The aim of the present work is the development of a new, rapid method for determining the size distribution of contaminant particles 2 \( \mu \text{m} \) and larger, in liquid fuels and oils. In solving this problem, we have used the principle and theory of small-angle light scattering by disperse-phase particles [1-4]. We have designed and built a unit that is shown schematically in Fig. 1. A monochromatic light beam from a helium–neon laser with a wavelength of 6328 \( \text{Å} \) passes through the neutral light filter 13 and condenser lens 14. The pinpoint diaphragm 15 and collimator lens 16 decrease the nonparallelism of the light beam. The iris diaphragm 17 limits the light flux. The light scattered by the system being studied (in cuvette 11) passes through the long-focus lens 18 and impinges on the diaphragm of the light receiver 19, which is shifted in the focal plane of the lens 18. The light receiver is an FEU-51 photoelectronic multiplier mounted on a positioning device that will give a uniform rate of shift through an angle \( \beta \). The positioning device permits the registration of scattered light from 0 to 20°. The signal from the photoelectronic multiplier, after amplification, is registered by the light beam of a loop oscillograph, simultaneously noting the position of the receiver diaphragm 19. Because of the large drop in intensity, the scattered light at angles from 0 to...

Fig. 1. Diagram of unit for determination of contaminant particle size distribution in fuels and oils:
1) power supply for He–Ne laser; 2) high-voltage regulated rectifier; 3) reversible motor; 4) He–Ne laser; 5) positioning device; 6) photoelectronic multiplier; 7) photoelectric amplifier; 8) ac–dc power supply; 9) oscillograph; 10) oscillograph power supply; 11) cuvette; 12) computer device; 13) neutral filter; 14) condenser lens; 15) pinpoint diaphragm; 16) collimator lens; 17) iris diaphragm; 18) receiver lens; 19) receiver diaphragm.
Fig. 2. Light scattering intensity of scattering angle for planar models of Styracryl powder: 1) 5-10 μ fraction; 2) 10-15 μ fraction.

Fig. 3. Comparison of experimental data on dispersity of quartz-dust suspension in TS-1 fuel and of Styracryl powder, obtained by small-angle light scattering method and by microscopic counting: a) quartz dust in TS-1 fuel; b) Styracryl powder, 5-10 μ; c) Styracryl powder, 10-15 μ; d) Styracryl powder, 1-5 μ.

3° is recorded while using neutral light filters. The readings on the oscillograph chart that correspond to these sections are calculated with a factor to account for light attenuation by the filters.

The indicatrix (angular distribution) of scattered light, I(β), is measured as follows: after positioning and cleaning the components, the intensity of incident monochromatic flux ("zero distribution") is determined. Then the cuvette with the test fluid is installed, and the position of the receiver diaphragm 19 is adjusted so as to compensate for the prismatic error introduced by the cuvette with the sample. The path length of the cuvette is chosen on the basis of the content of contaminant particles in the polydisperse system. Then the indicatrix of the light scattered by the disperse system is recorded. This characteristic curve is used to calculate the ordinate of "zero distribution" (taking attenuation into account). The difference curve that is obtained is used for further treatment by Eqs. (1) and (2):

\[
f(\rho) = \frac{C}{\rho^2} \int_{0}^{\infty} \psi(\beta) f(\rho) d\beta,
\]

where \( f(\rho) \) is the sought spectrum of particle sizes; \( \rho = \pi d/\lambda \) is the dimensionless particle diameter; \( d \) is the particle diameter, \( \mu \); \( \lambda \) is the wavelength of the light used, \( \mu \); \( \beta \) is the scattering angle, rad; \( I_0 \) is the intensity of the incident light; \( I(\beta) \) is the intensity of the scattered light; \( F(\rho, \beta) \) is an auxiliary function; and \( C \) is a constant.

The main stages in treatment of the experimental data are:

1) Plotting the scattered light intensity (difference curve) \( I(\beta) \) vs. scattering angle \( \beta \);

2) Selecting a certain step in angle \( \beta \), multiplying \( I(\beta) \) by \( \beta^3 \), plotting \( I(\beta) \cdot \beta^3 = f(\beta) \), and differentiating graphically with respect to \( \beta \);