes. The cell is filled with a molten electrolyte of complex composition, which includes magnesium chloride.

For the electrolytic decomposition of magnesium chloride, a current is passed through the electrolyte. As a result, chloride ions are formed, which move towards the anode. Magnesium ions move towards the cathode and, after the discharge, are released on the surface, forming droplets of liquid crude magnesium. Black magnesium is refined.

Methods for the production of products from metallic materials

METHODS OF PRODUCTION OF PRODUCTS. STAGES OF THE PRODUCTION PROCESS.

In relation to the product, the following **types of production process are distinguished:**

Main production processes

Auxiliary production processes

Service production processes.

METHODS OF PRODUCTION OF PRODUCTS. STAGES OF THE PRODUCTION PROCESS.

The main production processes change the qualitative state of the product:

- **- form;**
- **- dimensions;**
- **- structure and chemical composition of the material.**

Such processes are called **basic production processes.**

The totality **of the main production processes forms the main production of enterprises.**

METHODS OF PRODUCTION OF PRODUCTS. STAGES OF THE PRODUCTION PROCESS.

Production processes that **ensure the uninterrupted flow of the main processes are called auxiliary.** Their result is the products used in the enterprise itself.

Other **processes, such as transportation, control, warehousing, have no effect, although without them the production process could not be carried out.**

Such processes are called **serving.**

PRODUCTION TYPES

Each technological process is developed in relation to **a certain type of production.**

The type of production is a classification category defined by the following principles:

- the volume of annual output;

- the breadth of the product range;

- production capacity.

A technological process that is progressive for one type of production may be completely unacceptable for another type of production.

Basic concepts about blanks and processes for their production

The same part can be made from blanks obtained by different technological processes. One of the fundamental principles of choosing a process for obtaining a workpiece is to focus on such a manufacturing process that will provide it with the maximum approximation to the finished part.

A workpiece is an object of labor from which a part is made by changing the shape, size, surface properties and (or) material.

The blanks are characterized by the following indicators:

- A configuration that largely determines the technology, both its manufacture and subsequent processing.

- Dimensional accuracy and surface condition, which are the most important factors affecting the cost of manufacturing a part.

In mechanical engineering, there are <u>three main types of</u> workpieces:

- engineering profiles,

- piece blanks,

- combined blanks.

- Machine-building profiles are blanks of constant section (round, square, hexagonal or pipe). In large-scale and mass production, special rolled products are also used.

- **Some types of engineering profiles:**
  - **round bar (*a*),**
  - **stripe (*b*),**
  - **pipe (*in*)**

- **Piece blanks are obtained by casting, forging, stamping or welding.**
  - **Some types of piece blanks:**
    - **clutch (*a*),**
    - **body (*b*),**
    - **disk (*in*)**

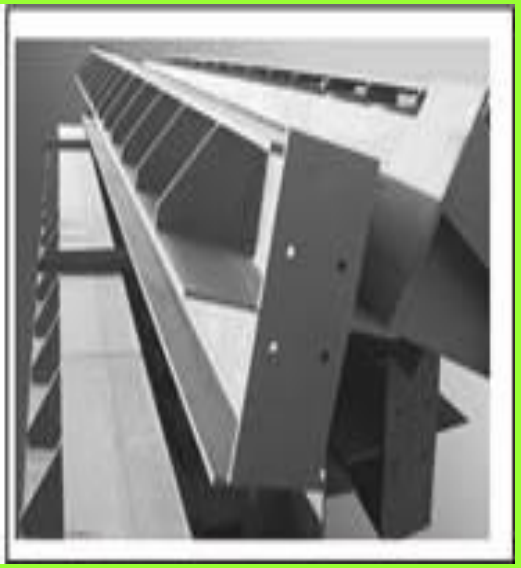
а)

б)

в)

Combined workpieces are complex workpieces obtained by joining (for example, welding) separate, simpler elements.

