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## Series A: Physical Sciences

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## Catalytic Hydrodechlorination of 2,4-Dichlorophenol Using Co-Current Down Flow Contactor Reactor

Asim Rehman<sup>a\*</sup>, Muhammad Nawaz<sup>b</sup>, Arshad Chughtai<sup>c</sup>, Muhammad Arif Butt<sup>a</sup> and Abdul Sattar<sup>a</sup>

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(received July 1, 2013; revised February 16, 2014; accepted February 18, 2014)

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**Abstract.** In this study, a new prospective regarding application of gas liquid reactions in the presence of catalyst was studied for pollution abatement in the novel reactor. Catalytic hydrodechlorination (CHDC) of 2,4-dichlorophenol (2,4-DCP) in aqueous system was carried out under the operating conditions at 25-75 °C, 1 atm in co-current down flow contactor reactor. Under these reaction conditions complete conversion of 2,4-DCP into less toxic products (phenol and cyclohexanone) was achieved using 5% Pd/C catalyst. At typical temperature the hydrodechlorination reaction of 2,4-DCP was completed after 10 min. 2,4-DCP was converted to 96.19% of phenol and 3.81% of cyclohexanone using 0.4 g/L of 5% Pd/C catalyst. The increase in initial concentration of 2,4-DCP resulted in the increase in time for the dechlorination of 2,4-DCP. The calculated activation energy values amounted to 43 KJ/mol for the CHDC of 2,4-DCP exhibiting that this reaction occurs mainly under the surface reaction rate controlled condition.

**Keywords:** catalytic hydrodechlorination, 2,4-dichlorophenol, palladium, carbon, co-current downflow contactor reactor

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## **Assessment of the Intrinsic Vulnerability to Groundwater Contamination in Lahore, Pakistan**

**Khalid Mahmood\*, Rabia Munsaf Khan, Mudabbar Ashfaq, Haseeb Ahsan,  
Zernain Shakoor and Muhammad Tanveer**

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(received November 27, 2013; revised February 4, 2014; accepted March 13, 2014)

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**Abstract.** This study was intended to map intrinsic vulnerability of groundwater contamination in Lahore using GIS based DRASTIC model. The final output of DRASTIC model was reclassified into three equal interval classes, corresponding to low, moderate and high vulnerability regions. Most of the study area was found to have low to moderate vulnerability, with 27.48% area of low, 66.48% of moderate and only 6.04% area of high vulnerability. Most of the drinking water wells are installed in the residential area of the city, which shows low chances of contamination due to deep water table and almost no recharge. However, an industrial drain is located in the high vulnerable area in the southeastern part of the study area. The previous studies are in agreement with vulnerability zones. Further to remove any doubt in the suitability of assigned weight, map removal sensitivity analysis had been carried out. The assessment of the sensitivity analysis had been made through visual as well as quantitative methods. Priority order for contribution of the parameters in the vulnerability for the study area is  $D > I > C > R > A > T > S$ .

**Keywords:** groundwater, intrinsic vulnerability, DRASTIC, weighted overlay, sensitivity analysis

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## **Role of Biodiesel-Diesel Blends in Alteration of Particulate Matter Emanated by Diesel Engine**

**Asad Naeem Shah<sup>a,b\*</sup>, Ge Yun-Shan<sup>b</sup>, Tan Jian-Wei<sup>b</sup> and Ejaz Mahmood Shahid<sup>a</sup>**

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**Abstracts:** The current study is focused on the investigation of the role of biodiesel in the alteration of particulate matter (PM) composition emitted from a direct injection-compression ignition. Two important blends of biodiesel with commercial diesel known as B20 (20% biodiesel and 80% diesel by volume) and B50 were used for the comparative analysis of their pollutants with those of 100% or traditional diesel (D). The experiments were performed under the auspices of the Chinese 8-mode steady-state cycle on a test bench by coupling the engine with an AC electrical dynamometer. As per experimental results, over-50 nm aerosols were abated by 8.7-47% and 6-51% with B20 and B50, respectively, on account of lofty nitrogen dioxide to nitrogen oxides ( $\text{NO}_2/\text{NO}_x$ ) ratios. In case of B50, sub-50 nm aerosols and sulphates were higher at maximum load modes of the test, owing to adsorption phenomenon of inorganic nuclei leading to heterogeneous nucleation. Moreover, trace metal emissions (TME) were substantially reduced reflecting the reduction rates of 42-57% and 64-80% with B20 and B50, respectively, relative to baseline measurements taken with diesel. In addition to this, individual elements such as Ca and Fe were greatly minimised, while Na was enhanced with biodiesel blended fuels.

**Keywords:** biodiesel, unregulated emissions, trace metals, nanoparticles, sulphates, diesel engine

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## **Preparation of GF/Wollastonite Reinforced Epoxy Hybrid Composite: Mechanical Properties**

**Gowkanapalli Ramachandra Reddy<sup>a</sup>, Mala Ashok Kumar<sup>\*b</sup>, Ati Ramesh<sup>b</sup>,  
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(received March 18, 2013; revised March 30, 2014; accepted April 3, 2014)

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**Abstract.** Performance of injection moulded short wollastonite fibre and chopped glass fibre reinforced hybrid epoxy composites was studied. The results showed that hybridisation of glass fibre and wollastonite was in congruence to epoxy glass fibre composite system. Effect of fibre length, fibre orientation in matrix and analysis and fracture surface was undertaken. The mechanical properties of injection moulded, chopped glass fibre/wollastonite/epoxy hybrid composites were investigated by considering the effect of hybridisation by these two fillers. It was observed that the tensile, flexural, and impact properties of the filled epoxy were higher than those of unfilled epoxy. The effect of filler on epoxy matrix subjected to the tensile strength and modulus was studied and compared with the rule of mixture. The actual results are marginally low as compared with the values obtained by the rule of hybrid mixtures (RoHM).

