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Appendix

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NOTICE

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A Note on Lateral Buckling And Web Buckling of I-Beam

Sumio NOMACHI and Kouji SAKAI

(Received September 30, 1974)

Abstract

The present paper discusses the elastic stability of an I-beam which is bent on the plane of the greatest flexural rigidity by a load. In this case elastic instability may occur in two different manners; one is lateral buckling of the beam and the other is the local buckling caused by the plane stress in the web plate due to the stress concentration of the load. In order to determine whether which of the 2 is dominant, the stress state formulated by H. G. Vögel, was applied to the buckling of the web plate and the critical value of the load intensity was calculated by Ritz's method, assuming that four sides of the web are simply supported. The corresponding lateral buckling of the beam was evaluated by Timoshenko's formula, and the obtained results are illustrated and a comparison between the lateral buckling and the local web buckling is shown in the figures.

A Simultaneous Measuring Method of Thermal Diffusivity, Thermal Conductivity and Specific Heat, and its Experimental Results applied to a Wet Building Material

Masamichi ENAI and Noboru ARATANI

(Received September 29, 1974)

Abstract

The authors proposed a measuring method of thermal diffusivity, thermal conductivity and specific heat of building materials both in wet and dry conditions.

The characteristics of this method are as follows:

- 1) The measurement is performed by giving a ramp functional curve of temperature at both sides of the material.
- 2) Thermal diffusivity, thermal conductivity and specific heat are readily and simultaneously obtained from previously calculated charts.
- 3) The influence of the thermal capacity of heating plates to the results is sufficiently compensated.
- 4) It requires a mere 3~12 minutes to run this test, therefore this method can be applied even to wet building materials.

The authors measured the thermal coefficient of a wet autoclaved lightweight concrete,

hebel ($\rho_0=500 \text{ kg/m}^3$) and obtained the following such results from this measurement :

1) Assuming that the thermal capacity of the wet material is equal to the sum of the thermal capacity of the material under dry conditions and that of material containing water, the specific heat C under wet conditions is expressed by the next equation and measured results were in agreement with the theoretical equation.

$$C = (C_0 + \varphi) / (1 + \varphi)$$

where C_0 = specific heat under dry condition (kcal/kg $^{\circ}$ c)

φ = water content ratio (weight) (kg/kg)

2) Thermal conductivity increased considerably between 0.0 and 0.4 of φ

3) Thermal diffusivity has the maximum value at $\varphi=0.2$.

Study on Surface-finishing with an Elastic Wheel (V)

— The Mechanical Structure and Properties of a PVA Grinding Wheel —

Satoru IGARASHI Katsumasa SAITO.

(Received September 30, 1974)

Abstract

The PVA grinding wheel (a kind of elastic grinding wheel) is quite different in its mechanical structure and properties from the usual vitrified grinding wheel. The difference arises from the fact that PVA sponge is used as bond material in the former.

The PVA grinding wheel is generally used for fine grinding to obtain a mirror surface finish. Especially it shows a superior performance in the surface-finishing of soft metals.

To clarify the mechanism of surface-finishing with the PVA grinding wheel, it is necessary to know the mechanical structure and properties of the PVA grinding wheel.

In this paper, the mechanical structure of the PVA grinding wheel was observed under an optical microscope, and the dynamic properties of the wheel were measured in a frequency range of 100 Hz to 1.5 kHz by using the Resonance Method and the Phase difference Method.

The conclusions were shown as follows :

(1) When the size of grains was smaller than that of the pores, the grains appeared to be finely dispersed in the PVA sponge bond. When the size of grains was comparable to the pore size, each grain appeared to be supported independently with the PVA bond posts.

(2) With the increase of frequency, dynamic Young's modulus of the PVA grinding wheel increased and dynamic viscosity decreased.

(3) With the increase of density of the structure, both dynamic Young's modulus and dynamic viscosity increased.

(4) With the increase of hardness or grade likewise dynamic Young's modulus increased.

Digital Computer Simulations by One Method of Power System Dynamic State Estimation

Hiroshi TAKAGI, Ken-ichi NISHIYA, Jun HASEGAWA
and Toichiro KOIKE

(Received September 30, 1974)

Abstract

The problem of estimating the various states of an electrical power system have been discussed by many authors. Particularly, the weighted least square state estimation is showing improvement for practical applications. However, since an actual power system is a time-varying system, the dynamic state estimation is yet to be produced. The difficulty in designing a dynamic state estimator is in the development of a mathematical model for the time evolution of the state vector.

