TOPIC 1.15 “First aid in case of fires”

Lecture for 2nd year students of the Faculty of Medicine

Study questions:

1. Fire. Its characteristics
2. Health consequences of fires
3. Providing medical care

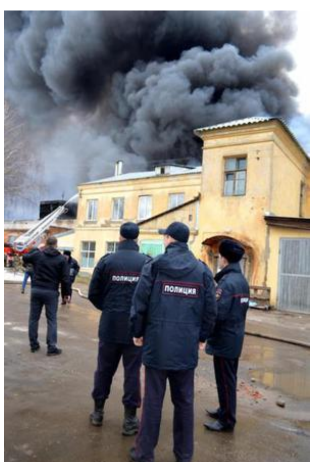
1. Fire. Its characteristics

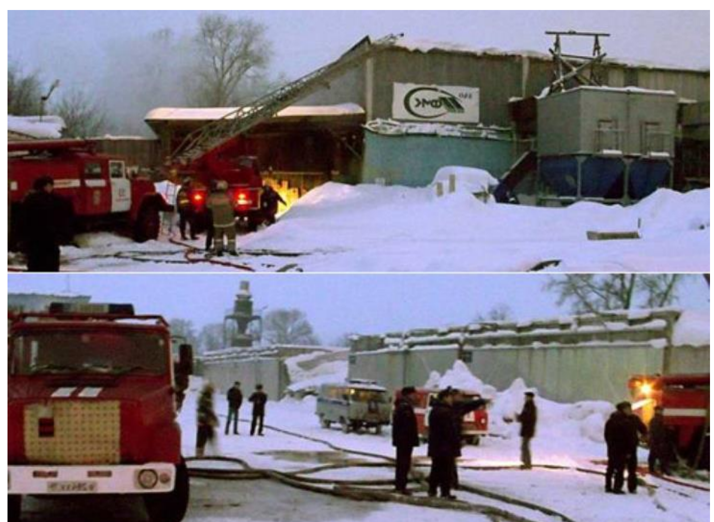
A fire is a combustion that results in the destruction or damage of material assets and creates a danger to the life and health of people.

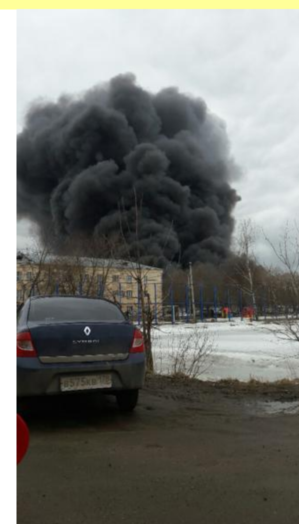
Combustion is a rapidly occurring chemical process of oxidation or combination of a combustible substance and oxygen in the air, accompanied by the release of gas, heat and light. Combustion is known even without oxygen in the air with the formation of heat and light. Thus, combustion is not only a chemical reaction of combination, but also of decomposition.

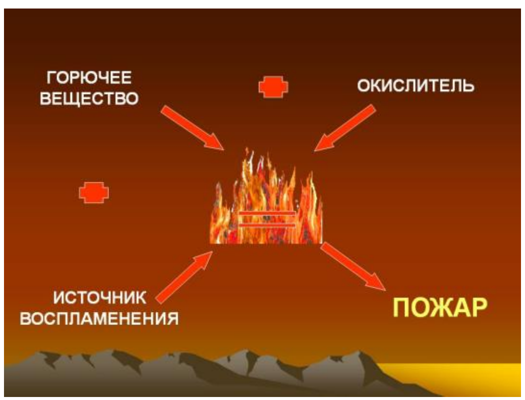
Differentiate between combustion itself, explosion and detonation. During combustion itself, the speed of flame propagation does not exceed tens of meters per second, during an explosion - hundreds of meters per second, and during detonation - thousands of meters per second.

The highest combustion rate occurs in pure oxygen. As the oxygen concentration decreases, the combustion process slows down, the lowest combustion rate is when the oxygen content in the air is 14-15%. Combustion requires combustible materials, an oxidizer, and an ignition source.









In practice, a distinction is made between complete and incomplete combustion. Complete combustion is achieved with a sufficient amount of oxygen, and incomplete combustion is achieved with a lack of oxygen. Incomplete combustion usually results in the formation of caustic, toxic and explosive mixtures.

