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Appendix

Abstracts & Titles, No. 55–No. 57

BULLETIN
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NOTICE

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Suction or Blowing Effects on the Laminar Boundary Layer with a Streamwise Pressure Gradient

Shoichiro FUKUSAKO
Masaru KIYA
Mikio ARIE

Abstract

The present paper deals with a theoretical aspect of the effect of suction and blowing on a laminar boundary layer flow accompanied by a streamwise pressure gradient complicated by a heat transfer between the wall and the fluid. The present analysis was made under very general conditions under which the pressure varies as x^m and the suction or blowing velocity as x^n with m and n being arbitrary constants.

However, m should not be equal to -1 in this case. The case of $m=-1$ was also treated in the appendix as an exceptional case. The wall is assumed to be isothermal.

In the same manner as in the case where zero pressure gradient is in the direction of flow, suction at the wall increases both skin friction and heat transfer, while a blowing decreases them. The effect of blowing or suction appears less markedly when the pressure gradient is negative as compared with the case of positive pressure gradient.

Analysis of a Half Frequency Changer

Masaki SATO
Shoji FUKUDA
Hajime FUJIWARA

Abstract

In recent years, frequency changers consisting of thyristors have been applied in many fields, and various analyses of these circuits have been made.

However, the focus of attention has been on producing higher frequencies than on the source frequency.

Thus, in the present paper, attempts were made to reduce the frequency in half.

The circuit used for this purpose consisted of 8 thyristors and was connected to a single phase source.

The analysis of the load current was carried out under an inductive load. The analysis was of considerable interest.

In the earlier part of this paper, general solutions of the load current was derived under continuous current conditions.

The changeable regions of the independently controlled angle β and dependently controlled angle α are determined in such a way that the load current is continuous, where the angle α is the function of angle β.

The latter halfof this paper is devoted to explanations concerning waveforms, effective values, the rate of harmonics of the load current, and power factor. These items are influenced by the change of SCR angle which is controlled independently in order to render the load current continuous.

The Effect of the Quantum Efficiency Distribution on Optical Heterodyne Detection of an Atmospherically Distorted Signal Wave

Hiroaki TAKAJŌ
Ichiro SAKURABA

Abstract

Fried's analysis of an optical heterodyne detection system of an atmospherically distorted signal wave was modified and applied to a case where the quantum efficiency of the photodetector is distributed in a Gaussian distribution.

The ratio of the saturation value of the signal-to-noise ratio, SNR, in the Gaussian distribution to that in the uniform distribution is given by $\left[1+\exp\left\{-(D/2a)^2\right\}\right]/2$, where D is the diameter of the photodetector surface and a is the distribution length. In the case in which the distribution length is small compared with the diameter of the photodetector surface, the ratio of the saturation value tends to a limit of 1/2. In the case where $D \ll a$, the effect of the quantum efficiency distribution on the saturation value of SNR is very small.

Slowing Down of Neutrons to Very Low Temperatures in Hydrogen-containing Cold Moderators

Kazuhiko INOUE

Abstract

The slowing down of neutrons to extremely low energies has been studied with regards to the production of cold neutrons. The neutron spectrum from very cold light water ice has been measured with an electron linear-accelerator pulsed neutron source and time-of-flight technique. At extremely low temperatures the neutron temperature is much greater than the moderator temperature, whereas at an intermediate range of temperature the neutron temperature does not differ too greatly from the moderator temperature. In other words, there is a limited neutron temperature which does not fall, even when the moderator temperature falls. Further, the general appearance of the cold neutron spectrum at very low temperatures reveals a close similarity to the thermal neutron spectrum. These results reveal some information on the nature of mechanisms for abstracting small amounts of neutron energy from slow neutrons in hydrogen-containing cold moderators.

It is shown that the neutron can lose small amounts of energy due to low frequency lattice vibrations, i.e., acoustic mode. Also quantitative analysis indicates that the cold neutron temperature depends weakly on the absorption but that the gain in cold neutron flux is strongly affected by the absorption.

Corrosion Studies of Metals in Molten $AlCl_3$–NaCl

Takenori NOTOYA
Tatsuo ISHIKAWA
Rinzo MIDORIKAWA

Abstract

Anodic polarization curves of various metals and alloys in molten salt mixtures of aluminium chloride-sodium chloride at 200°C were measured by using the potential sweep method at a sweep rate 2.50 mV/sec. The anodic polarization curves obtained from different metals are classified into three types by their shape; (i) Monotonic rise of the anodic dissolution current with the potential for Aluminium, Silver, Copper and Molybdenum. (ii) Characteristic passivation for Nickel, Palladium, Titanium, Iron, Stainless Steels and Platinum. (iii) Chlorine gas evolution without anodic dissolution for Tungsten. The effects of composition of Ni–Cu alloys on the corrosion rate, corrosion potential and anodic peak current in the melt were examined, and the corrosion rate of the alloy was found to decrease with increasing Ni content, particularly for the alloys with a more than 30% Ni content.

