

## Physical Sciences

Study of Transport Properties of Mineral Chalcopyrite ( $\text{CuFeS}_2$ ) at Relatively Low Temperatures (77-300 K)

Shabana Rizvi, Syed Munir Mehdi Raza Naqvi, Syed Mohsin Raza, Syed Dabir Hasan Rizvi and Shaikh Kamaluddin

117

Evaluation and Activation of Cambalpur Bentonite for Industrial Utilization

Shagufta Nasreen, Abdul Ghani and Sohail Noor

123

Geology and Geotechnical Appraisal of Some Clay Deposits Around Ijero-Ekiti Southwestern Nigeria: Implication for Industrial Uses

Olusola OlaOlorun and Akindele Oyinloye

127

## Biological Sciences

Haloperidol-Induced Tardive Dyskinesia: Role of  $5\text{-HT}_{2C}$  Receptors

Huma Ikram and Darakhshan Jabeen Haleem

136

Alkaline Protease Production from Industrial Waste by *Bacillus subtilis* ML-4

Muhammad Gul Sher, Muhammad Nadeem, Quratulain Syed, Muhammad Irfan and Shahjahan Baig

146

Identification of Potential F2 Populations from Intraspecific Crosses in Upland Cotton

Muhammad Jurial Baloch, Muhammad Sharif Kakar, Wajid Ali Jatoi and Nasreen Fatima Veesar

151

Impact of Egyptian and CIS Long Staple Cotton Varieties on Yarn Tensile Properties at Ring and Compact Spinning Systems

Nasir Mahmood, Muhammad Qamar Tusief and Mahmood Azeem

158

Effect of Calcium on Nitrogen Utilization by Rice in Saline Soils

Imdad Ali Mahmood, Armghan Shahzad, Muhammad Salim, Arshad Ali, Badr-uz-Zaman and Adil Mir

164

## Technology

Experimental Investigation of Attrition Resistance of Zeolite Catalysts in Two Particle Gas-Solid-Solid Fluidization System

Zeeshan Nawaz, Tang Xiaoping, Shahid Naveed, Qing Shu and Fei Wei

169

# Physical Sciences

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## Study of Transport Properties of Mineral Chalcopyrite ( $\text{CuFeS}_2$ ) at Relatively Low Temperatures (77-300 K)

Shabana Rizvi<sup>a</sup>, Syed Munir Mehdi Raza Naqvi<sup>a</sup>, Syed Mohsin Raza<sup>b</sup>,  
Syed Dabir Hasan Rizvi<sup>a\*</sup> and Shaikh Kamaluddin<sup>c</sup>

<sup>a</sup>Department of Physics, University of Karachi, Karachi - 75270, Pakistan

<sup>b</sup>Department of Physics, University of Balochistan, Quetta, Pakistan

<sup>c</sup>PCSIR Laboratories Complex, Shahrah-e-Dr. Salimuzzaman Siddiqui, Karachi - 75280, Pakistan

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**Abstract.** The electrical resistivity and thermoelectric power measurements were carried out on chalcopyrite; the mineral rock sample of Balochistan, Pakistan, in a temperature range down from liquid nitrogen temperature up to room temperature (77-300 K). The resistivity studies show diverse transitions at different temperature intervals especially a semi-superconductivity, where weak fermions (not the Cooper pairs) are produced. This transition is accompanied with another relatively low temperature transition, i.e., a metal-insulator transition which sets in at 92 K. The metal to insulator transition at 92 K occurs due to breakup of weak fermions. The Grüneisen function shows a transition at 215 K, where some kind of phonons become free from their respective Brillouin zones. Thus chalcopyrite at 215 K can produce excited phonons for semiconductor, imaging, nanotube, quantum well, optoelectronic and other devices. The sudden escalation of positive thermoelectric power at 240 K in chalcopyrite shows a phase transition perhaps due to diffusional recovery processes, i.e., shuffling of electrons and positive ion cores. Thermoelectric power measured shows an increasing trend similar to that of the theoretically estimated values with a room temperature value around 600  $\mu\text{V/K}$ .

