Project development laboratories energy fuels and oils based on NRU “MPEI”

I A Burakov¹, A Y Burakov², I S Nikitina¹, A M Khomenkov¹, A O Paramonova¹ and Aung Khtoo Naing¹

¹National Research University "Moscow Power Engineering Institute"
Russia, 111250 Moscow, Krasnokazarmennaya, 14
²Russian Research Center of Medical Rehabilitation and Health Resort
Russia, 121099 Moscow, Novy Arbat, 32

Abstract. In the process of improving the efficiency of power plants a hot topic is the use of high-quality fuels and lubricants. In the process of transportation, preparation for use, storage and maintenance of the properties of fuels and lubricants may deteriorate, which entails a reduction in the efficiency of power plants. One of the ways to prevent the deterioration of the properties is a timely analysis of the relevant laboratories. In this day, the existence of laboratories of energy fuels and energy laboratory oil at thermal power stations is satisfactory character. However, the training of qualified personnel to work in these laboratories is a serious problem, as the lack of opportunities in these laboratories a complete list of required tests. The solution to this problem is to explore the possibility of application of methods of analysis of the properties of fuels and lubricants in the stage of training and re-training of qualified personnel. In this regard, on the basis of MPEI developed laboratory projects of solid, liquid and gaseous fuels, power and energy oils and lubricants. Projects allow for a complete list of tests required for the timely control of properties and prevent the deterioration of these properties. Assess the financial component of the implementation of the developed projects based on the use of modern equipment used for tests. Projects allow for a complete list of tests required for the timely control of properties and prevent the deterioration of these properties.

Total reserves of mineral resources according to a number of studies [1-5], which can be used as energy fuel or processed for use as energy fuel in the territory of the Russian Federation (RF), are: coal – 17.6%, oil – 6.0%, gas – 24.6% in relation to the world's reserves. This indicator puts Russia in the top ten in terms of natural energy fuel reserves, and in terms of gas reserves Russia is in the lead. However, the quality of most coal and oil reserves is low. For example, the proven reserves of brown coal on the territory of the Russian Federation are estimated at 107,922 million tons, which is 68.7% of the total number of Russian coal reserves [1, 2]. In turn, the share of geological reserves of heavy oil on the territory of the Russian Federation is 48.8% of the total amount of Russian oil reserves [1, 6, 7]. The figures show that in the near future, low quality resources will be the main source of energy and auxiliary materials used in the energy sector. Thus, most of the enterprises of the Russian Federation will collide, and many have already encountered, with the problem of deeper preparation of minerals before the stage of their use. In this regard, an important role will be played by laboratory research aimed at determining the composition and main properties of coal, oil and gas, as well as developing new efficient methods for their processing.
In order to solve the problems of the exploitation of low-quality natural fuels, a laboratory project was developed on the basis of the Research Institute "MPEI", whose mission is research aimed at working with solid, liquid and gaseous energy fuels, as well as the products of their processing, among which the main ones are fuel oil, mineral technical oils and greases.

When creating the project, it was decided to divide the laboratory under development into two components: a laboratory of energy fuels and a laboratory of lubricants. The component of the laboratory of energy fuels includes laboratories of solid, liquid and gaseous fuels, allowing to work with natural fuels, with artificial fuels and fuel waste. The component of the laboratory of lubricants includes laboratories of technical oils and greases, allowing to work with the main types of lubricants used in thermal power plants (TPP) of the Russian Federation, namely: turbine, transformer, industrial and transmission oils, greases, lubricants Both mineral and synthetic origin [8, 9].

At the first stage of the development of the laboratory project, a selection, search and analysis of regulatory documents that should be followed when organizing and conducting tests and analyzes related to energy fuels and lubricants was carried out. The existing state standards (GOST), international standards (ISO), developed by the technical committee of the international organization for standardization, methodical instructions developed by the profile organizations, such as JSC "Firm ORGRES" and JSC VTI, were analyzed. Based on the results of the activities of the first stage, a list of documents, taken as a basis for carrying out basic laboratory tests in the laboratory being developed, was compiled. The compiled list consists of five sections corresponding to the activities of the laboratory project being developed, which have been described above (three refer to the energy fuel laboratory, two to the lubricant laboratory).

The second stage of project development included the analysis and selection of laboratory equipment, dishes and chemical reagents required for testing, as well as laboratory furniture for placing appliances, dishes and storage of reagents. During the work on this stage the following requirements were taken into account: all recommended equipment should be modern, meet the quality standards and the requirements for conducting laboratory experiments; The number of dishes should include not only the number of positions required for carrying out the experiments, but also have a certain reserve, taking into account the probability of a non-recurrent expenditure; the performance of experiments related to a certain item of normative documents should be assigned to the appropriate workplace, equipped with the characteristics of the work on this experiment (for example, when working with volatile substances, the workplace should be equipped with a fume hood connected to the exhaust ventilation system). The selection of equipment was carried out taking into account the possibility of its servicing, and under the conditions of import substitution, emphasis was placed on the BRICS markets, not excluding the common world market. According to the results of the second stage of work, a list of required equipment, utensils, chemical reagents and laboratory furniture with their current market value was formed. The total price of equipping devices, dishes and chemical reagents of the laboratory of energy fuels and lubricants amounted to 8 million rubles.

The third stage of the project was based on the norms for the development, equipping and provision of training and research laboratories [10, 11], for which a workplan was planned in a standard room designed for a laboratory. In the room were identified zones: testing, sample preparation, office space, storage space for supplies, a room for storage of samples. On the developed plan, according to the zones, furniture was arranged, appliances and utensils, equipment and machinery were placed, and a supply of communications was marked, the value of which was also taken into account in the project. These activities were carried out taking into account the analysis of the experience of organizing the functioning of existing laboratories of a similar profile.

