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ABSTRACTS OF TECHNICAL PAPERS FOR POSTER PRESENTATION

MATHEMATICAL, PHYSICAL, AND ENGINEERING SCIENCES

1. NONSINGULARITY CONDITIONS FOR TWO CLASSES OF CIRCULANT GRAPHS

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A graph is said to be *singular* if its adjacency matrix $A = A(G)$ is singular, otherwise, G is said to be nonsingular. For example, the complete graph K_n is known to be non-singular for $n \geq 1$, while the cycle graph C_n, is singular if and only if n is divisible by 4.

A matrix $A = [aij]$ is said to be *circulant* if for each $i \geq 2$, the element of row i are obtained by cyclically shifting the elements of the $(i\text{-}1)$-th row one position to the right. Graph G is circulant if its adjacency matrix is circular.

In this study, we consider two classes of circular graphs. For $n \geq 3$ and $1 \leq r < n$, the graph C_n^r or the r-th power graph of the cycle graph C_n is obtained by forming the edge xy whenever there is a path of length less than or equal to r joining the two vertices x and y. On the other hand, we denote by $C(r, n)$ the circulant graph of order $2n$ formed by adding to the graph C_{2n}^r the edges joining opposite vertices of the cycle graph. Our aim is to determine conditions under which these two classes of graphs will be nonsingular.

Key words: singular/nonsingular graphs, circulant matrix, circulant graphs, r-th power graph, eigenvalues, adjacency matrix, cycle graph, greatest common divisor, least common multiple

2. PULSED 1064 nm Nd-YAG LASER DEPOSITION OF TITANIUM ON SILICON IN AN AMBIENT NITROGEN ENVIRONMENT

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Pulsed laser deposition (PLD) technique was demonstrated for the deposition of titanium nitride (TiN) thin films on Si (100) substrates using 1064 nm excitation. The target material used was titanium (99.5%) and deposition was done under ambient N2 pressure. Spectroscopic analysis of the plasma plume revealed emission lines due to Ti(I) and N(I), which are the active species that lead to the formation of TiN. Images of the films grown at different laser pulse energies show an increase in the number and size of deposited droplets and clusters with increasing laser pulse energy. A decrease in cluster and droplet size is observed, with an increase in substrate temperature. EDS data show an increase in the Ti peak relative to the Si peak as the ambient N_2 pressure is decreased. An increase in deposition time was found to bring about the growth of large clusters and irregularly shaped structures on the substrate. Post-deposition annealing of the samples enhanced the crystallinity of the deposited thin film.

Key words: pulsed laser deposition, titanium nitride, laser ablation, laser-produced plasma, optical emission, Nd-YAG laser, SEM, XRD, titanium, nitrogen

3. TOURNAMENTS THAT ARE NOT RESIDUALLY GRACEFUL

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A digraph consist of a set of vertices and some directed line segments, called arcs, joining pairs of vertices. Let m be the number of arcs of a digraph D. Label the vertices of D using distinct values from the set $\{0, 1, 2, \ldots, m\}$. If x and y are vertices forming the arc xy, assign to it the value $f(x)$-$f(y)$, were $f(x)$ and $f(y)$ denote the labels given to the vertices x and y, respectively. If all these values assigned to the arcs are distinct modulo m, and none of them is 0, the labeling is said to be a *graceful labeling* and the digraph is called a *graceful digraph*. This

was the concept introduced by Bloom and Hsu in 1982. They noted that such a concept of labeling has an application to a problem on network addressing.

In 1999, the author introduced a similar labeling as follows. Label the vertices of the digraph using distinct values from the set $\{0, 1,2, \ldots, m\}$. Also compute for the induced arc labels $f(x)-f(y)$. If these values form a complete residue system modulo m, the labeling f is called a residually *graceful labeling* and the digraph is called a residually *graceful digraph*. In an ongoing research, the author has shown that there exist digraphs that are graceful but not residually graceful, and vice versa.

In this paper, we consider a special class of digraphs called tournaments. Consider a round-robin tournament involving n players. Let the players be vertices of a digraph. We form the arc from a vertex to another vertex y if an only if x beats y. The resulting digraph is called a tournament of order n. There are no published results yet on residually graceful digraphs inasmuch as the concept was an original idea of the author was introduced less than a year ago only. The author has obtained some results on graceful and residually graceful paths and circuits.

Examples of tournaments that are residually graceful are given in this paper. Likewise it establishes the existence of some tournaments that are not residually graceful. Sufficient conditions on the order of a tournament for it not to be residually graceful are established.

Key words: digraph, vertex, arc, path, circuit, graceful labeling, residually graceful labeling, tournament.