A Study on the Reaction Equilibrium of Aluminate and Oxalate

—Application to the Potentiometric Determination of Aluminate—

Takao YOTSUYANAGI
Masaru YAMADA
Kazuo AOMURA

Abstract

The equilibrium of the reaction of aluminate with oxalate was studied in alkaline solution by the potentiometric titration method and the 8-quinolinolate extraction method. It was found that, after neutralization of free alkali is completed, aluminate commences to react with oxalate and liberates four moles of hydroxide ion per mole of aluminum in a PH range of 8 to 9. The reaction is expressed as:

$$Al(OH)_4^- + 3C_2O_4^{2-} \rightleftharpoons Al(C_2O_4)_3^{3-} + 4OH^-$$

and the equilibrum constant is about 10^{-17}.

Based on the above findings, a new potentiometric titration method for the rapid determination of aluminate is proposed.

Recommended procedure: To a sample solution containing 0.02 to 0.2 m mole of aluminum, 15 mℓ of 0.5 M potassium oxalate solution is added and diluted to 100 mℓ with distilled water. The titration of the mixture with 0.1 N hydrochloric acid is carried out in a nitrogen atmosphere. Free and total alkali are determined by the first and the second equivalent points respectively and the aluminum can be calculated from the difference of total alkali and free alkali.

The average error for free alkali in a range of 0.5 to 1.4 meq/100 mℓ was 0.007 meq/100 mℓ and that for aluminum in the range of 0.1 to 0.16 m moℓ/100 mℓ was 0.003 m moℓ/100 mℓ.

Vapor-Liquid Mass Transfer

A Study of Liquid Film Resistance with a Wetted Wall Column

Toshiharu SHIBATA
Masao KUGO

Abstract

Absorptions of a gas (CO_2) and a vapor (ethylether) by water were experimented in a wetted wall column to clarify the transfer mechanisms between these gases.

In these cases the gas phese resistance of ether was negligible, but the effect of temperature on the absorption rate of vapor was rather remarkable and the operation temperature was found to have an increased rate as it approaches the boiling point of the solute.

It was also considered to be reasonable for the vapor absorption such as ethylether to water, to use a liquid-liquid equilibrium concentration instead of the gas-liquid equilibrium to determine the rate coefficients or HTU.

The H_L-Re relation in which the liquid-liquid equilibrium was used for the vapor was obtained by

$$(H_L/z)\,Ga^{1/3}Sc^{-1/2} = 1.66\,Re^{0.67}$$

In this correlation a fairly good agreement was shown for the gas and vapor.

The Vapor-Phase Hydration of Propylene

—The Catalytic Hydration of Propylene by the Solid Phosphoric Acid Catalysts and the Suspended Solid Phosphoric Acid Catalysts—

Osamu UEMAKI
Masahisa FUJIKAWA
Masao KUGO

Abstract

The hydration of propylene was investigated with solid phosphoric acid catalysts and suspended solid phoshoric acid catalysts which were prepared by suspending the solid phosphoric acid catalysts in organic solvents; the various effects of operating conditions on the reaction, such as the temperature, the pressure, the propylene-to-water mole ratio, and the catalyst life were studied.

The results showed that the yield of conversion increased with the rise of pressure and maximum values were obtained at 150–170°C, where possibly the liquid water

exerted an effect to produce a decrease of activity of the solid phosphoric acid catalysts. However, the suspended solid phospheric acid catalysts maintained a high activity and selectivity under these conditions as illustrated by the fact that were available for the hydration of olefines to alcohols favored at lower temperature as well as higher pressure.

Herstellung der Polyketodikarbonsäure durch Pyrolyse von Dikarbonsäuresalzen

Yoshiyuki TAKATA
Yukihiro SEKINE

Zusammenfassung

Wir versuchten eine Synthese der Polyketodikarbonsäure durch Pyrolyse der Metallsalzen von Azelainsäure und Sebacinsäure, unter andern der Salzen von Zn Cd, Mn, Co, Ni, Fe, Pb, Mg usw.

Nach der Pyrolyse bei Temperaturen um 330–400°C, ausscheidet man das Reaktionsgemisch vier Teile: Acetonlöslichen Teil (I) (mittleres Molekulargewicht 500–630), Xylollöslichen Teil (II) (mittleres M.G. 600–950), Eisessiglöslichen Teil (III) (mittleres M.G. 1000–1600) und Nichtlöslichen Teil (IV). Zn-salz bereitet (I) reichlich, wie Cd-salz bereitet (III) und Pb-salz bereitet (IV) im überfluss. Mn-, Co-, Mg-sazl bereiteten (I), (II), (III) und (IV) nebeneinander fast in gleichem Ausbeute. Fe (II)-salz bereitet (I), (II), (III) und (IV), jedoch Polyketodicarbonsäure nicht entsteht aus Fe (III)-salz. Ni-salz bereitet Caprylsäure usw., aber Polyketodikarbonsäure nict entsteht daraus.