As a result, the project being developed included all the works on equipping a modern laboratory of energy fuels and lubricants from scratch. The next step is for the development team to see the implementation of this project within the walls of NRU "MPEI", and the laboratory can function not within the framework of one particular department, but within the framework of the inter-departmental, inter-faculty or inter-institute cooperation program. For example, the topic of lubricants is relevant for both
thermal and nuclear power plants, and the topic of energy fuel for both industrial and small-scale power facilities.

The implemented project of the laboratory should be prepared for its subsequent certification. Moreover, at the time of the drafting of the project, the basic documents for the appraisal were also analyzed and aligned with the prospective appraisal program. Certification activities of the laboratory will make it possible to function not only in the framework of educational and research activities, but also within the framework of interaction with external customers, the advantage for which in choosing a laboratory will be more modern equipment and methods for determining the properties of energy fuels and lubricants to obtain Results of high accuracy, as well as a broader "line" of properties proposed for determination.

Passing attestation will make it possible to intensify research work, the field of activity for which is very wide on this subject.

In the direction of energy fuels, scientific research can be conducted in the search for ways to create fuel mixtures, calorific content (heat of combustion), sulfur content, as well as the content of ballast components (external and internal ballast) which will differ from the initial products in the positive direction. A particularly important area can be the work on processing solid and liquid feedstocks, both natural fuels and their wastes, in order to produce synthetic gas and pyrogas. Such research activities, namely: improving the quality of processes of destruction of fuels, such as gasification and pyrolysis, can play one of the first roles in addressing the problem of improving environmental safety in the regions of the Urals, Siberia and the Far East. This will be especially important for those regions where the supply of gas mains is limited due to the peculiarities of their location or is completely absent. In parallel with this activity, the problem of using ash and slag wastes from burning and processing of initial fuels can be solved. At the moment, they are used mostly for road construction, but the development team is confident that a deeper study of the composition and properties of ash and slag waste can allow them to expand their range of applications, as well as to provide the possibility of using these wastes in other industries. Another area of research and development in the part of the laboratory of energy fuels may be issues of upgrading the original solid fuels. The designed laboratory can provide basic and auxiliary measures for improving the initial solid fuels of low quality and obtaining high-quality coal fuel with reduced sulfur indexes and components of external ballast: humidity and ash content. In most cases, the method of mechanical enrichment of various types of low-quality solid fuel is used as an implementation of the complex of measures for coal upgrading, but it is possible to combine this method with the methods of thermal impact used in gasification and pyrolysis. Within the framework of a part of the energy fuel laboratory, a project can be implemented to address coal briquetting, screening, substandard and substandard coal. The solution of these issues can be implemented together with the development of measures for upgrading the coals according to the granulometric composition as a component of the complex of measures for upgrading the coals within the framework of the projected laboratory. Later, within the framework of the created laboratory, it will be possible to intensify the work on the study of water-coal fuel (VCF) in terms of obtaining, transporting and creating new types of plasticizers. One of the directions of these studies can be the development of various methods of increasing the stability of the VCF, as well as the creation of a scheme for obtaining VCF by sharing the methods of using plasticizers, cavitation and hydrodrive.

In the direction of lubricants, research activities can be aimed at the development and production of new generation lubricants, namely technical oils and greases with an extended temperature range of application (increased flash and drop points, reduced pour point), which will allow an expanded "line" of lubricants that can be operated under extreme conditions. Such activities can find a positive application not only in the energy sector, but also in the related industries. An important issue in the operation of lubricants is the aging process. In most cases, aging occurs due to oxidation processes, activated by the action of a water-vapor medium, short-circuit currents and other similar factors. A successful solution to this problem could be an increase in the service life of oils and increase their ability to withstand oxidative effects. The next direction of research of the laboratory of lubricants within the framework of the project is supposedly to be the production of energy oils with a more gentle viscous-
temperature curve and an increased value of the viscosity index. Obtaining oils with the appropriate characteristics will make it easier to work with them during operation, regeneration, transportation and storage. In addition to improving the properties of lubricants, work aimed at studying and obtaining additives of a new generation for technical oils improving anticorrosive and lubricating properties, reducing the pour point, increasing stability and viscosity, improving the passivating and demulsifying properties is of particular importance. Moreover, research activities should be aimed at the development of new additives belonging to the category of both monofunctional and multifunctional.

In addition to research in the developed laboratory, it is possible to implement other types of activities, the main one of which, of course, is academic work. Within the framework of educational activities of the laboratory, it is possible to conduct training courses for students of NRU "MPEI" of relevant specialties and training areas, as well as for students of other educational institutions studying in similar areas. In addition to working with students, it is possible to work with schoolchildren to increase the number of future university entrants, in the form of conducting training cycles of hours, daily, weekly duration. In addition, it is possible to organize training courses and advanced training for the personnel of industrial facilities and enterprises of the relevant industries and areas. This training can be designed for personnel of any skill and include 40, 72, 80 and 100 hour courses. At the moment, the programs have been prepared within the framework of refresher courses in the disciplines "Energy Fuel", "Energy Fuel: Processing and Preparation for Combustion", "Energy Technology Fuel Use", "Energy Oils" and "Insulating oils".

The project of the Laboratory of Energy Fuels and Lubricants developed on the basis of the Research Institute "MPEI" can be used both for its implementation within the walls of the Scientific Research Institute "MPEI", and for the creation of new energy and industrial facilities and management companies. The development team is ready for cooperation and joint work on this issue.

The implementation of this project within the walls of NIU "MEI" is extremely important, both from the point of view of scientific work and from the point of view of educational activity, in view of the urgency of the direction and the large number of topics required for study, development and research.

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