Pakistan Journal of Scientific and Industrial Research

Vol. 49, No. 3 **Contents** **May - June 2006**

Physical Sciences

Biological Sciences

Technology

Short Communication

Pak. J. Sci. Ind. Res. 2006 **49**(3) 147-152

Thermophysical Properties of Porous Media: Consolidated Sandstones

Asghari Maqsood*, I. H. Gul and Kashif Kamran
Thermal Physics Laboratory, Department of Physics, Quaid-i-Azam University, Islamabad-45320, Pakistan

(received August 4, 2004; revised January 24, 2006; accepted May 16, 2006)

Abstract. Thermal conductivity and thermal diffusivity of porous rocks have been measured simultaneously by Gustafsson probe in the temperature range of 280-330 K at normal pressure using air as the saturant. Data are presented for five types of samples ranging in porosity from 8 to 17%, and to show the variation of thermal conductivity with porosity. An empirical formula is suggested to account for the estimation of thermal conductivity of porous sandstones in terms of porosity and thermal conductivities of the mineral constituents. Thermal conductivities of the samples do not change much within the temperature of measurement.

Keywords: porosity, thermal conductivity, thermal diffusivity, sandstones, porous media

Pak. J. Sci. Ind. Res. 2006 **49**(3) 153-159

Electrical Conductances of Some Ammonium and Tetraalkylammonium Halides in Aqueous Binary Mixtures of 1,4-Dioxane at 298.15 K

Mahendra Nath Roy*, Biswajit Sinha, Vikas Kumar Dakua and Anuradha Sinha
Department of Chemistry, University of North Bengal, Darjeeling-734013, India

(received May 23, 2005; revised April 18, 2006; accepted April 21, 2006)

Abstract. Electrical conductances of some ammonium and tetraalkylammonium halides have been measured in different mass (20-80%) of 1,4-dioxane + water mixtures at 298.15 K. The limiting molar conductivity (Λ_0), the association constant (K_A), and association distance (R) in the solvent mixtures have been evaluated using Fuoss conductance equation (Fuoss, 1978). Based on the composition dependence of Walden product ($\Lambda_0\eta_0$), the influence of the mixed solvent composition on the solvation of ions has been also discussed. The results have been considered in terms of ion-solvent and ion-ion interactions and the structural changes in the mixed solvent systems.

Keywords: 1,4-dioxane, ammonium and tetraalkylammonium halides, limiting molar conductivity, association constant, solvation, Walden product, ion-solvent and ion-ion interactions, Fuoss conductance equation

Pak. J. Sci. Ind. Res. 2006 **49**(3) 160-169

Determination of Densities of Amino Compounds for Molar Volumes in Aqueous Solutions with Magnetic Float Densimeter at Various Temperatures

Man Singh

Chemistry Research Laboratory, Deshbandhu College, University of Delhi, New Delhi-110019, India

(received November 30, 2005; revised May 22, 2006; accepted May 24, 2006)

Abstract. Densities (ρ) of urea (H_2NCONH_2), methylurea (H_3C-$HNCONH_2$), melamine ($C_3N_6H_6$) in aqueous, alongwith mehtylurea in 0.05 mol kg^{-1} aqueous urea solutions have been measured with magnetic float densimeter (MFD) with the accuracy value of $1x10^{-3}$ kg m^{-3}. The data were used to calculate apparent molar volumes (V_ϕ) that are compared with the values obtained with Anton Paar densimeter DMA 60/601 model. The values of the ρ and V_ϕ parameters were regressed and extrapolated to zero concentration (m = 0), for their limiting densities (ρ^o) and limiting molar volumes (V_ϕ^o) alongwith their respective slope values. The values of the ρ^o and V_ϕ^o constants elucidated the heteromolecular interactions of -NH_2 group, and it was noted that -NH_2 in different chemical compounds influenced interactions with water, especially with electron donating -CH_3 group of methylurea.

