– расстояние от центра блока чалочного приспособления до точки сцепления смежных групп вагонов l_c принято по результатам предыдущего расчета величиной 18310 мм;

– расстояние от тягового кронштейна до точки сцепления смежных групп вагонов c принято по результатам предыдущего расчета величиной 750 мм;

– расстояние от центра блока чалочного приспособления до тягового кронштейна первого сцепа вагонов l_1 по результатам предыдущего расчета принято величиной 17560 мм;

– расстояние от центра блока чалочного приспособления до тягового кронштейна второго сцепа вагонов l_2 по результатам предыдущего расчета принято величиной 19060 мм.

Расчет:

– расстояние от тяговой лебедки до точки сцепления смежных групп вагонов

$$L_c = L + c = 22000 + 750 = 22750 \text{ мм};$$

– расстояние от тяговой лебедки до центра блока чалочного приспособления

$$L_б = L - l_1 = 22000 - 17560 = 4440 \text{ мм};$$

– расстояние от центра блока чалочного приспособления до тягового кронштейна на раме вагона h рассчитывается исходя из подобия двух прямоугольных треугольников с катетами, L_c, H и l_c, h:

$$L_c / H = l_c / h,$$

откуда

$$h = Hl_c / L_c = 1408 \cdot 18310 / 22750 = 1133 \text{ мм};$$

– расстояние между кузовом вагона и блоком чалочного приспособления перпендикулярно оси вагона:

$$B = h - R = 1133 - 160 = 973 \text{ мм};$$

– угол между тяговым тросом лебедки и рамой вагона

$$a = \text{arctg}(H / L_c) = \text{arctg}\ (1408 / 22750) = \text{arctg}(0{,}062) = 3{,}55°;$$

– угол между нижней по рисунку ветвью чалочного приспособления и рамой вагона

$$a = \text{arctg}(B / l_1) = (973 / 17560) = \text{arctg}(0{,}056) = 3{,}21°;$$

– угол между верхней по рисунку ветвью чалочного приспособления и рамой вагона

$$a = \text{arctg}[(B + D) / l_2] = [(973 + 320) / 19060)] = \text{arctg}(0{,}068) = 3{,}89°.$$

Таким образом, угол между стальным канатом и рамой вагона в месте установки тягового кронштейна во всех случаях меньше допустимого по ГОСТ 22235-210 в 5°. Следовательно, найденные в результате расчетов параметры тягового устройства для перемещения сцепа из двух вагонов (диаметра блока и длины троса чалочного приспособления) обеспечивают выполнение условий ГОСТ и планировки участка маневровых работ.

Разработанная методика позволяет рассчитать геометрические параметры тяговых устройств для участков маневровых работ с иной планировкой и проверить допустимость перемещения одной тяговой лебедкой одновременно двух сцепов вагонов в других условиях.

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LUBRICANTS GENERAL CHARACTERISTIC AND THEIR APPLICATION IN DIFFERENT MACHINES

A. A. RISKULOV, Kh. I. NURMETOV, M. R. ALIMOV
Tashkent State Transport University, Republic of Uzbekistan

Lubricants are substances which possess lubricity, i.e. the ability to decrease friction and wear rate and to remove seizure of rubbing surfaces. Most of lubricants, apart from solid lubricants (graphite, molybdenum disulphite, and some others), are liquids. As a rule, they have multicomponent composition which includes solid additions.

The basic types of lubricants include oils and grease (consistent) lubricants. As a rule, they are manufactured basing on base oils of different origin.

Petroleum (mineral) oils and synthetic fluids make up the basis of all kinds of lubricants. According to the production output and the consumption amount, mineral oils, obtained through refining of hydrocarbon fractions created in the course of petroleum refining, head the list. Petroleum oils are used as a lubricant in friction joints; such a lubricant provides hydrodynamic lubrication and intensive heat removal out of a friction area. Besides that, they are the basic component of sealing, conservation, and other compositions, including ones which are combined with synthetic fluids.

Synthetic fluids (or oils) are organic or organoelement polymer high- and medium-molecular compounds. They possess properties which are not typical of natural fluids, such as low freezing point, vapourability, and compressibility together with viscosity which hardly varies within a wide temperature range etc. Synthetic oils include organosilicon (siloxanorganic) and fluorocarbon fluids and some synthetic liquid hydrocarbons.

Additives, fillers, and bodying agents are introduced into base oil which is the basis for lubricants. Additives are substances intended to improve the quality of base oil and to impart it with new properties. Depending on the purpose, viscous (which increase viscosity), anti-wear (which decrease friction couple wear intensity), extreme-pressure (which prevent jamming and adhesion of friction surfaces), anti-friction (which decrease friction coefficient), antioxidant (which slow down oil oxidation), anti-corrosive (which decrease oil corrosiveness), and multifunctional (complex) additives which increase several quality criteria of lubricants are distinguished. Most additives are surfactants. Additive flow usually makes up fractions of per cent of oil weight.

The principal difference of fillers from additives is that the former ones are insoluble in base oil due to which they form a distinct phase in it. Introduction of fillers aims at the following: improving lubricity, sealing properties, and protection capability, increasing shear strength of grease lubricants etc. Sometimes a filler is introduced with the aim of saving a high-priced lubricant, if performance of the latter one does not change after the filling. Graphite, mica, molybdenum disulphite, powders of metals and their oxides etc. are most often used as fillers. Filler content in grease lubricants reaches 30 %.

