Research Activities
of the
School of Engineering

Annual Report 1961-62

Oregon State University
Corvallis, Oregon
RESEARCH ACTIVITIES

of the
School of Engineering
Oregon State University
1961-62

by

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Acting Assistant Dean of Engineering

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INTRODUCTION

This report describes research activities in the Oregon State University School of Engineering during the period from July 1, 1961 to June 30, 1962. Projects are listed according to the department in which the research is being conducted. In some instances, research activities are interdisciplinary and involve staff members from other schools of the University. Advanced degrees in engineering, which were conferred at the June 1962 commencement, are listed in a separate section together with theses titles. One section of the report lists the various publications of the engineering staff during the year. A complete listing of engineering staff publications may be obtained by writing to the Engineering Experiment Station.

Funds for the support of research are obtained through grants for the conduct of basic research, contracts for research on applied problems, and reimbursements for testing of an unusual nature not available through other sources, and by budgeted funds.

During the 1961-62 year, research activities involved 81 projects, with a total committed support of $693,000, and resulted in an annual expenditure of $294,000. Of this support, 61.3 percent was obtained by research grants from the federal government, 21.7 percent by research contracts or working agreements with the federal government, 11.2 percent from state funds, and 5.8 percent from private industry.
Local Shell-Side Heat Transfer Coefficients in Baffled Tubular Heat Exchangers

Investigator: J. G. Knudsen, Assistant Dean of Engineering.
Support: National Science Foundation.

This project has been continuing for a number of years and is concerned with determination of local shell-side heat transfer coefficients in baffled tubular heat exchangers. Considerable information has been obtained on effect of baffle spacing, clearance between tube and baffle, and type of baffle.

Heat Transfer and Flow Characteristics of Emulsions Made Up of Two Immiscible Liquids

Investigator: J. G. Knudsen, Assistant Dean of Engineering.
Support: National Science Foundation.

This study involves the determination of momentum and heat transfer characteristics of emulsions made up of two immiscible liquids. Heat transfer coefficients, velocity profiles, temperature profiles, and laminar and turbulent viscosities are being determined from flow in a circular tube.

A Study of High-Temperature Fuel Cells

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.
Support: Engineering Experiment Station, Electrochemical Society, Dow Fellowship, Texaco Fellowship.

This project covers research on the high-temperature, carbon-oxygen fuel cell. Studies are under way to determine to what extent this system can be catalyzed and thus find the maximum electrical power that may be obtained from such a cell.

A Study of High-Speed Transient Reactions in Electrochemical Reactions

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.
Support: Department of Chemical Engineering.
Chemical Engineering

This research is aimed at understanding some of the electrochemical discharge characteristics in batteries. The current-potential relations involved in the first microsecond of discharge of various electrochemical cells are being examined and from these measurements attempts are being made to interpret the individual polarization and kinetic phenomena.

Optimum Power Generation in a Streaming Potential Cell

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.
Support: Engineering Experiment Station, Electrochemical Society, Chemical Engineering Department.

The streaming potential which is generated by passing a liquid through a porous medium is being studied as a function of the ionic strength of the liquid.

Electrochemical Reactions in Thermal Batteries

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.
Support: Naval Ordnance Laboratory, National Defense Education Act - Title IV Fellowship Funds.

The physics and electrochemistry of fused salt electrolytes and porous electrode reactions are being studied with the objective of developing new voltaic cells for application in high energy reserve batteries.

A Study of the Gravitational Effects on Mass Transfer Phenomena in Electrochemical Processes

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.

An investigation is being conducted on the effects of high acceleration fields on electrochemical processes. Particular emphasis is being given to how limiting currents are affected in energy producing devices by such unusual gravitational fields.
Chemical Engineering

Electrochemical Extraction of Copper and Zinc from Low-Grade Ores

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.

Support: Oregon State Department of Planning and Development.

A process is being studied which may economically electro-winn or extract copper and zinc simultaneously from low-grade ores.

Electrostatic Water as a Source of Electrical Energy

Investigator: Robert E. Meredith, Assistant Professor of Chemical Engineering.

Support: National Defense Education Act - Title IV Fellowship Funds.

Research is being conducted on a device with no moving parts that will convert the potential energy of falling water to electrical energy. Efficiencies of conversion between 60 and 100 percent appear possible while power is generated with a very high voltage to current ratio.

Friction Head Loss in Liquid-Solid Streams

Investigator: Walter Meyer, Instructor in Chemical Engineering.

Support: General Research Fund.

The purpose of this work is to establish quantitative relationships and to determine in particular the effect of solids concentration and the angle of flow on the friction head loss as a function of stream flow rate.

Recovery of Thorium In a Pulsed Column by the Amex Process

Investigator: Walter Meyer, Instructor in Chemical Engineering.