Synthese von Polyketodikarbonsäuren durch Pyrolyse von Dikarbonsäurenhydriden

Yukihiro SEKINE
Yoshiyuki TAKATA

Zusammenfassung

Polyketodikarbonsäuren wurden durch Pyrolyse von Polysäureanhydriden der höheren Dikarbonsäuren synthetisiert.

Die Pyrolyse von Polysäureanhydrid aus Azelain- und Sebacinsäure bei 300–350°C ergab Polyketodikarbonsäuren, deren mittleres Moleculargewicht 500–600 war. Monoketodikarbonsäuredimethylester und Diketodikarbonsäuredimethylester wurden mit Vakuumdestillation von Dimethylester dieses Produktes erhalten. Dimethylester ergab bei Hykrolyse freie Säure.

Aus Azelainsäure wurden Pentakon-8-on-1, 15-dikarbonsäunredimethylester, Trikosan-8, 16-dion-1, 23-dikarbonsäuredimethylester und freie Säure von dieser, Fp. 125–128°C, erhalten. Aus Sebacinsäure wurden Nonadecan-9-on-1, 17-dikarbonsäuredimethylester, Hexakosan-9, 18-dion-1, 26-dikarbonsäuredimethylester und freie Säure von dieser, Fp. 125–128°C, erhalten.

Beckmann-Umlagerung in Gasphase (I)

—Synthese von Caprolactam aus Cyclohexanon-oxim—

Toshio MATSUDA, Chuichi MOTOHASHI, Kenji TAKAHASHI,
Shiro TSUCHIYA und Yoshiyuki TAKATA

Zusammenfassung

Katalytische Wirkung von sowohl japanische Säureerde und Kieselgur als Silicagel, Schwefelsäure, Phosphorsäure, Borsäure und Metalloxyde auf japanischer Säureerde und Kieselgur als Träger auf Umlagerung von Cyclohexanon-oxim in Caprolactam wurde untersucht.

Japanische Säureerde und andere Verbindungen auf japanischer Säureerde als Träger zeigt die schwache katalytische Wirkung auf Beckmann-Umlagerung von Cyclohexanon-oxim in Caprolactam und die Ausbeute von Caprolactam war sehr niedrige.

Kieselgur und andere Verbindungen auf Kieselgur als Träger auch ergab niedrige Ausbeute von Caprolactam, aber zeigte Borsäure-Kieselgur eine höhere Ausbeute. Der Katalysator, der durch Angaben von 20% der Borsäure an Makkari-Kieselgur dargestellt wurde, ergab Caprolactam bei 300°C in 67% iger Ausbeute.

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Statistical Analysis on Areal Concentration (I)

Etsuo YAMAMURA

Abstract

The present paper describes a few methods for deriving η curve suggested by Professor Hirozo Ogawa and applications were made on actual data for the analysis of areal concentration.

The author has proposed two new methods using η curve:

(1) one method is founded on the degree of curvature of η curve with the intent of deter mining the location of boundaries between the concentrated and unconcentrated area.

(2) the second method indicates the change of the distribution percentages of the function of concentration in a given area.

The author attempted to analyze the concentration of commercial function in the Hokkaido area.

Laminar Wall Jet of an Electrically Conducting Fluid in the Presence of a Transverse Magnetic Field

Shoichiro FUKUSAKO
Masaru KIYA
Mikio ARIE

Abstract

This note describes a laminar wall jet of an electrically conducting fluid over an isothermal impermeable wall in the presence of a transverse magnetic field of constant strength. The analysis was performed on the basis of the boundary layer theory and the solution was obtained by means of a similarity hypothesis. It was found from the analysis that the magnetic field decreases the skin friction and the heat transfer between the wall and the fluid by a considerable amount.

On a Performance Test of a Snow Melting Machine (II)

—Intermittent and Continuous Feeding of Snow—

Ken-ichi ITO Hiroshi TANIGUCHI
Takeshi SAITO Shoichi FUKAZAWA

Abstract

The method of a performance expression on a snow melting machine and the results of a performance test for a stationary machine which was usually operated in intermittent feeding of snow were described in the previous report of this study.

In this report the performance of the machine is analyzed under conditions of intermittent and continuous feeding of snow. The melting capacity of the new machine was about two times of the previous one.

Under continuous feeding, the snow which was fed in the melting pool floated on and covered its surface, in such a way that the heat exchange became effective and residual snow was reduced.

The efficiency of the machine increased under continuous feeding as compared with that of intermittent feeding. It was shown that the heat loss transported by the overflow was reduced.

