Impeller by Panel Method

Yutaka MIYAKE*, Kiyoshi BAN-DOH*, Yoshio MASUDA* and Shigetaka NAGAMATSU ** A panel method of obtaining accurate three-dimensional incompressible potential flow in a centrifugal impeller is presented. The basic equation is the surface integral representation for velocity poential based on Green's identity, which reduces to a set of linear equations by discretization procedure. Numerical calculations are performed at flow rates 100% and 75% for an impeller designed by the conventional method. The one-dimensional flow obtained by a simple one-dimensional theory, a two-dimensional calculation and the present three-dimensional one are compared to clarify the degree of approximation of each flow. The three-dimensional characteristics are investigated examining the pressure distribution along the blade elements on the hub, mid and shroud stream surfaces, the pressure contour and the relative velocity vector on the pressure and suction surfaces of the blade, the head distribution at the impeller outlet surface, and so on.

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studies on the Three-dimensional Flow Field in a Turbine Scroll (1st Report, Measurements of Secondary Flows)

Masahiro INOUE, Kazuo HARA and Masato FURUKAWA A test apparatus of turbine scroll has been devised to investigate the secondary flow phenomena in a scroll. The scroll is of parallel end wall type and based on a logarithmic spiral. The three-dimensional flow field survey can be taken in arbitrary cross sections with a probe traverse mechanism newly developed. Distributions of total pressure and three velocity components have been measured in detail, using a five-hole probe. The secondary flow field is to be dominated by passage vortices on end walls and low energy fluid accumulating on a tongue. The favorable pressure gradient and the inward secondary flow on end walls suppress an extreme growth of wall boundary layer. However, the secondary flow affects the distribution of exit flow angle in the direction of passage height.

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Improvement of Surface Condenser Performance by In-Situ Artificial Protective Film Coating

by Tadashi NOSETANI, Yasushi HOTTA, Yasukazu IKUSHIMA and Sadashige YAMASHITA A seriously fouled condenser of the Sakai-Port Power Station which started in 1965 has been renovated by in-situ artificial protective film (APF) coating of the condenser tubes. The condenser of the No. 2 unit with a capacity of 250 MW has two-water boxes called "A" and "B" condensers installed with aluminum-brass tubes. The gradual decrease in heat transfer performance of the condenser tubes has been revealed by inspections of remqved tubes. Based on measurements carried out in October 1983 for evaluating in-situ APF coating, in March 1984 in-situ APF coating was applied to only A condenser being more heavily fouled than B condenser. The comparative measurement conducted in October 1984 proved that the condenser vacuum was improved by about 0.6 kPa. The removed APF coated tubes presented sound coated surfaces, except for some tiny blisters at both ends, and no indication of corrosion after six months duration. In-situ APF coating is concluded as being a good countermeasure against corrosion and fouling.

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Combined Forced and Natural Convection Heat Transfer for

Upward flow in a Uniformly Heated Vertical Pipe

Hiroaki TANAKA, Shunichi HATANO and Shigeo MARUYAMA For predicting the fully developed upward flow in a uniformly heated vertical pipe by taking account of the buoyancy force, the k-ε models of turbulence for low Reynolds number flows were adopted. The regime map for forced, mixed and natural convections as well as for laminar and turbulent flows was plotted from the numerical calculations. At the same time, an experiment was carried out at Reynolds numbers of 3 000 and 5 000 with the Grashof number varied over a wide range by using pressurized nitrogen gas as a test fluid. In agreement with the prediction, buoyancy-induced impairment of hat transfer was measured right in the mixed convection region. Further, from hot-wire measurement, complete laminarization was demonstrated in the mixed convection region at a Reynolds number of 3 000.