Keywords: magnetic float densimeter, Anton Paar, heteromolecular interactions, hydrophilic interactions, hydrophobic interactions, molar volume, densities of urea/methylurea, melamine

Pak. J. Sci. Ind. Res. 2006 **49**(3) 170-173

Crystallization Studies of Lithium Borosilicate Glasses

Pervez Iqbal Qazi *, Wajid Ali Shah and Fadia Shaheen
Glass and Ceramics Research Centre, PCSIR Laboratories Complex, Lahore-54600, Pakistan

(received February 8, 2005; revised December 27, 2005; accepted December 31, 2005)

Abstract. Lithium borosilicate ternary system is analogous to the most commercially exploited Na_2O-B_2O_3-SiO_2 system. The tendency towards liquid-liquid immiscibility is enhanced when sodium is replaced by lithium, which facilitates the crystallization process. In the present work, three compositions of lithium borosilicate glasses were formulated and melted by varying the mol percent ratio of SiO_2 and Li_2O. The glasses were subsequently subjected to crystallization by isothermal heat-treatments at identical temperatures for various specific time durations. The crystal growth was found to be linear and the rate of crystallization was dependent on SiO_2/Li_2O ratio. The phases that developed during heat-treatments were identified using XRD.

Keywords: glass ceramic, nucleation, crystallization, lithium borosilicate

Pak. J. Sci. Ind. Res. 2006 **49**(3) 174-180

Some Copper(II) Complexes of Tetradentate β-Ketoimines and their Adducts

Aderoju A. Osowole
Department of Chemistry, University of Ibadan, Ibadan, Nigeria

(received January 1, 2006; revised April 27, 2006; accepted April 28, 2006)

Abstract. The β-ketoimine ligands {[$CH_3C(O)CHC(CH_3)(-NH(CH2)_nNH-)C(CH_3)CHC(O)CH_3$]; n = 2, 6, 8, 9}, their copper(II) chelates, and adducts with 2,2´-bipyridine (bipy) and 1,10-phenanthroline (phen) have been synthesized and characterized by elemental analysis, magnetic susceptibility, conductance, and infrared and electronic spectral measurements. The ligands were tetradentate in the complexes, using the imine N and keto O atoms in coordination. The room temperature magnetic moments of the complexes, suggest that they were magnetically dilute, while infrared and electronic spectra results were corroborative of a four coordinate square-planar geometry for the copper(II) chelates and a six coordinate octahedral geometry for their adducts. The compounds were non-electrolyte in nitromethane.

Keywords: 2,2´-bipyridine adducts, β-ketoimines, square-planar geometry, tetradentate ligands, octahedral geometry, copper(II) chelates

Pak. J. Sci. Ind. Res. 2006 **49**(3) 181-188

Evaluation of the Three-Stage BCR (European Community Bureau of Reference) Sequential Extraction Procedure to Assess the Potential Mobility and Toxicity of Heavy Metals in Roadside Soils

K. A. Yusuf
Department of Chemistry, Lagos State University, Ojo, PMB 1087, Apapa, Lagos, Nigeria

(received July 27, 2005; revised January 31, 2006; accepted March 29, 2006)

Abstract. The geochemical properties of roadside soils, specifically the association of metals with operationally defined solid fractions, were characterised. The new optimised four-step (acid extractable, reducible, oxidizable, and residual) sequential extraction procedure was applied to five roadside soils from an urban city, Lagos, Nigeria. Three elements were examined (Pb, Cu and Zn) in the < 250-μm fraction. Data so obtained indicated that more than 50% of the metals were associated with the residual fraction, reflecting lithogenic-pedogenic control. Zinc had one-sixth of its quantity in the most mobile and/or bioavailable fraction, which is susceptible to release into solution with the decrease in pH. The amount of lead associated with the reducible fraction was significant, while an appreciable amount of copper was associated with oxidizable fraction (19%).

Keywords: sequential extraction, metal mobility, metal toxicity, roadside soils, heavy metals

Pak. J. Sci. Ind. Res. 2006 **49**(3) 189-195

Physicochemical Process for the Reduction of Excessive Fluoride Contents in Potable Water Using Indigenous Materials

Mumtaz Khan[a]*, A. R. Khan[a], Tabraiz Anwer[a], Tahseen Aslam[a] and Shahab Ahmad[b]
[a]PCSIR Laboratories Complex, Peshawar -25120, Pakistan
[b]NWFP University of Engineering and Technology, Peshawar, Pakistan

(received May 28, 2005; revised December 21, 2005; accepted December 30, 2005)

Abstract. The chemical examination of drinking water samples colleted from twenty one sampling sites in a village of Khyber Agency (Pakistan) have been reported, described and discussed. It was noted that the quality of drinking water was poor in more than 60% of the samples collected, in respect of its excessive fluoride contents, which was found in the range of 0.27-5.03 mg/l, and was therefore many times higher in most of the samples than the WHO recommended limits of 0.5 mg/l. The higher concentration of fluoride in the potable water is considered to be the main cause of dental decay among the inhabitants of the area. Certain naturally occurring materials like plastic clay, bauxite, and high alumina clay were applied to remove the excessive fluoride contents from the potable water of the area. Fluoride removal from the potable water was effectively achieved using a mixture of indigenous plastic clay, bauxite, and high alumina clay in different ratios with sand. The process is cheap and simple, with 86% removal of fluoride contents achieved from the drinking water.

