

RHEOLOGY BULLETIN

Publication of the Society of Rheology

Volume 36 No. 1



January, 1967

FOURTH WINTER MEETING OF THE SOCIETY OF RHEOLOGY

MIRAMAR HOTEL-MOTEL
SANTA BARBARA, CALIFORNIA
FEBRUARY 6-8, 1967

Accommodations

Attendees are urged to pre-register by filling out the enclosed form and mailing it to the Local Arrangements Chairman. Reservations for hotel rooms should be made by sending the reservation form (attached) directly to Miramar Hotel-Motel. Santa Barbara is connected to Los Angeles and San Francisco by United and Pacific Airlines. Regular bus (Greyhound) and rail (Southern Pacific) services are also available. Both the bus depot and rail station are located in downtown Santa Barbara. For local transportation from the airport, there are frequent limousine connections to downtown. Miramar Hotel-Motel is located three miles south of Santa Barbara on U. S. highway 101 (El Camino Real) at San Ysidro Road.

The West Coast Gordon Conference on Polymers will be held at the same hotel the weekdays preceding the Winter Meeting of the Society of Rheology. Thomas O'Shaughnessy, Research Department, Phillips Petroleum Company, Bartlesville, Oklahoma, is the Chairman for the Gordon Conference.

Facilities

Speakers will be provided with a blackboard and 2 inch by 2 inch and 3¼ inch by 4¼ inch slide projectors. If other facilities are required for the presentation, the Local Arrangements Chairman should be contacted as soon as possible.

Publication

Authors are urged, but not required, to publish their papers presented at the meeting in the Transactions of the Society of Rheology. Manuscripts should be submitted to the editor: R. R. Myers, Chemistry Depart-

ment, Kent State University, Kent, Ohio. Acceptance for publication will be decided by the editor, in consultation with referees appointed by him for each manuscript.

Program Committee

J. L. White, (Chairman), U. S. Rubber Tire Company, Product Development, 6600 East Jefferson Ave., Detroit, Michigan, 48232.

A. Eisenberg, Department of Chemistry, University of California, Los Angeles, California.

D. J. Plazek, Mellon Institute, 4400 Fifth Ave., Pittsburgh, Pennsylvania, 15213.

N. W. Tschoegl, Division of Engineering and Applied Mechanics, California Institute of Technology, Pasadena, California.

M. C. Shen, (Local Arrangements Chairman), North American Aviation Science Center, Thousand Oaks, California, 91360.

A MESSAGE FROM THE EDITOR

Starting with Transactions of The Society of Rheology, Volume 11, publication will be on a quarterly basis. The new publication arrangement with Interscience Publishers requires us to submit with each manuscript the following information: authors, address, complete title, individual to whom proof should be sent. We do not always have unequivocal information regarding authors' addresses and the individual to whom proof is to be sent; consequently, manuscript accuracy is not always guaranteed. Henceforth, transmittal of a manuscript to the publisher will be done only after a given author will express in writing that he will assiduously correct proofs.

Another point of interest to authors of papers concerns the format of abstracts. You will note from the photo offset insert in this Bulletin that economies will be effected and errors will be minimized if abstracts are submitted in accord with these standard requirements: typed on white 8½" x 11" paper, with 5/8" margins at top and bottom of sheet and 3/4" margins at left and right sides, single spaced, with paper title, author, and address (avoid use of personal titles and degrees).

RHEOLOGY BULLETIN
Raymond R. Myers, Editor
Department of Chemistry
Kent State University
Kent, Ohio, 44240

PROGRAM

FOURTH WINTER MEETING SOCIETY OF RHEOLOGY

February 6-8, 1967

MONDAY, FEBRUARY 6, 1967

SESSION A—Monday Morning

Chairman: J. L. WHITE, U. S. Rubber Company, Detroit, Michigan.

A-1

8:45 a.m. INVITED LECTURE: "Mechanisms of Deformation of Rocks and Minerals at High Temperatures and Pressures," D. T. Griggs, University of California at Los Angeles, Los Angeles, California.

THERMODYNAMICS IN RHEOLOGY

A-2

9:45 a.m. "A Rational Theory of Non-Linear Viscoelasticity," K. C. Valanis, University of Iowa, Ames, Iowa.

10:15 a.m. Break

A-3

10:30 a.m. "Thermoelasticity of Natural Rubber at Small Strains," M. C. SHEN and J. D. Strong, North American Aviation Science Center, Thousand Oaks, California.

A-4

11:00 a.m. "Dissipation Function in Thermomechanical Phenomena of Viscoelastic Solids," N. C. Huang, University of California at San Diego, La Jolla, California.

SESSION B—Monday Afternoon

Chairman: A. EISENBERG, University of California at Los Angeles, Los Angeles, California.