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Laminar Forced Convection Heat Transfer in Rectangular Ducts Rotating about an Axis Perpendicular to the Duct Axis (2nd Report, Numerical Analysis in Case of Rectangular Ducts with Aspect Rations 0.2, 0.5, 2 and 5)

Yoshikata KOMIYAMA *, Fusao MIKAMI** and Kenichi OKUI** Numerical analysis is conducted on the forced convection heat transfer in rectangular ducts with aspect ratios 0.2, 0.5, 2.0 and 5.0, rotating at a constant angular velocity about an axis perpendicular to its axis. Navier-Stokes and energy equations are solved by a finite-difference method in the fully developed region of laminar flow. Velocity and temperature fields are obtained for various rotation rates and Reynolds numbers at each aspect ratio of the duct. A doucle-

vortex secondary flow appears at low to moderate rotation rates. An additional pair of vortices appeared and disappeared for a higher range of Reynolds numbers due to aspect ratios of the ducts. The friction factor and Nusselt number are influenced by the Coriolis force and aspect ratio. Numerical results of the friction factor for aspect ratios equal to 0.5 and 2.0 are in good agreement with experimental results by other researchers.

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A Numerical Analysis of the Fluid Motion and Heat Transfer in the Tank of a COM Carrier Ship Rolling in a Wavy Sea

Shinsuke AKAGI *, Yoshiyuki MATSUNO** and Hirohisa KATO*
A numerical analysis is presented for the fluid motion and heat transfer in the tank of a Coal Oil Mixture [COM] carrier ship rolling in a wavy sea. A non-Newtonian fluid model is adopted to describe the flow behavior of the COM. The motion of the tank is assumed to be a simple harmonic rolling motion, and similarity parameters for the fluid motion and the heat transfer are given. The flow velocity and temparature distribution in the tank is determined by a numerical solution of the basic equations describing the flows in a tank with rolling motion. Heat flows from the tank walls and the shear stress in the tank are predicted when a ship is rolling in waves. The influence of the frequency of the rolling motion on the heat transfer rate is also examined.

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An Experimental Study on Free Convection Heat Transfer from Horizontal Cylinders in a Vertical Duct

Hakaru SAITO, Koki KISHINAMI, Ikuo TOKURA and Toshiya

NAGASAWA This experimental study has been conducted on the free convection from horizontal cylinders, vertically lined in array, set in a vertical duct or in free space. It has been found that the Nusselt numbers for each cylinder in an array are proportional to the 1/4th power of Rayleigh number in both cases, and the experimental data concerning the average Nusselt number for the whole array can be well represented by a practical formula, Eq. (2·a), which covers the cylinder arrays set either in free space or in a vertical duct.

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The Temperature – Concentration Combined Melting of a Horizontal Ice Layer by an Aqua – Solvent with a Low Solidification Temperature

Masahiro SUGAWARA *, Hideo INABA** and Hitoshi NISHIMURA *** This paper is concerned with the melting of a horizontal ice layer from above by an aqua-solvent with a low solidification point. The solutes used in this experiment are Calcium Chloride and Urea. The upper surface of the melt layer is heated by radiative energy. The ice layer located under the melt layer the aqua-solvent melts greatly by a reaction, and the typical temperature distribuion in both the melt layer and the ice layer is examined. The relation between the melt amount of the ice layer per unit temperature gradient and the mean concentration in the melt layer of aqua-solvent was obtained.

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Measurement and Analysis of System Performance of Renewable Energy Laboratory

Kimio KANAYAMA, Hiromu BABA and Masaki YAMAMOTO
The renewable energy laboratory of the Kitami Institute of Technology is a facility for the research of space heating, cooling and hot water supply by means of solar and underground water energies using a solar system and a heat pump. The experiment at the first hall started in 1982 and the second hall has been used since 1983. The measurements for two combination types of series and parallel solar-heat . pump systems were carried out for two periods between Nov. 21st 1984 to Feb. 20 th 1985 respectively. Comparing the two combination types using a system C.O.P., the performance of the parallel combination of the solar-heat pump system was better than that of the series combination. Besides, several analyses of the solar-heat pump system were done for prediction of the system performance.

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Thermal Efficiency Analysis on Coal Gasificated Combined Cycle Power System (1st Report, Calory-Based Analysis)

Hideto MORITSUKA To analyze the thermal efficiency of the complicated power generation system such as a coal gasificated combined cycle power plant, it is necessary to prove differences of system components. This paper a simple coal gasification equation based on an equivalent coal composition $C_{18}H_hO_0$ is proposed. And a thermal efficiency analysis method with a net thermal flow chart is described in which each component is represented by several parameters. With the use of this method, it is possible to indicate an essential thermal flow and to indicate an essential thermal flow and to show an influence of differences of system components evidently.

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Thermal Efficiency Analysis on