4. ASSESSMENT OF INFLUENTIAL OBSERVATIONS IN PRINCIPAL FACTOR ANALYSIS

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In the present study, a method for detecting influential observations using iterative principal factor analysis is proposed. To do this, some influence functions $I(x; LL^T)$ and $I(x; \Delta)$ were derived for the common variance matrix $T = LL^T$ and the unique variance matrix Δ, respectively. The main objective here is to investigate the influence of a small change of data on the result of the analysis. To assess the influential observations, some influence measures like the Euclidean norm of $\Delta^{(l)}$ and $T^{(l)}$were derived which correspond to the theoretical influence

functions for the two components Δ and $T = LL^T$ of the common variance decomposition. The results of the study have shown that the application of the Principal Factor analysis (PFA) to the given data set clearly revealed a two-factor model. Furthermore, the proposed influence function at $\Delta^{(l)}$ showed that the Empirical Influence Curve (EIC) based on the differential coefficient can be used in practice instead of the Sample Influence Curve (SIC) for detecting influential observations In PFA.

Key words: influential observations; influence function; principal factor analysis; perturbation theory of eigenvalue problems; unique variance matrix; common variance matrix

5. INTRODUCTION TO THE JLC STUDY FRAMEWORK

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The importance of computers in the field of High Energy Physics (HEP) is beyond question. Computer simulations have been utilized to guide experiments, predicting the possible outcomes, providing a valid comparison to acquired data based on accepted or proposed physical theories.

In the last 10 years, wide experimental efforts have been poured to detect the last undiscovered particle in the Standard Model – the Higgs boson. Huge experimental projects have been initiated in the United State and Europe to this end. In consonance with this worldwide endeavor the Asian HEP community proposes to build its own: the Joint Linear Collider (JLC). /the JLC will be built in Japan.

Here we present a software designed to meet the needs for HELP studies in the JLC: the JLC Study Framework (JSF). We then discuss the processes of event generations, simulation, event reconstruction, data acquisition, and data analysis in JSF using as an example the Standard Model Higgs production process $e^+e \rightarrow Z^0H^0_{SM} > qqbb$.

Key words: high energy physics, JLC study framework, Higgs boson, computer simulation

6. COMPUTING IN A BEOWULF CLASS COMPUTER SYSTEM

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Current PCs have achieved a performance comparable to the high-end UNIX workstations, at a small fraction of the price. Commodity PCs have become the solution to CPU needs, even for large scale computing in physics. The development of free software has made computations even easier.

The Beowulf class computer system is a type of parallel or distributed system, which consists of interconnected commodity-of-the-shelf (COTS) personal computers working together as a single integrated computing resource. A certain computational task could be divided among the computers to fasten execution of the task.

At MSU-IIT, we built a three-node Beowulf system. Each node has two 350-MHz Pentium II processors. All softwares used are freely available in the Internet. Communication of the results between nodes is done by message passing library Message Passing Interface (MPI), or Parallel Virtual Machine (PVM).

Initial computations show that the performance of the MSU-IIT Beowulf system is 5 to 6 times faster compared to a single processor PC. Since a Beowulf computer system is expandable, installing additional nodes to the existing system increases its computational power.

We can thus build a system with performance comparable to high-end RISC-based computers at a small fraction of the price.

Key words: computing, Beowulf system, computer, message passing interface, parallel virtual machine

7. THE FULL PINCH TECHNIQUE GAUGE INVARIANT HIGGS BOSON SELF-ENERGY

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The Pinch Technique (PT) is an algorithm that renders one-loop gauge and scalar boson self-energies of renormalizable spontaneously broken non-abelian

gauge field theory gauge invariant. In scattering processes at one-loop level, PT unravels self energy contributions from vertex and box diagrams that are otherwise excluded in the conventional manner of computing self energies. In general, by itself, this pinch self-energy contribution is gauge dependent. When combined with the conventional self energy, this PT contribution exactly cancels the gauge dependence of the former rendering the combined self energy gauge invariant. The resulting PT gauge invariant self energy satisfies desirable properties like resummability, unitarity of the S-matrix, and process dependence.

The PT arose from a search for a self consistent scheme for constructing off shell Green's functions which are of utmost importance in cases where the conventional perturbation theory breaks down like in the strongly coupled theory of Quantum Chromodynamics and in the vicinity of resonance in a weakly coupled theory of electroweak interaction in the standard model.

In this work, the S-matrix PT framework inspired by Degrassi and Sirlin is implemented in calculating the full PT contribution to the Higgs boson self energy in the general renormalizable $R\xi$ gauge. The scattering process considered is a four-fermion process with the Higgs boson as intermediate state. The relevant amplitudes reflecting the gauge boson and external fermion interactions are described in terms of matrix elements of Fourier transforms of time-ordered product of current operators. Through successive current contraction with the longitudinal four-momentum found in the propagator of massive vector bosons, Ward identities are triggered. Relevant pinch contributions are then identified upon application of appropriate equal-time commutators of currents.