POLYMER MELTS AND CONCENTRATED SOLUTIONS

B-1

2:00 p.m. "Poly Vinyl Chloride Melt Rheology and Flow Activation Energy," Edward A. Collins, B. F. Goodrich Chemical Company, Development Center, Avon Lake, Ohio.

B-2

2:30 p.m. "Resin Particles as Flow Units in Polyvinyl Chloride Melts," A. R. BERENS and V. L. Folt, B. F. Goodrich Research Center, Brecksville, Ohio.

B-3

3:00 p.m. "Flow of Polymer Melts in Extruders," H. J. Zamodits, Polymer Corporation Limited, Sarnia, Ontario, and J. R. A. Pearson, Cambridge University, Cambridge, England.

3:30 p.m. Break

B-4

3:45 p.m. "The Steady Flow of Partially Crystalline Polyethylene," J. F. Johnson, Chevron Research, Richmond, California.

B-5

4:15 p.m. "Viscoelastic Properties of Monodisperse Polystyrene," JAMES M. O'REILLY and William M. Prest, Jr., General Electric, Schenectady, New York.

B-6

4:45 p.m. "Non-Newtonian Viscosity in Narrow Distribution Polystyrenes," WILLIAM W. GRAESSLEY, Ronald L. Hazelton, and Louis R. Lindeman, Northwestern University, Evanston, Illinois.

TUESDAY, FEBRUARY 7, 1967

SESSION C—Tuesday Morning

Chairman: R. F. LANDEL, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

C-1

8:45 a.m. INVITED LECTURE: "Statistical Mechanics and the WLF Equation," J. H. Gibbs, Brown University, Providence, Rhode Island.

RHEOLOGY OF BULK POLYMERS

C-2

9:45 a.m. "Molecular Flow and Lanthanum Catalyzed Bond Interchange in Sodium Phosphate Polymers," ADI EISENBERG and Shogo Saito, University of California at Los Angeles, Los Angeles, California.

10:15 a.m. Break

C-3

10:30 a.m. "Chemical Stress Relaxation of Crosslinked Poly(methylmethacrylate) Polymers at Elevated Temperatures in Vacuum," N. W. TSCHOEGL, J. E. Frederick, and T. L. Smith, Stanford Research Institute, Menlo Park, California.

C-4

11:00 a.m. "Stress-Strain and Ultimate Properties of Crosslinked Poly(methylmethacrylate) Polymers in the Rubbery State," T. L. SMITH, J. E. Frederick, and N. W. Tschoegl, Stanford Research Institute, Menlo Park, California.

SESSION D—Tuesday Afternoon

Chairman: N. W. TSCHOEGL, California Institute of Technology, Pasadena, California.

GENERAL SESSION

D-1

2:00 p.m. "Stress Wave Phenomena in a Three Dimensionally Reinforced Plastic," J. J. WU, G. M. WASSIL, and E. M. LENOE, Avco Space Systems Division, Avco Corporation, Lowell, Massachusetts.

D-2

2:30 p.m. "Effect of Process Variables on the Stress Relaxation Spectrum of Pure Aluminum," E. M. LENOE and G. W. WASSIL, Avco Space Systems Division, Avco Corporation, Lowell, Massachusetts.

D-3

3:00 p.m. "The Character of the Stress-Strain Function for Solid Propellant," R. J. FARRIS, Aerojet-General Corporation, Sacramento, California.

3:30 p.m. Break

D-4

3:45 p.m. "Impedance Matching as an Analog of Viscosity in Pulsating Hydraulic Systems," Harry Lobel, Independent School District, Council Bluffs, Iowa.

D-5

4:15 p.m. "Thermal Feedback in a Model of a Viscous Solid Under Cyclic and Random Adiabatic Loading or Straining," S. J. BECKER and I. J. GRUNTFEST, General Electric Company, Space Technology Center, King of Prussia, Pennsylvania.

D-6

4:45 p.m. "Stress Cracking of 0.95 Density Polyethylene Under Constant Load in an Environment as a Function of Load, Temperature and Molecular Weight," Glenn E. Fulmer, W. R. Grace and Company, Research Division, Clarksville, Maryland.

TUESDAY EVENING

6:00 p.m. Cocktail Hour

Courtesy of the Instron Company

7:00 p.m. Banquet

L. E. Nielsen, Monsanto Company, St. Louis, Missouri, will speak on glacier exploration in Alaska.

WEDNESDAY, FEBRUARY 8, 1967

SESSION E—Wednesday Morning

Chairman: P. J. BLATZ, North American Aviation Science Center, Thousand Oaks, California.

E-1

8:45 a.m. INVITED LECTURE: "The Continuum Has Boundaries," W. R. Schowalter, Princeton University, New Jersey.