**Keywords:** transport mechanism, mineral ore, chalcopyrite, electrical resistivity, thermoelectric power.

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## **Evaluation and Activation of Cambalpur Bentonite for Industrial Utilization**

**Shagufta Nasreen\***, Abdul Ghani and Sohail Noor

PCSIR Laboratories Complex, Jamrud Road, Peshawar-25120, Pakistan

(received October 6, 2009; revised March 6, 2010; accepted March 27, 2010)

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**Abstract.** An experimental study of the bentonite clays of Cambalpur (Attock) area of Pakistan, indicated their performance to be comparable with the imported clays and that these can be used as import substitute after activation by hydrochloric acid or sulphuric acid. No reversal of colour or adverse effects were noticed.

**Keywords:** Cambalpur, bentonite, clays, activation, Pakistan

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# Geology and Geotechnical Appraisal of Some Clay Deposits Around Ijero-Ekiti Southwestern Nigeria: Implication for Industrial Uses

**Olusola OlaOlorun\* and Akindele Oyinloye**

Department of Geology, University of Ado-Ekiti, P.M.B. 5363, Ado-Ekiti, Nigeria

(received June 18, 2009; revised December 31, 2009; accepted January 5, 2010)

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**Abstract.** The geotechnical appraisal of the clay deposits around Ijero-Ekiti, southwestern Nigeria, indicated that Ara and Ijero clays have 49.2% and 24.1% clay fractions, respectively, while Ilukuno variety has 32.8% clay fraction. The range of Atterberg liquid limits of Ara and Ijero clays was 41.8-48.0% and 25.6-36.5%, respectively, and those of plastic limits, 19.5-24.0% and 22.0-23.2%, respectively. XRD analyses showed kaolinite as the most prominent clay mineral present in the clays. Ara and Ijero clays were geochemically similar having  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$  concentrations, which reflect derivation from the underlying basement rocks. Thus, these clay deposits are suitable for the manufacture of paints, ceramics, refractories, agro-chemical and pharmaceutical products.

**Keywords:** Ara clay deposits, Ijero clay deposits, geochemistry, clay deposits, Nigeria

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# Biological Sciences

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## Haloperidol-Induced Tardive Dyskinesia: Role of 5-HT<sub>2C</sub> Receptors

**Huma Ikram\* and Darakhshan Jabeen Haleem**

Neurochemistry and Biochemical Neuropharmacology Research Unit, Department of Biochemistry,  
University of Karachi, Karachi-75250, Pakistan

(received January 9, 2010; revised March 24, 2010; accepted April 5, 2010)

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**Abstract.** Tardive dyskinesia (TD), an involuntary orofacial hyperkinetic disorder, is the major limitation of neuroleptic therapy. Role of 5-hydroxytryptamine (5-HT; serotonin) may be important in the treatment of schizophrenia and TD. Rats chronically treated with haloperidol exhibiting vacuous chewing movements (VCMs) with tongue protrusions and facial musculature are widely used as animal model of TD. Rats repeatedly injected with haloperidol at the dose of 1 mg/mL/kg twice a day for 2 weeks displayed VCMs that increased in a time dependent manner as the treatment was continued for 5 weeks. VCMs were produced two days after withdrawal; animals were given meta-chlorophenylpiperazine (m-CPP) challenge (3 mg/mL/kg) to monitor the responsiveness of 5-HT<sub>2C</sub> receptors. The intensity of m-CPP induced hypophagia was more in repeated haloperidol + m-CPP injected rats after 4 h but not after 2 h post m-CPP challenge. m-CPP also attenuated haloperidol induced increased dopamine (DA) and 5-HT metabolism both in dorsal and ventral striatum. However, these effects were more pronounced in ventral striatum. Results are discussed in context with responsiveness of 5-HT<sub>2C</sub> receptors. Findings may help in extending the therapeutics in schizophrenia.