On the Impact Vibration of a Mechanical System with Clearances

Ken-ichi FUKAYA
Toshihiro IRIE

Abstract

Mechanical systems with clearances are used in various types of machines. In such mechanical systems, impact vibration is often seen between the elements, and the performance of machine is hindered; however, the energy of impact vibration may sometimes be used for special purposes.

In this paper, impact vibration arising when a mass collides against rigid walls under the action of a harmonic exciting force and Coulomb friction in a mass-spring system of one degree of freedom was studied and the conditions for maintaining a stable periodic vibration were analyzed.

It was found from theoretical analysis and numerical calculations that the periodic impact vibration, whose period is n times as large as the input period, appears in the mechanical system without friction; however, the domain of values of frequencies and clearances for causing a periodic vibration decrease as the friction acting on a mass becomes large.

On the Vibration Characteristics of a Brush Cutter

Masaki NAGAMINE
Toshihiro IRIE

Abstract

Detrimental effects of vibration arising in workers operating portable vibrating tools, namely the so-called Raynaud's phenomena, have been discussed medically in detail for a considerable length of time.

However, up till the present, mechanical problems related to effective methods for vibration isolation remain uninvestigated.

In this paper, a brush cutter was investigated and the natural frequencies and the modes of vibration were calculated to study the vibration characteristics of a mechanical system involving the machine, shoulder band, hands and arms.

The vibration acceleration of the cutter shaft and the force transmitted from the engine to the hands and arms were studied under actual working conditions. Two peaks of vibration acceleration corresponding to the 4th and the 5th modes of vibration obtained theoretically, were also found in the experiment.

Reflection and Transmission of Electromagnetic Waves by a Moving Plasma Half-Space

Ichiro FUKAI
Teruwo KAZAMA
Michio SUZUKI

Abstract

Recently the problem of reflection and transmission of a plane electromagnetic wave by a moving dielectric half-space has been investigated in detail by various workers. However, only a few cases were treated where the dielectric medium moves perpendiculary to the interface. In this paper, we have proposed a solution for the reflection and transmission of electromagnetic waves by a semi-infinite plasma medium moving perpendiculary to the interface.

The same problem has been treated by C. Yeh (J. appl. Phys., 37, July 1966) under the condition that the propagation constant in a plasma medium is the same as that in free space. The transmission coefficient, the frequency of transmission and the permitivity of plasma given by functions of the propagation constant are quite different from the actual state. Numerical examples are given to illustrate these differences.

Measurement of Directivity Factors in Photomixing with Focused Beams

Kojiro KOYANAGI
Yoshinori YOSHIDA
Ichiro SAKURABA

Abstract

This paper deals with measurements of directivity factors in photomixing with focused beams.

An optical heterodyne with an effective aperture A_R for signals arriving within the field of view of the solid angle Ω_R is limited by the constraint $A_R\Omega_R \simeq \lambda^2$. A comparison of calculated and experimental values was made with circular detectors of M 7324 photomultipliers in optical homodyne receivers. A good experimental comparison was obtained.

The Second Kind of Mixed System of Electric and Magnetic Currents

—An Electric Current Antenna Fed by a Magnetic Current Transmission Line—

Masahiro SUZUKI
Kiyohiko ITOH
Tadashi MATSUMOTO

Abstract

The second kind of mixed system of electric and magnetic currents is a thin strip dipole antenna fed by a two-slot transmission line. It is similar in appearance to the dual system of the first kind of mixed system of electric and magnetic currents which is a slot antenna fed by a two-strip transmission line.

The authors discovered this second kind of mixed system of electric and magnetic currents and deduced the expression of magnetic admittance. The magnetic admittance was compared with the electric admittance of the first kind of mixed system of electric and magnetic currents and the difference between these two mixed systems was shown in equivalent circuits.

In addition to above discussions, the methods of the same phase excitation were proposed and a discussion for practical uses was made.

Critical Phenomena in Polymer Solutions

Masaji ONODERA

Abstract

The phase separation behavior of polymer solutions was investigated by applying the asymptotic method taking free volumes into consideration. Two types of critical temperatures that depend not only on the molecular weight but also on the coordination number z are obtained. They correspond to the upper and lower critical solution temperatures, respectively. One of the two has a positive energy of mixing and the other has a negative energy of mixing. Two kinds of temperature-composition curves are also obtained. The agreement of them with the experimental results is good. The comparison of the present theory with the existent theories is also discussed.

Electrical Conduction of Hydrous Ferric Oxide

Ryusaburo FURUICHI
Norio SATO
Go OKAMOTO

Abstract

Hydrous ferric oxide gel obtained by mixing ammonium hydroxide and ferric nitrate solution at 90°C was aged in water at 25°C and calcined at various temperatures up to 400°C, and the effect of aging and calcination on the electrical conductivity of the oxide was investigated.

