MORE ATTENTION TO JET FUEL CLEANLINESS (a discussion)

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UDC 665.521.3

Uninterrupted and reliable operation of the fuel-system equipment of gas turbine engines depends to a considerable extent on fuel cleanliness, i.e., on the amount of contaminants that get into the fuel. Therefore, efforts toward fuel cleanliness must be performed on a universal basis, i.e., in production, transport, storage, and use of the fuels [1, 3]. Along this route, extraneous contaminants enter the fuel; these contaminants include corrosion products from refinery equipment, storage systems, and transport equipment, as well as mineral particles and water that enter the fuel from the surrounding atmosphere [4].

The processes of contaminant formation and accumulation in fuels have been studied, and a number of measures for fuel decontamination have been proposed [2].

In some refineries, special measures are being taken to improve fuel cleanliness. For fuel terminals, a system has been developed for multistage filtration,and settling, with floating suction lines in the settling tanks to draw fuel from near the top level [3]. Refueling vehicles have been equipped with reliable filters. Improved fuel filtration systems have been developed for airport fuel terminals [4].

However, the rolling stock currently used for rail transport of fuel, as well as the loading and unloading racks, still do not ensure the required cleanliness for the fuel transported [5]. The principal source of fuel contamination en route is inadequate cleaning of tank car interiors prior to loading. The need has arisen for a reexamination of the requirements of GOST 1510-60 as to preparation of tank cars for fuel loading. The next logical question to consider is that of the manufacture of special tank cars with enamel or other interior coatings for corrosion protection.

Open loading of fuel into tank cars and the unloading of these tanks cars at the destinations create conditions for entry of rain and atmospheric dust into the fuel [6]; therefore, closed loading systems should be developed and put into service.

It is necessary to accelerate the construction of automated loading racks with closed loading of petroleum products into tank cars [7]. In other countries, France for example, use is being made of automatic closed loading of tank cars with automatic shutoff of the loading stream when necessary [8].

A system should be set up for in-line control of fuel cleanliness ahead of the loading operation or aircraft refueling, with automatic shutoff when the fuel contamination level exceeds the allowable limit. Methods have been developed in foreign (non-Soviet) countries for automatic sampling from the fuel stream with simultaneous analysis for cleanliness [9].

The accepted method for visual determination of particulate matter in fuels (GOST 10227-62) does not meet present-day requirements.

In order to determine the feasibility of replacing the visual method for particulate matter, the authors of the present article checked the cleanliness of 70 batches of commercial TS-1 fuel (aviation turbo kerosine) using the methods specified in GOST 10577-63 and GOST 9278-59 and a method of evaluating the condition of a fuel-water interface [10].

The GOST 10577-63 method is distinguished by high precision, but the time for analysis is excessive (60 min). The method is essentially a gravimetric determination of the particulate matter retained by a membrane filter during filtration of the test sample. The contaminant level as determined by this method on 33 batches of commercial TS-1 fuel ranged from 0.00005 to 0.00025% (0.5 to 2.5 ppm).

It should be noted that refineries can produce fuel with particulate matter content 0.0003% (3 ppm) maximum. This can be adopted as a specification limit for TS-1 type fuels by introducing the GOST 10577-63 method as a requirement for checking fuel cleanliness at the production site.

Novo-Ufa Petroleum Refinery. Translated from Khimiya i Tekhnologiya Topliv i Masel, No. 1, pp. 49-51, January, 1967.

GOST 9278-59 provides for determining the final filtration rate of two liters of fuel in the AzNII-FT-2*l* apparatus under specified conditions. The filter medium is felt and silk canvas [11]. The time required for the determination is 15 to 20 min. The method gives an indirect control over the extent of fuel contamination by particulate matter, corrosion products, naphthenate soaps, resinous sediments, and other materials, based on the filtration rate and the change in throughput capacity of the filter.

Using this method for controlling jet fuel cleanliness, fuel pumpability can be evaluated at the same time [12]. Thd disadvantage of the method is the relatively complex design of the AzNII-FT-2*l* apparatus and the large quantity of fuel sample (two liters) in comparison with other methods.

For the 28 batches of commercial TS-1 fuel that were checked, the final filtration rate ranged from 0.2 to 0.65 liter/min. The standard requirement for pumpability of fuel meeting GOST 10227-62 is 0.1 liter/min.

In foreign countries (England, U.S.A.), jet fuel cleanliness is checked by water treatment of a fuel-water interface [3]. Contaminants suspended or dissolved in the fuel are detected visually by this method. We used this method in checking 20 batches of TS-1 fuel. It is not suitable as a check on the cleanliness of fuels containing additives with emulsifying properties. Our observations showed that not all of the contaminants present in the fuel migrate to the interface during the two-minute shaking period.

The following are necessary for the development and introduction into practice of a more effective method of checking jet fuel cleanliness:

1. Along with the current visual method for evaluating fuel cleanliness, the gravimetric control method for particulate matter (GOST 10577-63) and the filtration method with the AzNII-FT-2*l* apparatus (GOST 9298-59) should be introduced on an optional basis for the accumulation of data. At the same time, a check should be made on the quantity of particulate matter by water treatment of a fuel-water interface (GOST 10277-62).

2. Differential limits should be established for the content of particulate matter in fuels—at the production site and at the use site.

3. The technical capabilities of refineries allow them to produce fuel with not more than 0.0003% (3 ppm) particulate matter. The maximum allowable content of particulate matter at the site of use should be decreased to 0.00010-0.00015% (1-1.5 ppm). With the widespread introduction of airport fuel filtration facilities and the required filtration on refuelers directly ahead of delivery to the aircraft, this degree of jet fuel cleanliness is also practical.

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