

非会合性液の粘度—粘度式の誘導と簡単な物質液に対する適用—(乙竹 直, 化学工学, 34, 1281~1288 (1970))

簡単な模型から非会合性液体の粘度表式を、次に示すようにもとめた。模型では、液体を固体分子の濃厚な分散系と見なし、また各衝突瞬間の分子速度分布は Boltzmann の統計にしたがうとしている。

$$\frac{\mu}{\rho T^{1/2}} - \frac{1}{K_2 M^{1/6} \rho_0 \mu^{1/3}} = \frac{1}{\rho_0 \mu} \left(\frac{\mu}{T^{1/2}} \right), \quad \mu \text{ [c.P]} \quad (1)$$

$$b_T^{-3} \left(\frac{\mu}{T_r^{1/2} \rho_r^{5/3}} \right) - a = \frac{\mu}{T_r^{1/2} \rho_r^{2/3}}, \quad \mu \text{ [c.P]} \quad (2)$$

ここに、 $b_T^{-3} = \rho_0 \mu / \rho_c$ 、 $a = (1/K_1 R^{2/3}) / (\xi_c Z_c^{2/3})$ 、また ξ_c は Licht-Stechert の臨界流動度、 Z_c は臨界圧縮係数であり、 b_T^{-3} および $1/K_1 R^{2/3}$ は 3.0 および $3(10)^{-4}$ に近い値となる。

多くの実測値と比較したところ、(1)式は $\rho/\rho_c \geq 2.8$ の範囲で 2%以下、(2)式は、 $\rho/\rho_c \geq 2.3$ の比較的広い範囲に対し、平均 2%程度の偏差で実測値を再現することを加った。

軟鋼の流動腐食速度に及ぼす加工度の影響 (竹本幹男・篠原孝順・末沢慶忠, 化学工学, 34, 1288~1295 (1970))

冷間引抜き軟鋼棒の稀塩酸流動液による腐食実験を行ない、流動腐食速度に及ぼす加工度の影響についてつぎのことを明らかにした。

- i) 初腐食速度はいずれの流速においても加工度の増大にともない増加する。この主原因は、冷間加工によるフェライト結晶粒の不均一化およびセメントタイトの変形にともなう水素ガス発生型カソード反応速度の増加である。
- ii) 腐食面の荒れ模様は、加工度の増大にともない細かく複雑となる一方、最大アラサは小さくなる。
- iii) 冷間加工を受けた軟鋼の腐れしるまたは寿命の推定法を示した。

反応を伴う 2 種のガスの同時吸収 (寺本正明・橋本健治・永田進治, 化学工学, 34, 1296~1302 (1970))

2 次反応を伴う 2 種のガスの同時吸収に関する理論的ならびに実験的研究を行なった。浸透説に基づく基礎方程式を有限差分法により解き、各ガスの反応係数を与える線図をパラメーターの種々の組に対して提出した。さらに液柱塔および濡壁塔を用いて CO_2 、 NH_3 の水中への同時吸収実験を行なった。実験データを CO_2 、 NH_3 両ガスの反応係数を考慮して解析したところ、 CO_2 の吸収速度は理論値と良く一致することが確かめられた。

連続式流動層における固体粒子の反応率 (森 滋勝・観 巖, 化学工学, 34, 1302~1308 (1970))

気系流動層における固体粒子の反応率を求めるための数学的モデルに基づいて、代表気泡径を採用し、デジタル計算機を使って、 R_d 、 W 、 U 、 v の四個の無次元操作変数が反応率に及ぼす効果を推算した。

気泡群とその周辺の分散相間のガス交換量をモデルのパラメータとして採用し、パラメータと反応率の間の関係について感度係数を用いて検討した。

固定層による流体・固体等温反応操作の解析法 (森山 昭, 化学工学, 34, 1308~1314 (1970))

固定層による流体・固体等温反応操作の基礎式を直接解き、層内の粒子反応率分布、反応完了帯の進行速度、反応操作完結時間、層平均粒子反応率に関する一般的な解式を導いた。

従来、3 種の反応速度式の形につき、他の研究者が報告している層内粒子反応率分布の解式は、本報で導いた解の特殊な場合に相当することを示した。それら 3 種の反応速度式につき、層内粒子反応率分布の特長を考察し層内の粒子反応率分布、反応操作完結時間および層平均粒子反応率のあたらしい解式を示した。

