

Meetings

FLOW PHENOMENA

SOCIETY OF RHEOLOGY MEETS IN NEW YORK

The twenty-second annual meeting of the Society of Rheology featured twelve papers on flow phenomena and presentation of the third Bingham medal to Dr. W. F. Fair, Jr. The meeting was held at the Hotel New Yorker on November 3 and 4 with an attendance of about 100 persons.

During the past fifty years the need for a more accurate value for the intrinsic viscosity of water, which is used as a reference standard in the calibration of viscometers, has become increasingly evident. In the early 1930's the Society of Rheology took an active part in urging the necessary measurements, and experimental work was started at the National Bureau of Standards. The final results of this work were presented by J. F. Swindells and J. R. Coe. The new value is $0.010019 (\pm 0.000003)$ poise at 20°C , compared with a previous value of 0.01005 poise.

G. J. Dienes discussed the interpretation of temperature dependence of flow viscosities of solutions, based on the concept of two different mechanisms: (1) the standard, high-temperature flow viscosity with its associated activation energy, and (2) a mechanism that becomes important at lower temperatures and probably results from the formation of either colloidal aggregates or networks, with which there is associated a second activation energy. The mathematical expression of this assumption leads to an equation involving the sum of two exponentials in reciprocal temperature. Dr. Dienes reported that this equation fits experimental data of Dillon and Spencer on polystyrene and of Fox and Flory on polyisobutylene, leading in each case to reasonable values of the constants involved.

M. Mooney reported an attempt to extend the Einstein viscosity equation to cover concentrated suspensions and also a distribution of particle sizes. His development leads to the conclusion that the coefficient of the concentration squared in the power series expansion should be a function of particle-size distribution. Dr. Mooney reported a reasonable agreement of his equation with Vand's data on glass spheres and Eiler's on polydisperse bitumens. A lengthy discussion following this paper centered largely around the emphasis placed by Dr. Mooney on the particle-size distribution.

A paper by T. Alfrey and T. Newman presented a summary of the solution of the problem of propagation of waves in a viscoelastic medium, in which linear differential operators are introduced into the equation relating stress and strain. For the case of sinusoidal waves this procedure is equivalent to the replacement of the ordinary elasticity modulus in the final equation by a complex modulus, but the more general results should be applicable to an arbitrary type of stress function, whereas the complex modulus treatment is not.

R. M. Wiley and R. S. Spencer presented an interesting discussion of the mixing of materials whose viscosity is so great that streamline rather than turbulent flow is involved. Their analysis showed that for most efficient mixing the "surface" between the two components involved should be parallel to imposed tensile strains or at an angle of between

45° to 90° to imposed shear strains. A matrix formulation of a "repetitive" mixing operation (in which a relatively simple operation is repeated, ending after each cycle with the material in its original gross form) was presented from which the number of cycles required to obtain a given degree of mixing could be calculated.

Two papers and a motion picture were presented by R. S. Spencer and G. D. Gilmore, illustrating flow phenomena in injection molding operations and a study of residual strains in articles formed by injection molding. Three types of strains are catalogued: (1) those accompanying quenching stresses, (2) frozen-in molecular orientation, and (3) configurational volume strains. The second type can be reduced by minimizing the packing time through the use of a mechanical seal which permits immediate removal of the external pressure once the mold is filled. This procedure results in articles less apt to "craze" and improves their dimensional stability on heating. The motion picture showed the injection of polystyrene into a disk mold with glass sides and demonstrated that the flow takes place only in the central part of the mold. The "back flow" of polymer with the ordinary type of open gate and the effect of inserts were also illustrated.

T. Alfrey and R. DeWaard presented a study on the distribution of residual stresses through the cross section of a bar of thermosetting resin cut from the center of a molded disk. Successive thin cuts were milled across the center of the bar and the bending after each cut measured with an optical lever. Sizeable stresses were found which agreed qualitatively with the results of examination of the same specimens under polarized light.

C. R. Malstrom, R. D. Keen and L. Green reported studies on the mechanical properties of graphite at high temperatures. It was observed that the strength of graphite specimens doubled as the temperature was increased from room temperature to 2500°C , and that at this temperature its strength was considerably greater than that of most ordinary structural materials. At the sublimation temperature of graphite the strength dropped off rapidly.

A summary of the results of shear strains on the dielectric properties of suspensions of iron particles was given by A. Voet and L. R. Suriani. Shearing a suspension results in a decrease in dielectric constant which can be correlated with a corresponding decrease in the extent of flocculation of the suspended particles. Further evidence for flocculation (also termed agglomeration) as the cause of non-Newtonian flow was adduced.

Sintering of synthetic latex particles was described by R. E. Dillon, L. A. Matheson, and E. B. Bradford. The mechanism of coalescence of the discrete particles of the polymer was considered in connection with the formation of continuous films. This is a subject of interest in the paint, paper, and textile industries since numerous products are now based on emulsion formulations.

W. A. Weyl, in a paper reviewing the concepts of ductility and brittleness, pointed out that the response of solids to shear stresses and their fracture are affected not only by the strength of the cohesive forces but also by the symmetry of their atomic arrangement and the polarizability of their constituent ions. Plastic deformations involve transitions through atomic arrangements which are characterized by strongly asymmetrical force fields. These positions represent the energy barriers between equilibrium positions. The symmetry of the substance and the direction of the shear stress determine the absolute distance between equilibrium positions. The activation energy of the flow process, however,

is determined primarily by the polarizability of the flow units and, thus, decreases with increasing polarizability of the ions.