- **Some types of combined blanks obtained by the connection**



BASIC PRODUCTION PROCESSES AND METHODS FOR OBTAINING BLANKS FROM METAL MATERIALS

In modern production, the following **main methods for obtaining blanks are used:**

- **casting method,**
- **metal forming method,**
- **welding method,**
- **method of powder metallurgy.**

Design Factors

The first group of constructive factors includes:

- geometry and shape of manufactured parts,

- the size of the produced parts.

Production factors

The second group of production factors includes:

- the nature and culture of production,
- technological equipment,
- organizational level of production,
- technological level of production.

Technological factors

The third group of technological factors include:

- brand of material,
- surface quality,
- dimensional accuracy,
- process performance.

BASIC PRODUCTION PROCESSES AND METHODS FOR OBTAINING BLANKS FROM METAL MATERIALS

casting get blanks of almost any size, both simple and very complex configuration. In this case, castings can have complex internal cavities and curved surfaces intersecting at different angles.

Dimensional accuracy and surface quality depend on the casting method.

Most often, blanks for body parts, machine beds, etc. are obtained by this method.

Machining of metals by pressure is used to obtain machine-building profiles, forged and stamped blanks.

BASIC PRODUCTION PROCESSES AND METHODS FOR OBTAINING BLANKS FROM METAL MATERIALS

Welded blanks are made by various welding methods. In some cases, welding simplifies the manufacture of a workpiece, especially of a complex configuration.

Powder metallurgy is the most promising method for obtaining blanks.

The raw materials for the production of blanks are polymer masses and powders of various materials.

The most characteristic feature of such blanks is that they can correspond in shape and size to the shape and size of finished parts and require only minor, most often finishing, finishing.

METAL SHAPING METHODS AND METHODS FOR PRODUCING BLANKS BY PLASTIC DEFORMATION

Metal shaping methods are:

- forging

- casting

- stamping.

METAL SHAPING METHODS AND METHODS FOR PRODUCING BLANKS BY PLASTIC DEFORMATION (2)

Methods for obtaining blanks by plastic deformation:

- pressing,

- mechanical restoration,

- drawing.

Welding (soldering) - the connection of several parts (when the product consists of several parts).

TYPES OF HEAT TREATMENT:

To improve the **mechanical qualities, the product is subjected to heat treatment** (changing the structure of the metal without violating its chemical composition).

The types of **heat treatment include:**

annealing - heating to 780-820 degrees C and slow cooling (metal machinability improves)

normalization - the steel is heated, then cooled in air (hardness increases)

hardening - steel is heated to 760-880 degrees C and quickly cooled in water or oil (hardness and strength).

Vacation - reduction of internal stresses in steel, hardened steel is heated to 150-650 degrees C, held for some time and cooled in air.

CASTING METHOD

Foundry technologies at the present stage make it possible to obtain products with high performance properties.

The casting method is understood as the process of obtaining workpieces by pouring molten metal of a given chemical composition into a mold, the cavity of which has the shape of a workpiece.

In modern foundry production, two main methods are most often used:

- casting in sand molds,

- special casting methods.

FOUNDRY METHOD. Casting in sand molds.

Sand casting is the most common casting method.

This method is used to produce castings from cast iron, steel, non-ferrous metals in a wide range of weights and sizes.

The essence of this process is to obtain castings from molten metal, hardened in molds, which are made from molding sands by compaction using a pattern kit.

FOUNDRY METHOD. Special casting methods.

For the production of castings by special casting methods, the following are most often used:

- gray, high-strength and malleable cast irons;

- carbon and alloy steels;

- copper (bronze and brass), zinc, aluminum and magnesium alloys;

- alloys of refractory metals (titanium, molybdenum, tungsten).

FOUNDRY METHOD. Special casting methods.

Advantages of special casting methods :

- production of blanks with high weight accuracy (for special casting methods);

- production of castings of practically unlimited dimensions and weight;

- production of workpieces from alloys that are resistant to plastic deformation and difficult to machine (magnets).

Technological process of manufacturing metal products

SHAPING

Enterprises supply metals in the form of:

- bars, strips, sheets, tapes, wires, pipes (steel, brass, aluminium),
- ingots (cast iron, bronze).

