USING OF THE TECHNICAL FLUIDS AND GASES IN MECHANICAL ENGINEERING

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Abstract

Use of technical fluids and gases is followed by waste expenditure of them in the course of spills, leakage, and evaporation aggravated by difficulty of complete collection of waste fluids and gases. Therefore, along with an increase in application effectiveness of technical fluids and gases, a decrease in waste expenditure of them is an important problem of materials science. Besides material saving, a solution to this problem also has ecological significance connected with an environment pollution concentration decrease.

Keywords: Technical fluids; lubricants; liquids; electrolyte solutions; corrosion inhibitors; conservation oils; film-forming inhibited petroleum compounds; protective water-displacing compounds; liquid fuels.

1. Introduction

Nowadays stringent and ever-increasing requirements concerning reliability, service life, and fuel, lubricant, and other process material consumption are imposed on materials and other technical articles. Technical fluids and gases obtained mostly from petroleum derivatives are actuating media, fuels, or process materials. They are equivalent to structural materials – metals, ceramics, and plastics etc. – in their impact on performance of machinery.

Therefore both workers of mechanical engineering and specialists who operate articles of machinery are in need of knowledge of their composition,

properties, areas of application, operating properties, and toxicological characteristics.

Technical fluids include liquid and plastic substances used as lubricants (oils, greases), actuating media (hydraulic oils, heat carriers etc.), process liquids (lubricant-coolants, washing, dissolving, and other agents) and liquid fuel.

Technical fluids play a big role in technology and a significant amount of extracted mineral raw materials, first of all petroleum ones, is spent on their manufacturing.

Lubricants used for lubricating movable joints of machinery and equipment, which decreases losses on overcoming friction forces and prevents wearing out and corrosion damage of machinery, play an important role in mechanical engineering.

Liquids used as process media are necessary for carrying out operations of mechanical, thermal, and thermochemical processing of structural metals and alloys. Actuating media, materials for which are liquids and gases, are widely used in hydraulic gears, shock absorbers, and machines and apparatus in which heating and cooling processes occur. Liquid and gaseous fuel is an energy source in various heat engines, internal combustion engines, and furnaces for thermal processing of materials.

2. Methods

Special agents and fluids used during processing, operation, and storage of articles of mechanical engineering have practical importance. They include liquid electrolytes and inhibited oils and fluids.

Electrolyte solutions are used for electroplating of metal articles. Electrolytes are liquid or solid substances which contain noticeable concentrations of ions which determine passage of electric current. Salts solutions of which conduct electric current through ions created as a result of electrolytic dissociation are most often used in mechanical engineering. Electrolytes are divided into acid and alkaline ones in electroplating. Acid electrolytes are characterised by high metal ion activity, simplicity of composition, and high performance when plating simple-shape articles. In alkali electrolytes, a metal being plated is in the form of complex ions which distribute uniformly on a cathode during electrolysis, which allows obtaining polycrystalline and dense coatings.

Sulphate electrolytes which contain nickel sulphate as the basic component have become most widely used for plating nickel coatings. Sodium or magnesium sulphates are introduced into an electrolyte to increase electrical conductance.

Sulphate electrolytes which contain chromium anhydride and sulphuric acid in the optimal ratio 100:1 are used during chromium plating. The necessity of especially precise maintaining electrolyte temperature in an electroplating bath is a peculiarity of chromium plating since a chromium plating mode is directly connected with coating quality.

Electrolytic zinc plating is carried out in acid, cyanide, ammoniate, and other electrolytes basic components of which are zinc oxide ZnO and sodium hydroxide NaOH. Zinc plating is the most widespread and cheap means of anode protection of steel parts. Zinc coatings not only protect steel from corrosion well, but, being

elastic, are not damaged during flare fitting, bending, and roller draft of workpieces. As-plated coatings are easily soldered using acid-free flux. Tubes, parts of devices and machine tools, and wire etc. undergo zinc plating.

Acid and cyanide electrolytes which contain cadmium sulphate or oxide are used during cadmium plating. Cadmium coatings are used to protect parts of devices and appliances operated in conditions of tropical and oceanic climate from corrosion.

Slightly soluble corrosion inhibitors, chemical compositions or their mixes which in low concentrations are able to prevent or decrease the rate of metal electrochemical corrosion, have become widely spread in mechanical engineering. They are an obligatory component of corrosion preventive agents used during storage, transportation, and operation of mechanical articles.

Conservation oils (K-17, NG-203, Kormin) and *corrosion preventive oils* with AKOR-1 and KP inhibited additives are widely used at works of automobile, tractor, tool, machine tool and shipbuilding, aviation, bearing industry and agricultural machine building for interoperation protection and conservation of articles (engines, compressors, reducers and so on). During long terms of storage and seasonal operation of machinery corrosion inhibitors are introduced into oils so that *corrosion preventive oils* are created. They provide protection of metal articles from corrosion and corrosion and mechanical wear during the period of 10-15 years. Such oils include M-4z/8 Grk all-season semi-synthetic based oil universal for gasoline and diesel engines, M-8Gi, and TM-5-12rk oils etc.

