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Mineral Oils

1

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MINERAL OILS

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1

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MINERAL OILS

Mineral (petroleum) oils represent a mixture of methane, naphthenic, aromatic and naphthen-aromatic compounds.

Molecular weight (average): solar oil 237 and 277 from the Grozny or Baku oil wells; 416, of machine oil, and 477, of cylinder oil (1,2).

Fractions which boil above 280°C contain solid methane hydrocarbons including 30-35% with branching chains. Naphthenic hydrocarbons usually contain 5-6 atoms of carbon in the ring. Predominating in the higher fractions are polycyclic compounds with a different number of rings and monocyclic with lateral chains which have higher boiling temperatures. The aromatic hydrocarbons are contained in all fractions. Prevailing among aromatic hydrocarbons in the fraction of 300-350° are naphthalene derivatives, in the next (370-400°) – a considerable amount of the same compounds, and also the polycyclic aromatic hydrocarbons. The aromatic fractions isolated from different distillates in the 260-550° interval incorporate the derivatives of benzene, naphthalene and citrocen.

Sulphur (elementary or as H_2S) is in the amount of 0.2-2.0%. It is contained in purified oils in the form of organic compounds (1).

Density: 0.885-0.900(1).

PRODUCTION PROCESS(ES)

In the Soviet Union the oil with a high content of oily distillates and the least content of resins, paraffins, sulphur and other unwanted components are used for the production of mineral oils.

Furnace oil (masut) distillation (usually in vacuum) produces light and heavy oils which are used directly or are additionally treated: purified, mixed etc. (1)

USE

Mineral oils are applied as lubricating, non-lubricating, fuel materials.

The following types of lubricating and fuel materials produced of oil are distinguished in the USSR: lubricating oils (air craft, motor, diesel, transmission, axle, turbine, compressor); industrial and instrument oil (light, medium, heavy); non-lubricating oils (transformer, technological, white oils); solid lubricants and pastes, lubricant-coolants-LC (colloidal solutions and pastes, petroleum oil mixed with sulphur).
with sulphur).

In agriculture mineral oils as pesticides are used for:

1) Summer sprinkling of fruit trees (summer oils).

2) To control wintering stages of fruit pests and pests of decorative plants (winter oils).

3) As solvents for varying insecticidal, fungicidal and herbicidal concentrates of emulsions and solutions to be applied as low volume dispersal sprinkling.

4) As a solvent of insecticides and antiseptics to control pests in household conditions and to protect non-metallic materials.

5) To control weeds in sowings of parsley and some other crops (2,3,4).

CONCENTRATION

Mineral oils are present in water as an iridescent film of various thickness and in the form of emulsions in a suspended state. Oozes saturated with furnace oil or solar oil frequently form granules of soil which incorporate petroproducts which creates a persistent pollution of water reservoirs. When the granules break up the petroproducts are released and produce secondary pollution of water. Up to 15 mg of petroproducts in 400 gr of soil is identified in a water extract from soil (5). Mineral oils used as LC, may pollute the environment.

In metal machining the amount of mineral oil aerosol depends on the machine tool, the type of the cutter, and the technology which is applied. The produced aerosol can be a sequence both of oil desintegration and the condensation of its vapours (6,7).

It has been found that the concentration of oil aerosol at work places in cold machining of metal by cutting varies from 10 to 80 mg/m^3. Oil aerosol, in the main, consists of particles reaching 5 mcm which easily reach along the air pathways the deep sections of the respiratory tract (6, 7, 8, 9).

MAMMALIAN TOXICITY ARRAY

The contact with mineral oils damages most frequently the skin and the respiratory organs. The inhaling of high concentrations of oil aerosols leads to lipoid pneumonia.

It has been shown that in shops where the concentration of oil mist exceeds 10 mg/m^3 there is a high incidence among machine-tool workers involving temporary loss of ability to work. Diseases of respiratory organs most commonly occur. Veteran women-machine tool workers are frequently ill with diseases of the liver and the gall bladder. Men machine-tool workers who are over 40 usually have a high incidence of cardiovascular diseases. In similar shops but with a lower content of the oil aerosol (not more than 3 mg/m^3) these regularities have not been found (10).