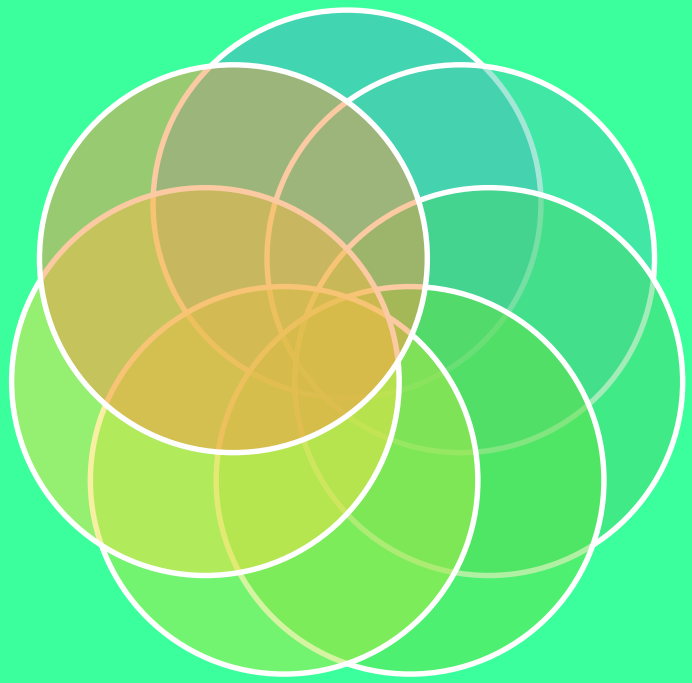
To obtain a product, it is necessary to carry out shaping - to give the product the desired shape and size.

Technological process of manufacturing metal products

SHAPING . Shaping methods:

- mechanical restoration.

- casting ,



- drawing ,

- forging,

- pressing ,

- stamping,

Technological process of manufacturing metal products

HEAT TREATMENT

Then the product is given the necessary properties, for example, strength, which is most often achieved by **heat treatment.**

Technological process of manufacturing metal products

SURFACE FINISH

After that, the surface of the product must be well finished in order to **provide the product with high performance properties** and give a beautiful appearance.
Surface finishing methods include:

- machining (grinding, polishing);

- electrochemical processing (electrogrinding , electropolishing).

PRODUCTION OF PRODUCTS CONSISTING OF SEVERAL PARTS

If the product consists of several parts, then they are connected using:

- welding or soldering.

Metals used to produce medical devices must be capable of being processed by one or more technological methods.

In this case, the **properties of metals often undergo significant changes, especially if the metal is heated to give the desired shape.** Often, as a result of such processing **, the internal structure of the metal changes and its mechanical properties deteriorate.**

PRODUCTION OF PRODUCTS CONSISTING OF SEVERAL PARTS

To **improve the mechanical qualities, the product is subjected to heat treatment** , as a result of which:

there is a **change in the structure of the metal without violating its chemical composition.**

TECHNOLOGICAL PROCESSES FOR PRODUCING BLANKS FROM NON-METALLIC MATERIALS

NON-METALLIC MATERIALS. ASSORTMENT, GROUPS

The concept of non-metallic materials **includes a wide range of materials such as plastics, composite materials, rubber materials, adhesives, paints, wood, as well as silicate glasses, ceramics, etc.**

Non-metallic materials are not only substitutes for metals, but are also **used as independent, sometimes even irreplaceable materials.**

The use of non-metallic materials provides significant economic efficiency.

CLASSIFICATION OF NON-METALLIC MATERIALS BY METHOD OF PRODUCTION (PROCESSING)

According to the method of production (processing), non-metallic structural materials are divided into the following groups:

- materials obtained by chemical technology (polycondensation, polymerization, vulcanization, synthesis and other types of chemical processing);

- materials obtained by thermal and thermomechanical processing (casting, sintering, stamping, pressing, etc.);

- materials obtained by mechanical processing (sawing, planing, peeling, milling, drilling, stamping, etc.);

-materials obtained by combined technology, which consists in the use of two or more of the listed technologies (chemical and thermal, chemical and mechanical).

