

MATHEMATICAL, PHYSICAL AND ENGINEERING SCIENCES

1. A STRATEGY TO CLONE A cDNA FRAGMENT CODING FOR A NOVEL METHIONINE-RICH PROTEIN IN SOYBEAN (*Glycine max*)

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An 8 KD (2D-1) methionine-rich protein (MRP) was purified through a combination of selective enrichment of the albumin fraction through heparin-Sepharose affinity chromatography, 2D-SDS-PAGE and radiolabelling of methionine-containing proteins with [1-¹⁴C] iodoacetate. The MRP contains 8.6% methionine, 11.4% lysine and high amounts of glutamic and aspartic acids. The N-terminus sequence facilitated the synthesis of degenerate oligonucleotide primers for use in Polymerase Chain Reaction (PCR) to amplify cDNA fragments specifically coding for the gene. The PCR generated fragment was then used to screen a cDNA library and analyze the DNA sequence which confirmed the high sulfur amino content of 17.2% (8.6% methionine and 8.6% cysteine). It was found to be present as two copies in the genome after Southern analysis. A search in the database to elucidate the MRP's biological role showed that it shares homology with DNA binding proteins in *Arabidopsis* and a sulfur-rich protein in lupine seed.

Keywords: degenerate oligonucleotide, selective enrichment, heparin-Sepharose affinity, Methionine-rich protein, radio-labelling

**2. BIOACTIVE PRINCIPLES FROM LIBAS (*Spondias pinnata*)
AND ELEPANTING PUTI (*Heliotropium indicum*)
AGAINST *Haemophilus gallinarum***

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Potential bioactive components from *Libas* and *Elepanting Puti* were extracted sequentially using solvents of different polarities. Bioassay of the crude solvent extract showed that the acetate extracts of the leaves and bark of *Libas* as well as the leaves and seeds of *Elepanting Puti* were effective in controlling the growth of *Haemophilus gallinarum*. The petroleum ether and ethanolic leaf extracts of *Libas* and *Elepanting Puti* also exhibited antimicrobial activity. The LD⁵⁰ of the ethanolic leaf extract of *Libas* and ethyl acetate extract of *Elepanting Puti* were 10.55 g and 11.78 g per kg body weight of albino mice, respectively. The phytochemicals responsible for its antimicrobial properties were found to be the flavonoidal group of compounds for *Libas* and tannins, and polyphenolics for the *Elepanting Puti* ethyl acetate extracts.

Keywords: bioassay, antimicrobial, bioactive components, phytochemical, flavonoidal, tannins, polyphenolic

**3. A CANONICAL CORRESPONDENCE ANALYSIS OF
SOME *IN VITRO* BIOLOGICAL ACTIVITIES OF
EXTRACTS FROM SPONGES AND
TUNICATES FROM BALER, QUEZON**

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An important aspect in natural products chemistry is the investigation of factors that influence the production of bioactive metabolites. If known, these factors may help predict the likelihood of finding active compounds, improving the generally low "hit rate" obtained in screening programs. A study was conducted to document the biological activities of natural products extracted from organisms in Baler, Quezon. More than 100 sponges and tunicates were screened for *in vitro* antimicrobial and antifungal activity, brine shrimp toxicity and cancer cell cytotoxicity. Thin layer chromatography profiles of the extracts were made. A canonical correspondence analysis was done to examine the possible relation between biological activity and 254 nm-flourescent spots. The results suggest that activity against *Klebsiella sp.*

accounts best for the occurrence of these spots in various species. The results imply that, to some extent, conditions at the geographical site of sampling influences the production of metabolites. Whether these conditions are due more to biotic than to abiotic factors remain to be confirmed.

Keywords: natural products chemistry, sponges, tunicates, biological activity, antimicrobial antifungal, canonical correspondence analysis, bioinformatics, bioactive metabolites

4. EXPRESSION OF THE THIRD ADENYLATE-FORMING REGION OF THE δ -(L- α -AMINOADIPYL)-L-CYSTEINYL-D-VALINE (ACV) SYNTHETASE FROM *Penicillium chrysogenum* IN THE *Aspergillus nidulans* EXPRESSION SYSTEM

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The penicillin precursor ACV is synthesized from the constituent L-amino acids and ATP by a multifunctional peptide synthetase, ACV Synthetase, (ACVS). Peptide synthesis proceeds via the non-ribosomal thiotemplate mechanism independent of the ribosomes and messenger RNA. The peptide products produced by the various peptide synthetases showed unusual amino-hydroxy- or carboxylic acids and comprised a diverse pool of antibiotics, immunosuppressants; insect-, plant- and animal toxins. The ACVS consisted of three domains, each containing key motifs involved in ATP-binding, acyladenylate formation and aminoacylation of the substrate amino acids. Presumably, one domain was associated with the recognition of one substrate amino acid. The substrate specificity of each domain apparently

resided on its primary structure. This encoded specificity had been proven by limited proteolysis with regard to the middle domain which recognized and activated residue incorporated into the peptide product, cysteine. Confirmation of the substrate specificity of the other domains was deemed useful for the construction of hybrid peptide synthetase genes by mixing domains of known substrate specificity/preference from different peptide synthetases to produce novel bioactive peptides. Determination of the substrate specificity of the third domain of the ACVS was further studied by overexpression of the fragment corresponding to the adenylate-forming region (*domC*). The integration of the fusion gene to the *A. nidulans* genome was targeted via homologous recombination to the *argB* locus yielding stable inte.