Support: Chemical Engineering Department.

The Amex process (liquid ion exchange) for the recovery and purification of thorium from monazite sands has been investigated in batch type and mixer-settler equipment. The purpose
of this work is to establish the efficiency and effectiveness with which the separation and purification can be carried out in a pulsed column.

**Moving Bed Ion Exchange Recovery of Cesium, Cerium, and Strontium**

**Investigator:** Walter Meyer, Instructor in Chemical Engineering.

**Support:** General Research Fund, Engineering Experiment Station, Chemical Engineering Department.

The purpose of this work is to develop a truly continuous countercurrent ion exchange system and to study in this system the recovery of and separation of the three cations: cerium, Ce$^{3+}$, strontium, Sr$^{2+}$, and cesium, Cs$^{+1}$.

**Solid Vapor Equilibria of Metal Salts**

**Investigator:** J. S. Walton, Head, Department of Chemical Engineering.

**Support:** National Science Foundation.

Investigations are being conducted of equilibria between vapor and solid mixtures, including metal salts and other solids-vapor systems.

**Computer Evaluation of Vapor-Liquid Equilibrium Data**

**Investigator:** C. E. Wicks, Professor of Chemical Engineering.

**Support:** Department of Chemical Engineering.

Using an orthogonal series developed in an earlier investigation, a detailed analysis of all binary data previously published in the literature will be made to determine the thermodynamic consistency of the reported data. A classification of the system by the terms involved in the orthogonal series will be attempted. An IBM 1620 computer will be used to analyze the data.

**High Temperature Calorimetric Measurement of Inorganic Chemicals Enthalpies**

**Investigator:** C. E. Wicks, Professor of Chemical Engineering.

**Support:** U.S. Bureau of Mines.
Chemical Engineering

A high temperature calorimeter was designed, constructed, and is in operation for experimental determination of enthalpies, heat capacities, and change in entropies for inorganic chemicals.

Efficiency of a Perforated-Plate Pulse Column, Liquid-Liquid Extractor

Investigator: C. E. Wicks, Professor Chemical Engineering.
Support: National Defense Education Act - Title IV Fellowship Award.

This investigation will consider all of the variables influencing the efficiency of a pulse extraction column. This will include an evaluation of the effects of frequency, amplitude, tray spacing, and system properties on the performance of this type of extractor. Tentative plans include the study of a single droplet's behavior as it passes through the column.

High Temperature Investigations Using a Solar Furnace

Investigator: C. E. Wicks, Professor of Chemical Engineering.
Support: Department of Chemical Engineering.

Utilizing the radiant energy from the sun, a solar furnace has been designed and operated which will provide high temperatures within a controlled atmosphere. Research has been initiated on zone refining of metals.

Effect of Entrance Diameter to Reactor Diameter Rates in Chemical Reactor Design

Investigator: C. E. Wicks, Professor of Chemical Engineering.
Support: Department of Chemical Engineering.

A detailed investigation of entrance effects on the design of chemical reactors has been initiated. With the residence volume held constant, the ratio of entrance diameter to reactor diameter is being varied at various flow rates in order to determine the influence of this ratio on the overall conversion.
Chemical Engineering

Influence of Turbulence Intensity on Mass Transfer

Investigator: C. E. Wicks, Professor of Chemical Engineering.

Support: Exploratory Research Fund - Oregon State University.

A fundamental investigation has been conducted on the effect of turbulence intensity at various Reynolds numbers on the mass transfer from various geometrical shapes. A detailed analysis of the three previous investigations indicated the need for additional experimental study. Accordingly, various models will be studied within a wind tunnel.

Vapor Pressure Measurement by Metal Diaphragm Technique

Investigator: C. E. Wicks, Professor of Chemical Engineering

Support: U. S. Bureau of Mines

A high temperature vapor pressure apparatus was constructed for determining vapor pressures of metal halides. Pressures can be determined accurately from 2 mm to 2000 mm of mercury.

The Effect of Frequency and Amplitude in a Pulsed Extraction Column Employing the System Carbon Tetrachloride-Acetic Acid-Water

Investigator: C. E. Wicks, Professor of Chemical Engineering

Support: Department of Chemical Engineering.

The performance of a perforated-plate pulse column, liquid-liquid extractor was evaluated. The change in extraction efficiency with pulse frequency at a given pulse amplitude was investigated. This was an initial investigation to determine some of the factors which should be studied in order to evaluate the effects of frequency, amplitude, tray spacing, and system properties on the performance of this type of extractor.
A Comprehensive Study of Ocean Outfall Diffusers

Investigators: C. E. Behlke, Professor of Civil Engineering; F. J. Burgess, Acting Assistant Dean of Engineering.

Support: U.S. Public Health Service.