The results obtained have the following desirable properties. The full Higgs boson PT contribution vanishes on-shell, which is a welcome property if one adheres to the correctness and validity of the Born approximation to the decay width of the Higgs boson. In the 't Hooft-Feynman gauge, the full PT result agrees with Papavassiliou's and Philaftsis' results. For gauges other than the 't Hooft-Feynman gauge, our results differ only with respect to the UV-quadratically divergent terms of the result whose origin may be traced to the contributions coming from tadpole and seagull graphs, which they omitted in their consideration. The significance of these UV-quadratically divergent terms should not be underestimated though, since they render the non-absorptive part of the Higgs boson self energy gauge independent as well. Finally, our results shows that the full PT gauge invariant Higgs boson self energy evaluated in the framework of the general renormalized R –gauge is identically equivalent to the full PT Higgs boson self energy 't Hooft-Feyman gauge, a property likewise found in Papavassiliou and Pilaftsis.

Key words: Higgs boson self energy, elementary particle physics, electroweak interactions, non abelian gauge field theory, S-matrix Pinch Technique, gauge invariance, radiative corrections, perturbation theory

8. NEW MEASUREMENT OF MEAN LIFETIME OF ATMOSPHERIC MUONS

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Recent measurements on the mean lifetime of atmospheric muons have been carried out through the months of August to October 1999 at IITHEP Laboratory, Iligan City. A vertical stack of three plastic detectors is utilized to identify cosmic ray muons decaying in a wooden absorber. The method employed is a measurement of the distribution in duration of the time intervals between the stopped cosmic-ray muons in plastic scintillation counters and the detection of the decaying electron in the downward direction.

The standard nuclear physics instrumentation, NIM and CAMAC, are used in this study. The experimental methods and technique are reported. A brief description on the properties and the electro weak decay of muon $\mu \rightarrow e\, \nu_e\, \nu_\mu$ are also discussed.

Muon decay time distribution curve is shown where a fit of the distribution to the exponential $(-t/\tau_\mu)$ yields a mean lifetime $\tau_\mu = 2.176 \pm 0.0429$ μsec, a value, which is significantly in good agreement with internationally accepted μ mean lifetime $\tau_\mu = 2.197 \pm 0.0004$ μsec as presented by the Particle Data Group.

Key words: muon lifetime, NIM, CAMAC

9. MBE GROWTH OF ZnTe/Zn(S, Te) SHORT-PERIOD SUPERLATTICES

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ZnTe/Zn (S, Te) short-period superlattices have been grown by our group on (001) GaAs substrates with very good structural quality. The growth conditions were found to be quite reproducible, leading to a series of samples with periods

between 12 to 29 angstroms. Characterization of the samples with high resolution x-ray diffraction confirmed the high structural quality of the samples showing that all are pseudomorphically grown. The relaxation behavior is strongly influenced by the ZnTe well-width with two critical ZnTe-thicknesses observable.

A substrate temperature of 280°C was chosen in order to avoid Tellurium clustering. ZnS was deposited from a compound source allowing the growth rate of ZnS at four different substrate- temperatures to be measured. Our group found from laser interferometric oscillations that the growth rate decreased from one A/sec at 150°C to 0.8 A/sec at 220°C. No ZnS growth could be observed at 240°C. Zn(S, Te) barriers with low Te content were grown instead of ZnS barriers.

A 200 mm-thick GaAs buffer was grown on (001) GaAs substrate in a III-V epitaxy chamber after oxygen desoption. The sample was then transferred under ultra-high vacuum to a II-VI changer. A 20 nm-thick ZnSe buffer was deposited followed by a ZnTe/Zn (S, Te) superlattice structure. A series of lattice-matched samples with intended periods of 1, 18, 24, and 30 angstroms were grown. The numbers of periods were between 120 and 200 leading to a total layer thickness of between 200 nm and 400 nm.

The superlattices were grown under Zn-rich conditions. Zn, Se, and Te were evaporated from elemental sources while ZnS was used in its compound form. A growth temperature of 280°C was chosen for all samples. The shutter opening times were varied to achieve lattice-matched samples with different periods. The beam fluxes were kept constant during the growth of the whole series. To circumvent the immediate relaxation of ZnTe grown on GaAs due to a very high lattice mismatch, the first ZnTe well was made to be only half as thick as the others. This first ZnTe well was then counterstrained by the succeeding Zn(S, Te)-barrier.

All samples were characterized with high resolution x-ray diffractometry (HRXRD). To determine the superlattice period, lattice constant and the strain, Ω-20 scans were performed around the (004)- and the asymmetrical (115)-reflections of the GaAs substrate. To distinguish between mosaicity and inhomogeneity, omega scans around the (004)-rehex of the zero-order satellite of the superlattice were carried out using a (200) four-crystal monochromator with an x-ray mirror on the incident side and a three reflection (220) Ge analyzer-crystal on the exit side of the diffractometer.