Keywords: penicillin precursor, peptide synthetase, fusion gene, hybrid peptides

5. A FIELD EFFECT TRANSISTOR (FET) SENSOR FOR DISSOLVED SULFUR DIOXIDE

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The measurement of sulfur dioxide is important in food industries and environmental monitoring. Field effect transistor (FET) sensor offers attractive features for the measurement of sulfur dioxide such as miniature size, fast response, low noise and low power consumption. An FET sensor was coated with a thin film of hydrogel containing a hydrogen sulfite electrolyte and found to be sensitive to sulfur dioxide. Sulfur dioxide generated from a pH-4 potassium hydrogen phthalate buffer solution that is monitored by the pH-FET. The sensor exhibited a response time of 2 min. and a very good linearity ($r=0.9952$) in the range of 5.6×10^{-2} to 1.6×10^{-5} M. Its sensitivity was 22 mV per decade of sulfur dioxide concentration. The response of the sensor was affected by factors such as the hydrogel concentration, the electrolyte concentration and the pH of the carrier solution. The study shows that a miniaturized sensor that provides a direct and fast determination of dissolved sulfur dioxide is feasible.

Keywords: sulfur dioxide, field sensor, hydrogel concentration, electrolyte concentration field effect.

6. AN OPTICAL BIOSENSOR FOR TOXIC METAL IONS BASED ON THE INHIBITION OF IMMOBILIZED UREASE

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The detection of toxic heavy metal ions in aquatic and terrestrial resources has become a major analytical endeavor in environmental control. Optical fiber biosensors based on immobilized enzymes promises a simple, sensitive, rapid and inexpensive approach to the on-line monitoring of these metal ions. The study used a fiber-optic biosensor based on an immobilized urease to detect toxic metal ions. The detection scheme involved the optical measurement of the inhibitory effects of metal ions on the immobilized enzyme. The sensitive optical reagent consisted of a mixture of urease bonded on an activated aminoglass beads and thymol blue indicator linked onto similar aminoglass material. When these glass beads were packed at the tip of a fiber optic bundle then situated in a microflow cell chamber, a convenient metal detection system was realized. Inhibition curves for different metal ions have been successfully obtained, exhibiting the following dynamic ranges: $5 \times 10^{-3} - 5 \times 10^{-6}$ M Hg₂, $5 \times 10^{-7} - 5 \times 10^{-5}$ M Ag-, $1 \times 10^{-5} - 1 \times 10^{-4}$ M Cu₂, $5 \times 10^{-5} - 5 \times 10^{-3}$ M Cd₂, $1 \times 10^{-4} - 1 \times 10^{-2}$ M Zn²⁺, and $5 \times 10^{-4} - 1 \times 10^{-2}$ M Pb²⁺. Various factors affecting the inhibition measurements (e.g. type of buffer, pH, buffer concentration, flow rate, temperature, and sample volume) were also investigated. Similarly, studies on the regeneration of the inhibited enzyme were pursued.

Keywords: metal ions, environment control, optical fiber biosensors, urease enzyme, optical measurement.

7. SOLID-STATE pH SENSOR BASED ON CONDUCTING POLYPYRROLE

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Interest in the field of coated wire electrode was generated by the desire to miniaturize, simplify and produce cheaper and more robust ion-selective electrodes.

In the study, a solid-state potentiometric pH sensor was fabricated by electro polymerization of pyrrole monomer onto a platinum wire. The conducting polypyrrole was electrodeposited under constant current from a phosphate buffer solution (pH7) containing bovine serum albumin and pyrrole. The sensor exhibited a linear response at the pH range 3 to 10 with a sensitivity of -42 mV per pH. The response which was measured against a Ag/AgCl reference electrode was highly reproducible with a relative standard deviation of less than 3%.

Keywords: pH sensor, polypyrrole, ion-selective electrode, electropolymerization

8. THE USE OF A LOCALLY ISOLATED LUMINOUS BACTERIUM: *Photobacterium Leiognathi* USTCC 26 AS A BIOSENSOR FOR THE RAPID DETECTION OF TOXICANTS IN WATER SAMPLES

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A total of 28 locally isolated marine bioluminescent bacteria and 2 type strains: *Vibrio fischeri* DSM 7175 and *Vibrio harveyi* DSM 6904 were taxonomically classified. Based on their bioluminescence property and sensitivity to the detergent sodium lauryl sulfate (SLS), a local strain identified as *Photobacterium leiognathi* USTCC 26 from squid (*Loligo sp.*) was chosen as the test strain. Under local condition, the test strain was observed to emit a stable amount of light as a form of metabolic by product. Exposure to a toxicant over a period of 5 minutes resulted in a significant decrease in light output which was directly proportional to the concentration of the toxicant. The light emitted was quantitatively measured using a luminescence fluorometer. A 52.9% reduction in light output was obtained with 50 ppm sodium lauryl sulfate (SLS); a 23.2% reduction with 0.7 ppm phenol, and a 6.7% reduction with 1:2 dilution of MWSS tap water sample.