This project studies the general problem of the discharge and dispersion of sewage and industrial wastes into the near shore ocean waters of the Pacific Northwest. Studies on an effective method of predilution and upon postdilution of sewage as affected by wave mixing are included.

Supercritical Flow Channel Junction Research

Investigators: C. E. Behlke, Professor of Civil Engineering; H. D. Pritchett, Assistant Professor of Civil Engineering.


To investigate flow phenomena which occur when two open channels join, each conveying water at supercritical velocities. This type of junction is frequently of interest for drainage channels operating in steep sloping areas. This study will be aimed at an understanding of this complicated flow phenomena in order to give design engineers some fundamentally sound precepts upon which they may base their design computations.

Physical-Chemical Aspects of Deep Trickling Filters

Investigators: F. J. Burgess, Acting Assistant Dean of Engineering; C. M. Gilmour, Professor of Bacteriology; D. C. Phillips, Assistant Professor of Civil Engineering.

Support: Engineering Experiment Station, Civil Engineering Department, Oregon State Sanitary Authority, U.S. Public Health Service.

The long-term goal of the research is attainment of a more fundamental understanding of the role played by deep trickling filters in disposal of domestic and industrial wastes. It is recognized that physical, biological, and chemical factors are
Civil Engineering

involved. The relative impact of the factors, however, is incompletely understood.

Waste Water Lagoon Criteria for Maritime Climates

Investigators: F. J. Burgess, Acting Assistant Dean of Engineering, M. E. Northcraft, Assistant Professor of Civil Engineering.

Support: Engineering Experiment Station, Oregon State Sanitary Authority, City of Corvallis, U.S. Public Health Service.

Primary purpose of this work is to determine loading criteria that may be used for design of waste water oxidation lagoons in western Oregon. Also involved will be study of survival in oxidation lagoons of coliform organisms and other groups of bacteria associated with potential health hazards. It also will be possible to study feasibility of using waste water oxidation lagoons in western Oregon for treatment of colored food processing waste, particularly from canning of beets. An experimental lagoon, 2 acres in area and with a variable depth, has been installed at the Corvallis Sewage Treatment Plant on City of Corvallis property.

Water Quality Management by Low Flow Augmentation

Investigator: F. J. Burgess, Acting Assistant Dean of Engineering.

Support: U.S. Public Health Service.

Purpose of this project is to develop the criteria and program logic to determine by a digital computer the dissolved oxygen profiles that may be achieved in a complex stream system receiving various sources of pollution and "N" sources of flow augmentation from reservoir storage. Continuing research on water quality management by low flow augmentation is planned subsequent to program development.

Effects upon the Receiving Stream Caused by Discharging Chlorinated and/or Unchlorinated Wastes High in Algal Concentration

Investigator: F. J. Burgess, Acting Assistant Dean of Engineering.

Support: U.S. Public Health Service - Traineeship Award.
The use of sewage and industrial waste oxidation lagoons is gaining wider acceptance in the maritime regions of the Pacific Northwest. The effluent from these facilities is generally high in algal concentration and can possibly contain pathogenic bacteria, hence disinfection is required. Rates and nature of the decomposition process of this type of waste in the receiving stream are unknown and are the subjects of this research effort.

Investigation of the Effects of Skewed Contraction Joints in P. C. Concrete Roadway Slabs

Investigator: M. P. Coopey, Professor of Civil Engineering.
Support: Department of Civil Engineering.

To date, most contraction joints in concrete pavement have been at 90 degrees with the centerline of the roadway. By placing joints at a skew, better riding qualities are obtained. It is possible that certain structural advantages may also accrue. This investigation will attempt to evaluate these possibilities.

The Influence of the Level of Illumination on the Effectiveness of Highway Signs

Investigator: M. P. Coopey, Professor of Civil Engineering.
Support: Department of Civil Engineering.

The optimum level of illumination of highway signs has never been determined. It is possible to "over" illuminate a sign, which decreases the sign's efficiency in addition to increasing the cost of operation. This investigation will attempt to establish a working optimum level of illumination.

Study of Hydraulic Characteristics of Testing Machines

Investigator: O. Kofoid, Associate Professor of Civil Engineering.
Support: Engineering Experiment Station.

Developmental research on a 300,000-pound testing machine employing full pump displacement without by-passing or leakage and with full load control is being conducted in this project.
Differential Thermal Analysis of Soils

Investigators: O. Kofoid, Associate Professor of Civil Engineering; H. B. Cheney, Head, Department of Soils.

Support: Agricultural Research Foundation.

This research is aimed at developing processes and equipment for applying thermal differentials to multiple soils samples in a single block and obtaining graphs of the differentials for various classifications of soils.

Investigation of a Two-Bay, Folded Plate Structure

Investigator: T. J. McClellan, Professor of Civil Engineering.

