at the onset of a first boiled-out region. The analysis of computational results indicate that a qualitative tendency exists between the characteristics such as heat generation rate, porosity, effective particle diameter and the temporal development of the liquid volumetric fraction field up to dryout.

Two phase thermalhydraulic code used for fast transient calculations
Prah M., Feretic D. & Grgic D., *International Journal for Engineering Modelling*, 1996, 9/1-4 (21-26). In English.

The thermalhydraulic model was developd as a base for a fast running computer code for the purpose of a nuclear power plant primary system simulation. The model is based on the drift flux theory and integrated momentum equation. It is a nonhomogeneous four-equation model of a two-phase flow. On the basis of the developed theoretical model, the computer code in FORTRAN 77 for PC 386/486 compatible computers was prepared. The results of simulation are quite good and the accuracy of the program for selected test cases is comparable to the accuracy of RELAP5/mod2 computer code with CPU time reduction.

The analysis of nonlinear internal wave induced by arbitrary pressure distribution in a stratified flow
Chin-Hwa Kong & Chieh-Yao Chang, *International Journal for Engineering Modelling*, 1996, 9/1-4 (11-20). In English.

Nonlinear internal waves induced by arbitrary pressure loads in a stratified flow are treated, and the analytical solutions are given. The analytical solutions are supplied by applying Rayleigh and Lamb methods to linear waves on the free surface with infinite depth. It is shown that for a stratified-flow category, a number of differences are influenced by interfacial Froude numbers between the two methods. These variances derived from the Froude numbers are interpreted physically. The purpose of this study is to analyze the effects of the nonlinearity, to compare the different results derived from different pressure distribution functions by the above two analytical methods and to develop the appropriate model which is capable of solving the similar problem under any other conditions.

Numerical prediction of two-phase flow in bubble columns
Boisson N. & Malin M.R., *International Journal for Numerical Methods in Fluids*, 1996, 23/12 (1289-1310). In English.

A numerical model is described for the prediction of turbulent continuum equations for two-phase gas-liquid flows in bubble columns. The mathematical formulation is based on the solution of each phase. The two-phase model incorporates interfacial models of momentum transfer to account for the effects of virtual mass, lift, drag and pressure discontinuities at the gas-liquid interface. Turbulence is represented by means of a two-equation k-ε model modified to account for bubble-induced turbulence production.

A multiphase mixture model for multiphase, multicomponent transport in capillary porous media - I. Model development
Wang C.Y. & Cheng P., *International Journal of Heat and Mass Transfer*, 1996, 39/17 (3607-3618). In English.

A new model for multiphase, multicomponent transport in capillary porous media is developed, in which the multiple phases are considered as constituents of a multiphase mixture. This multiphase mixture model consists only of the conservation equations for the multiphase mixture and is derived from the classic multiphase flow formulation without making any approximations. In addition, algebraic relations are found which can be used to back out the individual phase flow fields from the mixture velocity in a post-processing fashion.

New low-Reynolds-number k-ε model including damping effect due to buoyancy in a stratified flow field
Murakami S., Kato S., Chikamoto T., Laurence D. & Blay D., *International Journal of Heat and Mass Transfer*, 1996, 39/16 (3483-3496). In English.

A new k-ε model which includes damping effect on vertical turbulent transport due to thermal stratification is proposed. The proposed model was tested by application to two kinds of two-dimensional thermally stratified flow fields. One is a high-Reynolds-number open channel flow, and the other is a low-Reynolds-number flow-field within an enclosure. The new model also includes low-Reynolds-number treatment which is effective not only in the vicinity of the wall, but also apart from the wall.

A model for slurry rheology
Shi F.N. & Napier-Munn T.J., *International Journal of Mineral Processing*, 1996, 47/1-2 (103-123). In English.

A semi-empirical model has been developed to predict slurry rheology from easily-measured slurry properties. The model demonstrates the complex influence of these properties on rheology, and also permits rheological information to be predicted in cases where it cannot be measured. It is intended for use with slurries commonly encountered in mineral processing. The model has been applied to 127 sets of Debex viscometer measurements of a variety of slurries totalling more than 1200 data points, with good agreement between the predicted and the measured data. The separate effects of solids volume fraction and particle size on slurry rheological nature, simulated using the model and turbulence-corrected by the TC curve procedure, are demonstrated graphically. The influence of various factors of slurry rheology is discussed, and it is shown that a single slurry can exhibit many different rheological natures, depending only on the concentration and size distribution of the solids.

Measuring the rheology of slurries using an on-line viscometer
Shi F.N. & Napier-Munn T.J., *International Journal of Mineral Processing*, 1996, 47/3-4 (153-176). In English.

This paper presents a new procedure for obtaining a full shear rate-shear stress flow curve for unstable slurries using the single bobbin Debex on-line viscometer. It is based on the use of a calibration algorithm which incorporates a correction for turbulent flow in the measurement vessel. It is shown that torqueoc efficient data from a variety of Newtonian fluids and non-Newtonian slurries fall on a single curve, and it is suggested that this calibration curve (the 'TC curve') is characteristic for a particular instrument configuration. In principle, it can

be easily determined using Newtonian fluids alone. It is shown that the Debex on-line viscometer gives flow curves very similar to a conventional laboratory viscometer when this procedure is applied.