Keywords: biosensor, bacterium, toxicant detector, bioluminescence property

9. DESIGN OF AN ELECTRODE-IMMOBILIZED CATALYST INCORPORATING INORGANIC COMPLEXES AS POLYMERIC BACKBONES

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Several immobilized catalysts were found effective in electrochemically reducing carbon dioxide where increased efficiency and selectivity had been achieved compared with their homogeneous analogs. The inorganic complexes of the form, $\{[(bpy)_2Ru(dpq)]_2IrCl\}^{5+}$ and $\{[(bpy)_2Ru(dpb)]_2IrCl_2\}^{5+}$ where bpy = 2, 2'-bipyridine, dpq = 2, e-bis(2-pyridyl)quinoxaline and dpb = 2,3-bis(2-pyridyl)benzoquinoxaline, reduced CO₂ to CO with high selectivity. In this study, the substitution of bpy with vbpy (4-vinyl4'-methyl-2, 2'-bipyridine) to yield $\{[(ybpy)_2Ru(dpq)]_2IrCl_2\}^{5+}$ was achieved. Using this synthetic modification, the complex can be electropolymerized onto an electrode through the vbpy substituent to yield a catalytic surface. In addition, preliminary studies involving the $[Ru(vbpy)_2(dpq)]^{2+}$ chromophore yielded electrochemically robust polymeric backbone when deposited onto an electrode surface.

Keywords: chemically modified electrodes, inorganic complexes, electrocatalysis CO₂ reduction, electropolymerization, metallopolymer, bridging ligands iridium-based catalyst, ruthenium complexes, vinylbipyridine

10. MICROPOROUS SiO₂/VYCOR MEMBRANES FOR GAS SEPARATION

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Porous Vycor glass membranes with 40A initial pore diameter were modified using low pressure chemical vapor deposition (LPCVD) of silicon dioxide (SiO₂). Diethylsilane (DES) in conjunction with O₂ or N₂O were used as precursors to

synthesize the SiO_2 films. Both "single side" (reactions flowing on the same side of the porous membrane) and "counterflow" (reactants flowing on both sides of the porous membrane) reactant geometries were investigated. The flow of H_2 , He, N_2 , Ar, and toluene (C_7H_8) was monitored *in situ* after each deposition period. Membranes modified by the "single side" reactants geometry exhibited good selectivities between small and large molecules. However, cracking in these membranes after prolonged deposition limited the maximum achievable selectivity values. Higher selectivities and better mechanical stability were achieved with membranes produced using the "counterflow" reactants geometry. Pore narrowing rate was observed to increase with oxidant flow (O_2 or N_2O). For membranes prepared using both oxidants, selectivities on the order of 1000:1 were readily attained for H_2 and He over N_2 , Ar, and C_7H_8 . Compared to O_2 , the use of N_2O caused improvements in both the pore narrowing rate and N_2 : C_7H_8 selectivity. Membranes prepared using the "counterflow" geometry showed no signs of degradation or cracking after thermal cycling. The membranes produced can be useful for the improvement of the yield of equilibrium limited reactions such as hydrogenation and dehydrogenation reactions. They can also be useful for the prevention of the emission of hazardous volatile organic compounds which is a common problem in chemical industries.

Keywords: gas separation, membrane, chemical vapor deposition, permeability, selectivity, volatile organic compounds, pore size, silicon dioxide, vycor glass, and diethylsilane

11. LYOTROPIC LIQUID-CRYSTALLINITY OF ERYTHROCYTE GHOSTS

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Lytotropic liquid crystals are mixtures of amphiphilic compounds and a polar solvent, most often water. An example of such a mixture found in living systems is the cell membrane. A study was made on the mesomorphic properties of membrane preparations from normal and abnormal human red blood cells using optical micros-

copy and differential scanning calorimetry (DSC). Characteristics textures of the lyotropic neat phase were observed in normal erythrocyte ghosts which exhibit the nematic phase similar to those observed in thermotropic liquid crystals. DSC thermograms and optical textures of normal ghosts revealed phase transitions from crystalline gel to smectic to nematic to a homogenous solution at temperature ranges 10°C to 70°C. At the physiological temperature (35°C - 37°C), the membranes exhibited the lamellar smectic phase. Similar tests performed on membranes of Thallasemic (abnormal) red blood cells showed no similarity to the liquid crystalline behavior of normal membranes.

Keyword: amphiphilic, crystalline gel, erythrocyte ghosts, liquid crystals, lyotropic, nematic, optical microscopy, smectic, Thallasemic, thermotropic

12. CHOLESTERIC LIQUID CRYSTAL-POLYMER COMPOSITE MATERIALS FOR DISPLAY DEVICES

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Liquid crystal science has paved the way for the emergence of liquid crystal displays (LCDs) which has revolutionized the impact of information technology. Unfortunately, available display technologies still lack the capacity to cope with the sophistication of information transfer, hence, development of LCDs and other types of display devices are still limited. The study dealt with the basic preparation and characterization of polymer dispersed liquid crystal (PDLCs). PDLCs are another type of display devices which utilize the electro-optical properties of liquid crystal-polymer composites. With proper refractive index-matching, PDLCs may be switched from an opaque OFF state to a clear ON state upon application of voltage. Liquid crystals (LCs) formulations based on coco-cholesteryl esters (i.e., liquid-crystalline esters derived from coconut oil) were dispersed in commercially available polymethyl methacrylate (PMMA) and in laboratory-synthesized epoxy-based side chain polymers (SCP). Switching properties of the resulting polymer-dispersed liquid crystals (PDLC) were evaluated. PDLCs using PMMA as a binder exhibited distinguishable droplets with bipolar and twisted radial configuration. A maximum voltage of 60 volts was needed to transform a 70:30 (LC:PMMA) mixture into a transparent state. LC formulations dispersed in the epoxy-based SCP bearing cholesteryl and cyanobiphenyl pendant groups were found to exhibit fingerprint texture. Compared to the LC/PMMA composite, the LC dispersion required voltage for switching.