The function of external breathing and gas metabolism has been studied in 77 people including men and women machine tool workers with a varying record on the job, those working metalcutting machine tools with oil cooling (mineral oil mist concentration in the shops was 10 mg/m^3 on the average) and a control group. It was found that chronic inhalation of mineral oils (spindle oil and cutting oil) causes a lowering of the vital volume of lungs and the maximum ventilation of lungs when more than 10 years have been spent in this work. The amount of consumed oxygen and the efficiency of its use increase with veteran workers. The blood catalase test has shown that in veteran workers the activity of the enzyme increases reaching its maximum at the seniority of 9-10 years and subsequently it somewhat decreases (11).

The pathology of the upper respiratory tracts–chronic hypertrophic catars, atrophic phenomena in the mucous envelope of the nose have been found in machine-tool workers with a seniority over 10 years in shops where aerosol concentration ranged from 13 to 25 mg/m^3 (1, 6).

Workers who contact spindle, machine and other industrial oils exhibit similar changes of the peripheral blood circulation (angiospasms, spastic-atonic state of the capillaries) in 80% of machine-tool workers (seniority 6-9 years) (12).

The toxicity and the nature of damage caused by mineral oil aerosol of different content has been studied in experiments.

It was found that mineral oils of differing composition proved to be non-toxic when administered in the stomach and in case of a single inhaling action. The minimal concentrations of aerosol oils which cause changes in the functional state of the nervous and the respiratory system of test animals, given a single inhaling action, are at the level of 860-1.200 mg/m^3 (6).

In case of a single administration of 25 g/kg of IS-20, IS-45 oils, of machine (SV) and cylinder oil, mice died in 4 to 45 days. Chronic action (6 months) of IS-45 oil in a dose of 500 mg/kg produced an increase in the phagocytic index, the content of gamma-globulines in the blood serum of Guinea pigs. The administration of 5 mg/kg of IS-45 for six months did not induce any symptoms of intoxication in test animals (13).

Inhaling by rats of spindle oil aerosol in a concentration of 300 mg/m^3 (3 hour exposure) for 6 months caused an alteration in the body weight gain, produced a bronchitis and a lipoid pneumonia, protein dystrophia of the liver and kidneys. The inhaling of spindle oil at a concentration of 50 mg/m^3 (exposure 6 hours) for 6 months caused a catarrhaldesquamative bronchitis, a diffused inflamatory development in the lungs and an emphysema (1).

In case of a prolonged inhalation of a pure vaseline oil aerosol it was possible to observe in the lungs of test animals the deposition of droplets of oil in the interalveolar tissue and in the respiratory epithelium with a more or less expressed histiocyte reaction; omogranulomas have been found (1).

The inhalation of the medicinal vaseline oil aerosol by rabbits in a concentration of 10 mg/m^3 (4 hours exposure) for 100 days did not result in any symptoms of intoxication, an insignificant emphysemas of the lungs was microscopically determined (1).

Prolonged inhaling of the aerosol of different mineral oils at concentrations of 30-300 mg/m^3 caused lesions in the respiratory organs, disrupted the body weight gain, altered the consumption of oxygen and a number of other indicators of intoxication in test animals. The least effective concentrations of mineral oils in conditions of chronic inhaling vary from 10 to 18 mg/m^3 (6).

Chronic inhalation by test animals of aerosols of mineral oils in concentrations of 10-50 mg/m^3, produced morphologic and functional changes which characterize the response of the organism to a liquid low toxic foreign body, which poorly yields to enzymatic decomposition in the lungs. We also noted a catarrhal desquamative changes in the respiratory tract, an increase in enzymatic activity (an increase in the SH blood groups, activity of the blood catalase, an increase in oxygen consumption), and increase in the content of blood serum proteins, an alteration in the albumine and globuline content of blood serum proteins, a decrease of the anti-toxic function of the liver and of the immunoreactivity of the organism (10).

The influence of petrooil aerosol (spindle-3 and machine-C) upon the morphological blood content and the immunological reactivity of the organism was studied on albino rats in inhalation tests lasting for six months (4 hour exposure) in concentrations of 60, 30 and 12 mg/m^3. The study of animals during poisoning was carried out after 1, 2, 4, 6 month intervals and one month after the end of the recuperative period. In the subacute period of intoxication an increase in the leucocyte count was observed and a shift to the left of the leucocytic formula; and towards the end of the exposure period—a lowering of the hemoglobine, erythrocytes and leucocytes counts in the test animals. It has been showthat the aerosolof petrooils in chronic inhaling produced a dysproteinemia in rats, a lowering of the titre of agglutenines in serum, phagocytic activity of leucocytes and an increase of the neuroaminic acid content in blood which proved the inhibition of the immunologic reaction of the organism. A pathomorphological examination of internal organs of test animals showed hyperplastic processes in the spleen and lymphatic nodes, a reticular stroma and lymphoid tissue which point to the changes in immune processes in the organism (14, 15).