Keywords: fluoride removal, water fluoride, fluoride sorption, fluoride water treatment

Pak. J. Sci. Ind. Res. 2006 **49**(3) 196-202

Culture of the Microalga *Chlorella vulgaris* on Different Proportions of Sugar Mill Effluents

A. N. M. A. I. Khan[a], M. A. B. Habib[b]*, M. R. Islam[a], M. S. Hossain[b] and M. I. Miah[c]

[a]Department of Fisheries, Matshaya Bhaban, Dhaka, Bangladesh

[b]Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

[c]Department of Fisheries Management, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

(received November 22, 2003; revised April 21, 2006; accepted April 27, 2006)

Abstract. *Chlorella vulgaris* was cultured in four different dilutions of sugar mill effluent media (SMEM). Bold's basal medium (BBM) was used as the control under laboratory conditions. Maximum cell growth and chlorophyll-**a** content were obtained on 10th day of the culture in 50% diluted SMEM, followed by those grown in BBM, and 75, 25 and 100% SMEM at stationary phase. The specific growth rate (µg/day) of cells and chlorophyll-**a** of *C. vulgaris* grown in 50% SMEM varied significantly ($p < 0.01$) from those of *C. vulgaris* cultured in BBM, followed by other SMEM concentrations. Total biomass of *C. vulgaris*, cultured in 50% SMEM, was found to be significantly higher ($p < 0.01$) than that of *C. vulgaris* cultured in BBM, and 25, 75 and 100% SMEM concentrations. Similar trend was also observed in the case of optical density. Cell number and chlorophyll-**a** of *C. vulgaris* were highly ($p < 0.01$) and directly correlated with chlorophyll-**a** ($r^2 = 0.991$) of *C. vulgaris* and optical density ($r^2 = 0.989$) for the culture media containing *C. vulgaris*, respectively. Crude proteins and crude lipids of *C. vulgaris*, grown in 50% SMEM, were significantly ($p < 0.01$) higher than those of *C. vulgaris* cultured in other SMEM concentrations. Due to good growth performance exhibited in the 50% SMEM dilution, the sugar mill effluent may be used for efficient cultivation of *C. vulgaris* and possibly other microalgae.

Keywords: algal culture, *Chlorella vulgaris*, sugar mill effluents, *Chlorella* culture

Pak. J. Sci. Ind. Res. 2006 **49**(3) 203-210

Regeneration and Acclimatization of Salt-Tolerant *Arachis hypogaea* Plants Through Tissue Culture

Ejaz Gul Ghauri
PCSIR Laboratories Complex, P.O. Peshawar University, Jamrud Road, Peshawar-25120, Pakistan

(received July 21, 2004; revised December 12, 2005; accepted December 30, 2005)

Abstract. Excised embryos of *Arachis hypogaea* were cultured on Murashige and Skoog's medium (MS medium) supplemented with different combinations of growth hormones. The highest frequency of callus proliferation (80%) was recorded on MS medium mixed with 1.0 mg/l of 2,4-D and 0.5 mg/l of BAP. These cultures were treated with 0.65 mg/l of trans-4-hydroxy-L-proline (HyP) and various concentrations (0.1-0.5%) of NaCl. In all cases the presence of salt reduced the fresh mass of callus. Shoot regeneration in the cultures took place when transferred to MS medium supplemented with 1.0 mg/l of kinetin (Kin) and 0.5 mg/l of 6-benzylaminopurine (BAP). Percentage of shoot regeneration decreased with the increase of NaCl (0.1- 0.5%) in the shoot regeneration medium. Root formation in these cultures took place when the cultures were nurtured on MS medium free of growth hormones. Regeneration, hardening and acclimatization of the salt-tolerant plants was conducted.