Keywords: cholesteric, composite, liquid crystals, liquid crystal displays, polymer dispersed liquid crystals, coco-cholesteryl esters, epoxy-based polymers, finger-print texture.

13. PHYSICAL AND CHEMICAL IMMOBILIZATIONS OF QUINHYDRONE IN POLYMER MATRICES

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The physical-chemical immobilization of quinhydrone in polymer was determined. Quinhydrone, a combination of hydroquinone and quinone has found wide application in pH sensing advices. A quinhydrone-based polymer electrodes as pH sensor alternatives were fabricated and characterized. A poly(vinyl chloride) (PVC) membrane was used to physically immobilize quinhydrone (QH) showing attributed as a pH sensor (slope - 44.0 mV pH⁻¹). However, there was significant deviation in the range of electrode response due to segregation and variability in the PVC-QH mix and nonreproducible fabrication steps. X-ray photoelectron spectroscopy (XPS), a surface analytical and diagnostic technique, helped determine why the electrode surface possessed the desired of undesired property. The chemical immobilization by covalent bonding of quinhydrone in conducting polypyrrole allowed enhancement of sensor structure and fabrication reproducibility. The potentiometric characteristics of the resulting films showed sub-Nernstian response of 46.0 mV ph-1 (25°C); a detection limit of 1×10^{-10} mol dm⁻³; potential drift of ± 1.9 mV potential and low hysteresis with Aslope- ± 1.9 mv pH⁻¹. Quinhydrone functionalized polypyrrole offers potential for pH sensor devices with the electroactive species, conductive support and the mechanical support in an integrated form.

Keywords: quinhydrone, polymembrane, pH sensor devices, electroactive species

14. GROWTH OF AMORPHOUS CARBON, DIAMOND-LIKE CARBON AND DIAMOND FILMS VIA PLASMA-ENHANCED AND HOT FILAMENT CHEMICAL VAPOR DEPOSITION

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Amorphous carbon, diamond-like-carbon and diamond films were deposited on silicon (100) substrates via plasma-enhanced chemical vapor deposition (PECVD) and hot-filament chemical vapor deposition (HFCVD). In the PECVD method, depositions were made via a two-step process that involved negatively biasing the substrates in a 1-3% methane in hydrogen discharge followed by growth of the film for at least 10 hours. The substrates were heated to temperatures up to 500°C. They were exposed to the negative glow region of a d.c. discharge. On the other hand, the HFCVD technique involved pretreatment of the substrates and film growth. The registered temperatures of the substrates when deposited occurred within the range of 580-760°C. The total gases used in the process were hydrogen and methane which constituted 0.1-3% of the total gas filling pressure. In the pretreatment stage, a 7-8.3% methane concentration was fed. The total gas filling pressure was varied in the range of $8-40 \times 10^2$ Pa. A scanning electron microscope (SEM) and reflecting microscope were used in the determination of the films' surface morphologies. X-ray diffraction (XRD) was utilized in verifying the crystal structure of the films grown. Other characterization techniques, like Fourier transform infrared spectroscopy (FTIR) and Raman spectroscopy confirmed the grown films.

Keywords: chemical vapor deposition, diamond-like films, diamond thin films

15. SOLVENT EXTRACTION OF ESSENTIAL OILS FROM YLANG-YLANG *Cananga odorata*

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The essential oil local industry is restricted to compounders, blenders and other components which are mostly imported requiring large dollar outlays. To

minimize this dependency, the local industry started to tap indigenous sources of essential oils which include our Ylang-Ylang trees. Essential oils in concrete and absolute forms were extracted from mature freshly harvested Ylang-Ylang (*Cananga odorata*) flower using solvent extraction with petroleum ether as extractant. Percent yield, energy requirement and solvent recovery were determined as affected by extraction time or number of siphonings in a modified large volume soxhlet extractor. Results revealed the highest percent yields obtained were 2.18% and 1.37% for concrete and absolute forms, respectively, after ten siphonings (11 hr and 50 min extraction time). Percent recovery of petroleum ether averaged at 72%. Losses were due to solvent evaporation, solvent absorption by the Ylang-Ylang flowers and vacuum pump losses in vacuum evaporation. Power requirement for solvent extraction was determined to be 0.476 kWh per ml concrete essential oil. Average energy efficiency was 61.6%. Energy losses occurred due to lack of insulation and energy inefficiency of equipment. The absolute essential oils produced had an ether number of 188, characteristic of first class quality essential oils.