The results showed that short-period ZnTe/Zn(Z,Te) superlattices can be grown on GaAs substrates with high structural quality and reproducibility. The ZnTe well thickness is the crucial factor for growing samples of perfect crystalline quality. Moreover, the relaxation behavior is influenced by the amount of the average strain in the sample and the incorporation of nitrogen.

Key words: MBE, ZnTe/Zn (S,Te), short-period superlattice, substrate-temperature, ZnSe buffer, lattice-matched, relaxation, XRD, ZnTe well

10. ENERGY ANALYSIS OF A "DRAGON KILN" FOR FIRING "VIGAN JARS"

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The firing of ceramic products involves the partial fusion of the body and as it proceeds, the proportion of the glassy bond increases and the apparent porosity of the fired product becomes progressively lower. In the case of "Vigan Jars", these are fired to vitrify in fuelwood fired "Dragon Kilns" with a length of 30 to 50 meters. The kilns can accommodate different types of ware of various sizes. The thermal consumption.

Results of the evaluation indicate that the kilns consume an average of 30 to 50 cubic meters of fuelwood per firing, the firing cycle takes an average of five (5) days including the preheating phase. The maximum temperature recorded as 1250°C. The uneven heating of the kiln was found to be due the changes in wind directions during the firing process which resulted in cracking and over-firing.

Proper sequencing of the operation with the pre-heating process results in better fuelwood use efficiency. The installation of contraptions can reduce the occurrence of uneven heating.

Key words: ceramics, Dragon Kilns, energy, fuelwood, Vigan Jars, vitrification.

11. AN INVESTIGATION ON THE POTENTIAL OF HIGHLY ABSORBENT MATERIAL OBTAINED FROM SURPLUS DIAPERS AND SANITARY NAPKINS AS LAHAR CONDITIONER

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Volcanic eruptions such as that of Mt. Pinatubo in 1991 bring about great devastation to the lives of people especially those who rely on the land for their livelihood. In line with the effort of providing assistance to the lahar affected communities, the study was undertaken to explore the possibility of using highly absorbent material such as those obtained from surplus diapers and sanitary napkins as lahar conditioner.

Treatment of lahar containing varying amounts of the absorbent material (e.g., 0.6 kg, 1.2 kg, 1.8 kg, 2.4 kg, 3.0 kg, 3.6 kg) were prepared in three replicates under two experimental set ups – one set was treated with 14-14-14 balanced fertilizer and the other without fertilizer. Controls included pure lahar and pure garden soil. Each pot was planted with five kernels of corn and was watered with a specified amount of tap water daily. Observations on the length of stalk, number of leaves, length of leaves, and other changes in the general appearance of the plants were also noted daily. At the end of the test period, physical and chemical analyses were performed to determine the following: (physical bulk density, water holding capacity, field capacity, permanent wilting point, percent available moisture; (chemical) pH, available phosphorus, organic matter content, total nitrogen, cation exchange capacity.

The results showed that highly absorbent material produced some significant improvement of lahar such as decreased bulk density, increased water holding capacity and improved organic matter content. However, there was no improvement on the permanent wilting point and percent available moisture values. Results from the plant growth experiments show that the smaller the amount of conditioner added to lahar, the more fibrous the root system of the plant became. The addition of fertilizer resulted in healthier plants compared to their counterparts in the non-fertilizer set up.

Key words: Mt. Pinatubo, lahar, garden soil, diapers, sanitary napkins.

12. GENERATION OF NAFIL LOOPS OF SMALL ORDER

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The determination of all non-isomorphic loops of a given order n is one the difficult problems in the theory of loops and quasigroups. This paper deals with the computer generation of loops of small orders $n = 5$, 6, and 7 belonging to the class of NAFILs (non-associative finite invertible loops). This class includes the familiar IP, Moufang, and Bol loops. However, there are many other interesting loops in this class that have not yet been studied as much as the familiar loops.

The NAFILs of orders $n = 5$ and 6 were determined at PUP in 1996 using a Pascal program called ICONSTRUCT. Because of the enormous number of possible loops of order n = 7, the distinct NAFILs of this order were determined only in 1999 by a collaborative work with Prof. H. Zhang (Department of Computer Science, University of Iowa, USA) using two software system, SEM and SATO, and a upper computer (with 48 Pentium II400 processors). The results are shown in the table:

Order	5	6	7
Number	1 (CNA)	33 (7A+ 26NA)	2,333 (16A+2333NA)

Where A = Abelian and NA = Non-Abelian. These results have been posted in various Internet discussion forums and they have attracted the attention of loop theorists.

Key words: loops, non-associative, invertible, non-isomorphic, IP, Moufang, Bol Loops, NAFIL, quasigroups

13. IMMOBILIZATION OF TOXIC HEAVY METALS FROM ACADEMIC WASTE

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Stabilization/solidification is known as the immobilization of reforming toxic heavy metals to reusable material. Stabilization is a process by which contaminants are fully or partially bound by the addition of supporting media, binders, or other modifiers. Solidification is a process employing additives by which the physical nature of the waste is altered during the process.