Powder metallurgy processes

The essence of powder metallurgy is the production of powders and the manufacture of products, coatings or multifunctional materials from them using waste-free technology.

Powders are obtained from metal and non-metal raw materials, as well as secondary raw materials of machine-building and metallurgical production . Accordingly, such a process is applicable for the production of metal blanks.

PROCESSES FOR OBTAINING PRODUCTS FROM POLYMERS (PLASTICS)

In most cases, parts are made from plastics that are in a viscous state.

In mechanical engineering, the following methods are used to obtain parts and blanks from plastics:

- pressing,
- injection molding ,
- extrusion (extrusion),
- stamping ,
- blowing,
- calendering .

PRESSING

Conventional compression is more commonly used for thermosetting plastics , which are fed into molds in tablet or granular form. The surface of the products is smooth and shiny, but has burrs (burrs), which are subsequently removed.

Injection molding is used in the production of products with metal fittings or with deep holes. With this method, the mold is closed before the press powder enters it, and then softened thermosetting resin enters it through the gating channels.

Installation for the production of parts from thermosetting plastics

INJECTION MOLDING

Injection molding is mainly used to produce products from thermoplastics.

Preheated to a viscous state, the thermoplastic is injected under pressure into a closed injection mold, after cooling, the mold opens and the product is pushed out.

Products made in this way do not undergo additional processing.

EXTRUSION (EXTRACTION)

Extrusion (extrusion) consists in the continuous extrusion of profiled products of great length on an extruder.

The heated plastic is fed by a screw to the mouthpiece, which gives the desired profile to the product.

In this way, thermoplastics (polyethylene, PVC, polyamide, etc.) are processed, from which pipes, rods, sheets, and films are made . On extruders, the wire is covered with insulation.

STAMPING

Stamping is used to produce products mainly from sheet thermoplastics.

This method produces various products (soap dishes, cases for toothbrushes, glasses, etc.), mainly from celluloid.

BLOWING

Blowing is done as follows:

two sheets of plastic are placed in a heated mold,

air or steam is passed between the sheets, which are pressed against the walls of the mold, forming a hollow product.

The blowing of hollow products from pipes consists in the fact that the thermoplastic is intermittently fed in the form of a pipe into a mold, where the pipe is blown to the desired size and shape . On products usually there are traces of the form. This method produces polyethylene bottles, canisters, vials, etc.

CALENDING

Calendering is used for the manufacture of plates, sheets of PVC , as well as artificial leather on a fabric, knitted or fibrous basis.

A heated mixture of polymer with filler, plasticizer and dye is applied to one side of the fabric using a calender.

Sometimes plastic compound or artificial leather is embossed at the same time .

WELDING METHOD (for some plastic products)

Some plastic products (thermoplastics) are produced by welding.

Welding can be:

- contact (with a heated tool),

- high frequency currents,

- ultrasound.

METHODS FOR OBTAINING LAYERED PLASTICS

Laminated plastics form a special group. **The technology for their production is significantly different from the production of other types of plastics.**

The process of obtaining a layered material is as follows:

Packages of sheet material and binder resins (in the form of impregnation or powder) are collected, then they are loaded onto tile floor presses and pressed at high pressure and temperature.

this way, laminates are obtained, in which the filler is fibrous materials.

METHODS FOR OBTAINING LAYERED PLASTICS

Under the influence of heat and pressure at a certain exposure, a monolithic sheet material is obtained from loose materials.

In this way, both filled (textolite, getinax , fiberglass, asbestos textolite) and **unfilled plastics** (viniplast sheet, polystyrene sheet, polyvinyl chloride, etc.) are obtained.

METHODS FOR OBTAINING LAYERED PLASTICS

Roll paper, cotton, synthetic, asbestos fabrics, cotton wool, threads and other sheet and thread-like materials are used as fillers.

Plastics filled with these materials are made in a different way:

- impregnation of fabrics with liquid resin is carried out on mine impregnation-drying units;

- the fabric from the roll enters the impregnating bath, which contains the resin in liquid form (water emulsion, alcohol solution of formaldehyde or polyester resins).