Keywords: essential oils, solvent extraction, Ylang-Ylang, petroleum ether

16. DECOLORIZATION OF RAW SUGAR SOLUTION USING STEAM-ACTIVATED CARBON FROM CANE BAGASSE

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In a well-managed sugar factory, bagasse in excess of its fuel requirement may be processed and utilized in many ways, like in the production of activated carbon (AC). AC is an important product in the purification process, e.g. removal of odor and color. Determination of process conditions for AC production is vital for bagasses utilization. Samples of cane bagasses from the Canlubang Sugar Estate, Philippines were carbonized for one hour in a batch reactor (3.0 cm ID x 19 cm L.) inside a horizontal electric furnace, at 300°C, with nitrogen gas pressure maintained at 0.5 kg/cm.² and a flowrate 100 cc/min. The carbonized samples were activated for hour at 800°C by steam (3720 cc/min.) Seven batches of carbonization and activation resulted to the production of 10.12 g AC. Based on the air-dried bagasses, the average yield was 15.86% AC which approximately contained 0.89% moisture, 8.1% ash and 81% fixed carbon. The effective contact time (average of 60 min) and effective dosage

(average of 1. g AC/100 ml raw sugar solution of 50°Bx) were determined by measuring percent color removal at 560 mu. The adsorptive capacity of AC was measured by determining its iodine number, the milligram of iodine adsorbed per gram of carbon. The following values were obtained for the steam-activated carbon: 730.32 mg/g (AC from two-year old bagasses samples) and 647.92 mg/g (AC from 1-year old bagasses samples). Compared to the CO² - activated carbon of lower iodine number (301.13 mg/g), the steam-activated carbon had higher adsorptive capacity.

Keywords: activated carbon, bagasses, decolorization, sugar, raw sugar, steam-activated, carbon, iodine number, cane bagasse

17. PERFORMANCE EVALUATION OF A DUAL MODE BIOMASS GASIFIER-COMBUSTOR FOR PROCESS HEAT¹

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A gasifier-combustor was designed, fabricated and tested for its performance at different air flow rates in updraft (UM) and downdraft (DM) modes of operation.

Results indicated that a defined temperature profile characterized by a sequential surge of temperature starting from the oxidation zone occurred in the various levels during the runs, illustrating the movement of the fire/oxidation zones during the gasification process. In all the runs, the highest level of the gasifier had the lowest temperature. Gas composition varied at different air flow rates and changed with time. The downdraft mode of operation produced more combustible gases (CO, H₂ and CH₄) than the updraft mode operation. Low airflow rates gave better gasification performance than high airflow rates. Produced gas temperatures for all test ranged from 75-260°C and heating values ranged from 0.1 to 8MJ/m³. Mass and energy balance evaluation showed that dry air and clean gas comprised for the material input and output, respectively. The heating value of the output gas and tar made up most for the energy output along with the heat and unaccounted losses.

18. DESIGN, FABRICATION AND TESTING OF A COMPUTER INTERFACED PROCESS CONTROLLER FOR A SOLUTION HEATER

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The study conducted in anticipation of the need of village level technologies for small scale continuous solution heaters required in fermentation and similar processes. The study designed, fabricated and tested a computer interface control system as well as developed an automatic controller software. The apparatus had the following components: digitizer board, controller board, sensor transducers and transmitter, comparator, heater, heater sensor, level sensor and retention tank. Turbo language software was used in the system. Setpoints of 60°C, 40°C and 80°C at flowrates 5ml/sec, respectively, were tested for temperature responses. The settling point temperatures were determined from average responses at continuous operation at 60°C with 5ml/sec, a settling point temperature of 60.51°C was closest to the temperature setpoint. at 40°C and 80°C, the settling point temperature were above the setpoint. An empirical model was developed to determine the effective flowrate that will reach the given setpoint. At 40°C the flowrate was 24.026 ml/sec; at 60°C, 17.695 ml/sec; at 80°C, 11.836 ml/sec. Empirical model of effective flowrate and setpoint was also developed. The setpoint range was between 30°C to 73°C. The effective flowrate was between 0 ml/sec to 53.5 ml/sec.

Keywords: empirical model, sensor transducer, controller board, digitizer board, comparator, computer interface, process controller.

19. EXTRACTION OF ALUMINUM OXIDE Al_2O_3 FROM THE PYROCLASTIC MATERIALS OF MT. PINATUBO

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Mineralogical analyses of the volcanic material of Mt. Pinatubo indicated the presence of materials such as silicon oxide, aluminum oxide and lithium oxide in

varied amounts. Activated oxide (alumina) is the main raw material for the production of aluminum. Activated alumina is used in creating artificial jewels, high refractors and other material for optical instruments. Thus, effective and efficient extraction of alumina from pyroclastic materials may change the economic importance of lahar. Aluminum oxide was extracted from lahar using 10, 20, 30 and 40 g of NaOH as extractant using a modified Bayer process. The time of digestion was varied to 1, 2 4 and 5 hrs. The pH of precipitating aluminate ion to aluminum hydroxide was also varied by adding different amount of HCl acid to produce solutions with a pH range of 11.00 to 8.51, 8.50 to 6.51, and 6.50 to 0.01. The percent aluminum (% Al) composition of the pyroclastic materials and extracted alumina was determined using an Atomic Absorption Spectrophotometer. The aluminum composition of the pyroclastic materials used in this study was 0.32% by weight. The unpurified alumina product was analyzed from 0.01 to 1.8% by weight of aluminum. The average percent extraction yield of alumina ranges from 3.31% using 10 grams of NaOH as extractant at 1 hour digestion, with a pH range of precipitation of 0.01 to 6.50, to 95.83%, using 40 grams of NaOH as extractant at 5 hours of digestion, with a pH of precipitation range of 8.51 to 11.00. The amount of NaOH used, time of digestion and pH of precipitation range of 8.51 to 11.00. The amount of NaOH used, time of digestion and pH of precipitation was found to have significant effect on the percent extraction yield of alumina. An increase in the amount of NaOH used and time of digestion increased the percent extraction yield of alumina. The pH of precipitation that gave the higher extraction yield was found to be in the pH range of 8.51 to 11.00. Using 40 grams of NaOH and 5 hours of digestion time also maximized extraction yields.

