2. Borisov V.G., Svarovskaya M.G. EOR Methods Applicability Analysis for Heavy Oil Reservoirs under Polar Circle Conditions -, 2011 - SPE-149678-RU
3. Edelman I.Y., Shandrygin N.I. Approaches to Development of High-Viscosity Oil Fields in Arctic Conditions using the Example of the Russkoe Field (Russian), 2011 - SPE-149917-RU
4. Davletbaev A., Kovaleva L., Minnigalimov R. Recoveries of Heavy Oil and Bitumen Techniques With the Radio Frequency Electromagnetic Irradiation -2010 - SPE-13808
5. Dinariev O., Shandrygin A, Mikhailov D., Nukhaev M., Lutfullin A., Enhancing Efficiency of Steam-Thermal Treatment of Formations With High-Viscosity Oil (Russian) 2010 - SPE-138091-RU

COMPARISON BETWEEN MATHEMATICAL MODELS USED FOR CALCULATIONS OF DIESEL FUEL FRACTIONS CETANE INDEXES

I.A. Bogdanov, A.A. Altynov

Scientific advisor assistant teacher M.V. Kirgina

National Research Tomsk Polytechnic University, Tomsk, Russia

Nowadays, the main purpose of the Russian Federation energy policy is to use natural resources more efficient for sustainable economic growth, for improvement of the life quality of the population and strengthening foreign economic positions.

Diesel fuel is ranked third after oil and gas in the structure of Russian exports. According to the Energy strategy in Russia, until the 2030 year production volumes of diesel fuel should be more than 110 million tons per year [1]. However, despite the annual increase in the consumption of diesel fuel, the most industrialized countries devote increased attention to the quality of diesel fuels and supports efforts to reduce emissions.

Thus, improvement the quality of produced diesel fuels is an important task nowadays. Basic properties of diesel fuels produced in Russia are governed by three basic standards: USS 305-82, USS R 52368-2005 and Technical Regulations of the Customs Union "Requirements for automobile and aviation gasoline, diesel and marine fuel, jet fuel and heating oil". The most stringently controlled key indicators for diesel fuels are: cetane number, flash point, density, kinematic viscosity and low temperature properties (cloud point, cold filter plugging point, pour point), and others.

Experimental determination of cetane index is a multi-step and time-consuming process, as it requires certain skills, special equipment, as well as time and money. That is why the development of new methods and take the most accurate one for cetane index determination is a crucial task [2].

During the study, on the basis of the experimental data obtained from the operation units at the petroleum refinery in Western Siberia, cetane indexes for diesel fuels components were calculated. The calculation was carried out based on the international standard ISO 4264, in which the calculations of cetane index are described by the following formula:

$$\begin{gathered} CI = 45.2 + 0.0892 \cdot T_{10N} + (0.131 + 0.901B) \cdot T_{50N} + \\ +(0.0523 - 0.42B) \cdot T_{90N} + [0.00049 \cdot (T_{10N}^2 - T_{90N}^2)] + 107B + 60B^2; \\ T_{10N} = T_{10\%} - 215;\ T_{50N} = T_{50\%} - 260;\ T_{90N} = T_{90\%} - 310; \\ B = [\exp(-0.0035 \cdot D_N)] - 1;\ D_N = D - 850. \end{gathered} \quad (1)$$

CI – cetane index, points; $T_{10\%}$, $T_{50\%}$, $T_{90\%}$ – boiling point of 10%, 50%, 90% fraction, ºC; D – fraction density at 15 ºC, kg/cm^3.

Also, calculations were carried out according to the method presented in the USS 27768-88:

$$CI = 454.74 - 1641.416 \cdot \rho_4^{15} + 774.74 \cdot (\rho_4^{15})^2 - 0.554 \cdot t + 97.803 \cdot (\lg t)^2 \quad (2)$$

ρ_4^{15} – fraction density at 15ºC, kg/cm^3; t –boiling point of 50% fraction, ºC.

The calculation results of cetane index according to the ISO 4264 (CI_{ISO}), and USS 27768-88 (CI_{USS}) are presented in Table; the calculation results were compared with the experimentally determined cetane index (CI_{EX}).