The conducting current, i, decreases by the adsorption of oxygen on the oxide and i at a given temperature, T, is formulated by the equation: $i=i_0 \exp(-E_D/2kT)$ where E_D is the activation energy for conduction, k is the Boltzmann constant and i_0 is a constant. From these facts, the conclusion can be drawn that hydrous ferric oxide is an n-type semiconductor. The conductivity decreases with increasing time of aging and calcination temperature. The minimum values of E_D and i_0 are obtained at a range of the calcination temperature from 200°C to 300°C where the oxide transforms from an amorphous state to a crystalline state. E_D and $\log i_0$ decrease linearly with the increase of the amount of bound water in the oxide calcined at 110°C. On the basis of these results, it was suggested that the bound water forms the donor-center in the ferric oxide.

Effect of Water Vapor Adsorption on Electrical Conductivity of Ferric Oxide

Ryusaburo FURUICHI
Norio SATO
Go OKAMOTO

Abstract

Ferric oxide, aged for various periods of time and calcined at different temperatures, was allowed to adsorb water vapor and the effect of the adsorbed water on the electrical conductivity was investigated.

The amount of water adsorbed after 4hour-adsorption at 25°C decreases with the time of aging and calcination temperature of the oxide. The electrical conductivity (i) at a temperature (T) is represented by the equation: $i=i_0 \exp(-E_W/2kT)$ where E_W is the activation energy for conduction, k is the Boltzmann constant and i_0 is a constant. The oxides calcined at 200°C show the minimum values of E_W and i_0 and these values increase with the time of aging of the oxide. This calcination temperature corresponds to the temperature at which the oxide begins to transform from an amorphous state to a crystalline state.

The increase of the amount of adsorbed water decreases E_W and i. The results obtained from the quantitative measurements of the conductivity with the non-aged oxide calcined at 200°C show that (1) the conductivity at a given temperature increases exponentially with the increasing the amount of adsorbed water, (2) the activation energy decreases linearly with the amount of adsorbed water, and (3) Meyer-Neldel's rule is satisfied. It was concluded that the adsorbed water acted as a donor center in the ferric oxide.

Studies on the Boron Trifluoride Catalyst (V)

—On the Reactivity of Aromatic Hydrocarbon in the Alkylation with BF_3-H_2O Complex Catalyst—

Eishi HASEGAWA, Norihiko YONEDA,
Takao YOTSUYANAGI, Kazuo AOMURA
and Hiroshi OHTSUKA

Abstract

It is widely accepted that the reactivity of aromatic hydrocarbons in alkylation reaction is affected by the alkyl groups on the benzene ring. These effects of the alkyl groups may be considered as the inductive effect probability effect and steric effect.

In order to clarify the behaviors or BF_3-HO^2 catalyst and to abserve the presubstituted alkyl group effects, competitive alkylation of aromatic hydrocarbons with olefins was carried out in the presence of this catalyst. The life of BF_3-HO^2 catalyst was also observed. And the following results were obtained:

(1) The reactivity of aromatic hydrocarbons varied according to the type of attacking olefins. The reactivity of aromatic hydrocarbon in competitive alkylation with ethylene and propylene was in the descending order of B>T>E>C. While, in alkylation with isobutylene, the order was T>B>E>C. (B: Benzene, T: Toluene, E: Ethylbenzene, C: Cumene).

(2) The life of the catalyst in the alkylation with propylene decreased in the descending order: B>T>E>C. While, in the alkylation with isobutylene, no chang in the activity of the catalyst was observed within the present experimental conditions.

The difference in the reactivity of an individual aromatic hydrocarbon is explained by the steric or probability effect in the case of alkylation with ethylene and propylene, and by the inductive effect in the case of alkylation with isobutylene. Ethylene and propylene tend to make a polarcomplex ($R^{\delta+}\cdots Cat^{\delta-}$) or an ion-pair ($R^{+}—Cat^{-}$) with the catalyst. Hence, the attacking group to the aromatic ring may be considered to be a large ester-like substance as mentioned above. While, isobutylene seems to produce a carbonium ion (a tertiary butyl ion) by the addition of protons when reacting with the catalyst. In this case, the attacking group is a carbonium ion, which is very sensitive to the inductive effect the alkyl group on the aromatic nucleus.

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On the Design, Construction and Full Scale Experiments of "The Tengu Bashi"

Tomonori KANÔ

Abstract

A curved girder bridge, "The Tengu Bashi" which was designed and constructed by the Hokkaido Development Bureau is a three-span continuous curved grillage girder bridge.

The bending torsion theory of curved girder bridge was applied in the design of the Tengu Bashi and it was shown that this theory merely gives approximate solutions.

As to whether the bending torsion theory is applicable to this design is still problematic. The bending torsion theory was compared against the curved grillage girder theory which was accurately analysed in an attempt to settle this problem and at the same time a full scale experiment was conducted to obtain confirmation.