**Keywords:** hybrid fibres, wollastonite, glass fibre, mechanical properties

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# **Manufacturing of Kevlar/Polyester Composite by Resin Transfer Moulding using Conventional and Microwave Heating**

**Iram Abdullah**

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(received May 20, 2013; revised December 22, 2013; accepted January 07, 2014)

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**Abstract:** Microwave heating was incorporated into the resin transfer moulding technique. Polytetrafluoroethylene (PTFE) mould was used to cure the composite panel. Through the use of microwave heating, the mechanical and physical properties of produced Kevlar fibre/polyester composites were compared to those manufactured by conventional resin transfer moulding. The flexural modulus and flexural strength of 6-ply conventionally cured composites was 45% and 9% higher than the flexural modulus and flexural strength of 6-ply microwaved cured composites, respectively. However, 19% increase in interlaminar shear strength (ILSS) and 2% increase in compressive strength was observed in 6-ply microwave cured composites. This enhancement in ILSS and compressive strength is attributed to the better interfacial bonding of polyester resin with Kevlar fibres in microwaved cured composite, which was also confirmed *via* electron microscopy scanning. Furthermore, the microwave cured composite yielded maximum void contents (3%).

**Keywords:** microwave curing, resin transfer moulding, polymer matrix composites, mechanical properties

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## **Water Characterisation of Coal Mining Areas of Chakwal, Punjab, Pakistan**

**Syed Mahmood Arshad<sup>a</sup>, Syed Muhammad Tariq<sup>a</sup>, Muhammad Shahzad<sup>a\*</sup>,  
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(received July 1, 2013; revised February 7, 2014; accepted February 8, 2014)

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**Abstract.** Discharged water from mines shows alteration in its physical properties and may be acidic depending upon the concentration of heavy metals and sulphate ions, which pose hazardous effects on groundwater and ecosystem. This paper deals with the characterisation of water being affected by coal mining in the Basharat area of Punjab. Total eleven samples were collected from different water sources including groundwater, mine outflows, mine inflows and surface water in the vicinity of Hassan Kishor Coal Mine. All samples except that of groundwater showed higher turbidity, lower pH values and higher total solid contents. Higher concentration of iron and copper in all samples indicate higher acid mine drainage (AMD). Relatively larger concentration of calcium in groundwater as compared to its presence in other samples demonstrates quashing effect of overlying limestone to the AMD.

**Keywords:** water pollution, groundwater, coal mine, acid mine drainage

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## **Characterisation and Identification of Taraxerol and Taraxer-14-en-3-one from *Jatropha tanjorensis* (Ellis and Saroja) Leaves**

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(received September 3, 2013; revised January 31, 2014; accepted February 12, 2014)

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**Abstract.** *Jatropha tanjorensis* leaves were collected, air dried and pulverised. The pulverised sample was extracted with solvents (*n*-hexane, ethylacetate and ethanol) of varying polarity to obtain the crude extracts. Repeated column and thin layer chromatographic separation of the crude extracts afforded two compounds which were characterised by their IR, MS, <sup>1</sup>H and <sup>13</sup>C-NMR spectral data. Comparison of the data with literature confirmed the compounds to be taraxerol and taraxer-14-en-3-one.

**Keywords:** *Jatropha tanjorensis*, taraxerol, taraxer-14-en-3-one, chromatography

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## **Environmental Impact Assessment of Trace Metal Deposition Around the Petrol Filling Stations**

**Durdana Rais Hashmi\*, Akhtar Shareef, Farooq Ahmad Khan and Alia Bano Munshi**

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(received October 3, 2013; revised February 26, 2014; accepted March 11, 2014)

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**Abstract.** The wide use of petroleum products causes contamination of air, water, soil and plants. The present study was conducted to monitor the trace metal deposition in road side soil around the petrol filling stations along the busy roads of Karachi, Pakistan. Total 21 road side soil samples were collected from selected locations of busy roads. The soil samples were digested using acid digestion method and atomic absorption spectrophotometer (AAS) was used for the elemental analysis. Results of the study showed that concentration of lead was highest in the soil samples ranging from 41.3 to 361 mg/kg, then copper from 23.0 to 101 mg/kg, manganese from 36.2 to 125.0 mg/kg and zinc from 27.5 to 213.0 mg/kg, respectively. The correlation-coefficient ( $r$ ) was also calculated between the metals in soil samples. The correlation matrix showed that all the pollution is coming from the same source. The gravitational sedimentation and impact on vegetation of coarse fraction is responsible for the high lead contamination of vegetation and soils. Collected data showed that, almost all the pollution being generated by automobile exhaust in urban areas of Karachi. The soil acts as an important sink for pollutants released through different activities.

**Keywords:** petrol filling stations, trace metals, soil, vehicular traffic, acid digestion

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