**Keywords.** tardive dyskinesia, vacuous chewing, neuroleptics, 5-hydroxytryptamine receptors, haloperidol

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## Alkaline Protease Production from Industrial Waste by *Bacillus subtilis* ML-4

Muhammad Gul Sher\*, Muhammad Nadeem, Quratulain Syed, Muhammad Irfan and Shahjahan Baig  
Food and Biotechnology Research Centre, PCSIR Laboratories Complex, Lahore - 54600, Pakistan

(received August 29, 2009; revised March 26, 2010; accepted March 29, 2010)

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**Abstract.** The influence of various culture conditions on protease production by *Bacillus subtilis* ML-4 was studied in the presence of growth medium containing poultry feed waste (5%),  $K_2HPO_4$  (0.3%),  $CaCl_2$  (0.03%) and  $MgSO_4$  (0.015%). Maximum protease production ( $264.25 \pm 1.86$  U/ml) was observed at initial pH 9 with 3% (v/v) of inoculum size after 48 h of incubation at 37 °C. The alkaline protease was stable over a broad range of temperature (30 to 60 °C) and pH (8 to 11). However, maximum activity (155.45 U/ml) was observed at temperature 50 °C and pH 10.

**Keywords:** protease production, *B. subtilis*, poultry feed, detergent formulation

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## Identification of Potential F<sub>2</sub> Populations from Intraspecific Crosses in Upland Cotton

Muhammad Jurial Baloch\*, Muhammad Sharif Kakar, Wajid Ali Jatoi and Nasreen Fatima Veesar  
Department of Plant Breeding and Genetics, Sindh Agriculture University, Tandojam, Pakistan

(received February 23, 2009; revised March 8, 2010; accepted March 11, 2010)

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**Abstract.** Ten intraspecific F<sub>2</sub> progenies along with their six parental lines were evaluated for genetic parameters. The mean performance of genotypes differed significantly for various traits. Further, among F<sub>2</sub> progenies, NB-111/S × CIM-499 expressed maximum heritability percentage coupled with high genetic variance and more genetic gains for days to open first flower and plant height, whereas CIM-497 × CIM-506 exhibited higher heritability percentage, associated with more genetic variance, consequently higher genetic gains for boll weight and seed cotton yield. Progeny NB-111/S × CIM-506 exhibited moderate heritability percentage paired with fair amount of genetic variance and appreciable genetic gains for number of sympodia per plant. For number of bolls and lint percentage, progeny BH-147 × CIM-499 expressed maximum heritability percentage coupled with high genetic variance and greater genetic gains. Nevertheless, progeny B.T. cotton × CIM-499 displayed higher heritability percentage, paired with more genetic variance and greater genetic gains for fibre length and also expressed maximum values for all the other traits except plant height, boll weight and G.O.T%. As a whole, quite a number of F<sub>2</sub> progenies expressed moderate to high heritability estimates, fair amount of genetic variance and sufficient amount of predicted genetic gains, suggesting reliability of such breeding material for use as potential segregating populations for screening desirable segregants from subsequent generations of selfing for improvement of most of the traits studied.

**Keywords:** heritability estimates, genetic gains, F<sub>2</sub> intraspecific populations, *Gossypium hirsutum* L.

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# Impact of Egyptian and CIS Long Staple Cotton Varieties on Yarn Tensile Properties at Ring and Compact Spinning Systems

**Nasir Mahmood\***, **Muhammad Qamar Tusief** and **Mahmood Azeem**

Department of Fibre Technology, University of Agriculture, Faisalabad, Pakistan

(received November 19, 2009; revised April 4, 2010; accepted April 10, 2010)

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**Abstract.** Compact spinning system has proved itself better as compared to ring spinning system in improving the strength related properties of the yarn at low twist and high spindle speeds. The present study was undertaken to optimize the application of best combination of twist multiplier and spindle speed of ring and compact spinning system to Egyptian and CIS cotton varieties. Cotton varieties, twist multiplier and spinning system were found to be highly significant while spindle speed and all the interactions remained non-significant related to the tensile properties (yarn lea strength, single yarn strength, RKM and elongation) of the cotton varieties.