- the impregnated fabric passes through squeezing rollers, where excess resin is removed, dried, cooled, cut into pieces, from which bags are formed and then pressed on floor hydraulic presses.

As a result of processing, sheet material, blocks, monoliths are obtained.

Processes for obtaining blanks from rubber

Rubber is the vulcanization product of a mixture containing rubber, fillers, plasticizers, vulcanization activators, antioxidants and other ingredients.

The most important property of rubber is its high elasticity, i.e. the ability to large reversible deformations.

The manufacturing technology of products from rubber compounds consists of a number of operations performed in a certain sequence:

1 . **Cutting rubber into pieces and plasticizing it by repeatedly passing it through rollers heated to 40-50 ° C in order to improve miscibility with other ingredients.**

2. Mixing rubber with other components in a strictly defined sequence: anti -aging agents are first introduced , then vulcanizers. Mixing is carried out in rubber mixing or rolling machines.

The manufacturing technology of products from rubber compounds consists of a number of operations performed in a certain sequence:

3. Calendering the rubber mixture to obtain crude rubber by passing it through a three-byte stand of a sheet-rolling calender mill.

The rolls of the mill have different temperatures: the upper one is 90 °C, the lower one is 15 °C.

The rubber mass is heated and under the action of the rollers turns into a sheet or tape.

4. Manufacture of products from raw rubber by pressing in special molds under a pressure of 5–10 MPa or by injection molding by filling the mold with preheated raw rubber.

The manufacturing technology of products from rubber compounds consists of a number of operations performed in a certain sequence:

5. Vulcanization - the formation of the physical and mechanical properties of the product.

Hot vulcanization on vulcanizing machines at a temperature of 130–150 °C (heated steam, hot water, etc.).

During vulcanization, chemical interaction of rubber and vulcanizers takes place, as a result of which the linear molecular structure of rubber is transformed into a network.

Preparation of the rubber compound

The preparation of the rubber compound consists in mixing its constituent components.

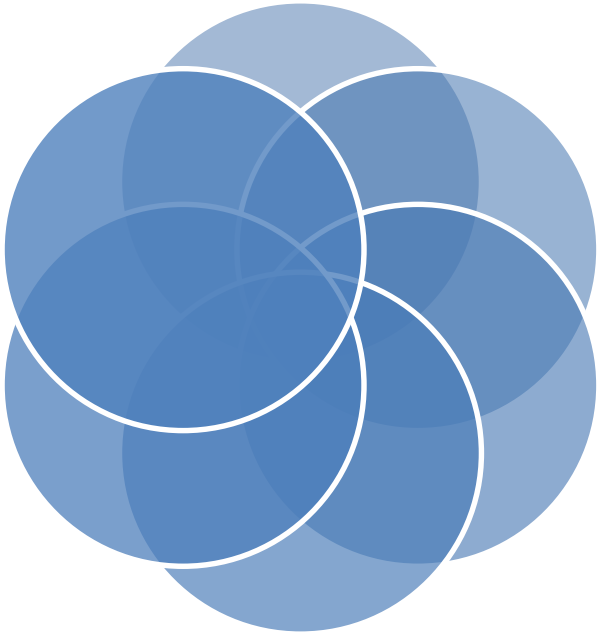
Before mixing, the rubber is transferred to a plastic state by repeatedly passing it through special rollers, preheated to a temperature of 40-50°C. Being in a plastic state, rubber has the ability to mix well with other components.

Mixing is carried out in worm or roller mixers.

Processes of shaping parts and blanks

Shaping parts and blanks. Various processes are used for this operation:

- Winding receive complex products (flexible armored hoses and sleeves).



- Calendering

- Injection molding produces parts of complex shape.

- Continuous extrusion

- Pressing.

Processes for obtaining blanks from rubber

- Calendering - this process is used to obtain rubber mixtures in the form of sheets and rubberized tapes, as well as to connect rubber sheets and rubberized tapes (duplication).

- Continuous extrusion - this process is used to obtain profiled rubber parts (pipes, rods, glazing profiles). **Details by continuous extrusion are made by worm-type machines.**

- Pressing - this process is one of the main ways to obtain shaped parts (cuffs, sealing rings, V-belts, etc.).