流通式液相反応管内の乱流混合 (宮入嘉夫・上野満男・山本一夫, 化学工学, 34, 1315~1323 (1970))

流動式反応管型装置を用いて注入二流体の乱流混合および瞬間反応の実験を行なった。その結果、乱流混合は流体濃度塊の偏在する状態である第 I 段階とその次の濃度塊が一様不規則に散布された状態である第 II 段階の二段階を経て進行することがわかった。前者の段階では外部から加える擾乱のスケールが混合効果に強く関係することを確かめ、また第 II 段階での混合については従来からの等方性乱流理論による混合の解析結果が妥当か否かを検討した。

水平回転円筒型混合機内の粒子の運動と混合過程 (井上一郎・山口賢治・佐藤一省, 化学工学, 34, 1323~1329 (1970))

円筒断面における粒子の循環流れに着目し、輸送領域内に検査面を設定し、粒子追跡法を用いてその運動特性を調べた。その結果、混合への寄与は主として粒子の半径および接線方向のランダムな運動によるもので、この実験範囲では混合機の回転速度の増加に対し、一方は減少し、他方は増大する傾向が認められた。また、混合過程を、セミ・マルコフ過程の考え方を用いて表現し、そのシミュレーションの結果が写真観測とほぼ一致することを確かめた。

<化学工学データ>

非ニュートン流体およびスラリーにおける拡散係数の推算 (星野定司, 化学工学, 34, 1330~1333 (1970))

前報にしたがえば、液相における粘度はマイクロ粘度とマクロ粘度とに区別して考えねばならぬ。前者は拡散に、後者は流動および攪拌に関係する。

故に Wilke-Chang の推算式における粘度はマクロ粘度ではなくマイクロ粘度であらねばならぬ。

本報においては、改良 Wilke-Chang 法を提案し、それにより 1% CMC 水溶液および 20% カオリナイト・クレー・スラリー中の溶質の拡散係数を推算したが、それらは Clough らの測定値および推算値とほぼ一致した。

<技術報告>

水平型 epitaxial 装置内のフローパターンについて (半沢保・伊藤宇太郎, 化学工学, 34, 1333~1338 (1970))

水平型 epitaxial 装置内のフローパターンをみるために、この装置のモデルとして高温物体が管内底部にある水平円管内に気体を流す方法を採用し、この場合のフローパターンを煙と O_2 ガスの各トレーサーを用いて測定した。その結果このような場合には管中央を上升し、側壁を下降しながら出口端に至る対称な 2 個の螺旋流が生じることを見出した。そしてこの場合、各流線同士の混合はきわめて僅かであることから、この結果を epitaxial 装置改良の考察に応用した。

微小電極による電解質水溶液中の濃度変動の測定法 (上野満雄・西岡哲夫・佐藤行成・山本一夫, 化学工学, 34, 1339~1343 (1970))

水溶液などの流れ中での混合現象を測定するのに、電解質をトレーサとして電極でその濃度を測定する方法がしばしば用いられるが、著者らは微小電極を用いて乱流混合現象のように速やかに変化する濃度を空間的にも時間的にもできるだけ忠実に測定することを試みた。結果として、空間的な分解能 0.01 mm³、濃度対出力信号の関係が良好な直線性を示し S/N 比が 50~70 dB 以上で、濃度変動に対する周波数応答が約 3 kHz まで一様な性能の測定装置を得ることができた。

<寄 書>

液相における多孔質媒体内の有効拡散係数 (城塚 正・戸上貴司・横山 功, 化学工学, 34, 1344~1345 (1970))

ガラスや珪藻土からなる粒状層内の液相有効拡散係数を非定常状態で測定する方法を示し、その測定結果が拡散過程を通じて一定値とみなし得ることを示した。また各種多孔質板内の有効拡散係数の測定結果も示し、同様な結果が得られたことを報告した。

<Chemical Engineering Data>

Estimation of Diffusion Coefficients in Non-Newtonian Fluid and in Slurry, S. Hoshino (Tokyo Institute of Technology)

Kagaku Kogaku, 34, 1330~1333 (1970)

According to the previous papers, the viscosity term in a liquid medium should be considered as two different terms those are the micro-viscosity and the macro-viscosity. The former is related to the diffusion of the solute and the latter to the flow and the agitation of the medium.

Consequently, the viscosity term in the Wilke-Chang equation should be the micro-viscosity of the medium instead of the macro-viscosity.