The concentrations of cadmium, copper, lead, manganese, mercury, and nickel was established utilizing Atomic Absorption Spectrophotometry (AAS). Varying proportions of waste, cement, fine aggregate, and coarse aggregate were mixed and solidified in metal cylindrical molds. Simulated leaching of toxic heavy metals was conducted and the amount of contaminants was determined using AAS. The compressive strengths of both control and experimental specimens were established utilizing the Universal Testing Machine. Scanning Electron Microscopy (SEM) confirmed the binding mechanism between cement and contaminants.

The SEM result supports the comprehensive strength and leaching data. It further confirmed that cement can immobilize the toxic heavy metals in academic waste. Whether in combination with cement alone, or with cement and aggregates, academic waste in liquid or solid form can be solidified to produce specimens with highly acceptable comprehensive strengths.

Key words: immobilization, solidification, stabilization, leaching, contaminants, concrete, toxic heavy metals, academic waste, comprehensive strength, solidified waste

14. CAUSTIC SODA RECOVERY IN A BOTTLE WASHING PLANT USING MEMBRANE TECHNOLOGY

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The advent of using light containers such as aluminum cans and polyethylene terepthalate (PÉT) bottles for beverage packing has not at all phased-out the use of glass bottle. Today, glass bottles are still being reused widely by beer and softdrink companies. The reuse of such in the production process entails a thorough cleaning of these returnable bottles before refilling. During the bottle cleaning process, the beverage industry uses a large quantity of water and caustic soda solution for washing and rinsing operations.

When spent caustic soda is finally discharged, the usual practice is to treat it by neutralization using acidic waste streams. The problem with this process is that it produces a solution highly loaded with sodium that will eventually be detrimental to soil quality. Therefore, an effective way of minimizing the amount of caustic soda used and discharged from a processing plant must be found.

Membrane technology can be applied for caustic recovery. This is done by passing the caustic solution through base-stable membranes that can remove some, if not all, types of dissolved and suspended organic contaminants. Particles and colloids with size greater than 0.2 μm can be effectively rejected by microfiltration (MF). On the other hand, nanofiltration (NF) can separate molecules and ions with size less than 10Å. When membrane filtration is employed, the caustic solution may be recovered and the amount used in the process would consequently be lessened. Likewise, the total required volume of process water would be reduced. However, very little information is available on this kind of membrane system application. Only manufacturers of alkali-stable membrane have conducted the few studies done on the feasibility of this membrane application.

This research aimed to determine the performance of MF and NF in caustic soda recovery at pilot-scale level in terms of rejection rate, optimum applied pressure, and permeate quality. The effluent stream from bottle washers of one of the largest softdrink manufacturing plants in Thailand was subjected to membrane filtration using MF and NF. The study revealed that the MF/NF system can purify the caustic soda to a certain extent and can be reused back to the bottle washing units. Within the studied pressure ranges, the optimum applied pressure was determined as 101 kPa for MF and 1,414 kPa for NF with corresponding permeate fluxes of 235 and 15 L/m^2-h, respectively. Based on these figures, a large-scale installation was designed for the research site and a financial analysis was conducted for the system.

Key words: caustic soda recovery, microfiltration, nanofiltration, beverage industry, membrane technology

15. A COMPOSITE INDICATOR FOR LAKE WATER QUALITY MONITORING AND ASSESSMENT

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A composite indicator of water quality was formulated in this study to assess the suitability of lake ecosystem for various intended purposes, such as fisheries development. A single value is amenable to the same description and interpretation whoever is doing the assessment and prejudices on certain water quality variables would be eliminated.

The composite water quality indicator (WQI) was formulated by eliciting opinions from a panel of water quality experts the choice of variables, scaling procedures, and weights. The sampling distribution of WQI was estimated using the Monte Carlo simulation, the validity of which was verified for simple cases by showing that simulation and analytical derivation yield the same results.

Ten physicochemical and two biological variables were identified to constitute the composite indicator. The additive model was used in formulating the WQI because of its relative simplicity and sensitivity to extreme values. The WQI, which ranges from 0 (extremely worse condition) to 1 (best condition) may be classified as either very good, moderate, poor, or unaccepted by referring to a tabulated guide.

The WQI was applied to the water quality data for Laguna de Bay. The WQI has a beta distribution, although tests also showed that normality has been attained for sample size $n = 4$ or higher. The standard error of the mean of WQI was $0.0513 / \sqrt{n}$, where n is the number of sampling stations. The reliability of WQI may be evaluated further by constructing confidence intervals about μ_Q.