Calendering. After the raw rubber is kneaded and mixed with the ingredients of the rubber compound, it is further processed before vulcanization to give it the shape of the final product. The type of processing depends on the application of the rubber product. Calendering and extrusion are widely used at this stage of the process.

Calenders **are machines designed to roll the rubber mixture into sheets or smear fabrics with it.** A standard calender usually consists of three horizontal rolls one above the other, although four and five roll calenders are used for some applications. Hollow calender rolls are up to 2.5 m long and up to 0.8 m in diameter. Steam and cold water are supplied to the rolls to control the temperature, the selection and maintenance of which is critical to obtaining a quality product with a constant thickness and a smooth surface. Neighboring shafts rotate in opposite directions, with the speed of each shaft and the distance between the shafts precisely controlled. On the calender, coating of fabrics, lubrication of fabrics and rolling of the rubber mixture into sheets are performed.

Extrusion. The extruder is used for forming pipes, hoses, tire treads, pneumatic tire tubes, car seals and other products. It consists of a steel cylindrical body, provided with a jacket for heating or cooling.

A tight-fitting auger feeds the unvulcanized rubber compound, preheated on the rollers, through the body to the head, into which an interchangeable molding tool is inserted to determine the shape of the resulting product. The product leaving the head is usually cooled by a water jet.

CURING

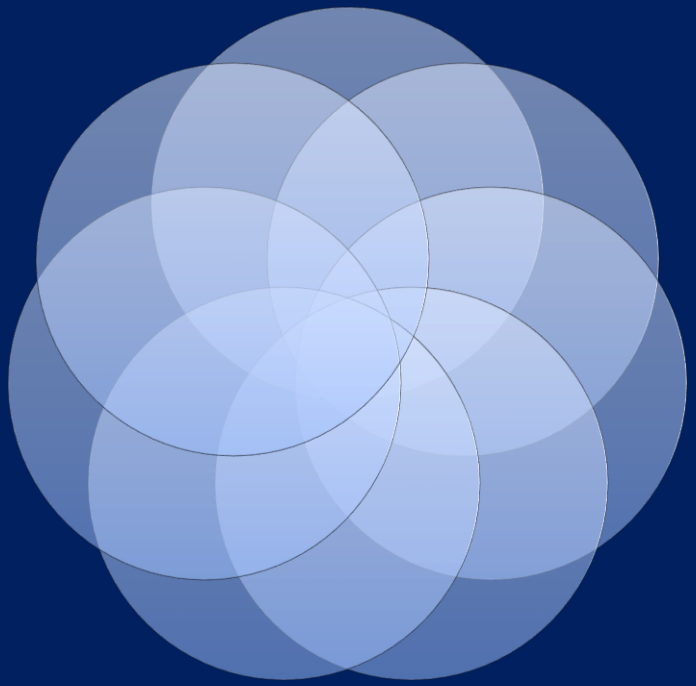
Vulcanization is the main stage of the technological process, which consists in heating a product made from a rubber compound .

During vulcanization, sulfur is added to the rubber, as a result of which the rubber acquires a number of valuable properties: high elasticity, strength, chemical resistance, etc.

The process of obtaining products from latex

The technological process of obtaining products from latex includes the following processes:

1. latex preparation mixtures;
2. obtaining a semi-finished latex product;
3. gel seal;
4. drying of the finished product;
5. vulcanization of the finished product ;
6. quality control, packaging and labeling.



The process of obtaining products from latex

1. Preparation of the latex mixture . In addition to the usual ingredients, the mixture includes surfactants, thickeners, antiseptics, defoamers .

2. A semi-finished latex product is obtained by dipping. To do this , a mold simulating the product heated to 60-100 ° C is lowered into a bath with a latex mixture . A thin layer of gel formed on the surface of the mold is dried in air and dipped again. **This is repeated as many times as necessary to obtain a product of the required thickness (no more than 2 mm).**

The process of obtaining products from latex

3. Seal the gel . The form with the product obtained on it is lowered into a bath of water and kept at room temperature. This causes the gel to thicken.