Support: Civil Engineering Department.

Experimental study of steel folded plate model structure using SR-4 strain gages and Ames dial deflectometers. Primary objective is to compare beam theory with strip bending theory and compare each with experimental results.

Soil Survey

Investigator: G. L. Martin, Instructor in Civil Engineering.

Support: Oregon State Highway Department.

A program of soil sampling and testing is planned over a period of approximately five years in order to establish information regarding engineering properties of soils throughout the State of Oregon. It is expected that such information will be of value in highway design, studies of alternate routes, and economic analysis. The overall program of soil sampling and testing is under supervision of the U.S. Bureau of Roads.

Studies on Performance of Plywood Plate Structures

Investigators: Sai-lung Pan, Associate Professor of Civil Engineering; T. J. McClellan, Professor of Civil Engineering.

Support: Engineering Experiment Station.

Comparisons of stresses and deflections determined by direct measurement and computed by available solutions of
homogeneous isotropic plates by theory of elasticity are included in this research. Performance coefficients pertinent to plywood plates are to be developed on basis of tests.

A Procedure for the Distribution of Internal Forces and Moments in Cylindrical Shells Under Uniform External Loading

Investigator: Sai-lung Pan, Associate Professor of Civil Engineering.

Support: Department of Civil Engineering.

A procedure, analogous to Hardy Cross moment distribution, was developed for the determination of internal forces and moments in cylindrical shells of the single-barrel type continuous over any number of rigid supports.

Degradation of Kraft Mill Wastes in Saline Water

Investigator: D.C. Phillips, Assistant Professor of Civil Engineering.

Support: Department of Civil Engineering, U.S. Public Health Service - Traineeship Award.

Rates of decomposition of the waste liquor from the kraft process of paper making were studied in water at various salinities and with cultures acclimatized for varying periods of time. Determination of the reaction rate constants, ultimate BOD, and COD were made on wastes degraded at varying salinity levels to gain a better understanding of the effects of such waste discharges into marine waters.

Two-Dimensional Enclosed Flow Division Research

Investigators: H. D. Pritchett, Assistant Professor of Civil Engineering; C. E. Behlke, Professor of Civil Engineering.

Support: General Research Fund.

To study the fluid mechanics of flow division with possible eventual use in manifold design. This project is aimed toward a basic study with applications not being considered at this phase.
Civil Engineering

Hydraulic Model Testing - Rear Riser Piping

Investigators: Roy H. Shoemaker, Associate Professor of Civil Engineering; H. D. Pritchett, Assistant Professor of Civil Engineering.

Support: General Electric Company.

Investigate analytically and through model studies the hydraulic characteristics of rear risers and crossunder piping of certain atomic reactors and to determine the capacities of such risers to convey water-air mixtures.

Ecological Studies of a Polluted Experimental Stream

Investigators: C. E. Warren, Associate Professor of Fish and Game Management; F. J. Burgess, Acting Assistant Dean of Engineering; H. K. Phinney, Associate Professor of Botany.

Support: U.S. Public Health Service.

This is part of a broad study to be made using a section of a test stream. Facilities have been completed to provide controlled water flow in a natural stream for research studies of effects of pollution on stream biota. The study will undertake to develop satisfactory methods for measuring velocity and quantity of flow through porous gravel deposits serving as aquatic insect habitats and salmonoid spawning beds. This study is a cooperative research project of the departments of Fish and Game Management, Civil Engineering, Botany, and Entomology.
Galaxy Adder Circuit Development

Investigator: D. L. Amort, Assistant Professor of Electrical Engineering.
Support: National Science Foundation.

The project covers the development of a high-speed binary adder for the Oregon State University Galaxy Computer Project. The adder is an asynchronous parallel type with an add time that will be as good or better than that obtained in presently operating computers.

The Electrical Response of a Capacitor-Shunted Circuit Breaker

Investigator: J. F. Engle, Associate Professor of Electrical Engineering.
Support: Department of Electrical Engineering.

The project objective was to determine the effectiveness of shunting a circuit breaker with a capacitor by using a digital computer to determine the electrical system response. A shunt capacitor would improve the circuit-interrupting characteristics of the breaker, but the necessary capacitor size would make the application impractical.

Equivalent Circuit of a Hydrogen-Oxygen Fuel Cell

Investigator: J. F. Engle, Associate Professor of Electrical Engineering.
Support: Department of Electrical Engineering.

The project objective was to determine the equivalent electrical circuit of the cell for either transient or steady-state operation. The equivalent circuit is for the mathematical analysis of electrical networks of systems that would use this cell as an energy source.

