EXHIBIT 1

RESUME

INDRESH RAMPALL, Ph.D.

PRINCIPAL ENGINEER
HOLTEC INTERNATIONAL

EDUCATION

Ph.D. in Chemical Engineering
University of Notre Dame (1992), GPA 3.97/4.0

M.S. in Chemical Engineering
University of Notre Dame (1989), GPA 4.0/4.0

B. Tech in Chemical Engineering
Indian Institute of Technology (1978), Grade A2

PROFESSIONAL EXPERIENCE

HOLTEC INTERNATIONAL

April 1993 - Present **Principal Engineer**

Heat exchange, steam generation and fuel pool cooling system design, licensing and consulting.

CLARKSON UNIVERSITY
Potsdam, NY

September 1992 - April 1993 **Research Associate**

ENGINEERS INDIA LIMITED (EIL)
New Delhi, India

1978 - 1987 **Senior Engineer, Research and Development Department**

A major consultancy and project engineering company in the refineries, petrochemicals and on- and off-shore exploration.

EXPERIENCE SUMMARY

- **Process Design and Development Experience**

  1. **Process design work including Heat and Material Balance Calculations, preparation of Process Flow and P&I Diagrams, Specifications for Process Instruments, Pumps and Equipment (Pressure Vessels, Heat Exchangers, etc.). Also prepared Operations Manuals for start-up, operations, shutdown, emergency procedures and plant safety.**
  2. **Developed process models for design of two-phase flow high pressure pipelines from off-shore platforms.**
  3. **Developed steady state and dynamic process design models of heterogeneous fixed bed catalytic reactors used in refineries and petrochemical plants. The models were used to**

analyze industrial and pilot-plant data for the o-xylene and ethylene oxidation reactors to develop a complete reactor simulation model.

4. Development of a process design and simulation model for the zeolites based ZSM-5 catalyst used in the xylenes isomerization reactor for a large petrochemical complex. Appointed as the lead process engineer for planning of bench scale experiments at plant site as well as analysis of data to obtain a detailed kinetic model of the process.

Chemical Process Plant Experience

1. Appointed as the *lead process engineer* for development of the Ethylene epoxidation technology. Completed the process design, construction supervision and operation of a highly automated, full-scale, single tube, medium pressure, pilot plant for the catalytic oxidation of ethylene to ethylene oxide. Highly experienced with hands-on work involving process instrumentation, continuous on-line analyzers as well as process gas chromatographs. Developed process models from statistical analysis of pilot-plant data to evaluate catalyst/reactor performance.

2. Commissioning of a 25 million lbs/yr industrial plant for the production of phthalic anhydride by oxidation of o-xylene. Worked in pre-commissioning activities, preparation for start-up, establishing stable and safe operating conditions and guarantee test runs to meet all process specifications for yield and purity of products.

PhD Thesis Title and Summary of Research

Shear induced structure and migration in non-colloidal suspensions

1. *Experimental determination of the pair distribution function for a suspension of spheres in simple shear flow*

   A new direct flow visualization technique, employing a thin sheet of laser light, is developed for imaging the interior of suspensions. This is combined with a novel pattern recognition algorithm to simultaneously locate the position and size of particles in a dynamic cross-section of a suspension of 3 mm acrylic spheres sheared in a flow visualization apparatus. Fundamental information on the nature of particle interactions and the suspension micro-structure is obtained. In addition to direct applications in predicting rheological properties of the suspension such as the bulk viscosity, we also gain insight into the more complex phenomena such as normal stress differences, anisotropy, particle migration, etc.

2. *The influence of shear induced migration on turbulent resuspension*

A new model is proposed to predict the condition when particles are first ejected from the viscous sub-layer of a fluid flowing over a settled layer of particles into the turbulent core of the fluid. The resuspension process is modelled in terms of a set of non-linear integro-differential convection-diffusion equations with moving singular boundaries. The equations are discretized and solved as a large set of *dense* differential and algebraic equations using the DASSL solver on the Convex mini-supercomputer.