The diffusion coefficients of a solute in a 1% CMC aqueous solution and in a 20% kaolinite clay slurry were estimated by means of the modified Wilke-Chang equation which is presented in this paper. They are nearly equal to Clough's experimental and estimated values.

<Technical Reports>

Flow Pattern in the Horizontal Epitaxial Reactor,

T. Hanzawa and U. Ito (Gunma Univ.)

Kagaku Kogaku, 34, 1333~1338 (1970)

In order to investigate the flow pattern in the horizontal epitaxial reactor, the stream lines of smoke and concentration profile of oxygen gas as the tracers are observed.

The following results were found; there are two symmetrical spiral flows rising up at the center region and going down at the wall sides of the pipe, and there is no mixing or very little mixing between the stream lines.

Those results are applied to improvement of the epitaxial reactor on semiconductor industry.

Conductometric Method Capable of Rapid Con-

centration-Fluctuation Measurements, M. Kamiwano, T. Nishioka, Y. Sato and K. Yamamoto (Yokohama National Univ.)

Kagaku Kogaku, 34, 1339~1343 (1970)

Conductometric method, which uses electrodes as conductivity-probe, is often adopted for the measurements of mixing of electrolyte tracer in aqueous solution.

Then, authors tried to measure precisely such a rapid mixing phenomena as turbulent mixing by conductometric method, using small electrodes which have spatial resolvability of 0.01 mm³, and electric circuits which have uniform frequency-response characteristics from 0 to 3 kHz, signal to noise ratio more than 50 or 70 dB and excellent linearity.

<Short Communication>

Effective Diffusivities in Liquid Phase within Porous Media, T. Shiotsuka, T. Togami and I. Yokoyama (Waseda Univ.)

Kagaku Kogaku, 34, 1344~1345 (1970)

This paper deals with an unsteady state method for observing the effective diffusivities in liquid phase within particle beds of glass and soils, and also, some discussions are done as to the experimental results for porous solids such as catalytic pellets as well as the data for the particle beds. Both results indicate that the effective diffusivity of KCl or NaCl in a certain porous medium can be regarded as a constant at a temperature.

Analysis of Fluid-Solid Reaction in Fixed-Bed Reactors under Isothermal Conditions, A. Moriyama (Nagoya Univ.)

Kagaku Kogaku, 34, 1308~1314 (1970)

Equations of fluid-solid reaction in fixed-bed reactors under isothermal conditions are exactly and analytically solved for concentrations of both reactant fluid and solid, and the general expressions of conversion of solid reactant, the advancing front of zone of reaction completion, the time for complete reaction through the reactor and the bed-average conversion of solid are derived.

Three previously solved cases from the literature are special cases of these solutions on conversion of solid reactant. With these three cases, the characteristic tendencies in profiles of conversion of solid reactant are considered, and further several new expressions of conversion of solid reactant, the time for complete reaction through the reactor and the bed-average conversion of solid are shown.

Turbulent Mixing in a Tubular Flow Reactor, Y.

Miyairi, M. Kamiwano and K. Yamamoto (Yokohama National Univ.)

Kagaku Kogaku, 34, 1315~1323 (1970)

Turbulent mixing and its effect on a rapid irreversible second-order chemical reaction were investigated for a tubular flow reactor. The turbulent mixing process was found to proceed in two stages, i.e., in the first mixing stage the liquid-components injected into the reactor were roughly dispersed into comparatively large lumps mainly by the convective action of liquid flow, but their uniform dispersions were not expected. In the second mixing stage the lumps of dispersed fluids were more diluted in concentration, and so uniformly dispersed due to the turbulent diffusion that their distributions were considered statistically homogeneous in a coarse-scale through-out flow field. It was made clear that large-scale disturbances exerted on the flow field promoted effectively the mixing in the first stage, whereas, the mixing process in the second stage was similar to that in the field of homogeneous and isotropic turbulence.

Motion of Particle and Mixing Process in a Horizontal Drum Mixer, I. Inoue, K. Yamaguchi and K. Sato (The Institute of Physical and Chemical Research)

Kagaku Kogaku, 34, 1323~1329 (1970)

A statistical analysis was applied to investigate the motion of solid particle in a horizontal drum mixer and the radial mixing was described as a Semi-Markov process.

From the observed trajectory of a labelled particle in the cross section of the mixer, the circulation time distribution and the transition probabilities of particle in the radial direction were determined. According to this experimental result, the radial distribution of particles decreased with the increase of the rotation speed of the drum and on the other hand, the distribution to the direction of circulation flow increased up to some critical speed. Therefore, the decrease of the mixing rate in higher rotation speed may attribute to that of the radial distribution.