Table

Comparison between the experimental and calculated cetane index for diesel fuel fractions

No.	$T_{10\%}$	$T_{50\%}$	$T_{90\%}$	Density at 15 ºC	CI_{EX}	CI_{ISO}	CI_{USS}	Δ_{ISO}	Δ_{USS}
	ºC			kg/cm^3					
Straight-run diesel fraction "Winter"									
1	200	234	275	827	46.8	46.795	46.506	0.005	0.294
2	197	235	279	830.6	45.5	45.532	45.525	0.032	0.025
3	205	238	287	832.7	46.3	46.291	45.680	0.008	0.619
average error								***0.015***	***0.313***
Straight-run diesel fraction "Summer"									
1	277	320	356	866.5	54.1	54.078	50.655	0.022	3.445

2	275	320	354	867.6	53.2	53.225	50.323	0.025	2.873
3	268	312	355	864.9	52.8	52.775	50.191	0.025	2.609
							average error	***0.024***	***2.976***
Hydrotreated diesel fraction “Winter”									
1	183	225	277	820.7	46.3	46.349	45.926	0.049	0.374
2	187	221	272	821.7	46.1	45.077	44.194	0.023	0.906
3	190	222	271	823.7	44.7	44.666	43.806	0.034	0.894
							average error	***0.035***	***0.725***
Hydrotreated diesel fraction “Summer”									
1	235	283	336	849.7	51.3	51.344	50.520	0.044	0.780
2	219	285	337	851.8	49.1	49.155	50.201	0.055	1.101
3	224	286	333	856.0	47.9	47.908	49.041	0.008	1.141
							average error	***0.036***	***1.007***

As it can be seen from Table , calculation according to ISO 4264 is more accurate and has less calculation error relatively to the experimental data in comparison with the calculation method by the USS 27768-88. However, it should be noted that the formula from USS 27768-88 uses less data and when cetane index changes within 42-50 points and it is characterized by the reasonable accuracy and can be used for the calculation. In the case of diesel fuel with a high cetane index (over 50 points), it is recommended to use a formula from ISO 4264.

References

1. Rasporyazhenie Pravitelstva RF ot 13 noyabrya 2009 g. N 1715-r «Ob utverzhdenii Energeticheskoy strategii Rossii na period do 2030 goda». (The order of the Government of the Russian Federation dated 13 November 2009 No. 1715-R "Approval of the Energy strategy of Russia for the period till 2030") (in Russian).
2. Kirgina M.V., Ivanchina E.D., Boldohonova M.V. Matematicheskoe modelirovanie svoystv i optimizatsiya protsessa kompaundirovanie dizelnyih topliv (Mathematical modeling and of the properties and diesel fuel blending optimization) // Sovremennyie tehnologii i modelirovanie protsessov pererabotki uglevodorodnogo syirya: materialyi Vserossiyskoy nauchno-prakticheskoy konferentsii, posvyaschennoy 75-letiyu so dnya rozhdeniya zasluzhennogo deyatelya nauki RF, professora A.V. Kravtsova, Tomsk, 1-3 Oktyabrya 2013. – Tomsk: Izd-vo TPU. – 2013. – pp. 87-89 (in Russian).

ANALYSIS OF GAS COMPRESSOR UNIT ACCIDENT FACTORS

O.L. Bulgakova

Scientific advisors associate professor N.V. Chukhareva, associate professor I.A. Matveenko

National Research Tomsk Polytechnic University, Tomsk, Russia

According to the official annual report from gas transmission provider, one of the reasons for gas supply limitation is usually emergency failure of gas compressor unit. This problem can be solved by formation of a new integrated approach to analyze gas compressor accident factors.

The problems of compressor station equipment fault tolerance was discussed in large number of researches [1 ... 3]. In order to obtain more detailed information, authors used operating data on each compressor station within no less than 5 years. Thus, in this work as inintial data was taken operating data of electric motor-driven compressor unit of two types SDT-4000-2 and EGPA-4,0/8200-56/1,26-P within 10 years, which are installed on the following compressor stations: “Aleksandrovskaja”, “Vertikos”, “Parabel”, “Chazhemto”, “Volodino”, “Proskokovo”. Accumulative operating time of electric motor-driven compressor unit was 805978 hours. At the same time 171 accidents of safe and unsafe accidental situations were recorded. Let the total amount of accident situation be 100% and further analysis will be carried out in percentage.

Statistical fault analysis of compressor station equipment within the period from 2005 to 2012 (Table) revealed the following causes for the emergency shutdowns of electric motor-driven compressor unit: failure / malfunction of electrical equipment, failure of instrumentation and control equipment systems, mechanical damage, power supply problems, malfunction of administration system, oil system problems, operational imperfection.