Effects of Nuclear Radiation on Semiconductor P-N Junctions

Investigator: J. C. Looney, Assistant Professor of Electrical Engineering.
Support: Engineering Experiment Station.
Electrical Engineering

This project is divided into two parts of one year each:

1. The fabrication of p-n junctions and the measurement of their characteristics.

2. The irradiation of p-n junctions and the measurement of the change in characteristics.

Present efforts are devoted to the first part. The second part has been deferred until the radiation center facilities are available.

Electron Devices Made with Unusual Semiconductor Materials

Investigator: J. C. Looney, Assistant Professor of Electrical Engineering.

Support: General Research Fund.

Available funds are being used to purchase small quantities of unusual semiconductor materials. An investigation of the characteristics of electronic devices made from these materials should result in significant information about new devices.

Impact Ionization of Impurities in Silicon

Investigator: J. C. Looney, Assistant Professor of Electrical Engineering.

Support: Engineering Experiment Station.

The purpose of this investigation is to develop a very fast computer memory element based on the phenomena of impact ionization of impurities in a semiconductor. The memory element should be inexpensive and capable of operating at room temperature. Indium-doped silicon appears to be suitable for the semiconductor material.

A-C Impedance Bridge Control by Perturbation Techniques

Investigator: J. C. Looney, Assistant Professor of Electrical Engineering.

Support: Electroscientific Industries Fellowship Grant.

The object is to separate the resistive and reactive parameters of an A-C impedance bridge by perturbing them differently. The result is an output signal proportional to each parameter, which then can be used in a null balancing circuit to control bridge.
Electrical Engineering

Photomagneto Electric Effect in Measuring Lifetime of Minority Carriers in Semiconductors

Investigator: J.C. Looney, Assistant Professor of Electrical Engineering.

Support: Department of Electrical Engineering.

The photomagneto electric effect, together with the photoconductive effect, can be used to measure minority or majority carrier lifetimes in semiconductors even when trapping effects are large. The objective is to use these effects in measuring lifetimes of different shaped specimens, concentrating in materials with short minority carrier lifetimes; i.e., Ga As.

Variable-Width Pulse Generation Using Avalanche Transistors

Investigator: J.C. Looney, Assistant Professor of Electrical Engineering.

Support: Department of Electrical Engineering.

When the reverse bias of a p-n junction is increased, eventually the junction will break down. This may occur due to surface, zener, or avalanche breakdown. In the case of the last type, the breakdown is exceedingly fast and provides a method of producing millimicrosecond pulses with high peak powers. The object of this thesis project is to study this effect with particular emphasis placed on investigating circuits in which the duration of the pulse may be varied. Fast rise and fall times are additional design objectives. Pulses with these features may be applied in areas such as computer circuitry, sampling oscillography, and nuclear instrumentation.

Fast Access Core Memory Unit

Investigator: J.C. Looney, Assistant Professor of Electrical Engineering.

Support: Department of Electrical Engineering.

The project is in conjunction with the NSF Galaxy Computer Project. The purpose is circuit design of the circuits associated with this memory. The problems encountered are speed and power handling capacity needed for some of the circuits and detection of small S/N signals needed in other circuits.
Electron Tunneling Through Thin $\text{Al}_2\text{O}_3$ Films

Investigator: J. C. Looney, Assistant Professor of Electrical Engineering.

Support: Department of Electrical Engineering.

To demonstrate electron tunneling phenomena through thin insulating films, particularly $\text{Al}_2\text{O}_3$, and to demonstrate that this phenomena can be observed with films made from equipment of an inelaborate nature. A simple vacuum system designed for metallizing electron microscope specimens was used to produce thin metal films. $\text{Al}_2\text{O}_3$ films in thicknesses from 20-150 angstroms were obtained by a simple anodizing procedure. Tunneling currents were obtained at voltages depending on film thicknesses over the range mentioned above.

Analysis of Nuclear Reactor Period Measurements

Investigator: R. R. Michael, Associate Professor of Electrical Engineering.

Support: Electrical Engineering Department.

The ultimate limits in the measurement of the time rate of change of power in a nuclear reactor lie in the statistical nature of the processes involved. The objective of this project is the definition of these limits in terms of accuracy and speed of response obtainable with analog and digital measurement devices.

Neuro-Muscular Potential Applied to the Operation of Control Mechanisms

Investigators: R. R. Michael, Associate Professor of Electrical Engineering; F. R. Crawford, Assistant Professor of Psychology.

Support: Electrical Engineering Department.

To establish the feasibility of actuating off-on devices from surface electrodes responding to neuro-muscular action potentials.
Electrical Engineering

Portable, Fast-Responding Temperature Indicator

Investigator: R. R. Michael, Associate Professor of Electrical Engineering.

Support: Electrical Engineering Department.

This investigation was undertaken as a result of a need in the frozen food industry for a fast, portable temperature indicator. An instrument meeting industrial requirements has been developed and a prototype made available for field test.