Keywords: aluminum oxide, pyroclastic materials, extraction, Mt. Pinatubo, alumina extraction

20. FORMATION OF TIN ON METAL SUBSTRATES USING A MAGNETIZED SHEET PLASMA

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Numerous titanium nitride (TiN) films were produced on different target materials (Cu or stainless steel) using a magnetized sheet plasma. The use of a magnetized sheet plasma presents a new approach to the production of TiN. The mixed-species plasma was formed from a total initial gas filling pressure of 5.33 Pa consisting of 1% N_2 in Ar. The plasma current was 12.0 A and the potential between the cathode and anode was 150.0 V. A titanium disc placed near the anode is sputtered by the plasma beam. The target substrate was either immersed in the sheet plasma or placed about

4.0 cm parallel to the sheet plasma. In the case of Cu substrate, the to form TiN require heating of the substrate. Both substrates were biased 20.0 V relative to the anode. X-ray fraction (XRD), Raman and microchemical energy dispersive X-ray emission (EDX) spectroscopic characterizations confirmed the produced TiN films. The films were characterized by the golden color attributed to TiN.

Keywords: magnetized sheet plasma, titanium nitride thin film.

21. FUEL AND COMBUSTION MODELLING OF A NATURAL CONVECTION FLUE-CURING BARN

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The flue-curing of tobacco is energy intensive. Most if not all of it is derived from fuelwood. The existing system result to high energy losses. A fuelwood combustion analysis and modeling were undertaken using a mathematical model. Subsequent testing of the model was undertaken under field conditions. The model illustrated the importance of analyzing the fuel use and combustion process to estimate the energy efficiency of the barns. The fuelwood use rate, combustion processes and products of combustion were determined and analyzed. The analysis indicated that the fuelwood use can be predicted at different stage of the flue-curing process. The products of combustion like carbon dioxide, carbon monoxide and sulfur dioxide were predicted using the model. The result of the study is a very important tool in tobacco barn design and improvements specially in combustion, energy efficiency and emissions control.

Keywords: barn, carbon dioxide, carbon monoxide, combustion, efficiency, energy, flue-curing, fuel, fuelwood, sulfur dioxide, tobacco.

22. A KNOWLEDGE-BASED SYSTEM FOR SHIP HULL FORM DEFINITION

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The purpose of this research was to develop a software for designing knowledge-based ship hull forms. The study developed an easy-to-use, parameter based, shape selection hull definition computer program which was linked to an advisory component that provided useful, necessary and explainable advice to the user. A combined object oriented and knowledge based systems methodology was employed for development and implementation. System objects, structures and models of activities developed during the analysis and design stage greatly facilitated rapid program writing. The design system generated a hull form by aggregating user-selected shapes representing different geometric boundaries of the hull. Hull variation was accomplished by changing simple parameters such as entrance angles, length-breadth ratios and radii. Hydrostatic calculations were included for analysis and referred to the advise system for evaluation. The advise system consisted of a fishing boat knowledge base implemented in an expert system development environment. Rules for the advise system were elicited from experts using a program written to derive basic decision making elements. Using the software resulted in an easy-to-use process for designing a ship hull.

Keywords: *ship, design, hull form, expert system, knowledge based system, artificial intelligence, programming, object-oriented, knowledge acquisition, model*

23. A NEW LOOK AT VASOMOTION USING CHAOS ANALYSIS

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The vasomotion observed in rat mesenteric at rest using video-microscopy was analyzed using nonlinear analysis. It appears that the dynamics of vasomotion, as assessed by RBC velocity in single arterioles, is naturally chaotic. Temporal

variations in the RBC velocity were found to be aperiodic and the power spectrum indicated the presence of different frequencies. To differentiate from noise, the phase space plot was graphed revealing that the points are bounded. Although this could either indicate a chaotic system or periodicity, the first return map showed that no two points overlap, thereby indicating a chaotic behavior. Quantitative analysis demonstrated that altering the embedding dimension from values of 4 to 6, 8 and 10 produced the same signature, suggestive of self-similarity. The plateau of the signature corresponded to a non-integer value of approximately 1.2, again characteristic of a chaotic system. The temporal profiles of the blood velocity signals decreased in amplitude as the injected volume of the calcium channel blocker Nicardipine (NIC) was increased from 0.3 ml to 0.9 ml and 1.8 ml. The decrease in blood velocity is expected, considering that the drug produces an increase in arteriolar diameter and a fall in blood pressure. Qualitative analysis of the signals using the phase space plot and the power spectrum indicated the presence of different periods in the signals. The observed multiperiodicity was evident under all concentrations of NIC. Thus it appears that while Nicardipine is able to produce the desired alterations in systemic blood pressure and vessel diameter, it is also able to preserve the naturally chaotic character of the microcirculation.