The response of regional lymph nodes in rabbits was studied during the inhaling of MC-20 oil aerosol in concentrations of 10 and 150 mg/m^3 for 4.5 months (4 hours exposure). It was found that the inhaling of oil aerosol produced an inhibition of reactive centres of follicles in the lymph nodes, an impoverishment of some sections of the cortical substance, the inhibition of the phagocytic reaction, a drop in the number of plasmatic cells, the absence of mast cell and eosinophilic reaction in the regional tracheobronchial and the neck lymph nodes which proves the inhibition of their immunogenetic function. At the same time an intensification of lymphopoesis was noted as well as the phagocytic; plasmocellular, eosinophilic and mast cell reaction in remote mesenteric and inguinal lymph nodes, a slight increase in the count of alfa and betta-globulines in the blood and lymph which indicates the immunologic activity of the lymphatic tissue in other parts of the organism. The activisation of the defensive reactions is also confirmed by an intensification of the redox processes (an increase in the activity of blood catalase, a higher content of sulfhydryl and disulfide groups (16).

The permeability of the purely hematic lung barrier was studied on albino male rats exposed to IC-20 industrial oil aerosol in concentrations of 5, 10 and 20 mg/m^3 for 4 months (4 hours exposure). In the case of inhaling of the oil aerosol in concentration of 5 mg/m^3 the permeability of the histohematic lung barrier was not observed—a fact which is connected with the straining of the compensatory-adaptive mechanisms. The influence of aerosol in concentrations of 10 and 20 mg/m^3 induces an increase in the permeability of the histohematic barrier of lungs which is predetermined by morphofunctional damage of the cells of thepulmonary epithelium, endothelium of the blood vessels and lymphatic capillaries which is reaffirmed by the findings of electronic-microscopic examination (17).

The content and distribution of catecholamines and their precursors in the endocrynal glands—the adrenal glands, the pituitary body, the thyroid and the hypothalamus, in the blood and urine of test animals have been studied in acute and chronic experiment under exposure to petrol oils in concentrations of 10 to 200 mg/m^3. The activation of the sympatho-adrenal system, and an increase in the content of catecholamines in organs and tissues, an increase in their excretion with urine was revealed in acute experiments. In chronic experiments, in the first months a lowering of the catecholamines count was found in the majority of the studied organs, and a decrease in the urine excretion which point to a lower activity of the sympatho-adrenal system. By the end of the experiment a restoration of the function of the sympatho-adrenal system was observed which revealed itself in the activation of hormonoformation (18).

The influence of the oil mist on the state of the intraorgan lymph flow of a rabbit was studied for 16 weeks during inhalation exposure in concentrations of 15, 20, 120 and 150 mg/m^3. It was found that the effect of the oil aerosol in concentrations of 120 and 150 mg/m^3 results in a levelling out of the surface and deep lymphatic networks of the trachea. The caliber of capillaries and the size of their loops varied from 0.045 to 0. 08 mcm, the orientation of the loops of the network disappeared. The density of the lymphatic capillaries and vessels per a unit of area of the mucous and the submucous foundation of the trachea increases (19).

The toxic action of some oils is also shown in their penetration through the undamaged skin. The application of the spindle oil to the skin of animals produced loss of hair, the symptoms of general toxic action: exhaustion, the decrease in the hemoglobine content, leucopenia, an increase in the content of gammaglobulines in the blood serum (20).

The IC-12 and IC-20 oils when applied to the skin of albino mice for 7-20 months produced dystrophic changes in the liver and kidneys, myocarditis, foci of bronchiopneumonia in lungs, hyperplasia of lymphoid cells in the spleen (21).

SPECIAL TOXICITY STUDIES

Carcinogenicity. The carcinogenicity of petroleum oils depends upon the origin of petrol. The perfumery oil and the diesel fuel, produced from the Grozny oil, when applied to mice skin for a year did not cause any tumours (1).