One technique to realize the dynamic state estimator was proposed, namely a simple model for the time behavior of a power system was assumed, to which a Kalman filter was applied. In this paper, the performance of this estimator was discussed with numerous results of digital computer simulations.

Trial Manufacture of a Prototype Slot-Unipole Energy-Density Antenna for 900 MHz-Band Mobile Telephone

Kiyohiko ITOH, Ryuichi WATANABE, Kaijiro NAKAOKA,
Tadashi MATSUMOTO

(Received September 30, 1973)

Abstract

Radio signals received by moving vehicles in mountainous regions or in large modern cities with high buildings may exhibit violent amplitude fluctuations leading to fade out because of the existence of standing wave patterns. An energy-density antenna system which samples the electromagnetic energy density in space was suggested as a means for coping with this spatial fading phenomenon.

One of the authors has previously proposed a unipole and crossed slot combination as a new and universal energy-density antenna system. Also, we mentioned that a shallow-cavity-backed slot antenna is convenient for the slot of the above mentioned slot-unipole antenna system, and that a unipole can be mounted on this shallow-cavity. Therefore, in connection with our previous reports, a prototype of the slot-unipole energy-density antenna system can be constructed.

This report deals with a trial model of the slot-unipole energy-density antenna system and its experimental results.

Minicomputer-Oriented System Description Language and its Implementation

Keiji MAKINO, Koji TOCHINAI and Kuniichi NAGATA

(Received September 30, 1974)

Abstract

In this report, a new minicomputer-oriented system description language and its implementation on a minicomputer are described.

Owing to inefficient tools for software implementation in the minicomputer field, usually, the system programs are implemented using assembly language or the cross-compiling technique on a large computer, and moreover their features are also constrained by hardware restrictions, namely, short word length, small memory storage, low speed I/O etc. Therefore, for the satisfactory utilization of a minicomputer, it is necessary to design a system description language and implement its language processor to use these features effectively.

From the above point of view, we developed an effective language for minicomputers and implemented its processor using the bootstrapping method from facets of

- 1) seeking central and basic concept of system description language,
- 2) designing a grammar of minicomputer-oriented system description language, and
- 3) implementing this language processor.

As the result, we have been able to obtain uniformity, simpleness, flexibility etc.

Granulation of Ammonium Sulphate Fertilizer in a Spouted Bed

Osamu UEMAKI, K. B. Mathur* and Masao KUGO

(Received September 26, 1974)

Abstract

Ammonium sulphate was successfully granulated in a spouted bed by atomizing a solution of the salt into a bed of seed particles spouted with hot air. The granules thus

produced had a uniform layered structure. The particle growth rate was correlated with the solution feed rate, and an estimate was made of the rate of size reduction due to attrition which occurred concurrently.

It was found that under a given set of operating conditions, the net growth rate increased in approximate proportion to solution feed rate raised to the power of 0.8, but remained independent of the seed particle diameter.

Considerable amount of fine dust was produced. It was caused by incomplete deposition of sprayed solution and the attrition of the particles in the spout. The rate of attrition under granulation conditions was independent of the particle diameter, and was strongly affected by the moisture content of the bed solids.

Experimental Conditions for Complete Transition to Cellulose III from I or II

Jisuke HAYASHI, Akinori SUEOKA and Sadayoshi WATANABE

(Received September, 30, 1974)

Abstract

In general, Complete transition to cellulose III from I or II is rather difficult. The experimental conditions for the complete transition were examined. It was clarified that the following conditions must be met.

Namely, when the reaction vessel, cellulose fiber and liquid ammonium was dried sufficiently, the drying condition was maintained during the production reaction of ammonium-Cellulose complex, and the evaporation of ammonium from this complex occurred, and evaporation proceeded slowly at lower temperatures (approximately -20°C).

Cellulose III_I derived from cellulose I was backed completely to cellulose I' by treatment with water at 150°C .