Keywords: vasomotor, rat mesentri arterioles, video-microscopy, temporal variation, Nicardipine, microcirculation, power spectrum, periodicity

24. DEVELOPMENT OF THE THEORY OF FINITE PSEUDOGROUPS

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Non-associative finite algebraic structures have many important applications in pure and applied mathematics. In particular, structures belonging to the quasigroup family have been the focus of many studies. Along this line, an interesting structure called the pseudogroup - a not-associative loop in which every element has a unique inverse was studied.

Very little is known about pseudogroups in general but they constitute an important class of loops that includes IP loops and Moufang loops and they are involved in the theories of non associative algebras, loop theory, as well as in theoretical physics. This paper presents some important results of our research program to develop the foundations of the *Theory of Finite Pseudogroups*.

25. CHARACTERIZATION OF ABELIAN PSEUDOGRUUPS OF ORDER SIX

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A pseudogroup $\langle G; \rangle$ is a not associative loop such that every element has a unique inverse. The existence of finite pseudogroups had been established in 1981 by R.E. Cawagas for all orders $n \geq 5$. However, the number of non-isomorphic pseudogroups of any given order is not yet known except for order 5. The study determined and characterized all pseudogroups of small order. To achieve this, two computer programs were developed, the *ICONSTRUCT* and *FINITAS* which were used in generating and analyzing all pseudogroups of orders $n = 5, 6$ and 7 . Using these two programs, it was found that a total of 7 non-isomorphic abelian pseudogroups of order 6 exist.

Keywords: pseudogroup, finite, non-isomorphy, Abelian

26. SIMULATION OF LAHAR/FLOOD FLOWS OF PASIG-POTRERO RIVER

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A two-dimensional mathematical hydraulic model was developed simulating the dynamics of combined lahar and flood flow events that are initiated by storm rainfall inside a given river basin. Applying the mass and momentum conservation laws, together with the rheological properties of non-Newtonian flowing mixtures of water and non-cohesive sediments (lahar sand), a system of partial differential equations was formulated and coded into a 'FORTRAN Powerstation' microcomputer program. The model predict spatial and temporal variations of flow surface elevations, river bed elevations (deposition and erosion), flow velocity vectors and discharges, sediment concentrations and transport rates, and hydraulic/lahar forces, over a two-dimensional grid of nodes which geometrically represents the river basin. Utilizing as inputs the meteorological, topographical, hydrological, geological, and engineering data from various agencies (DPWH, PAGASA, PHIVOLCS, ZLSMG, and others), the combined lahar and flood flows of the Pasig-Potrero River basin inside the Megadike system were simulated. The simulation outputs consist of computed

discharge and stage hydrographs, sedigraphs, elevation-discharge rating curves, sediment-discharge rating curves, profiles of bed and flow surface along the dikes, and contour maps of deposition and scour pattern. The output was presented to the Mt. Pinatubo Commission to provide critical design criteria in the upgrading/revision of the existing Megadike system which consists of east and west lateral dikes, a transverse dike, two spillways, and several bridges along the Gapan-San Fernando-Olongapo Road.

Keywords: lahar flood, mathematical modeling, hydraulic, rheology, simulation

27. MOUNT PINATUBO – MOUNT ARAYAT TRANSECT: ALONG-AND ACROSS-ARC VARIATIONS

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Whole rock geochemical analyses confirmed the existence of along and across-arc variations in the Central Luzon area. The variations are basically due to the differences in the degree of partial melting of the source of the regions and amount of magma fractionation. The amount of fluids varied for each volcanic center. The Ba/La versus La/Sm relationship suggested that there appeared to be an increasing amount of fluid from south to north at the same degree of partial melting. At a first order of approximation, there appeared to be high fluid/high sediment correlation from Balungao (highest) - Balaybay; Tarlac; Pinatubo - Arayat - Mariveles; Natib; Samat (lowest). Mount Cuyapo and Simsiman did not follow the trend. The increased Zr/Y content could be due to continental sediments or fluid/melt interaction with the lower crust. Adakite-like rocks (high Sr/Y, low Sc, low HREE) were also observed among the sample population. This could be due to slab melting, lower crust melting, intracrustal fractionation or plagioclase accumulation. An understanding of the spatial-temporal-geochemical relationships of these different volcanic centers is critical in the understanding of the evolution of the Philippine island arc system. It will also help formulate the necessary mitigating and remedial measures with respect to volcano-related hazards.

Keywords: arc, volcano Mount Pinatubo, Mount Arayat, geochemistry, hazards, evolution, variations

28. LEVELS OF INORGANIC ARSENIC SPECIES IN MANILA BAY USING SELECTIVE HYDRIDE GENERATION-ATOMIC ABSORPTION SPECTROPHOTOMETRY

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The distribution of the inorganic forms of arsenic in the waters of Manila Bay was investigated using selective hydride generation atomic absorption spectrophotometry. An automated hydride generator coupled to an atomic absorption spectrophotometer enabled the determination of As(III) and As(III) + As(V) using the batch extraction method. The distribution of the dissolved arsenic species in the waters of Manila Bay was found to be in the following concentration ranges: <3-7 nmole/l As(III), 5-36 nmole/l As(V) and 8-36 nmole/l total arsenic. The horizontal distribution profiles of As(V) and total arsenic did not vary greatly among stations within the same period. Surface depletion of As(V) and total arsenic was generally observed during the wet season. The concentrations of As(V) and total As during the dry season were higher and more evenly distributed.

