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Series A: Physical Sciences

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Turmeric Powder as a Natural Heavy Metal Chelating Agent: Surface Characterisation

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Abstract. The present study was conducted to investigate surface properties of turmeric in order to evaluate its detoxification potential and ability to sequester toxic metals ions. Scanning Electron Microscopy (SEM), Energy Dispersion Spectroscopy (EDS), Infra-Red (IR) spectroscopy and potentiometric titrations were employed for characterisation of the surface of turmeric powder. Spectroscopic studies revealed that the surface of turmeric powder was porous mainly composed of polymeric -OH , -NH , -CH₂ , -COO and -OH groups of polysaccharides. From potentiometric titrations and modelling of batch titration data, it was found that surface of the turmeric contains at least four binding sites with pK_a values 3.56 (pK₁), 4.83 (pK₂), 7.68 (pK₃) and 10.4 (pK₄). Turmeric powder contains highest concentration of amino and hydroxyl groups for the pK₄ values i.e., 0.55 mmol/ g. The total binding sites concentration for turmeric powder was 1.2 mmol/ g.

Keywords: turmeric, chelation, surface characterisation, potentiometric titration

Beneficiation Study on Barite Ore of Duddar Area, District Lasbela, Balochistan Province, Pakistan

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Abstract. This study highlights the results of processing an indigenous low to medium grade barite ore of Duddar area, district Lasbela, Balochistan, Pakistan. The ore was characterized by x-ray diffraction technique. The gravity concentration and forth flotation technologies were employed to beneficiate the ore in order to achieve commercial grade barite concentrate with economical recovery. The results showed that flotation was the better method than gravity concentration to concentrate the barite mineral. A process flow sheet was designed in the light of these experiments. The flotation tests revealed that barite concentrate assaying 95.85% BaSO₄ could be obtained with recovery of 82.06% from an ore containing 76.04% BaSO₄. The flotation concentrate was leached to get rid of objectionable impurities. The final leached barite concentrate possesses 98.86% BaSO₄ content and conforms to the specifications of industrial grade barite concentrate.

Keywords: Duddar area, barite, beneficiation, tabling, flotation, leaching, recovery

Experimental Investigation of Performance Characteristics of Compression Ignition Engine Fuelled with Punnai Oil Methyl Ester Blended Diesel

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(received March 14, 2016; revised September 15, 2016; accepted October 18, 2016)

Abstract. Biodiesel is a renewable substitute to conventional diesel and offers cleaner performance. This paper deals with performance characteristics of four stroke, water cooled Compression Ignition (CI) engine fuelled with four different oils: diesel, diesel-punnai oil biodiesel 10% (B10), diesel-punnai oil biodiesel 20% (B20) and diesel-punnai oil biodiesel 30% (B30). The present research, experiments were conducted to study the effect of viscosity, cetane number, flash point, calorific value and density on performance characteristics of diesel, Punnai oil biodiesel and its different blends (B10, B20, B30). The experimental results of this study showed that the diesel has 2.6% and 4.6% higher brake specific fuel consumption (BSFC) as compared to B10 and B20, respectively at full load, whereas BSFC of diesel was same as B30 at higher load. Volumetric efficiency and mechanical efficiency of B10 was 1.2% and 7.5% higher as compared to diesel at full load condition. Brake Thermal Efficiency (BTE) and indicated thermal efficiency of B20 was 8.12% and 7% higher as compared to diesel at full load. From this study, it is concluded that Punnai oil biodiesel could be used as a viable alternative fuel in a single cylinder, four stroke, water cooled direct injection diesel engine.

Keywords: biodiesel, compression ignition engine, Punnai oil biodiesel, performance

Qualitative Analysis of Siro-spun and Two Fold Yarns Tensile Properties under the Influence of Twist Factor

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(received August 22, 2016; revised September 26, 2016; accepted September 30, 2016)

Abstract. Siro yarns are spun from two separate roving of same type of materials. Similarly in textile arts, folding is a process used to create a strong and balance yarn by putting together two separate yarns. Hence, this research study was carried to analyse the quality of Siro-spun and two fold yarns under the influence of twist factor with special reference to their tensile properties. The results disclosed better tensile properties of yarn made from Siro spinning technique as compared to two plied yarn. This indicates the supremacy of Siro-spun yarn over two fold yarn. These findings enhance the fact that Siro spinning technique produces better quality yarn as compared to conventional ring spinning technique.