Conservation and later corrosion protective oils completely superseded grease lubricants in the sphere of conservation of internal combustion engines. Advantages of use of these lubricants are as follows: a decrease in corrosion and mechanical wear of machinery and mechanisms, an extension of their service life and a reliability increase, a decrease in expenses and cost of conservation and depreservation of equipment (3–5 times compared to power oils and 6–10 times compared to consistent compounds).

Film-forming inhibited petroleum compounds create protective coatings on the surface of metal articles; the coatings may be easily removed using petroleum solvents. Wide use of these compounds in mechanical engineering is determined by a number of their specific properties. The coatings being 20–200 μm thick, they are able to protect metal during a longer period of time than consistent lubricants applied in a 3–5 mm thick layer. The compounds are applied to articles as easy as conservation oils are (with a brush, by dipping, spraying) and do not require special heating. The temperature range of use of the compounds is from –40 to +70°C. The compounds possess good penetrability and fill gaps and clearances between parts, displace adsorbed water and salt and acid solutions from the surface of metal articles. The most widespread products of the family of film-forming inhibited petroleum compounds include: NG-216B, Akvamin, Movil, and Ingibit-S etc.

Protective water-displacing compounds make up a distinct class of washable anti-corrosion coatings. They contain up to 60% solvents, mineral or synthetic oils, and compound additives (anti-friction, antioxidant, anti-wear, and bodying ones).

The compounds are used to protect threaded joints from corrosion and facilitate their disassembling, to conserve spare parts and tools, to protect welded and riveted joints. The compounds penetrate into corrosion products well and therefore are effective when processing rusty surfaces of metal articles.

Liquid fuels – gasolines, diesel fuels, kerosene, and mazut which are petroleum refining products – play a huge role in technology according to the amount and range of use. Along with their primary purpose, these fluids are also used as components of washing fluids, lubricant-coolants, and solvents etc. in mechanical engineering.

Gaseous media which are used, particularly, in nitration and cementation processes were described earlier when considering operations of thermochemical processing of steels.

Gases and their mixtures are widely used as fuels during flame cutting and hardening of metals, as plasma-supporting media during ion-plasma processing of metals, as welding gases, and as refrigerants in refrigerating units etc.

3. Results and Discussion

Nitrogen is used to create neutral atmosphere during thermal processing of metal articles. It is an operating medium during nitration of metals and ion implantation of metal articles carried out with the purpose of strengthening their surface layers; it also serves as a component of technological gas mixtures. Ammonia is used mostly during thermal processing of steels and as a refrigerant in refrigerating units.

Areas of application of argon include creation of neutral atmosphere during welding and remelting of metals and creation of plasma during ion-plasma processing of metals. Welding and cutting of metals is carried out using acetylene. Hydrogen is used mostly during gas cutting and thermochemical processing of steels. Difluorochloromethane (Freon-22) and difluorodichloromethane (Halon-12, Freon-12) are typical refrigerants and aerosol components. Oxygen is used for gas cutting and material welding, for intensifying thermal processing of metal articles, and for intensifying metallurgical processes. Krypton and xenon serve to fill different devices of vacuum tube technology. Methane and propane are necessary constituents of controlled atmospheres during thermochemical processing and of fuel during plasma hardening. Carbon dioxide is widely used for regulating intensity of thermochemical processing and metal welding.

Exothermic and endothermic gases (mixtures of hydrogen, nitrogen, methane, and carbon oxide, a mixture of ammonia with hydrogen etc.) are used during thermal processing of steel.

4. Conclusion

Fluids and gases are components of a big unity of *biphasic media* used in mechanical engineering.

Magnetic fluids, grease lubricants, and suspensions with powdery additions, which represent liquid–solid body biphasic systems, were mentioned earlier in this chapter. Emulsions are disperse systems with a liquid dispersion medium

microparticles of which are distributed in the carrier fluid. Such biphasic systems include water-based paints, water-soluble lubricant-coolants, and some inhibitor fluids.

Gas–liquid biphasic systems (aerosols and fogs), which include paints, lacquers, oils, and other fluids which are mixed with gas before application to the surface of articles, find application in technology. Gas–solid body biphasic systems include aerosols with solid particles used during plating of powdery coatings and fuel injection into furnaces; they also include a mixture of compressed air and sand which serves as an operating medium during sand-blasting of surfaces of castings and parts.

The role of biphasic systems in technology increases since normally such systems possess fundamentally new properties compared to primary components.

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