Keywords: inorganic arsenic species, Manila Bay, selective hydride generation, atomic absorption spectrophotometry, total arsenic, batch extraction, distribution profile

29. TRACE METAL SPECIATION OF MANILA BAY WATER SAMPLES USING LINEAR SWEEP ANODIC STRIPPING VOLTAMMETRY

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Voltammetric methods of analysis were developed using the linear sweep anodic stripping voltammetry (LSASV) for the trace metals analysis in seawater. A

rotating gold disc electrode was used for the simultaneous determination of Cu(II) and Hg(II), while a mercury-thin film (*in situ*) on a rotating glassy carbon disc electrode for the determination of Cd(II), Pb(II), and Zn(II) in acetate buffers. Stripping peak potentials observed at +0.51 V, +0.28 V, -0.47 V, -0.65 V and -1.04 V (vs SCE) for Hg(II), Cu(II), Pb(II), Cd(II) and Zn(II), respectively, were used for quantitative analysis. The chemical speciation of some coastal waters of Manila Bay by Showed that, Except, for zinc, which averaged about 40% labile metals, the dissolved metals namely copper, cadmium, lead and mercury were all in the bound or non-labile forms. These non-labile metals were found to be mainly composed of inorganic complexes and/or metals probably adsorbed on inorganic matter, with the exception of Pb(II). The percentage of non-labile inorganics were 65%, 69%, 70%, and 18% for Cu(II), Hg(II), Cd(II), and Pb(II), respectively.

Keywords: trace metal speciation, Manila Bay, linear sweep anodic stripping voltammetry

30. WATER QUALITY ASSESSMENT OF VARIOUS SELECTED SITES IN MANILA BAY USING PHYSICO-CHEMICAL PARAMETERS

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Manila Bay is one of the centers of shipping, fishing, commercial and domestic activities in the country. It serves as catch basin of the major tributaries in Metro Manila. Despite these activities there are few existing studies on the water quality of the bay. This study aimed to determine the Bay's physico-chemical parameters in sites representing the various activities. Assessment of pH, temperature, DO, salinity, conductivity, and turbidity were done using the Horiba Water Quality Checker. Nitrate content were analyzed using the Cadmium Reduction Method. The amount of orthophosphate was determined using the Vanadomolybdophosphoric acid Method, qualitatively, analysis was performed by FT-IR and NMR. Samples were obtained from October to December 1996. Data gathered showed estuarine and areas with fish markets and domestic settlements had considerably lower values in salinity and DO; and significantly higher values for nitrates and orthophosphates. Extremely high concentration of oil and grease exceeded the standard which is 3 mg/L for shipping, fishing and boating areas. Data obtained can be used as baseline information for the monitoring of pollution trends of various near-shore areas of Metro Manila. It can serve as basis for pollution management policies.

Keywords: water quality assessment, Manila Bay, pollution management, physico-chemical parameters

**31. EPITOMORPHIC COMBIPEPTIDES TARGETTING
THE ANTIGENIC DIVERSITY OF THE VP1
POLYPROTEIN (135-146) OF THE FOOT-AND-
MOUTH DISEASE VIRUS SEROTYPE A**

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Epitomorphic mimetics taken as strung-ensemble of peptide sequences are engineered against linearly immunogenic regions of the foot-and-mouth disease virus (FMDV) belonging to the serofamily A. These comprise residues flanking the RGD loop, an important structural motif identified with integrin-binding proteins and CAM families, of the immunodominant epitope VP1 known as the antigen site A. With the current vaccination strategy applied worldwide, such as, with live and killed viral vaccines and monovalent synthetic peptides, the failure to attenuate epidemics in cattle-producing countries have been, to a certain extent, attributed to the impotency of administered vaccines in the presence of antigenic drifts of highly mutating viruses. A biophysical approach involving empirically-guided hyper-mutation of a strong signaling epitope for designing new-generation synthetic vaccines aimed at countering this problem was developed. In the study, the importance of salient molecular endowments of the synthetic combipeptides was emphasized. Assignment of exhaustive functional mutations within the residue 135-146 has been biased by RNA and protein sequence and conformational comparisons between 6 known and antigenically distinct subtypes, A²², A^{rg79}, A^{ven76}, A²⁴, A³² and A⁵. The iterated epitomorphs (altered epitopes) were filtered using an exclusional scanning procedure involving computational algorithms of the antigenicity-determining parameters (hydrophilicity plots; strict (residuewise) and charge palindromicity; secondary structure and its retention states as an intact viral sequence, as an epitopic clustering as "high" and "low-stringency" groupings. The study showed that molecular design of

the anti-viral immunogens, the epitomorphic combipeptides, may be used as fine structured tools for immunologic studies as basis for the development of novel vaccines deemed to capture a strong neutralizing antibody repertoire and a solid cell-mediated protection against FMDV challenge in economically important livestock.

Keywords: Synthetic vaccines, antigenic drifts, quasi-speciation, Foot-and-mouth disease virus, vaccine designing, Biophysics, aphovirus, epitopes, epitomorphs, virology and immunology