Self-ignition (thermal explosion) occurs when a flammable substance is internally heated as a result of chemical processes. The auto-ignition temperature depends on various factors: the composition and volume of the combustible mixture, pressure, etc. Most gases and liquids ignite at a temperature of 400-700 ° C, and solids (wood, coal, peat, etc.) - 250-450 ° WITH. It should be borne in mind that an increase in the oxygen content in substances and a decrease in the carbon content reduce the auto-ignition temperature.

The concentration of gases and vapors in the air is important for combustion and ignition. The combustion and ignition range is characterized by lower and upper explosive limits. They are the most important characteristic of the explosiveness of flammable substances. The lower explosion limit is characterized by the lowest concentration of gases and air vapors at which an explosion is possible, and the upper limit is characterized by their highest concentration at which an explosion is still possible.

In the explosions of certain gases, vapors and mixtures, combustion transforms into a special form - detonation. In this case, the speed of flame propagation reaches 1000-4000 m/s, which exceeds the speed of sound. Detonation, as a rule, occurs in pipes of sufficient diameter and length; it can occur with a certain heating of the mixture and a strong shock wave, as well as with the special ignition of an explosive substance. Detonation has upper and lower concentration limits.

Classification of materials by flammability

Based on flammability, substances and materials are divided into the following groups:

1) Non-flammable - substances and materials that are unable to burn in air. Non-flammable substances can be fire-explosive (for example, oxidizers or substances that release flammable products when interacting with water, air oxygen, or with each other);

2) Low-flammability - substances and materials that can burn in air when exposed to an ignition source, but are unable to burn independently after its removal;

3) Combustible - substances and materials capable of spontaneous combustion, as well as ignite under the influence of an ignition source and burn independently after its removal.

Fires are classified according to the type of combustible material and are divided into the following classes:

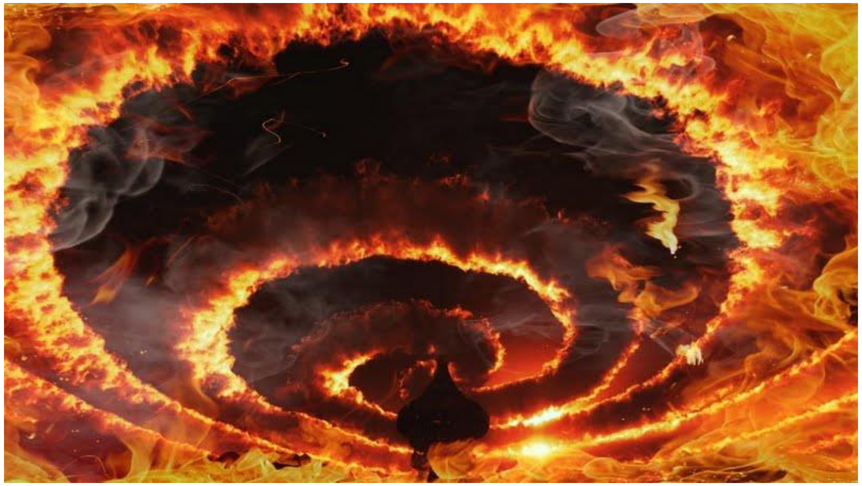
1) Fires of solid flammable substances and materials (A)
2) Fires of flammable liquids or melting solids and materials (B)
3) Gas fires (C)
4) Metal fires (D)
5) Fires of flammable substances and materials of electrical installations under voltage (E)
6) Fires of nuclear materials, radioactive waste and radioactive substances (F).

Classification of fires by type

- **Industrial (fires in factories, factories and warehouses).**
- **Domestic fires (fires in residential buildings and cultural facilities).**
- **Natural fires (forest and peat fires).**

Classification of fires by building density

- **Isolated fires. (City fires) - burning in a single building with a low building density. (Building density is the percentage of built-up areas to the total area of the settlement. A building density of up to 20% is considered safe.)**
- **Complete fires are a type of urban fire that covers a large area with a building density of more than 20-30%.**
- **A firestorm is a rare but dangerous consequence of a fire when the building density is more than 30%. • Smoldering in the rubble.**



2. Health consequences of fires

Main damaging factors of fire and explosion

People in the combustion zone are usually affected simultaneously by several factors: open fire and sparks, increased ambient temperature, toxic combustion products, smoke, reduced oxygen concentration, falling parts of building structures, units and installations.