A test of hypothesis was formulated that would declare a given body of water as suitable for fisheries development if the computed composite indictor is at least 0.50. The power function was plotted for varying sample sizes and values for μ_Q. A graph showing the required sample size for fixed power and tolerance $(0.50-\mu_Q.)$ was also constructed which can be used to determine a cost-effective monitoring program. Thus, 25 observations are needed to attain a power of 0.90 when the tolerance level is set at 0.03.

The WQI was also applied in the assessment of bodies of water other than Laguna de Bay. Using the same WQI, results showed that the state of water quality of Taal Lake in Batangas and Tadlak Lake in Laguna were "good" and "moderate," respectively. The ability of the composite WQI to differentiate the state of lake water quality demonstrates the potential applicability of the composite indicator.

16. RADIOLOGICAL ASSESSMENT OF FORMER US BASES: I. CLARK AIR BASE

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Conversion of the former US Air Base at Clark, Pampanga into an economic zone with plans for extensive commercialization of the area requires radiological assessment of Clark Special Economic Zone (CSEZ). The Philippine Nuclear Research Institute, having the capability to measure radiation contamination, initiated a study to perform a radiological surveillance of the former US base in Clark. Natural and anthropogenic radiation measurements in ambient air in 131 km of CSEZ road network is achieved using a computer-based carbome gamma radiation spectrometric system (Eploranium Gr-650) equipped with a global positioning system (GPS).

Natural radioactivity concentrations by carbome gamma spectrometer for potassium (K-40), uranium (U-238), and thorium (Th-232) were measured at 316.44±82.28; 15.86 ± 3.23, and 13.08 ± 3.16 Bq. kg sample, respectively with corresponding total absorbed dose rate in air of 26.30 ± 6.68 nGy/h. Total absorbed dose rate in topsoil of natural radionuclides (K-40, U-238, and Th-232) measured by gamma spectrometer (HPGe) is 19-22 nGy/h. These values are within the background concentration vis-à-vis terrestrial absorbed dose rate of the whole country (23 nGy/h).

Evaluation of anthropogenic or man-made source of radiation in air using the carbome gamma spectrometric system indicated man-made sources from Cs-137 gamma radiation is not present within the CSEZ. Measurements of Cs-137 in topsoil showed values (0.98 – 4.64 Bq/kg) lower than the activity range concentration of Cs-137 in the country (<0.09-12.77 Bq/kg dry weight). Analysis of Cs-137 in drinking water from wells including those from Cabcom and DCDC main office showed values lower than the lower limit of detection in HPGe. The results of radioactivity analyses of air, topsoil, and water from the Clark Special

Economic Zone further established that man-made radioactivity (Cs-137) is not present in the former US Base in Clark.

Key words: assessment, US military bases, natural radioactivity, anthropogenic, radionuclides, air gamma dose rate

17. VISCOSITY SENSOR BASED ON A PIEZOELECTRIC QUARTZ CRYSTAL

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Conventional viscosity measurements usually require a sizeable amount of liquid sample (ca. 5 to 20 mL), considerable measurement time, and some specialized personnel skills. The most commonly used devices are the capillary viscometer and the "steel ball" viscometer. In order to simplify viscosity determination, a novel viscosity sensor was developed based on a piezoelectric quartz crystal. This device exploits the effect of the viscosity of a liquid medium on the resonant frequency of a piezoelectric crystal.

In this sensor, one side of the quartz crystal was exposed to about μL of the liquid sample in a fabricated sensor cell. The piezoelectric crystal was driven to vibrate through an oscillation circuit based on a TTL device and the oscillation frequency was measured through a frequency counter. The sensor exhibited a response within 1 second and reached a steady state in 2 minutes. In the presence of liquid sample, the sensor displayed a decreased frequency. The response was highly repeatable even at random sampling procedures. A highly linear relationship was observed between the frequency and the square root of the product of density and viscosity. The response characteristics of this sensor cold make it useful for the on-line measurement of viscosity in industrial processes.

Key word: viscosity sensor, piezoelectric crystal, quartz crystal

18. PROCESSABLE pH SENSOR BASED ON CONDUCTING POLYANILINE

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Polyaniline (Pan) is one of the many organic polymers that offer commercial applications. It is being used as coating of films for corrosion protection and as material for electrochromic displays that operate rechargeable batteries and optical devices. We have developed it as a processable pH-sensor that serve as an alternative to glass electrode. The latter has been found impractical in clinical laboratories because of its fragility and large volume requirement of body fluids that are difficult to obtain. A Pan-coated metal wire is robust and could be as small as 0.17 cm^2. Hence, it could be inserted in vivo for real time pH monitoring. The preparation of the potentiometric pH-sensor involves a straightforward procedure, and is inexpensive, making it highly processable. Absence of an internal filling solution in the sensor allows it to be used in any position – it may be placed vertically, horizontally, or upside down. Electrochemical polymerization was carried out in devising polyaniline-coated pH sensor. The optimum starting compounds and conditions for electrode fabrication are: 0.10 M aniline monomer, 30 mg Bovine Serum Albumin (BSA) dopant, 0.10 M Tris(hydroxymethyl)-aminomethane, at pH 7 30-minute polymerization time without stirring, platinum wire support and 9.34 mA cm^2 current density.