Keywords: tissue culture, *Arachis hypogaea*, salt-tolerant plant, *in vitro* regeneration, salt-tolerant peanuts

Pak. J. Sci. Ind. Res. 2006 **49**(3) 211-214

Yield and Quality of Two Cultivars of Sugar Beet as Influenced by Fertilizer Applications

Zahoor ul Haq[a], Aurang Zeb[b]* and F. Mahmood[b]

[a]Cereal Crops Research Institute, Pirsabak, Nowshera, Pakistan

[b]Nuclear Institute for Food and Agriculture (NIFA), Peshawar, Pakistan

(received February 21, 2006; revised June 15, 2006; accepted June 21, 2006)

Abstract. Studies were conducted to determine the effect of different doses of nitrogen and phosphorous applications on the yield and quality of two varieties of sugar beet. The genotypic varieties included in the study were: USH-10 and Maribo Extrapoli. Fertilizer doses applied were: 56.2, 113.7 and 170.0 (kg/ha) each of N and P. Results indicated that at the same leavel of fertilizer application, the two varieties did not differ significantly in root yield (kg/ha), sugar contents (%) and sugar yield (kg/ha). Yield, however, was significantly ($p < 0.01$) influenced by the application of different doses of N and P. The yield was the lowest for control (zero fertilizer application), and increased ($p > 0.01$) with the first two fertilizer doses. However, a decline in the yield ($p < 0.01$) was noted with the further higher dose of fertilizers. Sugar contents as percent yield did not differ in the two varieties. Fertilizer application resulted in significantly ($p < 001$) higher sugar level only upto the second dose. The results revealed that the second dose (113.7 : 113.7 kg/h of N : P) was the most economical level of fertilizer application for sugar beet crop cultivation in the agro-climatic region of Peshawar, Pakistan.

Keywords: sugar beet, fertilizer applications, sugar beet root yield, sugar beet sugar contents, sugar beet var. USH-10, sugar beet var Maribo Extrapoli

Pak. J. Sci. Ind. Res. 2006 **49**(3) 215-221

Solvent Extraction and Electrowinning of Copper from Hot Rolling Mill Scale Liquor

Rehmat Ali Gohar*, Sameer Ahmad and Asma Haleem Khan
Materials Science Research Centre, PCSIR Laboratories Complex, Lahore-54600, Pakistan

(received August 8, 2004; revised December 30, 2005; accepted December 30, 2005)

Abstract. The Acorga M5640 solvent extraction reagent was used for the extraction of copper from hot rolling mill scale liquor. The copper concentration in this liquor ranged between 2 g per litre to 14 g per litre. Ten g per litre Cu and 3 g per litre Fe of the prepared initial feed was used in the solvent extraction and electrowinning unit. Six g per litre Cu in the aqueous solution was used during laboratory scale experimentation because the lower strength was almost completely loaded in the organic extractant, Acorga M5640. The conditions optimized were: organic phase of 30% (v/v) in kerosene and the loaded organic extractant was 5.43 g per litre at 90.5% extraction; pH 2.5; extraction aqueous to organic phase ratio of 5:1 and stripping aqueous to organic phase ratio of 3:1; extraction cycle performance 3 and stripping cycle performance 2; and phase disengagement and equilibration time 10 min. The electrolyte containing sulphuric acid, 35 g per litre in combination with varying amounts of copper sulphate ranging from 25 g per litre to 40 g per litre was used as the strip solution on laboratory scale. Atomic absorption spectrophotometry and electrogravimetric analysis were used for the determination of electrowon copper, which in the present study were 99.89% and 99.78%, respectively. The solvent stability and reliability was excellent, which was also verified by the results achieved during the bench scale study for further use in solvent extraction mixer-settler counter-current unit.

Keywords: Acorga M5640, copper extraction, copper recovery, raffinate copper, solvent extraction, copper electro-winning, waste copper, rolling mill copper scale

Pak. J. Sci. Ind. Res. 2006 **49**(3) 222-224

Short Communication

Cathodic Efficiency of Industrial Chromium Plating

Inam-ul-Haque*, Asim Khan and Abdul Rasheed
Department of Chemistry, University of Engineering and Technology, Lahore-54890, Pakistan

(received September 17, 2004; revised June 18, 2005; accepted September 22, 2005)

Abstract. Current efficiency of hard chrome plating bath was studied. Experiments were carried out using industrial grade chromic acid. The best results were obtained from the chrome plating bath comprising chromic acid 300-350 g/l, sodium silicofluoride 5-6 g/l, CrO_3/H_2SO_4 ratio of 125 : 1, at current density 12 A/dm^2 and temperature 30-35 °C. The current efficiency of the bath was ≃ 32%.

Keywords: chrome plating, copper coulometer, sodium silicoflouride, cathode efficiency