A Theoretical Analysis and Experimental Study on a Continuous Curved Grillage Girder Bridge

Tomonori KANÔ

Abstract

In this paper, the author presents a method of analysis for a continuous curved girder bridge composed of multiple continuous curved main griders and cross beams which are rigidly connected with the main girders.

This method is based on the curved grillage girder theory including the bending torsion theory. Some experiments were carried out to confirm the propriety of this method. The experimental results were in good agreement with the theoretical calculated values.

A Measurement of Bed-Load Transport

Tsutomu KISHI
Tadaoki ITAKURA
Hideaki AI

Abstract

Several analytical formulae are available for the estimation of bedload transport rates. On the other hand, it is a very difficult problem to measure the bedload transport accurately in rivers and a confirmation of the formulae has not been carried out satisfactorilly.

Generally, there are so many variables in the estimation of bedload transport rates that even if a formula is verified in an experimental flume, its validity in a natural river bed would still not be clear. It has become necessary to carry out the measurements of bedload transport rates in a natural river.

Thus, it is necessary to develop an economical technique to measure the bedload in

a natural river or channel. Recently, a sonic depth sounder has been developed which may well be a useful technique.

An attempt was made to apply a method given by D. B. Simons and others[1] by a statistical method. Especially, the average forward velocity of the sand dunes in the direction of flow and the height of the dunes were studied. The accuracy was examined by flume data.

In this investigation bed configurations of dunes were interested in an experimental flume. Some investigations on the characteristics of the plane geometry of dunes were made.

Study on the Mechanics of Turbulence in Relation to the Analysis of the Accuracy of Velocity Measurements in natural Rivers (First Report)

Tsutomu KISHI
Akio MORI
Ken-ichi HIRAYAMA

Abstract

Accuracy of velocity measurements in rivers depends on the duration of observation time. Considerations are made, in the present paper, to the theoretical relationship between them.

Mean velocity, $\bar{U}$, observed in any duration of time, T_*, is considered as a stochastic quantity of which distribution is a function of T_*.

The variance of $\bar{U}$, named as the variance-length curve, is related to the auto-correlation function of flow velocity, $R(\tau)$, by the following expression.

$$C(T_*) = 2\frac{u^2}{T_*^2}\int_0^{T_*}(T_*-\tau)\,R(\tau)\,d\tau$$

where u^2 is the variance of velocity fluctuations.

On the one hand, $R(\tau)$ is expressed in terms of the power spectral function $E(f)$ as shown by the following equation.

$$R(\tau) = \frac{1}{u^2}\int_0^{\infty} E(f)\cos 2\pi f\tau\, df$$

Consequently, characteristics of $C(T_*)$ curve could be investigated by finding general functional form for $R(\tau)$ or $E(f)$.

The authors give the following expression for the function $C(T_*)$ by analyzing the field data obtained in several rivers in Hokkaido.

$$\frac{C(T_*)}{u^2} = 2\frac{\tan^{-1}\omega}{\omega} - \frac{\log(\omega^2+1)}{\omega^2}$$

where $\omega = \frac{\pi}{2}\frac{T_*}{T_E}$

T_E: Eulerian integral time scale

A Study of Film Cooling (Report 1)

Kohshi MITACHI
Kazuhide YAMANO
Takeshi SAITO

Abstract

Analytical and experimental studies of a film cooling system are presented for a range of boundary layer where the velocity distribution is under the influence of injection. The velocity and temperature distribution was calculated using Nicoll's method with an assumption of a two parameter velocity profile and a finite difference representation for the energy equation in the boundary layer. From these results the wall temperature and film cooling effectiveness on an adiabatic wall was deduced.

The analytical results were compared with the experimental data and against the measurements of Hartnett et al.

An Experimental Study on Oscillatory Combustion of Premixed Flames

Shogo ITOH Yutaka TSUKADA
Kenichi ITOH Shoichi FUKAZAWA

Abstract

There are two states of oscillatory combustion which occur in a combustion system of Helmholtz resonator type. One is a high-frequency or acoustic reasonance oscillatory combstion and the other is a low-frequency oscillatory combustion. The mechanism of the latter combustion has not been clarified as yet.

In this study, propane-air premixed gases were burned in a glass mantle tube burner mounted on a surge tank into which secondary air was fed through.

The oscillation mechanism and the relations between the two states of combustion oscillation have been investigated by means of high speed photography, measurements of the mantle tube pressure loss which characterize the vibratory combustion, the fluctuation of flow velocity, static pressure and flame position.

The low-frequency oscillation evidently begins with momentary blow off as the secondary air is increased, and consists of a repeat cycle, flame existence and the blow off.

Wave patterns on low-frequency oscillation show that acoustic oscillation is observed during flame existence which varies its amplitudes in accordance with the low-frequency oscillation.

Effects of Impact Damper on the Vibration of Beam

Kan-yo DODO
Toshihiro IRIE

Abstract

Studying the steady-state vibration of an impact damper attached to a beam vibrating under the action of a harmonic exciting displacement, conditions for maintaining a stable periodic vibration were obtained.