The sensor showed a sub-Nernstian response of -42.06 mV/pH (0.5), a linearity of 0.9985 and favorable response time of ~ 3 minutes for 3 replicates from pH3 to pH10 at room temperature. The conducting polyaniline-based pH sensor exhibited low hysteresis with –m-5.83 mV/pH, low drift with an RSD ~ <4% high reproductibility with an RSD = ~ <3% and lifetime of > 1.5 months. Through Cyclic Voltammetry, the growth of polyaniline onto a platinum disc was monitored. The voltammogram showed three forms of polyaniline: the reduced (-1.03V), conducting (-1.069V), and oxidized (^{4}0.061 V) states.

The polymer film surface of PAnIBSA sensor was analyzed using X-ray Photoelectron Spectroscopy (XPS) and Scanning Electron Microscopy (SEM). Via XPS, a wide scan spectrum of Pan/BSA was achieved showing the elemental composition Cis, N1s, and 01s. The absence of S2p peak at Eg ~ 168 eV indicates that the BSA dopant exist mostly in the bulk of the polymer film. SEM showed hexagonal-shaped flakes on Pan film on Pt wire under 5000 magnifications. The characteristics of the devised potentiometric pH sensor based on conductive

polyaniline presented are that it has good sensitivity and linearity making it a suitable alternative to the conventional pH glass electrode.

Key words: polyaniline, conducting polymer, sensor, pH, potentiometry, SEM, XPS, BSA dopant, Tris (hydroxymethyl)-amino methane buffer, Nernstian

19. FABRICATION AND CHARACTERIZATION OF CONDUCTING POLYTHIOPHENE AND POLY (3-METHYLTHIOPHENE) MODIFIED SENSORS

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Conducting polymer, an organic material with both electrical and mechanical properties had gained its popularity as potentiometric electrode. This kind of electrode has the advantages of being robust, and with higher mechanical strength. In this study, conducting polymers such as polythiophene (Pyp) and poly(3-methylthiphene) (P3MTp) were developed by electrochemical polymerization. The optimum polymerization conditions for P3MTp monomer, and 30s polymerization time. While the optimized polymerization conditions for PTp were 0.1 m thiophene (Tp) monomer, 10 mL chloroform, Pt solid support, 1 mA current, 0.1 $MC10_4$ dopant, and 20 s polymerization time.

The PTp-coated [H] sensor exhibited sub-Nernstian response (335.42 + 3.80 mV/pH) and good linearity (-0.9925) over hydrogen ion concentrations of 10^{-3} to 10^{-10} M. The 3MTp-based electrode gave a sensitivity response of -47.56 ± 2.51, V/pH with linearity of –0.0.99775 towards [H] in concentration range of 10^{-3} to 10^{-10}M. The potentiometric characteristics of the sensor include calibration curve, memory effect, electrode lifetime, hysteresis, electrode drift, and electrode selectivity. Scanning electron microscopy (SEM) was used to study the electrode surface composition was characterized by X-ray photoelectron spectroscopy (XPS).

Key words: polythiophene, poly(3-methylthiphene), conducting polymer, electropolymerization, pH potentiometry, sensor, cyclic voltammetry, XPS, SEM

20. COMPARISON – CONTINUOUS PROCESS OF LYSINE PRODUCTION USING IMMOBILIZED AND FREE CELLS OF *Corynebacterium glutamicum*

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Different gelling agents were used to immobilize viable cells via either alginate or κ-carrageenan gel beads. Based on cell leakage from the gel beads, oxygen and glucose diffusion coefficients and toxicity of the gelling agents, $SrCl_2$ was found to be the best for the immobilization of microbial cells not only in alginate but also in carrageenan beads. Using Sr-carrageenan gel beads, a lysine concentration of 12.5 g/L was reached in the continuous fermentation with a productivity of 0.75 g lysine/L.h.

To overcome problems of low mass transfer commonly encountered in immobilized aerobic cell fermentation, continuous L-lysine production using free cells in a stirred tank bioreactor coupled with a ceramic membrane was developed. Without ceramic membrane, batch fermentation with *Corynebacterium glutamicum* (wild type) exhibited a volumetric productivity of 0.18 g lysine/L. h. with a maximum lysine concentration of 9.4 g/L. When a ceramic membrane was coupled continuous lysine fermentation process at a dilution rate of 0.6 h^{-1} increased volumetric activity of 1.83 g lysine/L.h. and a maximum concentration of 30.5 g/L were obtained.