Important Applications of PhD Research

- Knowledge of the micro-structure (i.e., the local arrangement and orientation of particles) has important applications in the area of Rheology of Suspensions and mechanical properties of Filled Polymer Composites. The bulk properties of the suspension such as effective viscosity, thermal and electrical conductivities are strongly influenced by this local distribution of particles.

- In the area of Multi-Phase Flow, the resuspension and transport of an initially settled bed of particles due to turbulent flow of fluid is solved. This work has applications in viscous systems such as flow of coal-oil slurry or drilling muds.

- Solved the mass transfer due to turbulent eddies near a wall in sedimenting systems. The model is applicable for the analysis of the improved performance of cross-flow microfiltration of suspended particles as well as in ultrafiltration of large molecular species. Increased mass fluxes can be obtained due to an induced secondary eddy flow in the near wall region.

Computational Experience

Developed programs in Fortran and C for solving complex engineering problems using advanced numerical techniques on a variety of hardwares - IBM, Vax, Convex, and Sun workstations - and operating systems - DOS, VAX/VMS, Unix, etc.

Supercomputer Training

Undertaken special training programs to take advantage of the Convex vectorization support in Fortran. Familiar with programming techniques on the massively parallel Connection Machine.

Patent

An improved process scheme for production of phthalic anhydride by oxidation of o-xylene in multistage reaction systems, by I. Rampall, A. Datta and P.K. Mukhopadhayay, Patent application in India (submitted).

PUBLICATIONS

1. *Measurement of the shear-induced microstructure of concentrated suspensions of non-colloidal spheres*, by D.T. Leighton and I. Rampall, Review paper in "Particulate Two-Phase Flow", M. Roco (editor), Butterworths, (1993).

2. *The influence of shear induced migration on turbulent resuspension*, by I. Rampall and D.T. Leighton, Submitted to the Int. J. of Multiphase Flow, (1992).

3. *The influence of surface roughness on the pair-particle distribution function in dilute suspensions of non-colloidal spheres in simple shear flow*, by I. Rampall, J.R. Smart, D.T. Leighton, Submitted to the Journal of Fluid Mechanics, (1992).

4. *Studies in reactor configuration for phthalic anhydride production*, by I. Rampall, A. Datta and P.K. Mukhopadhayay, "Frontiers in Chemical Reaction Engineering", vol. II, L.K. Doraiswamy and R.A. Mashelksar (Editors), 241-258, John Wiley and Sons, (1984).

5. *Parameter estimation and simulation of multi-tubular ethylene oxide reactor*, by R. Aggarwal, I. Rampall and A. Datta, "Recent Trends in Chemical Reaction Engineering", vol. II, B.D. Kulkarni, R.A. Mashelkar and M.M. Sharma (Editors), 360-374, Wiley Eastern, (1987).

PRESENTATIONS

1. *Flow driven by oscillatory gravitational fields in a vertical channel wall effects*, by I. Rampall and R. Shankar Subramanian, First international workshop on g-jitter, Clarkson University, Potsdam, NY (June 13-18, 1993).

2. *A direct flow visualization method to study the shear-induced microstructure of non-colloidal suspensions*, by I. Rampall, Invited seminar talk at Clarkson University, Potsdam, NY (1993).

3. *Particle dynamics near a solid wall in concentrated suspensions of non-colloidal spheres*, by G. Krishnan, I. Rampall and D.T. Leighton, Presented at the AIChE Annual meeting in Miami, FL (1992).

4. *The influence of shear induced migration on turbulent resuspension*, by I. Rampall and D.T. Leighton, Presented at the AIChE Annual meeting in Los Angeles, CA (1991).

5. *On the pair-particle distribution function in dilute suspensions of non-colloidal spheres in simple shear flow*, by I. Rampall, J.R. Smart and D.T. Leighton, Paper presented at the AIChE Annual meeting in Chicago (1990).