4. Drying in an air chamber at 40-80 °C for 10-15 hours.

5. Vulcanization is carried out in special chambers with hot air at a temperature of 100-140 °C. The form with the product is placed in the chamber and kept at a given temperature for the required amount of time in accordance with the technological regulations for a particular product.

Processes for obtaining blanks from composite materials

The modern production of structural elements from CM is largely focused on the prepreg technology for manufacturing products.

- Prepregs are composite materials pre-impregnated with resin at high temperature and pressure. The resin in prepregs is in a semi-solid state. Its complete curing occurs during molding.

Prepregs are usually rolls or packs of tape sized material with a separating film between **the layers and are then flat or shaped molded** .

METHODS FOR MANUFACTURING PRODUCTS FROM COMPOSITE MATERIALS:

Contact molding with laying resin-impregnated fibrous canvas on a mold (contact molding produces a wide range of products).

Spraying a fibrous-polymer composition onto the mold surface. The method of spraying onto the mold surface is used for the manufacture of large-sized lightly loaded parts of complex configuration.

Molding in a closed mold.

Winding resin-impregnated fiber onto a mould. The winding technology is used primarily in the manufacture of bodies of revolution from fiberglass.

METHODS FOR MANUFACTURING PRODUCTS FROM COMPOSITE MATERIALS:

Pultrusion, or molding of profile products from composite materials by pulling the fiber through a polymer bath and a sizing die.

Applications of pultrusion profiles: window profiles, ventilation systems, reinforcement for concrete, noise barriers, electrical insulators, cable routes, poles for installing road equipment, ladders and handrails, building structures.

METHODS FOR OBTAINING FIBERGLASS

Fiberglass - structural materials based on polymers on a fiberglass or fiberglass basis.

Depending on the type of binder and filler, technological regimes, properties and methods of processing the material into products, glass-reinforced plastics are divided into two groups:

The first group is fiberglass based on phenol-formaldehyde, organosilicon, urea and other resins, requiring high temperatures (180 °C and above) and pressure (250 ... 1,000 MPa (25 ... 100 kg / cm2) for processing into products).

This type of fiberglass is produced mainly in the form of sheets, slates, parts with small overall dimensions, since complex equipment, large-sized presses and high pressure are required.

METHODS FOR OBTAINING FIBERGLASS (2)

Another group of glass-reinforced plastics based on unsaturated polyester and epoxy resins is obtained by "cold" curing at ordinary temperatures by the contact method without pressure.

The contact method for obtaining products from fiberglass is as follows .

First, a non-standard shape is made from wood, plaster or other material that can be easily molded into any shape, even a complex configuration.

This form is overlaid with a sheet of fiberglass, impregnated or filled with polyester or other "cold" curing resins, then the next layer of fabric is applied, etc.

By this method, it is possible to obtain a product of a given shape with any thickness, for example, small-sized pleasure boats, etc.

MEDICAL GLASS

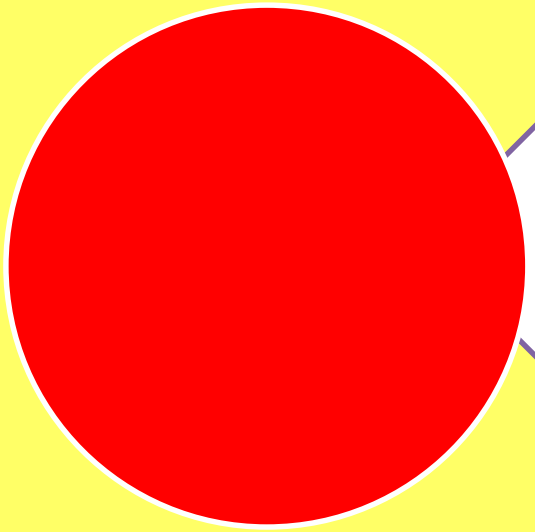
Key quality indicators:

Medical glass is obtained by cooling a molten mixture of silicates, metal oxides, salts and is a solid solution.