Bodying agents are introduced into lubricants to make them more viscous. A bodying agent creates a skeleton of supramolecular structures of its own or finely-dispersed particles in the volume of a lubricating layer. Solid hydrocarbons, salts of high-molecular fatty acids (soaps), and inorganic silicate products (silica gel, bentonite) are used as bodying agents. Normally bodying agent content in base oil does not exceed 10–15 %.

Sometimes water or aqueous solutions of electrolytes are introduced into lubricant-coolants to create emulsions which consist of non-miscible aqueous and oil phases.

General indicators judging by which operating characteristics of lubricants are estimated include anti-corrosion ability or corrosiveness, antioxygenic properties, oxidisability or stability of compositions in an oxidising medium, viscosity (for liquids) or strength limit (for grease lubricants), vapourability, density, lubricating ability, mechanical impurity content or ash content, and temperature resistance.

In addition to that, specific indicators are determined for distinct lubricants, which will be specified further. Lubricating oils are conventionally divided into four groups: motor, gear, industrial, and oils for steam turbines and compressors.

Motor oils which consist of base oil and additives are used for lubrication of internal combustion engines. The most important characteristics of motor oils which determine the possibility of their use in engines are detergency (prevention of carbon formation in an engine), anti-corrosion ability, wear resistance, and oxidation resistance. Compliance of a motor oil with operational requirements is determined in the process of a series of standard tests which are held when an engine is running or using special facilities.

Motor oils are manufactured, as a rule, basing on low-viscosity mineral oils with wear-resistant additives (esters of phosphoric, thio- and dithiophosphoric acids, and zinc salts). Some oils for reaction engines and gas turbines are prepared basing on synthetic fluids.

Oils for steam turbines, engines, and compressors, on which tightened requirements in resistance to oxidation in the air at high temperatures are imposed, are close to motor oils in the basic characteristics. Their properties are specified in GOST 6411-76, GOST 32-75, and GOST 1861-73.

Gear oils are designed to lubricate mechanical and hydrodynamic gears of ground means of transportation. Since fatigue pitting of friction surfaces or their jamming at high temperatures are the main types of destruction in gears, the mentioned oils have to possess high extreme-pressure properties.

This is achieved through introduction of special additives, first of all organic derivatives of sulphur and chlorine and compounds containing both of these elements, into the mineral body of oil.

Extreme-pressure additives react chemically with a heated friction surface of a metal part and form films of reaction products which prevent from adhesion and scoring. Properties of gear oils and their test methods are specified in GOST 23652-79. Properties of some types of lubricating oils are given in table 1.

Table 1 – **Properties and areas of application of lubricating oils**

Oil grade	Oil type	Viscosity / density ratio at 100 °C, mm²/s	Ash content, %, not more	Temperature, °C		Application objects
				Pour	Flash	
МС-14	Motor	14	0.003	–30	200	Aviation technical equipment
М-8А		8	0,45	–25	200	Automotives
ДС-8		8	0.005	–25	190	Diesel engines
МС-6		6	0.005	–55	145	Reaction engines
Ц-11	Cylinder	9–13	0.03	+5	215	Steam machines
T_{22}	Turbine	22–23	0.005	–15	180	Steam and gas turbines
К-12	Compressor	11–14	0.015	–25	216	Piston and rotary compressors
$ТА_{П}$-10 $ТС_{П}$-14	Gear	10 14–15	0.1 0.01	–37 –	95 140	Automotives Trucks
И-5А И-20А И-100А	Industrial	4–5* 17–23* 90–118*	– 0.15 0.45	–25 –15 –10	120 180 210	Indoor machinery and equipment
* At 50 °C						

Oils for industrial equipment (industrial oils) are designed mostly to decrease friction coefficient in movable joints of machine tools, presses, rolling mills, and other equipment. Besides that, they have to remove friction heat, protect friction joints from corrosion, clean contamination from friction surfaces etc.

The main characteristic of industrial oils is viscosity stability in operating conditions, which is especially important when lubricating hydraulic gears of precise machine tools. Combination of these properties is typical of refined petroleum oils and their mixtures without additives, which are used in mechanical engineering – general-purpose industrial oils (GOST 20799-88). However in recent years a tendency to use oils modified by additives, first of all antioxidant and anti-friction ones, in lubrication systems of industrial equipment appeared.

Electrical insulating oils and fluids are adjacent to lubricating oils of the above mentioned basic groups.

They are used not only as actuating media in electrical equipment (transformers, capacitors etc.), but also for lubrication of some types of equipment. Electrical insulating oils are, as a rule, ultrapure mineral oils and organosilicon or synthetic fluids of special purity.

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THE INFLUENCE OF RAW RUBBERS VULCANIZATION ON THEIR MECHANICAL PROPERTIES

A. A. RISKULOV, Kh. I. NURMETOV, M. I. RAKHMATOV
Tashkent State Transport University, Republic of Uzbekistan

We know that vulcanization is a technologic process of converting raw rubber into rubber. Vulcanization induces changes in the following raw rubber parameters: strain under assigned elongation, hardness, strength (modulus of elasticity) at extension, relative elongation, residual deformation, elasticity as well as some operation parameters (freeze resistance, swelling capacity, gas permeability, etc.).