The Hygroscopic, Accessibility and LODP of Cellulose Fibers with Various Crystalline Structures

Jisuke HAYASHI, Akinori SUEOKA and Sadayoshi WATANABE

(Received September 30, 1974)

Abstract

The hygroscopic water, the accessibility in acid hydrolysis reaction and the leveling-off degree of polymerization (LODP) of cellulose fibers with various crystalline structures and fine structures were examined.

The hygroscopic water at an atmosphere of 5~10% relative humidity was found to be influenced mainly by crystalline structures. That of cellulose I, III_I and VI_I with "bent" form molecular conformation was larger than in others. But it was found that the hygroscopic water in ordinary atmosphere and the accessibility on acid hydrolysis reaction were influenced mainly by fine structure of fibers, especially their crystallinity. The lower hygroscopic water in cellulose I and IV_I under normal atmospheric conditions were explained by their crystalline structures with bridge oxygen covered hydrogen bonds and higher crystallinity.

Compressibility of Mercerized Pulp Removed the Outer Layers

Jisuke HAYASHI and Sadayoshi WATANABE

(Received September 30, 1974)

Abstract

The compressibility of the pulp removed the outer layers and 0-fiber, after streaming mercerization was examined.

By removal, the compressing resistance of mercerized pulp decreased and the maximum value of the compression ratio of that was increased. It was considered that this result was due to the decrease of agglutination between fibers and the solution retentiveness of fiber by removal of the outer layer and 0-fiber which has a higher degree of swelling.

The compression ratios of the original beech pulp and the treated beech pulp were 2.6 and 2.3 respectively. The decrease of this ratio is significant in the recovery of alkali solution.

The thickness of compressed pulp cake under various pressures and the elastic recovery under removed pressure was examined.

By removing the outer layer and 0-fiber the elasticity of pulp cake increased in beech pulp and decreased in red pine pulp.

The Influence of Outer Layer of Pulp Fiber on the Reactions for Production of Viscose

Jisuke HAYASHI and Sadayoshi WATANABE

(Received September 30, 1974)

Abstract

The influence of outer layer of pulp fiber on the reactions for production of viscose was examined.

The resistance index for the mercerization reaction was highest in pulp from which the outer layer was removed, lower in the original pulp and lowest in the outer layer of pulp fiber. This index was higher with the increase of crystallinity of the samples.

The resistance index for the xanthation reaction was highest in the outer layer and pulp from which the outer layer was removed and lower in the original pulp.

It was considered that xanthation showed a strong heterogeneous reaction and was influenced by the macro structure of fiber. The outer layer was xanthated and a strong swelling covered the surface of fiber, which resulted the hinderance of permeation of reagent into the inner part of the fiber.

The outer layer was higher in reactivity, however, it was lower in solubility in alkali solution which caused an increased turbidity of the viscose obtained.

Estimation of Degree of Mercerization by Esterification Method

Jisuke HAYASHI, Kikuya KIMURA, Motoyuki AKI and Sadayoshi WATANABE

(Received September 9, 1974)

Abstract

The minimum concentration of NaOH solution required for complete mercerization of natural cellulose fibers depends on their crystallinity

And the degree of mercerization is estimated by the content of cellulose II in the fiber mercerized which is then regenerated with water.

In this paper, nitration and acetylation of natural cellulose fibers mercerized with NaOH solution of various concentrations and then regenerated was carried out.

The degree of esterification of natural cellulose fibers dropped at a given concentration of NaOH solution characteristic to each fiber. And this concentration agreed well with the concentration required for the transition to cellulose II as estimated by X-ray method.

It was considered that the drop of reactivity was not based on the crystalline structure of cellulose II.

A series of treatment of relaxation by NaOH solution, hydration and drying of fibers, formed new strong hydrogen bonds between the microfibrils or fibrils. Fibers with a lower crystallinity allowed permeation into their inner part with NaOH solution of lower concentrations and formation of the new hydrogen bonds were seen.

It was considered that the new hydrogen bonds disturbed permeation of reagents related to esterification and gave rise to the drop of reactivity.

Softening and Fluidifying Properties of Glasses in the System $\text{PbO-SiO}_2\text{-B}_2\text{O}_3$

Toru MATSUSHITA

(Received September 30, 1974)

Abstract

The purpose of this paper is to investigate a suitable chemical composition for the binder glass of the glass bonded natural mica in the system $\text{PbO-SiO}_2\text{-B}_2\text{O}_3$.