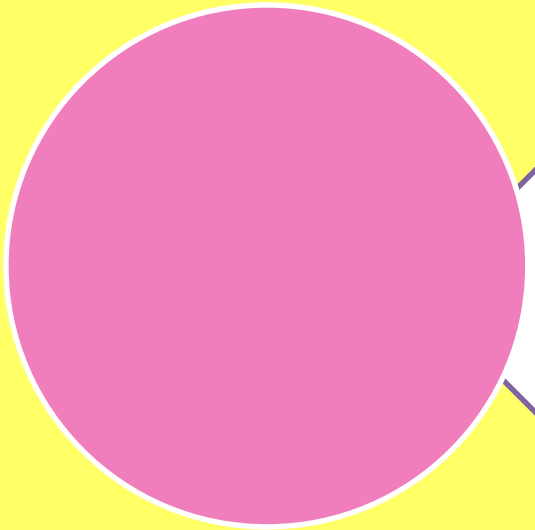
Due to the fact that **medical glass is made from quartz glass, consisting of 95-98% silicon dioxide, it has a very high thermal and chemical resistance** . It is difficult to manufacture and seal ampoules from such glass because of the extremely high melting point (1550–1800°C).

Special modifiers (potassium and sodium oxides) are added to the composition of glass to lower the melting point. The introduction of these substances can reduce the chemical resistance to such an extent that it is possible to obtain liquid or soluble glass (potassium or sodium silicates).

The main raw materials for glass production are:



quartz sand;
nepheline;
magnesite (magnesium carbonate);
dolomite (magnesium and calcium carbonate);
sodium tetraborate ;



boric acid;
limestone (calcium carbonate);
potash (potassium carbonate);
soda ash (sodium carbonate);
sodium sulfate.

METHODS OF GLASS PRODUCTION AND PRODUCTS PRODUCTION

The melting of medical glasses is carried out in continuous bath furnaces with a capacity of 5-25 tons of glass melt per day.

The cooking temperature is on average 1480-1520 °C, the production temperature is 1200-1250 °C.

Medical glasses are well boiled and clarified (with the exception of glasses of the HC- grades, due to the low content of alkaline oxides, they are poorly clarified).

METHODS OF GLASS PRODUCTION AND PRODUCTS PRODUCTION

During the melting of these glasses, the bubbling of the glass mass has an effective effect. When cooking **orange glasses, sodium sulfate is added to their mixture for coloring with an excess of a reducing agent (coal**). During the melting of such glasses, metal sulfides are formed in them, coloring the glass in an orange color.

The production of medical glass products is carried out on various machines.

A number of products are made from droit, which in these cases is a semi-finished product. These include ampoules and vials.

Getting glass

Medical products are produced mainly from neutral glasses (grades MS-1 and NS-2), from alkaline glass (grades NB-1, MT and OS) and from light-protective orange glass .

It is not allowed to introduce toxic oxides into the composition of glass, such as As_2O_3, Sb_2O_3, P_2O_5 and fluorine compounds.

Some brands of foreign glasses contain BaO and ZnO .

Getting glass

Depending on the composition, medical glasses are characterized by different chemical resistance and have different purposes. Glass grades NS-1 and NS-2 belong to the class of neutral glasses. They are highly resistant to steam sterilization in an autoclave at a pressure of 200-103 Pa.

Neutral glass NS-3 is characterized by increased chemical resistance.

Chemically and thermally resistant glass T-1 (sial) has proven itself well.

Glass brand AB-1 allows sterilization in an autoclave and does not form highly alkaline solutions and precipitation in the form of flakes.

Glass grades MT and OS do not allow steam sterilization in an autoclave, as this creates a high alkalinity of the solutions.

Getting glass

For the manufacture of cans, flasks, bottles, AV-4 and AV-6 machines are used, including two-cell ones . They can also be used to make vials.

They are also obtained on vacuum blow molding machines BB-6. Products with a capacity of 5-250 ml can be produced on vacuum blow molding machines BB-6.

After production, the products are sent to the annealing furnace. For annealing, tunnel annealing furnaces LN 10000-18 and PO-180 are used.

THANK YOU FOR ATTENTION!