From the results of numerical calculations and experiments carried out on the vibration of a beam-damper system whose frequency is close to the resonant vibration of the fundamental vibration of the beam, it was found that ranges of parameters for which asymptotic stability is assured become small, but the amplitude of beam can be small, when the free path of the damper mass is short and the mass ratio of the damper to beam and the restitution coefficient between the damper mass and the container are large.

Dynamic Behavior of a Body Colliding with a Plane Wall

Ken-ichi FUKAYA
Toshihiro IRIE

Abstract

The problems of the motion of a body and forces caused when a body impacting upon a wall are important in engineering.

In this paper, two dimensional motion when a body collides with a plane wall was analyzed theoretically with the body-wall system represented by an equivalent mechanical model. Neglecting the friction of the wall surface, the dynamic behavior of the body after collision, duration of impact, coefficient of restitution, impact force and absorbed energy were calculated.

The results of a few experiments carried out on a rectangular steel plate colliding with a beam (a wall model) were in agreement with the theoretical results, and, thus, it was shown that the theory is reasonable. It was also shown that the impact problem of such a system can be explained by a simple model.

Effects of Incident Beam Points on Optical Heterodyne Detection of Gaussian Plane Waves

Ichiro SAKURABA
Teruhito MISHIMA

Abstract

The effect of incident beam points on optical heterodyne detection of Gaussian plane waves was presented. The derivation was based on Corcoran and Sakuraba's analysis for a one-dimensional photocathode.

The full width for the power pattern between half-power points decreases when the distribution length increases in the case where the cathode width and the wavelength are kept constant and the signal and local-oscillator beams are assumed to be directed toward the middle point of the cathode width. A chart which shows the effect of incident beam points on the full width of 3-db points is given.

Delay Time of Transistor Logic Circuits

Kazuhiko AZUMI
Teiichi KUROBE

Abstract

The authors proposed a new definition of the delay time which is applicable although an overshoot exists. Numerical calculations based on this definition and experiments on the delay time were carried out for various transistor logic circuits. The experimental results agreed well with the calculated values.

The following conclusions were obtained from the numerical calculations and experiments in which calculations of delay time of transistor logic circuits may be done for the step input in the case of any input waveforms and the total delay time of multistage transistor logic circuits is the sum of delay time of each stage if the overshoot does not exist.

Liquid Laser (II)

—The Enhancement of Fluorescence in Tb^{3+} and Eu^{3+} ions by the $POCl_3$–$SnCl_4$ solvent—

Kenji NAGASHIMA
Michio SUZUKI

Abstract

The fluorescence yield of solutions of europium and terbium salts in solution are greatly enhanced by using $POCl_3$–$SnCl_4$ solvent. The magnitude of fluorescence intensity from a 10-fold enhancement for terbium chloride to a 20-fold enhancement for europium chloride dissolved in $POCl_3$–$SnCl_4$ was compared with a $TbCl_3$ and $EuCl_3$ aqueous solution. The enhancement is proportional to the rate of H_2O in the solution. And it was found that the lifetime of the rare earth ions solvated with $POCl_3$–$SnCl_4$ was substantially longer than the lifetime of the ions solvated with H_2O. The significant increase in the observed fluorescence intensities and mean decay time is attributed to a decrease in the radiationless process of the excited states of the Tb^{3+}, Eu^{3+} ions brought about by the substitution of $POCl_3$–$SnCl_4$ for H_2O.

Vapor-Liquid Mass Transfer

—Absorption in Horizontal Flow—

Toshiharu SHIBATA
Masao KUGO

Abstract

Absorptions of gases (CO_2, NH_3) and vapors (Ethylether, Ethylformate) by water were studied experimentally with a horizontal flow apparatus to detect idiosyncrasies, if any, of the transfer mechanism of vapors.

At a constant liquid depth in a tray, the vapor transfer to the liquid seems to be similar to the diffusion rate-controlled mechanism in a range of $Re>20\sim30$, but in another small region a rather peculiar result was observed. Hence the experiments were carried out in the former region.

The results reconfirmed that a HTU corelation based on liquid-liquid equilibrium concentration is more reasonable than HTU due to vapor-liquid equilibrium, as shown in the previous paper.

The H_L-Re relation was obtained as

$$(H_L/z) = 0.1\,(Re\cdot Sc)^{1/2}$$

The nearer the absorption temperature to the boiling point of vapor, the higher the transfer-rate became. This may be attributed to the higher equilibruim concentration. Discussions were led forth and a noteworthy simple relation was revealled.

Kinetics of Water Vapor Adsorption on Hydrous Ferric Oxide

Ryusaburo FURUICHI
Norio SATO
Go OKAMOTO

Abstract

Hydrous ferric oxide, obtained by mixing ammonium hydroxide and ferric nitrate solution, was allowed to adsorb water vapor and the kinetics of the adsorption was investigated by use of a microbalance.