Keywords: Siro-spun twist multiplier, two fold yarn, yarn tensile properties

Appraisal of Drinking Water Quality in Lahore Residence, Pakistan

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Abstract. A comprehensive study for the spatial distribution of drinking water quality had been conducted for residential area of Lahore, Pakistan. The study had made use of the geographic information system (GIS) for geographical representation and spatial analysis of groundwater quality. Physicochemical parameters including electric conductivity, pH, TDS, Cl, Mg, Ca, alkalinity and bicarbonates from 73 of the water samples had been included in the analysis. Water quality data had been geo-referenced followed by its interpolation using inverse distance weighted (IDW) for each of the parameters. Very high alkalinity and bicarbonates values were observed in most parts of the area. For the comprehensive view, water quality index map had been prepared using weighted overlay analysis (WOA). The water quality index map was classified into five zones of excellent, good, poor, very poor and unfit for drinking as per WHO standards of drinking water. 21% region had excellent quality of the underground water and 50% was found good for drinking. Poor quality of water was found in southeastern part, covering 27% of the study area. Only 2% of the area was found under the very poor and unfit water quality conditions for drinking.

Keywords: drinking water quality, groundwater, water quality index, GIS, weighted overlay

Sulphide Removal from Sewage Wastewater by Oxidation Technique

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(received August 19, 2015; revised March 31, 2016; accepted April 08, 2016)

Abstract. In this study sewage wastewater samples were collected from different areas of Lahore, Pakistan from the WASA sewer system and then different chemical oxidizers: O_2 , $KMnO_4$, H_2O_2 were used to remove the sulphides from these samples for selection of suitable oxidizer for treatment. From these results, it was observed that H_2O_2 was found effective and suitable for treatment and it can be used for this purpose. Theoretical and experimental doses required for treatment were similar. The $KMnO_4$ oxidation reactions were completed in five minutes time while H_2O_2 required more time and removed sulphide completely with slow chemical reaction. Different doses of oxidizer such as 1 to 6 g of oxygen, 1 to 14 g of $KMnO_4$, 1 to 11 g of H_2O_2 with different ratios were used and H_2O_2 was found suitable. Using 11 g of H_2O_2 dose, 100 % sulphides were removed, H_2O_2 as an oxidizer was found more suitable for sulphide removal from wastewater.

Keywords: treatment, sulphide removal, wastewater, oxidation technique

The Study of PM₁₀ Concentration and Trace Metal Content in Different Areas of Karachi, Pakistan

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(received August 6, 2015; revised April 4, 2016; accepted April 8, 2016)

Abstract. Atmospheric particulate matter may exert serious health hazards because of its chemical characteristics. Aim of this study was to determine the concentrations of particulate matter (PM) with an aerodynamic diameter $\leq 10 \mu\text{m}$ (PM₁₀), and air transmitted particulate trace metals in different areas of Karachi's ambient air, for the period of 01 year *viz.* June 2011 to June 2012. Furthermore, the present work compares the levels of particulate matter and trace metals with the proposed limiting values from the U.S. Environmental Protection Agency ($65 \mu\text{g}/\text{m}^3$ for PM₁₀). The sampling for PM₁₀ was performed by using a high volume air sampler. The PM₁₀ levels were determined by gravimetry and the metals by graphite furnace. Arithmetic means of $361.0 \mu\text{g}/\text{m}^3$ was determined for PM₁₀ in commercial areas, $275.0 \mu\text{g}/\text{m}^3$ in residential areas, $438.0 \mu\text{g}/\text{m}^3$ in industrial areas and $68.9 \mu\text{g}/\text{m}^3$ in background areas of Karachi. Trace metal content in PM₁₀, such as lead (Pb) and cadmium (Cd) were also analysed separately during the same period using atomic absorption spectrometry. The average concentration of Pb were found in commercial zone $1.36 \mu\text{g}/\text{m}^3$, in residential zone $1.0 \mu\text{g}/\text{m}^3$, in industrial zone $1.46 \mu\text{g}/\text{m}^3$ and in urban background zone $0.6 \mu\text{g}/\text{m}^3$, whereas; Cd concentration in commercial zone $0.10 \mu\text{g}/\text{m}^3$, in residential zone $0.02 \mu\text{g}/\text{m}^3$, in industrial zone $0.25 \mu\text{g}/\text{m}^3$ and in urban background zone $0.01 \mu\text{g}/\text{m}^3$, respectively.

Keywords: trace metal, atmospheric particulate matter, ambient air, Karachi