The main damaging factors of the explosion:

- **shock wave, which is an area of highly compressed air spreading in all directions from the center of the explosion at supersonic speed;**
- **fragmentation fields created by flying debris of building structures, equipment, explosive devices, and ammunition.**

Secondary damaging factors of explosions can be the impact of glass fragments and debris from destroyed buildings and structures, fires, contamination of the atmosphere and area, flooding, as well as subsequent destruction (collapse) of buildings and structures.

The products of an explosion and the air shock wave formed as a result of their action are capable of causing injuries of varying severity to a person, including fatal ones.

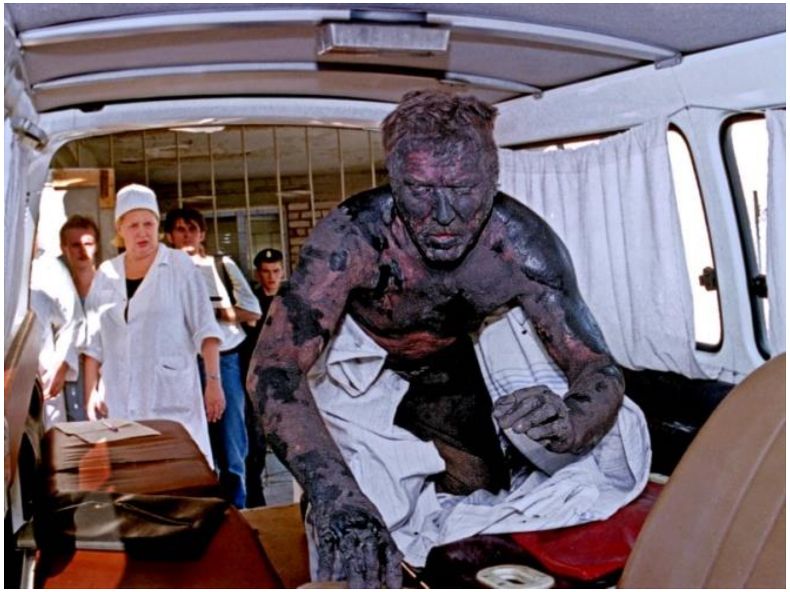
At the epicenter of the explosion, people are completely injured: they are torn into pieces, charred under the influence of expanding explosion products that have a very high temperature.

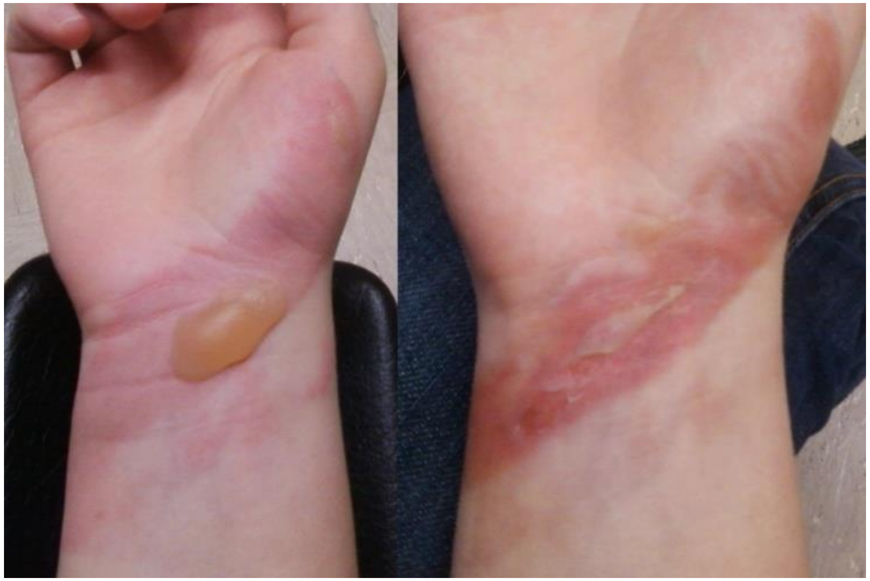
In an area far from the epicenter, damage to people is caused by both direct and indirect effects of the shock wave. When exposed directly, the main cause of injury in people is an instantaneous increase in air pressure, which is perceived by a person as a sharp blow.