Furnace oil and IC-45 oil from the eastern sulphurous oils, being applied to mice skin, produced papillomas, mastocytes, adenoma of sebaceous glands and, in some cases, planocellular cancer and hemangioendotheliomas (1).

Small, warty and warty-papillomatous growths were obtained when aircraft oils from the Tuimazin deposit were applied (1).

The blastomogenous properties of IC-12 and IC-20 industrial lubricating oils produced from the Tuimazin deposit oil, was studied using 180 albino mice by applying it to the back skin 1-2 times a week for 7-20 months. It was found that the studied oils produced papillomas in 3 mice when the experiment lasted more than 12 months. In 2 mice which were in contact with the oils for 19 months the growth of the epithelium of large bronchi was found. The application of IC-12 oil led to the origination of a considerable proliferation of the cells of the pleura mesothelium in 2 mice. When applied for 10-12 months IC-12 oil produced the adenomas of lungs in 3 mice; when it was applied for 16 months, 2 mice exhibited an alveolar cellular cancer and the cancer of the adenocarcinoma, was found in one mice (21).

In most cases the Soviet industrial petro-oils did not reveal 3, 4-benzopyrene.

It was also shown that while machine-working articles (in baths and on machine-tools) IC-20 oil can be heated to a high temperature which leads to the formation of 3,4-benzpyren. The content of 3,4-benzpyren in the oil reached 0.5 mcg/g after 6 hours and 7.9 mcg/g after 17 hours of the operation of the machine-tool. The aerosol concentration and that of soot in the zone of respiration of the worker amounted to 22 and 40 mg/m^3 and 3,4-benzpyrene 17-18 mcg/m^3, respectively. The amount of 3,4-benzpyrene in the oil given protracted exploitation in industrial conditions went up practically from zero (not more than 5 mcg of oil) to 10,000 mcg of oil (23).

Potentiation. The toxicity of industrial oil aerosol and of the products of thermooxidation destruction was studied in albino male rats during the inhalation of 3 different concentrations for 6 months. The concentration of hydrocarbons and of carbon oxide were taken at the level of maximum allowable concentrations and the least, that of the industrial oil aerosol—at the maximum, medium and minimum level as applicable to production conditions.

It was shown that the aerosol of industrial oil and the products of thermooxidation destruction in a chronic action produced disturbances in the functional state of the nervous system (an increase in the threshold of excitability and a reduction in the frequency of breathing); the cardiovascular system (the lowering of arterial pressure, a decrease in the frequency of heart beats, a slowing down of atrio-venticular and intraventicular conductivity, the lowering of the voltage peaks); disturbances in the respiratory organs; in the liver (alterations of the protein-forming, hydrous and enzymatic functions); that of the suprarenals (the decrease in the count of andrenalin-like substances and 11-oxicorticosteroids in the blood); inhibition of the immunological reactivity (the lowering of the lysozymes in the serum, and increased content of the neuraminic acid in the blood).

The study of the toxicity of the industrial oil aerosol, and also of the aerosol and products of thermooxidizing destruction in the comparative aspect showed a more pronounced damaging action of toxic substance in case of their combined action (9, 24, 25, 26).

It was found that the administering of different additives (up to 20%) does not influence the toxicity of mineral oil when administered to the stomach of test animals but frequently alters the nature of its cutaneous effect. It was also demonstrated that the administering of additives into mineral oils did not facilitate their permeability in the organism through undamaged skin. Given single administering of the aerosol resulted from the desintegration of 4 turbine oils (with a common base, but with different additives) and of AMT-300, Mobilterm-600 oils similar changes were observed in the excitability of the nervous system and the frequency of respiration when inhaling it in concentrations of 860-1,200 mg/m^3 (oil aerosol). It was shown in a chronic experiment that the effect of the aerosol of mineral oil desintegration (the turbine oil with a mix of additives, like AMT-300, spindle and other oils), produced a similar pattern of intoxication which was determined by the content of the oil aerosol in the air (15-30 mg/m^3) (27, 28).

It was also found that the inhaling of lubricating-coolants aerosols (LCLZ-4, LZ-105, LZ-C-1) in concentrations of 5 and 10 mg/m^3 for four months (4 hours exposure) induced in white rats and rabbits a retarding of body weight gain, an increase in oxygen consumption, an alteration of the morphologic blood content. Violations in the function of the nervous system were found in rats and also an increase in the catalase and transaminase of the blood. It was also found that the total protein content and the albumine level decreased while the level of globulines in test animals increased. A fatty dystrophia was found in the kidneys and the liver, a development of lipoid interstitial pneumonia with the phenomena of a bronchitis and peribronchitis was found in the lungs (29).

