Title	Interactions of breathers and solitons of the extended Korteweg - de Vries equation
Author(s)	Shek, CM; Grimshaw, RHJ; Ding, E; Chow, KW
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1:20PM HK.00001 A continuum model with microstructural evolution for Stokesian suspensions, viscoplastic dispersions and granular media , JOE GODDARD, University of California, San Diego — A special case of the "thixotropic" fluid proposed several years ago by this author (*J. NonNewtonian Fluid Mech.* **14** 141-160,1984) is explored as a plausible model for the flow of homogeneous particle suspensions and dense granular media. The effect of deformation history is described by the shear-induced evolution of a second-rank "fabric" tensor, which serves to define a pair of non-negative fourth-rank tensors for viscosity and plasticity. The viscous model predicts qualitatively most of the time-dependent viscous shear-stress and normal-stress effects observed experimentally in Stokesian suspensions. The addition of plastic terms allows for yield stress arising from mechanical contact between particles, and the purely plastic form provides a model for quasi-static deformation of dry granular media. Addition of viscous effects to the latter provides a generalization of models currently being employed to describe dense, rapid granular flows, where the relevant microstructural time scale is associated with granular micro-inertia. A brief consideration is given to non-homogeneous (Acrivos-Leighton) models, of a type that allow for particle segregation and possibly for material instability.

1:33PM HK.00002 The rise velocity and shape of an air bubble moving in HASE fluid , E. SOTO, C. GOUJON, T. BEHAGHEL, R. ZENIT, IIM-UNAM, Mexico — Experiments were conducted to determine the shape and the rise velocity of an air bubble moving in a HASE fluid. These type of non Newtonian materials can be classified as associative fluids, because their internal structure is formed by hydrophobic molecules which associate or dissociate as a result of flow. In particular, the liquid used in this investigation has a nearly constant shear viscosity for a wide range of shear rates but shows significant elasticity above a certain critical shear rate. Millimetric size bubbles were released from rest in a tall cylindrical container. Two types of images were obtained: high resolution photographs, from which the bubble shape and volume were obtained; and, low resolution high speed videos were used to measure the bubble velocity. We found that the bubble velocity increases with the bubble volume; however, a sudden increase of the bubble velocity is observed as the bubble volume reaches a critical value. This phenomena, known as the bubble velocity discontinuity, has been observed in other non Newtonian fluids but, to our knowledge, has never been reported for associative fluids. Additionally, we identified that a significant change of the bubble shape occurs along with the appearance of the velocity discontinuity. Moreover, by performing PIV measurements we are able to relate the appearance of the velocity jump with values of the local shear rate at which the elasticity of the fluid becomes important.

1:46PM HK.00003 Electrorheology of single wall carbon nanotubes/silicone oil suspensions under AC fields , CHEN LIN, JERRY W. SHAN, Rutgers University — Electrorheological properties of single wall carbon nanotubes (SWNTs) suspended in silicone oil are experimentally investigated in this work. Nanotube alignment and the formation of strands and chains of nanotubes are observed in the suspensions when an alternating current (AC) electric field is applied. The rheological measurements show that the nominal viscosity of a 0.002% mass-fraction SWNT/silicone oil suspension increases by more than 15% at low shear rates under an AC field. The relationship between stress and strain rate is investigated for varying electric-field strengths and suspension concentrations.

1:59PM HK.00004 Dynamics of nematic liquid crystal polymers in coupled flow and magnetic field , QI WANG, Florida State University, M.G. FOREST, UNC-Chapel Hill, RUHAI ZHOU, Old Dominion University, HONG ZHOU, Naval Postgraduate School, SARTHOK SIRCAR, Florida State University — We study the hydrodynamics of the nematic liquid crystals in coupled flow and magnetic field. We focus on two prototypes of the idealized flow geometries: general linear planar flows and elongational flows. For both flows, we give a complete flow phase diagram for all flow strength and the strength of the imposed magnetic field. For the elongational flows, we show rigorously that the magnetic field must coincide with one of the principle axes of the second moment of the probability density function for the distribution of the nematic polymers.

2:12PM HK.00005 The application of non-Newtonian models to thin film flow , TIM MYERS, University of Cape Town — In this talk I will describe an investigation into the use of lubrication models on thin film flow. Power law, Ellis and Carreau models will be compared for free surface flow and flow within a channel. It will be shown that the Ellis law (or a slight modification) can give very similar viscosity curves to Carreau. The three models will then be compared for thin film flow with a constant height free surface. For low shear rates the power law model can give very inaccurate predictions. Having shown Carreau and Ellis may produce similar results I will then study flow in a channel for Ellis and power law fluids. Again the power law can give inaccurate results due to the high viscosity around the turning point for the velocity.

Monday, November 21, 2005 1:20PM - 2:25PM –
Session HL Waves II Hilton Chicago Astoria

1:20PM HL.00001 The Effects of Surfactants on Wind Waves[1] , X. LIU, M. TAVAKOLINEJAD, J.H. DUNCAN, University of Maryland — The effects of surfactants on wind waves are studied experimentally in a tank that is 11.8 m long, 1.1 m wide and 1.8 m high. The water depth is 1.0 m and the top 0.8 meters of the tank contains air flowing with speeds up to 10 m/s. A mechanical wave maker, which resides at the upwind end of the tank, is used in some cases to superimpose a monochromatic wavetrain with frequencies of about 2 Hz on the wind wave system. Wave profiles are measured along the center plane of the tank with an LIF technique that utilizes a high-speed digital camera. The measurement system is mounted on an instrument carriage that can be set to move along the tank with various speeds. Measurements were performed with clean water and with water mixed with Triton X-100, a soluble surfactant. The results show that in clean water strong and active gravity-capillary wave phenomena are observed at the leeward side of wind wave crests. In the presence of Triton X-100, these capillary wave phenomena become weaker and eventually disappear as the surfactant concentration (Triton X-100) is increased. The detailed experiments to quantify these features are undergoing.

[1]Supported by the Ocean Sciences Division of the National Science Foundation

1:33PM HL.00002 Interactions of breathers and solitons of the extended Korteweg de Vries equation[1] , C.M. SHEK, University of Hong Kong, R.H.J. GRIMSHAW, Loughborough University, E. DING, K.W. CHOW, University of Hong Kong — A popular model for the evolution of weakly nonlinear, weakly dispersive waves in the ocean is the extended Korteweg – de Vries equation (eKdV), which incorporates both quadratic and cubic nonlinearities. The case of positive cubic nonlinearity allows for both solitons of elevation and depression, as well as breathers (pulsating modes). Multi-soliton solutions are computed analytically, and will yield expressions for breather-soliton interactions. Both the soliton and breather will retain their identities after interactions, but suffer phase shifts. However, the details of the interaction process will depend on the polarity of the interacting soliton, and have been investigated by a computer algebra software. This highly time dependent motion during the interaction process is important in nonlinear science and physical oceanography. As the dynamics of the current and an evolving internal oceanic tide can be modeled by eKdV, this knowledge is relevant to the temporal and spatial variability observed in the oceanic internal soliton fields.

[1]supported by Research Grants Council HKU7184/04E, 7123/05E