CONTINUUM MECHANICS OF NON-NEWTONIAN FLUIDS

E-2

9:45 a.m. "A Modified Functional Expansion for Viscoelastic Fluids," J. D. Goddard, The University of Michigan, Ann Arbor, Michigan.

10:15 a.m. Break

E-3

10:30 a.m. "A Modified Superposition Principle Applied to Creep of Non-Linear Viscoelastic Material Under Abrupt Changes in State of Combined Stress," W. N. FINDLEY and J. S. Y. Lai, Brown University, Providence, Rhode Island.

E-4

11:00 a.m. "The Motion of a Continuous Sheet Through an Infinite Stagnant Non-Newtonian Fluid," James L. White, University of Delaware, Newark, New Jersey, and U. S. Rubber Tire Company, Detroit, Michigan.

SESSION F—Wednesday Afternoon

Chairman: M. C. SHEN, North American Aviation Science Center, Thousand Oaks, California.

FLOW OF POLYMER SOLUTIONS AND SUSPENSIONS

F-1

2:00 p.m. "Prediction of Drag Reduction Using a Viscoelastic Model," G. K. PATTERSON and J. L. ZAKIN, University of Missouri, Rolla, Missouri.

F-2

2:30 p.m. "Effects of Local Injection of a Drag-Reducing Fluid Into Turbulent Pipe Flow of a Newtonian Fluid," C. SINCLAIR WELLS, JR. and Jack G. Spangler, LTV Research Center, Dallas, Texas.

F-3

3:00 p.m. "Intrinsic Viscosity of Polymer Solutions at High Shear Rates," A. Ram and A. SIEGMAN, Polymer Science and Engineering, Case Institute of Technology, Cleveland, Ohio.

3:30 p.m. Break

F-4

3:45 p.m. "The Viscosity of Slurries, II: Studies of Lower Volumetric Loadings," B. G. Moser and R. F. Landel, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

F-5

4:15 p.m. "Prediction of the Viscosity of Multimodal Suspensions From Monomodal Viscosity Data," R. J. FARRIS, Aerojet-General Corporation, Sacramento, California.

SYMPOSIUM ON BLOCK COPOLYMERS

A one day symposium on Block Copolymers, covering their chemistry, properties, and technology, will be held at the California Institute of Technology, Pasadena, California, on June 5, 1967. Joint sponsors are the Polymer Group of the Southern California Section, American Chemical Society, and the Institute. Papers are by invitation, and will include review lectures as well as discussions of recent advances in the field of block copolymers.

Requests for further information and preregistration forms should be directed to N. W. Tschoegl, California Institute of Technology, 1201 East California Street, Pasadena, California 91109 prior to May 1, 1967. There will be no registration fee.

THE SOCIETY OF RHEOLOGY
TREASURER'S REPORT - OCTOBER, 1966

I. SUMMARY OF ACCOUNT

Balance in Account January 1, 1966	\$8,127.42
Balance on Hand September 30, 1966	9,164.60
Projected Balance January 1, 1967	8,007.42

II. REVIEW OF COSTS PER MEMBER

Year	Total Cost (Per Member)	Proportion of Cost for TRANSACTIONS
1965(a)	\$19.50	\$9.00 (1000 pages)
1966	13.70	7.30 (700 pages)
1967(b)	8.60	3.00 (700 pages)

(a) High cost due to publication of back issue of TRANSACTIONS in addition to two regular issues. Furthermore, remainder of bills incurred from the 4th International Rheology Congress were paid.

(b) Page charge instituted.

III. PROJECTED RECEIPTS AND EXPENSES, 1966

Balance in Account January 1, 1966	\$ 8,127.42
RECEIPTS	
Dues	\$9,200.00
Meeting Income (Monterery)	350.00
Savings Bond Interest	40.00
Total Receipts	\$9,590.00
TOTAL	\$17,717.42
EXPENSES	
AIP (Dues and Administration)	\$1,700.00
Secretarial Services (AIP)	150.00
Winter Bulletin	600.00
Spring Bulletin	70.00
Fall Bulletin	650.00
TRANSACTIONS (700 pages)	5,500.00
Editorial Expenses	650.00
Brochure	90.00
Miscellaneous	300.00
	\$9,710.00
TOTAL EXPENSES	\$ 9,710.00
PROJECTED BALANCE IN ACCOUNT JANUARY 1, 1967	\$ 8,007.42

(Continued)

THE SOCIETY OF RHEOLOGY
 TREASURER'S REPORT - OCTOBER, 1966
 (Continued)