The Bingham Medal was presented at the evening meeting on November 3rd to Dr. W. F. Fair, Jr. A past-president of the Society, Dr. Fair is well known for his work in the bituminous products field. The citation read as follows: "For notable contributions to colloid chemistry, to the technology of bituminous materials, and to the science of rheology; for distinguished service to the American Society for Testing Materials in establishing standards; for his counsel in his position as a member of the governing board of the American Institute of Physics; and for his guidance of the affairs of the Society of Rheology in various positions and finally that of president for the years 1945 to 1949."

Previous recipients of the Bingham Medal were Melvin Mooney (1948) and Henry Eyring (1949).

The evening meeting concluded with a demonstration on color by George Welp and a motion picture "Rainbows to Order", produced by Interchemical Corporation.

E. K. Fischer and R. S. Marvin

SIGMA PI SIGMA

FIFTH NATIONAL CONVENTION

Sigma Pi Sigma, physics honor society, held its fifth national convention at Berea College, Berea, Kentucky, December 27-30. Eighty-seven delegates representing a majority of the 76 chapters were in attendance. As a prelude to the convention the delegates visited the Oak Ridge atomic energy installations on December 27. The alumni members of the Society at Oak Ridge joined with the visiting delegates in a luncheon which was addressed by James A. Lane, Associate Director of the Technical Division of the Oak Ridge National Laboratories. Dr. Lane described the current and long-range reactor programs of the Atomic Energy Commission. At one of the open meetings featuring the convention, William Webb, head of the physics department at the University of Kentucky, spoke on "America Before Columbus". He presented some findings in which the methods of physics were used in archaeological research in the southeastern section of the United States. The convention banquet speaker was M. H. Trytten, Director of the National Research Council Office of Scientific Personnel, who talked on "Physicists as National Assets", describing some of the scientific manpower problems facing the nation. Featuring the convention were several panel discussions on the problems facing physics students during emergency conditions. The retiring president of the Society, Homer L. Dodge, presided at the convention. The chairman of the local committee on arrangements was Waldemar Noll, head of the physics department at Berea College. Officers elected for the next triennium were: president, M. H. Trytten; vice-president, Vincent E. Parker, Louisiana State University; executive secretary, Marsh W. White, The Pennsylvania State College.

Marsh W. White

POCONO CONFERENCE

ON LATTICE IMPERFECTIONS

Amidst the rich display of warm red, orange, and yellow hues of fall foliage, a conference on lattice imperfections was held on October 12-14 at Pocono Manor. This conference, organized under the auspices of the Committee of Solid State Physics of the National Research Council, was aimed at bringing together representatives of various sciences interested in the general problem of imperfections in

crystalline lattices. It is the main purpose of the committee to provide such contacts between the physical sciences and to report results in the form of monographs on selected topics. A previous conference of this kind, which concerned the phase transformations in solids, was held at Cornell University in 1948; the resulting monograph is to appear shortly.

The present conference opened with a paper by W. Shockley and W. T. Read, Jr. on imperfections in almost perfect crystals, in which the natural occurrence of dislocations of various types was discussed. This was followed by a paper by J. Bardeen and C. Herring on diffusion in alloys and the Kirkendall Effect, which had primarily to do with interpretation of the peculiar movement of markers during diffusion in metals in terms of creation and disappearance of vacancies, and by two reviews of experimental data. The first review, by W. T. Read, Jr., summarized the present experimental information on slip lines; the second, by J. C. Fisher and C. G. Dunn, presented a critical survey of the very recent results on surface and interfacial tensions of single phase solids. In the afternoon of the same day F. Seitz presented a paper on imperfections in almost perfect crystals, in which a general survey of the various kinds of lattice imperfections was made and in particular their mutual interaction was analyzed. This paper, which leaned heavily on experimental data pertaining to ionic crystals, was followed by R. G. Breckenridge's survey of his work on relaxation effects in ionic crystals, in which the behavior and mobility of various impurities were discussed. The day's session was closed by a paper on the influence of dislocations and impurities on the damping and elastic constants of metal single crystals by J. S. Koehler, who described his theoretical investigation of damping due to movement of dislocations "pinned down" by impurities.

The second day of the conference was opened with a paper by N. F. Mott, entitled "Strength of Materials". In the absence of the author, it was presented by H. Brooks, who added his own interpretation of the various phenomena in terms of dislocations. Properties and effects of grain boundaries were then discussed by B. Chalmers, who stressed the distinction between the properties of the grain boundaries themselves and those properties resulting from the presence of grain boundaries. This general topic was carried further by W. T. Read, Jr. who described the dislocation models of grain boundaries and the quantitative conclusions and predictions obtainable from the theory. The basic question of the nature of deformed metal was subsequently discussed by B. E. Warren and B. L. Averbach in their paper on x-ray diffraction studies of cold work in metals. Their results seem to cast new light on this old problem. In the afternoon of the same day, C. S. Smith presented his analysis of interphase interfaces in which various experimental results were surveyed and certain new topological relationships deduced, followed by a review of substructures in crystals by A. Guinier, who described numerous recent results of his x-ray studies of polygonization. At the close of the session C. Zener presented his paper on diffusion theory in which the various proposed mechanisms of diffusion are compared, including his recently suggested "ring diffusion".

The last day of the conference started with a paper by C. S. Barrett dealing with imperfections from transformation and deformation, in which the resulting faults and stacking disorders were discussed, followed by a review of the present theoretical and experimental information pertaining to movement and diffusion phenomena in grain boundaries by R. Smoluchowski.