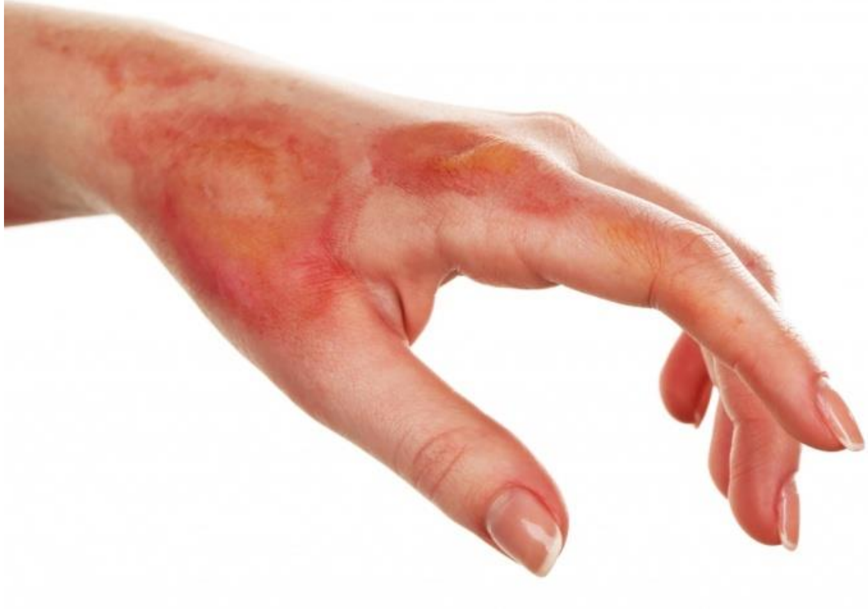
In this case, damage to internal organs, rupture of blood vessels, eardrums, concussion, fractures and injuries are possible. In addition, the shock wave can throw a person a considerable distance and cause him various damage when he hits the ground (or obstacle).

The most severe injuries are suffered by people who are standing outside the shelters when the shock wave arrives. Injuries that occur under the influence of a shock wave are divided into mild, moderate, severe and extremely severe (fatal).

The damage to people who are in buildings and structures at the time of the explosion depends on the degree of their destruction. For example, when a building is completely destroyed, all the people in it usually die. In case of severe and moderate destruction, approximately half of the people can survive, and the rest receive injuries of varying severity, since many may find themselves under the rubble of structures, as well as in rooms with littered and destroyed escape routes. Hazardous fire factors affecting people are the following:







Flame

Fire and sparks falling on clothing can cause it to ignite, resulting in burns and charring of the skin. Damage that occurs when exposed to a thermal factor (flame, hot metal, boiling water, steam, molten bitumen, resin, explosion of flammable substances, sunlight, quartz radiation) on open areas of the body is called a thermal burn. The temperature threshold for preserving the vital functions of human tissue is 45–50 °C.

With higher heating, tissues die. Among all injuries, burns account for 8-10%.

Every year, 1 person out of 1 thousand people on the planet receives a thermal burn. Among them, from 8 to 12% of victims are elderly and senile people. In St. Petersburg, 5 thousand people suffer from burn injuries every year, among whom 50% are children, and preschoolers receive burns 2 times more often than schoolchildren. The hands and upper limbs are most often affected (up to 75%). The average stay in a hospital bed per year is 23 days.

Around the world, 70-80 thousand people die from burns every year.

Smoke

Combustion, especially diffusion, occurs with an excess of air, so oxygen is always present in the smoke. Its quantity depends on the composition of the combustible substance and the conditions of air flow to it. In addition to oxygen, smoke may contain decomposition products of burning substances and their partial oxidation (products of incomplete combustion).

The smoke released during the combustion of various substances and materials (flammable liquids, insulation of wires and cables, etc.) deprives a person of the ability to navigate, and reaching a critical value for the smoke density of the room means that visibility at a certain distance from a person is lost, and he is not able to evacuate on his own, that is, to walk through a smoky area to an emergency exit or a safe zone. In general, there is a possibility of evacuation when the smoke concentration exceeds a critical value, when a person, gradually moving through a smoky environment by touch, sooner or later discovers a way out of the room.