Softening temperature T_1 [viscosity approx. 5×10^7 poise], fluidifying temperature T_2 [viscosity approx. 3×10^2 poise], B [an exponent in the equation of viscosity: $\eta = A \exp(B/T)$] and solubility S [percentage of weight loss after testing in boiling water for 6 hours] of glasses in the system $n\text{PbO} \cdot (1-x)\text{SiO}_2 \cdot x\text{BO}_{3/2}$ ($0 \leq x \leq 1$, $0.5 \leq n \leq 1.5$) were obtained by the same method as described in a previous report.

Up to 0.7 of x , S took a very low value, and a remarkable increase in S was seen as x increased above 0.7. In the case of high or low values for both x and n , $5\text{PbO} \cdot \text{B}_2\text{O}_3 \cdot \text{SiO}_2$ or both α -quartz and -tridymite were frequently deposited in the glasses, respectively.

As x increased T_1 and T_2 decreased and B increased linearly. The increasing rate of B with x linearly increased with an increase in n , with the exception of the compositions having a high devitrifying property. As n increased T_1 and T_2 decreased. In a range of $n < 1.1$, B linearly increased with an increase in n , and the increasing rate of B with n linearly increased with an increase in x . It is assumed that the increase of B with the increase in x and n is due to the formation of tetragonal BO_4 from triangular BO_3 in the network of glasses.

It is concluded, from the experimental results described above, that the most suitable composition in this system for the binder glass of the glass bonded natural mica is in the neighbourhood of the following composition; $\text{PbO} \cdot 0.5\text{SiO}_2 \cdot 0.5\text{BO}_{3/2}$.

Neutron Time-of-flight Spectrometer Based on Electron Linear Accelerator and Molecular Spectroscopy

Kazuhiko INOUE and Hidetosi KONNO

(Received September 30, 1974)

Abstract

A time-of-flight graphite-filter-detector neutron spectrometer with a pulsed neutron source based on the Hokkaido University 45-MeV electron linear accelerator (ELA) was constructed.

This paper describes the design features of this prototype neutron spectrometer and the results of the preliminary inelastic neutron scattering (INS) experiments. The time-of-flight spectra of neutrons downscattered from some hydrogenous compounds, benzene, toluene and polyethylene over a range of 30–1,000 cm^{-1} were measured and compared with other available data of molecular vibration spectra. It is confirmed that the luminosity of this ELA pulsed neutron source is sufficient for INS, provided that a high efficient second monochromator can be used.

Picosecond Pulse Radiolysis Studies

Takashi SUMIYOSHI, Kaichi TAKAHASHI, Sadashi SAWAMURA
and Meiseki KATAYAMA

(Received September 30, 1974)

Abstract

A stroboscopic pulse radiolysis system is described which uses Čerenkov light produced by the fine structure pulses of a 45 MeV electron beam from the electron linear accelerator installed at Hokkaido University. Tests of this stroboscopic pulse radiolysis system are carried out using Čerenkov light without any samples. The Čerenkov light eliminated below 350 nm by a glass filter passed through a monochromator and is detected with a photomultiplier tube connected in a five stage configuration. Three types of signal are obtained and the light intensity is found to be highly satisfactory. The electron beam can be focused to about a 20 mm diameter at the sample position. A dose measured at this position is 46 rads per fine structure pulse.

Optimal Power Change of a Reactor Having Internal Feedback

— Imposing Restrictions on the Reactor Period and on the
Maximum Overshoot of Reactor Power —

Tadashi AKIMOTO, Yuichi OGAWA and Taizo YASUTAKE

(Received September 28, 1974)

Abstract

Optimal control of a reactor having an internal feedback, which brings the system from the initial equilibrium state to the objective equilibrium state in minimum time, was obtained,

this imposed restrictions on the reactor period and on the maximum overshoot of the reactor power, as well as on the externally applied reactivity and its rate.

The controllability of the nonlinear system is rigorously satisfied if the effective lifetime of the reactor is adopted and the delayed neutrons are ignored, and even when the delayed neutrons are taken into account the system can be optimally controlled for practical purposes.

The reactor power is raised temporarily over the objecting value and then dropped to the objecting power level. This operation enables the density of the delayed neutron precursor to rise quickly and the system is transferred to the final equilibrium state at an extremely rapid rate.