Digital Procedures for Electric Network Analysis and Design In Complex Frequency Variable "S"

Investigator: Hendrik J. Oorthuys, Associate Professor of Electrical Engineering.

Support: Engineering Experiment Station.

1. Development of an automated digital procedure for handling routine calculations associated with network analysis and design in terms of the complex variable "s".

2. Development of an automated digital procedure to design a passive network yielding an acceptable approximation to an ideal response with a minimum number of elements.

Pulsed-Current Operation of Hall-Effect Generators

Investigator: L.N. Stone, Professor of Electrical Engineering.

Support: Electrical Engineering Department.

Pulsed-current operation of Hall-effect generators greatly increases the output voltage. This method of operation was investigated using several commercial generators. About two orders of magnitude improvement were obtained.

Compensation Network Synthesis by Inverse Root Locus Method

Investigator: L.N. Stone, Professor of Electrical Engineering.

Support: Electrical Engineering Department.

Servomechanism compensating networks are usually designed by a "cut and try" process. The method developed by this project gives the network characteristics directly.
Exploding Wire Current Pulse and the Resulting Luminous Radiation

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Electrical Engineering Department.

A study was made of the luminous radiation from an exploding wire. The waveform of the actuating current pulse and the luminous radiation were correlated. It was determined that the time to melt and vaporize a wire can be predicted under various conditions.

Multiple-Variable Simulation for Advanced Control System Synthesis

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Electrical Engineering Department.

Multiple-variable, nonlinear functions are considered for use in the simulation of advanced control systems. The electrolytic tank is used to generate such functions, and a study is made of the developmental possibilities of this method.

Magnetic Powder Digital Memory

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Electrical Engineering Department.

Investigation of the possibility of using magnetic powder, either in the form of thin film on tape or in bulk, for digital memory. This is contrasted with the present core memories which are bulky and expensive.

Calibration of High-Voltage, Radio-Noise Measuring Circuits in the United States

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Electrical Engineering Department.

A means has been devised whereby it is possible to calibrate high-voltage, radio-noise measuring circuits. This device will be sent to all high-voltage laboratories in the United States. Some inquiries have come in from Europe. This work is being done with the cooperation of the American Institute of Electrical
Electrical Engineering

Engineers Subcommittee on Radio Noise Measurement.

Aspects of Corona Formation and Radio Interference

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Bonneville Power Administration

Investigation includes the radio-noise characteristics and corona onset voltage characteristics of high-voltage conductors and insulators. Work is continuing on the correlation between measurements made in the laboratory and those made in the field.

Metal-Dielectric Junction. High-Voltage Phenomena in Vacuum

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: Electrical Engineering Department.

Investigation of breakdown phenomena in $10^{-6}$ mm Hg vacuum in voltage ranges from 10 kv to 200 kv, both d.c. and a.c. are being conducted. An understanding of the breakdown phenomena should lead to better control of high voltages in vacuum.

This project is being conducted as a cooperative unfunded project between L. N. Stone, Head, Department of Electrical Engineering and M. J. Kofoid of Boeing Scientific Research Laboratories.

Digital Computer Design and Development (GALAXY)

Investigator: L. N. Stone, Professor of Electrical Engineering.
Support: National Science Foundation.

This project covers the logical design, engineering design, and construction of computer for Computer Research Center. Will be parallel, asynchronous digital computer with 58 bit word. Memory cycle time of one microsecond. Logical design is nearly completed and the "Galaxy" computer installation will be undertaken in the near future.

A Transistorized Sonic Generator and Detector for Finding Young's Modulus of Wooden Beams

Investigator: Leonard J. Weber, Associate Professor of Electrical Engineering.
A nondestructive method of measuring Young's modulus of wooden beams would be useful in the lumber industry. This project involves the design, construction, and testing of a sonic generator and detector which will be used to measure Young's modulus of wooden beams. Correlation with destructive test data will be considered.

**Transistor Circuit Design for Optimum Noise Performance**

**Investigator:** Leonard J. Weber, Associate Professor of Electrical Engineering.

**Support:** Electrical Engineering Department.

A theoretical and experimental investigation of the requirements for low noise transistor circuit design. The investigation includes: (1) device parameters which affect the noise performance, (2) optimum operating point, and (3) effect of the base-bias network on the theoretical noise figure.

**Design of Probability Density Function Measuring Equipment**

**Investigator:** Leonard J. Weber, Associate Professor of Electrical Engineering.

**Support:** Electrical Engineering Department.

Communication circuits produce transmission errors when noise is present. A knowledge of the probability density function of the noise is necessary if the system error probability is to be calculated. This study involves the design, construction, and evaluation of equipment required to measure probability density functions for electrical signals.