However, as studies of people's behavior in the event of a fire have shown, 43% of all those killed in a fire died precisely because they could not leave the room due to its heavy smoke, i.e. were unable to overcome the smoky area. Even in the case when people knew well the layout of the building and the location of emergency exits from the premises, they decided to overcome the smoke-filled zone with a length of no more than 15 m. It was also established that a person feels in danger if visibility is less than 10 m.

The danger of smoke to human life lies not only in the presence of toxic products in the smoke. Even if there are no dangerous toxic products in the smoke, inhalation of smoke heated to 60 ° C can lead to death.

Toxic combustion products

Smoke is a dispersed system consisting of tiny solid particles suspended in a mixture of combustion products with air. The diameter of smoke particles ranges between 10-3 – 10-5 mm.

When organic matter burns, particulate matter in the smoke is most often carbon (soot).

Smoke from fires in buildings where plastics were used in construction can contain substances that are very harmful to breathing. So, when burning Relin linoleum, hydrogen sulfide and sulfur dioxide are formed, when burning polyurethane foam, hydrogen cyanide (hydrogen cyanide), when burning vinyl plastic, hydrogen chloride and carbon monoxide, and when burning nylon, hydrogen cyanide. For example, when a TV burns in a closed room with an area of 16 m2 and a height of 2.5 m, concentrations of toxic substances that are dangerous to human life are formed within a few minutes.

Reduced oxygen concentration

The air that a person inhales consists mainly of a mixture of two gases: nitrogen (78%) and oxygen (21%), and the air exhaled consists of nitrogen (78%), oxygen (17%) and carbon dioxide (4 %). Part of the inhaled oxygen remains in the human lungs and is used for carbon oxidation. During a fire, the inhaled air contains carbon monoxide and therefore, even with a sufficient amount of oxygen, a person may experience oxygen deficiency. Considering that a decrease in oxygen concentration to 14% becomes dangerous to human life. Poisoning with certain toxicants, for example, nitrogen oxides, can contribute to additional overheating of the human body.

Carbon monoxide poisoning

An acute pathological condition that develops as a result of carbon monoxide entering the human body is dangerous to life and health, and without adequate medical care can be fatal. Carbon monoxide enters the atmospheric air during any type of combustion. In cities, mainly as part of exhaust gases from internal combustion engines. Carbon monoxide actively binds to hemoglobin, forming carboxyhemoglobin, and blocks the transfer of oxygen to tissue cells.

Carbon monoxide is also included in oxidative reactions, disturbing the biochemical balance in tissues. • in production, where carbon monoxide is used for the synthesis of a number of organic substances (acetone, methyl alcohol, phenol, etc.);

• in garages with poor ventilation, in other unventilated or poorly ventilated rooms, tunnels, since the car exhaust contains up to 1-3% CO according to standards and over 10% if the carburetor engine is poorly adjusted;

• when spending a long time on or near a busy road. On major highways, the average CO concentration exceeds the toxicity threshold;

• at home when there is a leak of lighting gas and when the stove dampers are untimely closed in rooms with stove heating (houses, bathhouses);

• when using low-quality air in breathing apparatus. When the inhaled air contains 0.08% CO, a person feels a headache and suffocation. When the CO concentration increases to 0.32%, paralysis and loss of consciousness occurs (death occurs within 30 minutes). At concentrations above 1.2%, consciousness is lost after 2-3 breaths, the person dies in less than 3 minutes

3 Providing medical care

A. First aid for burns.

The victim must first be taken out of the zone of action of the thermal factor, then extinguish the burning parts of clothing using a sheet, blanket, coat or stream of water. You can extinguish fires on clothes with sand, earth, or snow. The victim himself can put out the fire by rolling on the ground. After the burning stops, clothing is removed or cut off from the affected areas of the patient’s body. Further actions are aimed at quickly cooling the burned areas.

Cooling of burned surfaces is carried out by quickly placing these parts of the body under a stream of cold water, applying plastic bags with snow or ice packs. For extensive burns, cold water can be applied. If there is no cold water or snow at hand, wipe the burned areas with ethyl alcohol or cologne, which quickly evaporate and cool the burn site. If these solutions are not available, you can use kefir, which contains 3% alcohol.

