ALL-UNION SEMINAR ON PHYSICOCHEMICAL PROBLEMS IN REDUCING TURBULENT RESISTANCE

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This seminar was held by Donetsk State University in the city of Zhdanov Sept. 4-6, 1978; there were 52 representatives of scientific organizations in Moscow, Leningrad, Kiev, Minsk, Kishinev, Novosibirsk, and Donetsk. These included 14 DScs and 18 PhDs. There were papers from the Institute of Mechanics at Moscow University; the Institute of Mechanics Problems, Academy of Sciences of the USSR; the Institute of Heat and Mass Transfer, Academy of Sciences of the Belorussian SSR; the Kurchatov Institute of Atomic Energy; the Institute of Thermophysics, Siberian Branch, Academy of Sciences of the USSR; the Institute of Hydromechanics, Academy of Sciences of the Ukrainian SSR; the Institute of Macromolecular Compounds, Academy of Sciences of the USSR; the Institute of Zoology, Academy of Sciences of the Ukrainian SSR; the Karpov Institute of Physical Chemistry; the Zhukovskii Central Aerodynamics Institute; Kiev and Donetsk Universities; the All-Union Energy Industry Research Institute; etc.

The following eight papers were presented: 1) I. L. Povkh (Donetsk University), "Basic problems in research on resistance reduction," 2) V. A. Ioselevich, N. G. Vasetskaya, and V. N. Pilipenko (Moscow University), "Polymer additives in turbulent boundary layers," 3) Z. P. Shul'man and N. A. Pokryvailo (Institute of Heat and Mass Transfer, Academy of Sciences of the Belorussian SSR), "Turbulent diffusion of resistance-reducing substances in solution," 4) M. A. Gol'dshtik (Institute of Thermophysics, Siberian Branch, Academy of Sciences of the USSR), "Theory of the Thoms effect," 5) I. A. Uskov and E. T. Uskova, "Physicochemical aspects of the effects of hydrodynamically active substances," 6) A. B. Stupin, "Resistance reduction by surfactants," 7) A. I. Serdyuk, "Physicochemical features of surfactant solutions that reduce hydrodynamic resistance," and 8) A. I. Toryanik, V. G. Pogrebnyak, and B. P. Makogon, "Effects of solvent structure on macromolecule size and hydrodynamic resistance."

It was observed that theoretical and experimental researches and application developments have been extensive in the USSR in the last decade, particularly those related to turbulent flows of liquids containing various additives: polymers, micelle-producing substances, solid particles that influence the turbulent structure, etc. Some valuable experimental evidence has been accumulated on velocity patterns, pressures, tangential stresses, and statistical flow parameters. Some major technical advances have been made in the use of additives in hydraulic transport, heat grids, etc.

Novel physical and mathematical models for consistency have been formulated, on the basis of the available evidence, that in some instances correctly predict resistance changes and other characteristics of transport processes in internal and external conditions.

However, the research and development in this area still fails to meet the industrial need for high-performance substances, particularly water-soluble polymers of reasonably high stability at acceptable cost.

There is also a lack of physicochemical research on the properties and microstructures of solutions and suspensions that reduce hydrodynamic resistance.

The seminar recommended the following lines of work:

1. Increased research on high-performance polymers and micelle-producing surfactants, particularly in order to utilize laboratory results. There are good prospects for using polyelectrolytes and biopolymers (extracts from fish, marine animals, algae, etc.) as resistance-reducing additives. General metrological indications for identifying such solutions are also extremely desirable.

2. More extensive research on mechanical and thermal degradation or aging of polymer solutions in liquid flows at high shear rates.

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3. Particular attention to new methods of research in the physics and chemistry of hydrodynamically active substances, with emphasis on the molecular level, which involves the creation of polymer and surfactant solutions adequately described by new theories that relate molecular parameters to hydrodynamic characteristics.

4. Combined theoretical and experimental researches on convective transport of momentum, heat, and mass in liquids containing resistance-reducing additives.

5. Improved instruments employing novel techniques for hydrodynamic research, in particular lasers, electrochemical devices, and ones using magnetic induction.

6. Continued research on the definition of more versatile theoretical schemes for calculating not only integral parameters representing response to additives but also local characteristics representing the velocity, pressure, tangential stress, etc. in enclosed flows and wakes.

7. Careful research on the effects of wall roughness in the presence of resistance-reducing additives.

8. More detailed research on the use of additives in nonaqueous media, particularly petroleum products, for long-distance pipeline transport and general use in chemical plants.

9. Industrial utilization of research data, in particular the valuable results from Donetsk University on the use of additives in existing circulation systems for heat and cold supply in mines and heat-distribution networks.

It was also stated that recent advances in this area should be reflected in textbooks and in the teaching programs of technical colleges, while such seminars on various aspects of convective transport in turbulent flows should in future be held regularly.