**Protection of Semiconductor Devices from Electrical Transients**

**Investigator:** Leonard J. Weber, Associate Professor of Electrical Engineering.

**Support:** Electrical Engineering Department.

A study of methods of protecting semiconductor devices from voltage transients and power supply failures to determine a method of optimizing a protection system.
Investigation of a High-Lift Wing with a Circular Airfoil and Boundary Layer Control

Investigator: Edward W. Geller, Assistant Professor of Mechanical Engineering.

Support: Engineering Experiment Station and General Research Fund (Graduate School).

Experimental verification of theoretical work indicating the feasibility of a circular airfoil with boundary layer control. Wind tunnel tests are being made to determine the minimum power required to prevent separation by suction boundary layer removal.

Photographing a Boundary Layer Velocity Profile Using an $\alpha$ Source and a Spark Discharge

Investigator: Edward W. Geller, Assistant Professor of Mechanical Engineering.

Support: General Research Fund (Graduate School).

A new technique is proposed for recording the boundary layer velocity profile directly on a photograph taken of the flow. If perfected, the method will be particularly useful for thin boundary layers which are difficult, if not impossible, to survey by standard techniques.

Effects of Different Components of the Lignin Derivatives From Waste Sulfite Liquor on the Properties of Portland Cement Concrete

Investigators: C. O. Heath, Professor of Engineering Materials; D. W. Glennie, Professor of Forest Products Chemistry.

Support: General Research Grant.

Lignosulfonate products are used extensively in concrete work as water-reducing admixtures and as set-retarders. Results vary, depending on the composition which differs from batch to batch and from different sources. An attempt is being made to obtain a better understanding of the relative importance of the different constituents.
Mechanical Engineering

Cyclonic Waste Wood Burner

Investigator: A. D. Hughes, Professor of Mechanical Engineering.
Support: Mechanical Engineering Department.

It is apparent that with greater utilization of wood chips in the production of hardboard and pulp, there soon will be only bark, knots, and sander dust left to burn to produce steam to operate the lumber and plywood mills. A cyclonic type furnace for efficient burning of these waste fuels has been built and preliminary tests made, indicating considerable promise.

Convection Heat Transfer in Separated Regions - Subsonic Dif- fusers

Investigator: M. B. Larson, Associate Professor of Mechanical Engineering.
Support: Mechanical Engineering Department.

Heat transfer coefficients in subsonic diffusers will be determined experimentally. Data are not presently available to predict satisfactorily the film coefficients obtained when the diffuser is operating under conditions to give flow separation.

Effects of Oscillations on Natural Convection Heat Transfer From a Cylinder to a Liquid

Investigator: M. B. Larson, Associate Professor of Mechanical Engineering.
Support: Mechanical Engineering Department.

Previous work by others has shown that the experiment by Martinelli to evaluate the heat transfer rate from an oscillating cylinder cannot be reproduced. The possible role of cavitation, and hence gas content of the liquid, are considered in the present work.

Investigation of the Steady State Forces and Moments Associated with Flow Over Oscillating Surfaces as Affected by Waveform, Frequency, and Amplitude

Investigator: M. B. Larson, Associate Professor of Mechanical Engineering.
A theoretical and experimental evaluation is to be made of the forces and moments exerted on an oscillating surface when various frequencies, waveforms, and amplitudes are used to oscillate the surface.

Verification of a Rapid Method for Determination of Nitrogen Oxides in Engine Exhaust Gas

Investigator: John G. Mingle, Assistant Professor of Mechanical Engineering.

Support: Engineering Experiment Station.

Nitrogen oxides from engine exhaust gas have been shown to contribute to the smog formation, photochemical cycle. Purpose of this project is to further develop a rapid test for nitrogen oxide (NO), thereby reducing the time and expense of the classical test method when engine exhaust testing is required for atmospheric pollution control purposes.

Creep Tests of Aluminum Conductor Cable

Investigator: O.G. Paasche, Professor of Mechanical Engineering; L.E. Johnson, Assistant Professor of Mechanical Engineering.

Support: Bonneville Power Administration.

Purpose of this research is to obtain creep characteristics on aluminum conductor cable under various conditions of prestress, tension, and time.

Investigation of the Interaction of Environmental Factors on Human Motor and Mental Performance

Investigators: L. Siegel, Professor of Mechanical Engineering; W.W. Smith, Associate Professor of Mechanical Engineering.

Support: Mechanical Engineering Department.

Considerable work has been done in the past concerning desirable levels of individual environmental factors. The purpose of this investigation is to determine if interaction exists between the factors which will influence optimum efficiency levels.
Cutting of Aluminum, Magnesium, and Stainless Steel by the Gas-Shielded Nonrestricted Tungsten Arc (TIG) Process

Investigator: Asa A. Robley, Associate Professor of Production Technology.