A digital simulation of the mixing process was presented by employing the theory of Semi-Markov process. Excellent agreement was obtained between the result of simulation and the photographic observation.

The Viscosity of non-Associated Liquids, N. Ototake (Univ. of Tokyo)

Kagaku Kogaku, 34, 1281~1288 (1970)

Newly approximate expressions for the viscosity of non-associated liquids have been derived as follows from the simple mode where the liquid system is regarded as an uniformly concentrated dispersion of rigid molecules and the velocity of them during each collision follows to Boltzmann's statistics.

$$\frac{\mu}{\rho T^{1/2}} = \frac{1}{K_2 M^{1/6} \rho_0 \mu^{1/3}} = \frac{1}{\rho_0 \mu T^{1/2}}, \quad \mu \text{ [c.P]} \quad (1)$$

$$b_T^{-3} \left(\frac{\mu}{T_r^{1/2} \rho_r^{2/3}} \right) - \alpha = \frac{\mu}{T_r^{1/2} \rho_r^{2/3}}, \quad \mu \text{ [c.P]} \quad (2)$$

where, $b_T^{-3} = \rho_0 \mu / \rho_c$, $\alpha = (1/K_4 R^{2/3}) / (\xi_c z_c^{2/3})$. And ξ_c , z_c are Licht-Stechert's critical mobility and critical compressibility, respectively. The values of b_T^{-3} and $1/K_4 R^{2/3}$ are close to 3.0 and $3.0(10)^{-4}$.

More than 300 experimental points of non-associated liquids have been compared with Eq. (1) and about 200 pints of simple liquids, Ar, Kr, Xe, Co, N₂, O₂, p-H₂, Methane, Ethane, Benzene, Cyclopentane and others also with Eq. (2). Eq. (1) produced an average deviation of smaller than 2% for the range of $\rho / \rho_c \geq 2.8$ and Eq. (2) produced 2% for the range of $\rho / \rho_c \geq 2.3$, respectively.

Effect of Cold Work on Corrosion Rate of Mild Steel by Flowing Solution, T. Shinohara (Toyo Engineering Co.), M. Takemoto (Chiyoda Chemical & Construction Co.) and Y. Suezawa (Aoyama Gakuin Univ.)

Kagaku Kogaku, 34, 1288~1295 (1970)

Effects of cold work on corrosion rate of metals by flowing solution were studied with corrosion tests of cold drawn mild steel bars by flowing dilute hydrochloric acid solution and following results were obtained.

i) Initial corrosion rate of mild steel increases with increase of its reduction of area. This is mainly due to increase of heterogeneity of ferrite grain and increase of hydrogen evolution rate at cathode with deformation of cementite by cold work.

ii) The specimen surface of a heavily cold worked bar is roughened by corrosion in fine and complex manner. The surface roughness of a specimen after test decreases with increase of its reduction of area.

iii) Estimation method of the lifetime or the corrosion allowance of cold drawn mild steel bars was obtained.

Simultaneous Absorption of Two Gases Accom-

panied by Chemical Reactions, M. Teramoto, K. Hashimoto and S. Nagata (Kyoto Univ.)

Kagaku Kogaku, 34, 1296~1302 (1970)

Absorption of two gases accompanied by a bimolecular reaction in the liquid phase is studied theoretically and experimentally. Basic equations based upon the penetration theory are solved numerically by a finite difference method, and charts of reaction factors of two gases are presented for various combinations of parameters.

Simultaneous absorption of CO₂ and NH₃ into water was carried out with a liquid jet column and a wetted-wall column, and experimental data are analyzed by taking into account the reaction factors of both CO₂ and NH₃. It is found that observed absorption rates of CO₂ are in good agreement with theoretical predictions.

Conversion of Solid Particles in Continuous Flu-

idized Bed, S. Mori and I. Muchi (Nagoya Univ.)

Kagaku Kogaku, 34, 1302~1308 (1970)

On the basis of employing the equivalent diameter of bubbles, the effects of the non-dimensional operating conditions, such as R_d , W , U and v , on the conversion have been evaluated by the use of the mathematical model proposed previously by the authors with the aid of digital computer.

Cross-flow rate of gas between bubbles and surrounding dispersed phase has been taken as a parameter of the model, and the relations between parameter and conversion have been discussed on the basis of sensibility coefficient.