**Keywords:** cotton varieties, yarn properties, spinning systems

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## Effect of Calcium on Nitrogen Utilization by Rice in Saline Soils

Imdad Ali Mahmood<sup>a</sup>, Armghan Shahzad<sup>b\*</sup>, Muhammad Salim<sup>a</sup>, Arshad Ali<sup>a</sup>,  
Badr-uz-Zaman<sup>a</sup> and Adil Mir<sup>a</sup>

<sup>a</sup>Land Resources Research Programme, Institute of Natural Resources and Environmental Sciences, National Agricultural Research Centre, Islamabad-45500, Pakistan

<sup>b</sup>PBP, Institute of Agricultural Biotech. and Genetic Resources, National Agricultural Research Centre, Islamabad-45500, Pakistan

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**Abstract.** In the study of the effect of CaSO<sub>4</sub> application and soaking of rice seedlings in 2% CaSO<sub>4</sub> on N use efficiency of rice (var. Shaheen) in 3 sample soils (ECe=0.4, 4.8 and 8.7 dS/m, SAR=1.05, 14.86 and 21.43, pH=7.7, 8.3 and 9.20, respectively), a considerable reduction was observed in tillering (about 26% and 46%), plant height (about 20% and 46%) and yield (about 33% and 53%) of paddy grown in the saline soil (ECe=4.8 and 8.7 dS/m, respectively), as compared to the non-saline soil (ECe=0.4 dS/m), while soaking of seedlings in CaSO<sub>4</sub> and N application with or without CaSO<sub>4</sub> nutrition, significantly improved plant growth and paddy yield in all types of soil; overall, 26% increase in plant growth and 48% gain in paddy yield over the control was observed due to N and CaSO<sub>4</sub> application, respectively, with soaking of seedlings in high salinity soil. Interestingly, seedlings soaked in 2% CaSO<sub>4</sub> and with N application but with or without Ca supplementation performed statistically equal. Tissue Na<sup>+</sup> significantly decreased, while K<sup>+</sup> and Ca<sup>+2</sup> concentrations were high due to N application along with Ca nutrition and soaking of seedlings in all types of soil. Maximum N uptake and apparent N recovery were detected in treatments, where N was applied supplemented with CaSO<sub>4</sub>.

**Keywords:** soil salinity; rice; seedling soaking; N efficiency; CaSO<sub>4</sub> application

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# Technology

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## Experimental Investigation of Attrition Resistance of Zeolite Catalysts in Two Particle Gas-Solid-Solid Fluidization System

**Zeeshan Nawaz<sup>a</sup>, Tang Xiaoping<sup>a</sup>, Shahid Naveed<sup>b\*</sup>, Qing Shu<sup>a</sup> and Fei Wei<sup>a</sup>**

<sup>a</sup>FLOTU, Department of Chemical Engineering, Tsinghua University, Beijing 100084, China

<sup>b</sup>Department of Chemical Engineering, University of Engineering & Technology, Lahore, Pakistan

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**Abstract.** In the study of mechanical degradation of 34 ZSM-5 and SAPO catalysts, using the gas jet attrition - ASTM standard fluidized bed test (D-5757), the effect of particle size and its quantitative analysis in co-fluidization environment was investigated on the air jet index (AJI) basis. In gas-solid-solid fluidized bed reactors (GSS-FBR), two different sized particles were fluidized under isothermal conditions. In case of ZSM-5 and SAPO-34, significant attrition resistance was observed, which was attributed to small pore size and specific structural strength of the mobile framework image (MFI) and chabasite (CHA) structures, respectively. The optimum AJI for SAPO-34 and ZSM-5 (of particle size 0.2 mm) in GSS-fluidization system was observed to be 0.0118 and 0.0062, respectively. In co-fluidization, deviations from Gwyn relationship were observed due to change in impact of collision. Therefore, zeolites are recommended as suitable catalysts or catalytic supports (for doping of expensive metals) and for commercial use in GSS-FBR.

**Keywords:** attrition; zeolite catalyst, two particle system, gas-solid-solid fluidized bed reactor

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