The study of the state of health of 100 male machine-tool workers (20-49 in a age group, with 4 to 15 years of work experience), working in contact with lubricant-coolants (oil aerosol concentration of 4-168 mg/m^3) revealed disturbances of the bronchopulmonary apparatus (the lowering of indicators of external breathing and gas metabolism), of cardiovascular system (hypothenia, bradicardia, hypodynamia of the myocardium), of the morphological composition of peripheral blood (the lowering of the leucocyte count, and of segmentonuclear neutrophiles, an increase in the number of eosinophiles and lymphocytes). The examined workers demonstrated a lowering of the phagocytic activity of leucocytes, an increase in the histamine and serotonine content in the blood. It was found that the incidence of temporary disability among those working in contact with lubricant-coolants (machine-tool operators) was higher than in the control group (assembly workers) (9).

The examination of the state of health of young workers in the 16-19 age group, working in contact with lubricant-coolants NTL-205, E-2, E-3 from 6 months to 4 years (oil aerosol concentration of 14.68-4.91 mg/m^3), revealed variations in the alfactory reaction to odours, total protein and protein fractions (LC E-2 and NTL-205) of the blood serum, blood catalase activity, reactive hyperemia and capillaroscopia (LC E-3 and NTL-205), the activity of alkaline phosphatase (LC NTL-205), the cardiovascular system, tactile sensitivity (all 3 types of LC), which were within the physiological norm. It was shown that the emulsion containing mineral oil (LC E-2) causes an insignificant increase in arterial pressure, and when a lubricant includes 1% of sodium nitrate (LC NTL-205, E-3) this effect becomes stronger (30).

Primary irritation. Mineral oils possess a well-pronounced property of being a local irritant. Upon contacting skin they produce dermatitis, eczemas, folliculites (2).

It has been found that the level of contamination of work clothes of machine-tool operators varied from 29.5 to 168.5 mg/100 cm^2 and that of skin – from 8.6 to 43.5 mg/100 cm^2 when operating machine tools with an oil cooling and a guarding shield and, it was 45.6-246.4 mg/100 cm^2 and 12.7-69.4 mg/100 cm^2, respectively when oil cooled machine-tools were used without a guarding shield; oil caused folliculites and occupational dermatitis have been found in 23%, and only in 15% of workers when guarding shields were used (9).

The determination of oil on the fabric of work clothes in case of unshielded machine-tools revealed up to 30-50 mg/100 cm^2 of oil in the area of shoulders, chest and stomach. The amount of oil on the clothes of those operating shielded machine tools reached 40-120 mg/100 cm^2 (37).

The examination of 460 workers who contact lubricant-coolants, revealed dermatoses in 41: acne sebacea, pyodermas, dermatitis (32).

The study of case histories of people suffering from occupational diseases of the skin (limited or wide-spread dermatitis and eczemas) caused by cooling emulsions and lubricating oils, revealed that the peripheral blood of the patients had an increased content of eisinophils, specifically in case of the wide-spread forms of occupational dermatoses (33).

The application of industrial lubricating oils (IC-12 and IC-20) to albino mice 1-2 times a week for 7-10 months produced focal and diffused hyperplastic changes in the epithelium with lymphoid-histiocytic infiltrates in the derma. Dystrophic processes were found in the fibrillary formations of the skin. Application of oil for one year and more also produced the phenomena of displasia, of the skin epithelium. A chronic inflammation with plasmatic, mast and lymphoid-histocytic cells was found in the derma. Elastic fibers had mast and lymphoid-histocytic cells was found in the derma. Elastic fibers had decomposed and melted (21).

The peculiarities of skin ultrastructure was studied by applying industrial lubricating oils (IC-12, IC-20, IC-30, IC-45, IC-50) when they were applied to albino mice at a rate of 0.25 ml 3 times a week for 2 months. All 5 samples of industrial oils produced pathological lesions at the place of application. Beginning with the second-third week of the experiment it was possible to observe macroscopically on the skin: alopecia, erythema, separate patches of erosion and small desquamation. On discontinuing the application (beginning with the third month) complete healing was observed. Microscopically by the end of the first month it was possible to see a thickening of the epidermis, the decrease in the number of hair follicules with their partial atrophia, cellular infiltration of the derma proper, by the second month—the thinning of epidermis, the flattening of the papillary layer and a strongly pronounced cellular infiltration of skin proper. Beginning with the third month of the experiment it was possible to observe the regeneration of the lesioned areas of skin. The electronic microscopic examination revealed that the influence of the samples of industrial oils, produce disfurbances in the ulfrastructure of individual cellular elements of one and the same type which are reversible and which are characterized by atrophic, distrophic and proliferative processes in the epidermis (34).