Key words: continuous lysine production, *Corynebacterium glutamicum*, free cells, gelling agent-$SrCl_2$, immobilized cells

21. DETERMINATION OF ANIONIC SURFACTANTS IN FRESH WATER BODIES IN THE PHILIPPINES BY NEGATIVE ION ELECTROSPRAY IONIZATION-MASS ESPECTROMETRY

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The presence of branched and linear alkylbenzene sulfonates (ABS and LAS, respectively) and cocofatty alcohol sulfates (CFAS) were determined in the

Pasig River, Laguna de Bay, and Balatuin River (San Pablo City, Laguna using negative ion Electrospray Ionization-Mass Spectrometry. The anionic surfactants were concentrated from the water samples by solid phase extraction (SPE) using a C2 SPE column and introduced into the MS direct injection. CFAS quantification was performed using the ratio of the m/z 237,265 and 293 peak areas against that of m/z247 of barium per fluorobenze sulfonate (internal standard). LAS and ABS quantification was performed using the ratio of the m/z297,311,325,399 and 343 peak areas against that of m/z of the internal standard. The detection limits for both CFAS and ABS/LAS analytes were below 0.5 ppm. Use for formaldehyde as a sample preservative improved the % recovery of CFAS, but did not affect the % recovery of LAS and ABS.

The commercial feedstock of CFAS, ABS, and LAS were analyzed to determine the respective profiles of carbon chain length.

CFAS was not detected in any of the water samples collected between September and November 1999 (below detection limit, <0.48 ppm). The combination of LAS and ABS was detected at around the limit of detection (0.28 ppm), but due to the low level, it was not possible to differentiate LAS and ABS by collision induced dissociation (CID)

Key words: surfactant analysis, LAS, CFAS, ESI-MS

22. STUDIES ON A LECTIN ISOLATED FROM THE SEEDS OF *Dolichos lablab* L. (BATAO)

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Crude extracts from seeds of *Dolichos lablab* L. (batao) indicated lectin activity with hemaglutination assay using human blood types A,B., AB and O. The highest activity was observed with blood type AB. Sugar inhibition assays suggested specificity for mannose and galNAc. The extracts were fractionated by saturated ammonium sulfate and affinity purified through a mannose sepharose column. SDS-PAGE showed bands of 14 and 60 kDal which stained positive to periodic acid Schiff reagent indicating a glycoprotein nature.

The purified lectin showed non specific dependence on cations when tested with Ca^{++}, M^{++}, Mn^{++}, and Zn^{++}. Dialysis against different concentrations of EDTA abrogated lectin activity. Hemagglutination activity was observed to be high at pH 8 to 9.0 and absent at low pH. It is stable up to 60°C.

Purified extracts showed an ability to induce release of superoxide anions in human neutrophils, indicating positive influence in phagocytic cell activity important in cells challenged by infections and tumors. Activity was observed to be dose dependent but not time dependent. The lectin was also observed to induce the release of NO_2, also indicating positive influence on immune response. It showed minimal ability to induce the release of cytokines, TNFa and IL2 by human monocuclear white blood cells. MTT assays using cell lines A549 a non small cell human lung adenocarcinoma and human breast cell line T47, showed cytotoxic activity especially with the breast cells in a manner almost comparable to the cytotoxicity of taxol which was the positive control used. Moreover, exudates of human mononuclear white blood cells incubated with different concentrations of lectin were cytotoxic to the same cell lines.

Key words: lectin, *Dolichos lablab*, glycoproteins, cytotoxicity, immunodulatory

23. PRODUCTION OF PROTEIN-ENRICHED BANANA PEELINGS FOR ANIMAL FEED INGREDIENT

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High carbohydrate, low protein, and high tannin contents of banana peeling wastes from the food processing company disposal around the country posed several environmental problems for the social health communities. These raw materials could be beneficial to food companies if it will be processed into animal feed. The objective of this study is to convert the high tannin-carbohydrate into more digestible protein feed ingredient using solid state fermentation (SSF) process.

A total of 44 selected fungal strains and isolates were screened for protein enrichment of banana peelings with low tannin and more soluble substances of products. The criteria of selection were the whitish color rapidity of growth in the SSf process, high protein content, and no toxic compounds in the final product. The following microbial strains obtained were *Aspergillus niger* BIOTECH 3104, and its auxotrophs 1031 and 1032B, *A. niger* BIOTECH 3105 and A. oryzae BIOTECH 3078 and KBN 616.

Based on the protein, the crude protein (CP) content of dried product from banana peelings fermented with *A. niger* BIOTECH 3104 had increased from 7.24% in raw material to 31.90% in the fermented products after 3 days of SSF process. On the other hand, the water soluble substances increased from 22% in the raw materials to 32% in final product. Feeding toxicity study on mice revealed that 50% substitution of soybean meal by protein-enriched banana peelings in their diets could be formulated without adverse effects on the growth performance of mice during the feeling trial.

Key words: bioconversion, banana peeling wastes, Aspergillus niger BIOTECH-314, high protein product, animal feeds