IV. PROJECTED RECEIPTS AND EXPENSES, 1967	
Projected Balance in Account January 1, 1967	\$ 8,007.42
PROJECTED RECEIPTS	
Dues	\$9,200.00
Meeting Income	400.00
Savings Bond Interest	40.00
Total Projected Receipts	<u>\$9,640.00</u>
 TOTAL	 \$17,647.42
PROJECTED EXPENSES	
TRANSACTIONS Charge (700 pages)	\$2,250.00
Other Publications	1,500.00
AIP Expenses	1,900.00
Editorial Expenses	700.00
Miscellaneous Expenses	100.00
	<u>\$6,450.00</u>
 TOTAL PROJECTED EXPENSES	 \$ 6,450.00
 PROJECTED BALANCE IN ACCOUNT JANUARY 1, 1968	 \$11,197.42

Respectfully submitted,
 Armand F. Lewis
 Treasurer, Society of Rheology

THE SOCIETY OF RHEOLOGY
 SUPPLEMENTARY TREASURER'S REPORT
 PUBLICATION ACCOUNT

PROJECTED INCOME FROM PAGE CHARGE	\$7,350.00
(Assume 700 pages at \$15.00 per page with 70% honoring charge)	
PROJECTED COST OF TRANSACTIONS FOR 1967	
"Per Page Charge"(a)	\$4,140.00
"Subscription Charge"(b)	<u>1,575.00</u>
 TOTAL PROJECTED COST	 \$5,715.00
(a) Assume 1900 total subscription and 750 SOR members, therefore $\frac{750 \times \$15.00}{1900} = \5.92 per page charge.	
(b) Assume $\$0.003 \times 700$ (pages) \times 750 (members).	
 PROJECTED INCOME FROM PAGE CHARGE	 \$1,635.00

Respectfully submitted,
 Armand F. Lewis
 Treasurer, Society of Rheology

AMERICAN INSTITUTE OF PHYSICS, INCORPORATED
FOR
SOCIETY OF RHEOLOGY

Statement of Receipts and Disbursements
At September 30, 1966

Balance in Account - January 1, 1966		\$ 8,127.42
Receipts (January 1 - September 30, 1966)		
Dues Collections:		
1965 Dues	\$ 100.00	
1966 Dues	1,658.88	
1967 Dues	<u>1,180.00</u>	2,938.88
Interest on U. S. Government Bond*		19.37
Transfer of Funds from West Coast Checking Account		<u>535.05</u>
Total Receipts		<u>\$11,620.72</u>
Disbursements (January 1 - September 30, 1966)		
Charge for Dues Billing and Collection	\$201.47	
Charge for Maintenance of Society List	394.42	
Contribution for Support of AIP for 1966 (Nine Months)	<u>710.49</u>	\$ 1,306.38
Bulletins:		
Winter Bulletin	\$109.45	
Spring Bulletin	<u>71.53</u>	180.98
Meetings:		
Winter Meeting - Monterey, California	\$ 65.93	
Fall Meeting - Atlantic City, N. J.	<u>194.81</u>	260.74
Symposium on Biomedical Fluid Flow Constitution		14.78
Brochure		18.57
Editorial Expenses - R. R. Myers:		89.91
Secretarial Services	\$363.77	
Office Expense	<u>54.05</u>	417.82
Secretarial Duties - E. Wolf:		
Welcoming Letters	\$ 36.47	
Miscellaneous Correspondence	<u>40.49</u>	76.96
Other:		
Addressing Galley in Alphabetical Order for Miller and Lewis	\$ 3.68	
Addressing List in Duplicate for Coulehan and Miller	18.40	
Four-Drawer Letter Size Gray File	62.50	
Telephone	<u>5.40</u>	89.98
Total Disbursements		<u>2,456.12</u>
Balance in Account, September 30, 1966		<u>\$ 9,164.60</u>

* Bingham Fund: \$1,000.00 U. S. Government Bond 37/8%—Due May 15, 1968

PRE-REGISTRATION FOR THE 4TH WINTER MEETING OF THE SOCIETY OF
RHEOLOGY, SANTA BARBARA, CALIFORNIA (FEBRUARY 6-8, 1967)

Send request and registration fee prior to February 1, 1967 to M. C. Shen, North American
Aviation Science Center, Thousand Oaks, California, 91360.

Name

Affiliation

Address

.....

Dates: Arrival Departure

Registration Fees: \$ 5.00 for members of the Society of Rheology;
\$10.00 for non-members;
\$15.00 for registration fee and new membership.

Please make checks payable to "SOR - Santa Barbara."

RESERVATION FOR THE 4TH WINTER MEETING OF THE SOCIETY OF
RHEOLOGY, SANTA BARBARA, CALIFORNIA (FEBRUARY 6-8, 1967)

Send request to Miramar Hotel, P. O. Box "M", Santa Barbara, California *DIRECTLY*.

Name

Address

.....

Dates: Arrival Departure

Number of Persons:Adults;Children

Types of Accommodations: Single Occupancy \$10-12;
Double Occupancy \$16.

Number of bedrooms and type of beds desired

Prefer to share twin-bedded room (\$8/person)

Name of person to share double room with (if known)