Rheological characterization of mineral suspensions using a vibrating sphere and a rotational viscometer

Kawatra S.K., Bakshi A.K. & Miller T.E. Jr, *International Journal of Mineral Processing*, 1996, 44-45/- (155-165). In English.

A new technique has been developed for the characterization of the rheology of mineral slurries into Newtonian and non-Newtonian flows. It utilizes a rotating type viscometer to measure apparent viscosity at a low shear rate, and a vibrating sphere type viscometer to measure the apparent viscosity at a high shear rate. Special precautions were taken to allow measurements of apparent viscosity of rapidly setting mineral suspensions. Both the viscometers are able to measure apparent viscosity as low as one mPa.s (millipascal-seconds) (1 mPa.s = 1 centipoise), which is the approximate room temperature viscosity of water.

Swirl flow characteristics and froth phase features in air-sparged hydrocyclone flotation as revealed by X-ray CT analysis

Das A. & Miller J.D., *International Journal of Mineral Processing*, 1996, 47/3-4 (251-274). In English.

The time-averaged multiphase flow characteristics of air-sparged hydrocyclone flotation have been studied using X-ray computed tomography. Criteria of froth stability and the relationship between froth phase features and flotation response have been established. Quantification of the spatial extent of the different flow regimes has been done in order to characterize the flow behavior during steady-state operation of a nominal 2-inch diameter air-sparged hydrocylone (ASH-2C). The influence of different operating and design variables on multiphase flow characteristics has also been established.

On-line measurement of viscosity and determination of flow types for mineral suspensions

Kawatra S.K. & Bakshi A.K., *International Journal of Mineral Processing*, 1996, 47/3-4 (275-283). In English.

A viscometry system involving a vibrating sphere viscometer and a rotational viscometer has been developed for on-line measurement of viscosity, and for rheological characterization of mineral slurries into either Newtonian or non-Newtonian flows. Both the viscometers were able to measure viscosity as low as one centipoise, which is the approximate room temperature viscosity of water. Ground silica of 80% passing 65 μm size was suspended in water, and was used to prepare slurries at different percent solids. Viscosity of each slurry sample was measured simultaneously by both the viscometers, and the results were compared to determine the rheological characters of the slurries. With this technique, it was found that all the silica slurry samples (up to 70 wt% solids) at the given size distribution were in the Newtonian flow regime.

Some characteristics of air-water two-phase flow in small diameter vertical tubes

Mishima K. & Hibiki T., *International Journal of Multiphase Flow*, 1996, 22/4 (703-712). In English.

Flow regime, void fraction, rise velocity of slug bubbles and frictional pressure loss were measured for air-water flows in capillary tubes with inner diameters in the range from 1 to 4 mm. Although some flow regimes peculiar to capillary tubes were observed in addition to commonly observed ones, overall trends of the boundaries between flow regimes were predicted well by Mishima-Ishii's model. The void fraction was correlated well by the drift flux model with a new equation for the distribution parameter as a function of inner diameter.

A computer based hot-film technique used for flow measurements in a vertical kerosene-water pipe flow

Farrar B. & Bruun H.H., *International Journal of Multiphase Flow*, 1996, 22/4 (733-751). In English.

This paper presents the application of a hot-film anemometer based two-phase flow measurement technique to the investigation of the structure of a vertical pipe flow of a water-kerosene mixture. Experiments were carried out within the bubbly flow, spherical cap bubble and churn flow regimes. The results obtained show that the radial profile of the local volume fraction is uniform at low volumetric quality, β, but becomes wall peaked as β increases. The average oil drop size is uniform across the pipe and independent of β for values of β below 15%, but at higher values the drop size increases in the central region of the pipe.

Design of a flow metering process for two-phase dispersed flows

Boyer C. & Lemonnier H., *International Journal of Multiphase Flow*, 1996, 22/4 (713-732). In English.

This paper describes the methodology used to conceive and size a flowmeter for two-phase dispersed flows. The Venturi having been chosen as the velocity measurement device, focuses on its measurement sensitivity to the velocity slip between the phases at the throat. Among the different two-phase flow models reviewed, an original one has been selected and adapted to predict; velocity and pressure distributions along a Venturi tube with air/water and oil/water flows. Bubble and liquid velocity calculations performed by this model are compared with experimental data to show a good agreement between predicted and measured velocities at the throat.

Experimental study of a two-phase bubbly flow in a flat duct symmetric sudden expansion - part II: liquid and bubble velocities, bubble sizes

Aloui F. & Souhar M., *International Journal of Multiphase Flow*, 1996, 22/5 (849-861). In English.

Experimental results obtained in a gas-liquid bubbly flow in a flat horizontal sudden expansion are presented in this study and constitute useful data for the numerical code. The use of hot film anemometry in the continuous phase (liquid) of a bubbly flow allows a determination of the average and fluctuating velocity. For the dispersed phase, the use of a double optical probe allows the determination of the average and fluctuating axial velocity and the granulometry of the bubbles. A comparison of these quantities with the results obtained by a fast video camera shows very good agreement.

Relation of slug stability to shedding rate

Woods B.D. & Hanratty T.J., *International Journal of Multiphase Flow*, 1996, 22/5 (809-828). In English.