This study may be useful for the optimal power change of a practical power reactor for electric power generation or for propulsion purposes.

On Dry and Wet Corrosion of Iron

M. I. ISMAIL* and N. SATO

Corrosion Research Group, Faculty of Engineering, Hokkaido University, Sapporo, Japan

(Received September, 30, 1974)

Abstract

Metallographic and polarographic techniques were used to study the role played by metal substrate metallurgical conditions on corrosion of pure iron. Different heat treatment cycles were employed, viz: 1 hour at 600–900°C, 10^{-3} Torr, rapidly cooled (WQ), or slowly furnace cooled (FC), or rapidly heated specimens in air (30 sec, 1000 C, air cooled); and the effect of heat treatment cycling. It was found that the oxide film formed in air has random orientation while the one formed in vacuum is oriented. Potentiostatically corrosion was determined by measuring the anodic current under potential control. The rate of controlled dissolution in 0.1 NH_2SO_4 at 20 C. The anodic current decay during polarization, the amount of dissolved metal and surface morphology were used to clarify the effect of heat treatment in corrosion of iron.

1. Introduction

Several investigators have studied the different parameters affecting corrosion of iron^{1–12}. Usually it has been investigated from stand point of electrochemistry^{13–16} and rarely from the stand point of metal substrate^{16,17}. However, metallographic study can provide important possible answers to the problems of active dissolution or corrosion of iron. Metal substrate grain size and internal stresses are controlled by the different heat treatment cycles (temperature, time, and rate of cooling). The aim of this work was to clarify the interrelationship between metal substrate and surface behaviour of pure iron.

The Role of Straining in the Electrochemical and Mechanical Behaviour of Pure Iron

M. I. Ismail* and N. Sato

Corrosion Research Group, Faculty of Engineering, Hokkaido University, Sapporo, Japan

(Received September, 30, 1974)

Abstract

The effect of straining and its rate on the corrosion behavior of heat treated (800°C for one hour followed by furnace cooling or water quenching) pure iron was studied by measuring the anodic current density (cd) of potentiostatically polarized specimens in 0.1 N H₂SO₄ at 20°C. Results, thus obtained, show that there are critical points in the relation, cd-strain rate. These points depend on metallurgical conditions of the metal substrate. Furnace cooled (FC) specimens have a maximum cd at a certain strain rate and passive potential (1200 mV), while at active potentials (600 mV) there exists a minimum. Water quenched (WQ) specimens always have a minimum cd at a certain rate.

In the relation of cd to strain at the same strain rate, there is a certain strain at which the average grain size of metal is larger, and at this critical strain cd is lowest (minimum). At these critical strain rates, the yield stress is also lowest (minimum), but the total strain is independent of strain rate. An identification of crystallographic, pitting and active modes of attack has been made. It is emphasized that metallographic conditions play an important role in this type of corrosion of iron.

The Effect of the Recovery and Recrystallization Processes on the Mechanical Properties of a Mild Steel

Heishichiro TAKAHASHI, Hiroshi UETSUKA and Taro TAKEYAMA

(Received August 1, 1974)

Abstract

The effect of recovery and recrystallization on the mechanical properties of a mild steel were investigated after rolling from 10 to 40% reduction in thickness and annealing in a temperature range between 200 to 800°C.

After annealing below 500°C, both the yield and the ultimate tensile stresses became higher, and the elongation decreased with increasing reduction in thickness. Also, with the rise in annealing temperature above 200°C, the strength decreased gradually and the elongation became larger. Dislocation structures observed after annealing in such a temperature range

still showed well-developed cell structures, but were not rearranged into stable low-angle polygonization boundaries, i.e., subboundaries.

When the annealing temperature exceeded 500°C, the yield stress and the ultimate tensile stress of the materials after 30-40% rolling rapidly decreased, and in contrast the elongation became very large. While, in material after 10% rolling a relatively larger elongation was obtained without a great decrement of strength even after annealing at elevated temperatures.

From an observation of the corresponding dislocation structures, it was clarified that the change of the mechanical properties of heavily deformed materials contributed to the occurrence of recrystallized grains, and on the other hand high strength and large elongation after annealing above 500°C of the weakly deformed materials took place by the stable subgrain formation.