Support: Linde Company and Engineering Experiment Station.

To establish procedure charts and tables to enable fabricators of aluminum, magnesium, and stainless steel to use their existing inert gas tungsten arc welding torches for accurate cutting of parts and components to size and shape. The variable factors of gas nozzle design, gas mixtures, gas flow volumes, electrode materials, and current will be explored in the course of work on this project.
NATIONAL COUNCIL FOR STREAM IMPROVEMENT

The following projects are being carried on in the research laboratory of the National Council for Stream Improvement (of the Pulp, Paper, and Paperboard Industries), Inc. The work is supported by grants from the National Council for Stream Improvement, and funds for equipment, supplies, and services are administered by the Engineering Experiment Station.

Investigators: Isaiah Gellman, (former) West Coast Regional Engineer; Russell O. Blosser (present) West Coast Regional Engineer; Eben L. Owens, Development Engineer.

Laboratory Study of Pulp and Papermill Waste Disposal by Irrigation and Land Application

This project involves a study of influence of soil permeability, texture, and chemical composition on its capacity for treatment of various mill effluents. Also included are studies of importance of cover vegetation, effluent composition and pre-treatment, and an evaluation of possibility of occurrence of ground water contamination from irrigation disposal of mill effluents.

Effect of Tidal Action in Lower Portland Harbor on Natural Self-Purification Characteristics of the Lower Willamette River

A continuation of work begun in the summer of 1959 designed to establish the manner in which observed tidal action in lower Portland Harbor affects the dissolved oxygen profile sag during critical low-flow period occurring each summer.

Characteristics of Kraft Mill Effluents

A study of sanitary characteristics of kraft mill effluents that may contribute to odor conditions in the vicinity of the discharge into receiving waters.
PUBLICATIONS OF THE ENGINEERING STAFF
1961-1962


ADVANCED DEGREES IN ENGINEERING
June 1962

(Names in parentheses denote major professor)

ABBEY, Charles Richard......................... MS EE
Detection of Phase-Modulated Signals Using Digital Techniques. (A. L. Albert)

AKKAYA, Dogan Ibrahim......................... ME EE
Lumped Model Transistor Noise Analysis. (J. C. Looney)

BALLIEU, Howard Lee......................... ME EE
The Binistor as an Electronic Switching Element. (A. L. Albert)

BARTON, Donald Roger......................... ME EE

BAYLISS, Edward Tebben......................... MS EE
Pulsed-Current Operation of Hall-Effect Generators. (L. N. Stone)

BERGSTAD, Ralph Hundley......................... MS ChE
A Comparison of Three Probes Used for Measuring Local Heat Transfer Coefficients. (J. G. Knudsen)

BITHELL, Robin Allan.......................... MS Aero E
The Design and Construction of a Small, Intermittent Supersonic Wind Tunnel. (H. D. Christensen)

BOEHME, Martin Leon.......................... MS ME
The Use of a Stirling Hot-Air Engine in Converting Solar Energy to Mechanical Power. (A. D. Hughes)

BROWN, Clyde Owen.......................... MS EE
Exploding Wire Current Pulse and the Resulting Luminous Radiation. (L. N. Stone)

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NARAYANAN, Krishnaswami ................. PhD ChE
Local and Overall Heat Transfer Coefficients in Baffled Heat Exchangers. (J.G. Knudsen)

PAN, Robert Benloun ....................... MS ChE
Natural Convection Heat Transfer from Finned Tubes. (J.G. Knudsen)

PEARL, John Joseph ........................ MS ME
Development and Design of Veneer Scarfing Machinery. (L. Siegel)

POSTLEWAITE, John Edward.................. MS ME
Production of Uniform Condensation from Saturated Air Flow in Cooled Porous Media. (M.B. Larson)

RILEY, Jack Carter .......................... MS EE
The Development of a Graphical Technique for the Analysis of the Performance of an Impedance Bridge. (L.N. Stone)

RYAN, William Lee ........................... MS SanE
Characteristics of Jet Diffusers for Ocean Outfall. (C.E. Behlke)

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SCHAER, Michael Jon......................... MS ChE
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TEJASEN, Jumsak .............................. MS CE
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THOMPSON, Ralph Allen ......................... MS ME
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VAN KLEECk, Nelson Leeds ...................... MS ME
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WELCH, John Allen ............................. MS ChE
The Effects of Frequency and Amplitude in a Pulsed
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WELTY, James Richard ......................... PhD ChE
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Calorimeter; High-Temperature Thermodynamic Properties
of Selected Inorganic Compounds. (C. E. Wicks)

WILKERSON, John Lee .......................... MS EE
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(L. J. Weber)

WITHYCOMBE, Richard Perry, Jr. .............. MS IE
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YU, John Bosco ............................... MS CE
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