The rate of adsorption is described by a modification of the Rozinsky-Zeldovich equation,

$$\frac{dq}{dt} = k_0 P^{0.63} n_0 \exp\left\{\frac{-\beta' q}{P_{H_2O}{}^{0.5}}\right\} \exp\left\{\frac{E_D}{RT} + \frac{\gamma' q}{RTP_{H_2O}{}^{0.5}}\right\}$$

where q is the amount of adsorbed water, n_0 the number of active sites for the adsorption at $q=0$, E_D the activation energy at $q=0$, P_{H_2O} the pressure of water vapor and k_0, β' and γ' are constants.

This equation is interpreted by a model in which the water molecules are adsorbed physically by the hydrous ferric oxide in the first stage of the adsorption and thereafter the water molecules changed to a chemisorbed state. The change of the constant terms in above equation with the increase of the aging time and the calcination temperature of the oxide was discussed.

Katalytische Wirkung der Metalle und Metallsalze für Friedel-Crafts-Acylierung. II.

Benzoylierung von Aromatischen Verbindungen mit Eisenpulverkatalysator aus Ferroformiat

Hiroyuki ŌMORI
Kunihisa ŌIE
Yoshiyuki TAKATA

Zusammenfassung

Durch Reduktion von Ferroformiat hergestelltes Eisenpulver hat die starke katalytische Wirkung bei Umsetzung von Toluol und Aethylbenzol mit Benzoylchlorid gezeigt.

Das um 260–280°C reduzierten Eisenpulver hat die stärkste katalytische Wirkung, aber das um 230–330°C reduzierten Eisenpulver wirkt aufs schwächtens.

Reaktionsbedingungen: 0.025–0.05 Gramme-Atom Eisenpulver zum 1 mol Säurechlorid; Reaktionstemperatur: 130–150°C; Reaktionszeit: 2–5 Stunden.

In Gegenwart von reduzierten Eisenpulver haben wir entsprechende Ketonen aus Benzol, Xylol, Cumol und Anisol synthetisiert.

Thermal Decomposition of Butylmercaptane

—The relationship between the structure of butylmercaptane isomers and the reactivity of the thermal decomposition—

Masatoshi SUGIOKA
Takao YOTSUYANAGI
Kazuo AOMURA

Abstract

The relationship between the moleculan structure of three isomers of butylmercaptane (*n*-butylmercaptane, *sec*-butylmercaptane and *tert*-butylmercaptane) and the reactivity of the thermal decomposition was studied using a microreactor.

It was found that the activation energies of the thermal decomposition of these isomers were 21.4 kcal/mol (*n*-butylmercaptane), 20.3 kcal/mol (*sec*-butylmercaptane) and 57.9 kcal/mol (*tert*-butylmercaptane), respectively. These results may suggest that the mechanism of the thermal decomposition between *n*-butylmercaptane or *sec*-butylmercaptane and *tert*-butylmercaptane was quite different. It was considered from the results mentioned above that the thermal decomposition of *n*-butylmercaptane and *sec*-butylmercaptane proceeds *via* a mechanism of H_2S abstruction from the carbon atom adjacent to the SH group, however, the decomposition of *tert*-butylmercaptane proceeds *via* a free radical mechanism. And it was also found that the hydrogen coexisting in the reaction did not affect the decomposition of mercaptane.

Kinetic Studies of Catalytic Cracking of Ethylmercaptane and Diethylsulfide on Silica-Alumina Catalyst with a Pulse-reactor

Masatoshi SUGIOKA Toshiyuki HIRANO
Takao YOTSUYANAGI Kazuo AOMURA

Abstract

Recently, a pulse flow-reactor equipped with a gaschromatograph was applied in order to study various catalytic reactions. This paper deals with the catalytic cracking of ethylmercaptane and diethylsulfide on silica-alumina with a pulse-reactor and the experimental results were also discussed kinetically.

The conclusions obtained were as follows:

1) Both reactions of catalytic cracking of ethylmercaptane and diethylsulfide proceeded following an irreversible first order rate equation.
2) The catalytic cracking of diethylsulfide was found to proceed together with and including a consecutive and parallel reaction. In the former reaction, ethylmercaptane proceeded as the intermediate product and then cracked secondarily to produce ethylene and hydrogen sulfide. In the latter reaction, ethylene and hydrogen sulfide were produced directly without producing the intermediate.
3) It was found that the cracking mechanism of ethylmercaptane and diethylsulfide on

silica-alumina catalyst was similar to that of the hydration of alcohol and ether with special regards to the proton.

4) Further discussions were made concerning the pulse-reactor. It was concluded that, if each reaction may be regarded as a first order reaction, a complex reaction such as catalytic cracking of diethylsulfide can also be analyzed kinetically with a pulse-reactor.