EFFECTS ON ORGANISM IN THE ENVIRONMENT

It was found that the harmful influence of petroproducts of hydrobionts is associated with the disruption of the gas metabolism and a deficit of oxygen in the water. Petroproducts form a thin film on gill fringes and reduce gas metabolism in the gills which produces the asphyxia of fishes. More than 16 mg/l of petroproducts in water leads to the perish of fish, disrupt normal development of ova. Fish larvae perish at a concentration of 1.2 mg/1. Daphnia perish at a concentration of 0.1 mg/l, chironomids--at 1.4 mg/l. Petroproducts at a concentration of 0.1 mg/l lend the smell and aftertaste of oil to fish and this does not disappear after cooking (5).

The mechanism of action of oils upon plant pests (scales, coccids, leafhoppers, aphids, ticks etc.), and upon their eggs, is not absolutely clear. It is suggested that the influence disrupts the gas metabolism (hinders the access of oxygen) and brings about a disruption of the water balance of the insect and its eggs, the disturbance of the cover (the envelope, which is particularly important for eggs), penetration of oils into the organism of the insect or to the egg and the disruption of enzymatic processes, coagulation of the protoplasm and the disturbance of tissue structure (3).

The experiments carried out with fruit lecanium have shown that a 4% emulsion of solar oil kills 30% of larvae, and a 8% emulsion – 70% of larvae; a 6% emulsion of spindle oil kills 100% of lavrae (4).

SAMPLING/PREPARATION/ANALYSIS

As a rule, mineral oils in the air are in the form of aerosol. Pipets with a vacuum method or an absorber with a glass porous plate, and an AFA-B-10 filter are used for air sampling. Identification can be carried out by the technique of fluorescence or emulsion and also the weight technique.

The emulsion technique of identification of mineral oils (turbine, spindle, machine) in the air is based on the formation of an emulsion when an oil solution is deluted in acetic acid or acetone by water. The identification sensitivity egualc 50 mkg in the identified volume. The identification is hindered by vapours of other petroproducts (35).

The qualitative and quantitative composition of individual products of the thermooxidizing destruction of mineral oils in air is identified by the gas-liquid chromatography and by infrared spectroscopy, thin-layer and liquid chromatography (36, 37).

The spectrophotometric technique of identification which is based on the ability of petroproducts to be luminiscent in the ultraviolet range of the spectrum is used to test the content of mineral oils in water. The sensitivity of the technique for transformer oil is 0.4 mcg/ml, for turbine oil–1.2 mcg/ml, for compressor– 0.6 mcg/ml. It has been also shown that the organic additives and inorganic salts do not hinder the oil analysis (38).

TREATMENT OF POISONING

There is no descriptions of the specific methods of treament of intoxication with mineral oils. Treatment is symptomatic. Treatment of lesions of the skin is carried out by the conventional methods (2).

RECOMMENDATIONS (LEGAL MECHANISMS)

In case of contact with mineral oils, thorough protection is necessary for the eyes, the respiratory organs and the skin (2).

It is recommended to protect the skin against oils by using protective clothes with a polyvinylchloride coating or with a coating of polyethylene, Teflon, which cannot be penetrated by oils (32).

Effective skin disease prevention is achieved by applying hydrophillous film-producing protective oinments, pastes and thick creams and new detergents based on DNC-AK (1, 32, 39).

Considering the high share of diseases affecting the bronchi and lungs and skin of those who come in contact with petrooils, machine-tool operators have to be examined once a year by a therapeutist, ENT doctor and dermatologist (1, 9, 11).

The maximum allowable concentration of mineral petrooils in industrial atmosphere is 5 mg/m^3 (22).

The maximum allowable concentration of petrol and petroproducts in a solution or in an emulsified state in water reservoirs where fish is caught is 0.05 mg/l, the criterion being the fish population damage (36).

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