Cooling quickly stops further tissue destruction. Burn blisters should not be opened, and pieces of clothing stuck to the burn areas should not be torn off. Adhered molten bitumen can be peeled off from the burn surface by pouring any vegetable oil under the bitumen crust. When providing first aid, a burn wound is not subjected to primary surgical treatment, but only sanitary and hygienic treatment is carried out. A dry aseptic bandage is applied to the burn surface. Extensive burns can be covered with clean, ironed sheets, diapers, or other cotton cloth.

Contour bandages are very convenient for this purpose. If the limbs are damaged, in addition to applying bandages, it is necessary to perform immobilization. The victim should be given plenty of fluids to drink; give him painkillers (analgin, baralgin, citramon, aspirin); if you have a chill, wrap it in a blanket or clothes. After providing first aid, the patient should be immediately sent to the hospital. Treatment of extensive burns is carried out in a complex manner and consists of general and local methods. General treatment includes parenteral administration of saline and protein solutions, antibiotics and sulfonamides, vitamin therapy, painkillers, sleeping pills and cardiovascular drugs. Local treatment is carried out using open or closed methods.

The open method, i.e. without bandages, is used for shallow burns on the face. The burned areas are lubricated with a strong solution of potassium permanganate, which dries and forms crusts at the site of the burn defect, and the skin underneath heals. Antiseptic furacilin paste - furagel - helps very well in this case. For extensive burns of the patient's torso, the patient is placed with the damage side up and covered with a frame (metal arcs such as greenhouses) with 10-12 electric lamps connected to the network, 40 W each. The frame is covered from above with a sheet and blanket. A dry, warm microclimate is created under the frame, due to which the burn surface dries out and heals.

The closed method is used for burns on the torso and limbs. In this case, the burn surface is covered with gauze napkins in 2-3 layers, moistened with a solution of furatsilin or a 1% solution of catapol. The napkins are fixed with retiloplast or a contour bandage. Dressing changes are often performed under general anesthesia. Solcoseryl, a biological stimulator of tissue repair that activates oxygen utilization, is widely used to treat burns. Used for the treatment of wounds, severe thermal burns, healing of varicose ulcers, bedsores, radiation ulcers, trophic lesions

Treatment with solcoseryl is most effective when used in combination: injection of the drug is combined with local application to the affected area (wound, burn, ulcer, bedsore). Available in 10 ml ampoules and 20 g tubes in the form of ointment and jelly. A large deep burn wound up to 2.5 cm can independently close along the edge on all sides due to the proliferation of healthy skin cells. If the skin defect is more than 5 cm, then the center of the burn does not heal. In such cases, i.e. with large and deep burns, skin transplantation (dermoplasty) is used.

Extensive severe burns are treated in specialized burn departments or burn centers with appropriate equipment and facilities.

First aid for carbon monoxide poisoning

Remove the victim from the room with high carbon monoxide content. If poisoning occurs while using a breathing apparatus, it should be replaced. If shallow breathing is weak or stops, begin artificial respiration. Help eliminate the consequences of poisoning: rubbing the body, applying a heating pad to the legs, short-term inhalation of ammonia (the swab with alcohol should be no closer than 1 cm, the swab should be waved in front of the nose, which is very important, since when the swab touches the nose, due to the powerful exposure of ammonia to the respiratory center can cause paralysis).

Patients with severe poisoning are subject to hospitalization, as complications from the lungs and nervous system are possible at a later date. Treatment. It is necessary to immediately eliminate the source of polluted air and provide breathing with pure oxygen under an increased partial pressure of 1.5-2 atm. or, preferably, carbogen. In the first minutes, administer the Acizol antidote solution intramuscularly to the victim. Further treatment in hospital.

To relieve seizures and psychomotor agitation, you can use neuroleptics, for example, aminazine (1-3 ml of a 2.5% solution intramuscularly, previously diluted in 5 ml of a 0.5% sterile solution of novocaine) or chloral hydrate in an enema. If breathing is impaired - 10 ml of 2.4% aminophylline solution into a vein again. In case of severe cyanosis (blue discoloration), intravenous administration of a 5% solution of ascorbic acid (20-30 ml) with glucose is indicated in the 1st hour after poisoning. Intravenous infusion of 5% glucose solution (500 ml) with 2% novocaine solution (50 ml), 40% glucose solution into a vein drip (200 ml) with 10 units of insulin under the skin.

Thank you for attention