Research Activities of the School of Engineering

Annual Report 1960-61

Oregon State University

Corvallis, Oregon

RESEARCH ACTIVITIES

of the

School of Engineering
Oregon State University
1960-61

by

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RESEARCH ACTIVITIES
of the
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Oregon State University
1960-61

INTRODUCTION

This report describes research activities in the Oregon State University School of Engineering during the school year 1960-61. Projects are listed according to the department wherein the work is conducted. Advanced degrees in engineering, which were conferred at the June 1961 Commencement, are listed in a separate section along with thesis titles. A final section lists the various publications of the engineering staff during the year.

Some projects in the departments are supported by the Engineering Experiment Station. This consists of several research assistantships and other limited support for materials and supplies. In addition, the engineering departments in which the research is carried out provide facilities and equipment. The Engineering Experiment Station administers a number of projects which are supported by state, federal, or industrial agencies. In listing research projects, source of financial support is indicated. Where no source is mentioned, the research is completely supported by the department in which the work is conducted.

AGRICULTURAL ENGINEERING

J.B. Rodgers, Department Head

Development of Economical Types of Farm Service Buildings and Systems for Their Utilization

Investigator: L.W. Bonnicksen.

Support: Agricultural Experiment Station, U.S. Department of Agriculture.

The objective of this project was to develop types of farm service buildings and systems for their utilization which would aid the farmer in obtaining maximum net income from agricultural production. Project evaluates types of construction, prefabrication, and assembly of economical farm service buildings.

Development of Improved Equipment and Methods for Harvesting and Processing Seed Crops—Design and Development of an Electrostatic Seed Separator

Investigators: D.E. Booster, Assistant Professor of Agricultural Engineering; J.E. Harmond, Principal Agricultural Engineer, USDA.

Support: Agricultural Experiment Station, U.S. Department of Agriculture.

An electrostatic seed separator has been built by the Agricultural Engineering Department for the purpose of making seed separations that are impossible or impracticable with conventional seed cleaning equipment.

Development and Testing of Equipment for Seeding Grasses on Sagebrush-Bunchgrass Range

Investigators: D.E. Booster, Assistant Professor of Agricultural Engineering; D.N. Hyder, F.A. Sneva, Range Conservationists.

Support: Agricultural Experiment Station, U.S. Department of Agriculture.

A heavy-duty range seeder has been developed for use in range improvement programs. This machine is especially suited for use in areas where dry, loose soils prevail. Plans and specifications for a 12-row seeder are available to interested parties, and also

to governmental agencies.

Development of Specialized Farm Machinery and Equipment—Design, Development, and Testing of a Mechanical Blackberry Harvester

Investigator: D. E. Booster, Assistant Professor of Agricultural Engineering.

Support: Agricultural Research Foundation, Agricultural Experiment Station.

A self-propelled, one-row, mechanical blackberry harvester has been constructed. The machine incorporates two powered picking heads, two hand-controlled picking heads, and a catching and conveying mechanism.

Evaluation of Soil as a Source of Heat

Investigator: M. G. Cropsey, Professor of Agricultural Engineering.

Support: Agricultural Experiment Station.

An attempt is being made to predict the amount of heat that can be obtained from soil when conductivity, density, specific heat, and moisture content of the soil are known.

Determination of Effect of Cathode Ray Irradiation on the Germination, Respiration Rate, Microorganism, and Taste of Wheat

Investigator: M. G. Cropsey, Professor of Agricultural Engineering.

Support: Agricultural Experiment Station.

Tests are being made to determine effectiveness of cathode rays in prevention of spoilage of wheat without impairing taste or germination qualities.

Factors Affecting Character of Frozen Strawberries

Investigator: D. E. Kirk, Associate Professor of Agricultural Engineering.

Support: Agricultural Experiment Station.

Agricultural Engineering

This is a cooperative project with the Department of Food and Dairy Technology. Department of Agricultural Engineering is concerned with studying the mechanical damage currently suffered by frozen strawberries and recommending equipment and procedures for improving the final frozen product.

Drainage of Stratified Soil

Investigator: J.E. Schoof, Instructor in Agricultural Engineering.

Support: Agricultural Experiment Station.

Depth and spacing criteria for the design of tile drainage systems in stratified soils are being studied. Installation and backfilling modifications that appear to have promise in Oregon also are being investigated. Methods for obtaining improved drainage in less permeable soils are being evaluated.

Adaptation of Sprinkler Irrigation to Soils of Low Intake Rate

Investigators: J. W. Wolfe, Associate Professor of Agricultural Engineering; James Berney, Graduate Research Assistant.

Support: Agricultural Experiment Station, U. S. Department of Agriculture.

Objective of project is to develop a procedure for determining optimum sprinkler application rate on low intake rate soils and to determine adaptability of sprinkler equipment with modifications, if necessary, for applying water at the required low rates.

Maintenance of Constant Soil Moisture During Plant Growth

Investigators: John Wolfe, Associate Professor of Agricultural Engineering; M. B. Larson, Associate Professor of Mechanical Engineering; C. Y. Shen, Graduate Assistant.

Support: National Science Foundation.

An attempt is being made to evaluate the important factors involved in placing moisture in soil by condensation from saturated air being passed through it.

CHEMICAL ENGINEERING

J. S. Walton, Department Head

RESEARCH ACTIVITIES

Local Shell-Side Heat Transfer Coefficients in Baffled Tubular Heat Exchangers

Investigators: J. G. Knudsen, Assistant Dean of Engineering; K. Narayanan, Graduate Assistant.

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.

Rates of Natural Convection Heat Transfer from Finned Tubes

Investigators: J. G. Knudsen, Assistant Dean of Engineering; R. B. Pan, Graduate Assistant.

Support: Engineering Experiment Station

Objective of investigation is to make a theoretical and experimental study of natural convection heat transfer to still air from heated finned tubes.

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

Investigators: J. G. Knudsen, Assistant Dean of Engineering; A. A. Faruqui, Graduate Assistant.

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 Fuel Cells

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; V. Hauser, Graduate Assistant.

Support: Engineering Experiment Station

Chemical Engineering

Potential uses of an operative fuel cell are extremely great. Proposed research in this project will be designed to investigate the electrode reactions and chemical mechanisms with which maximum power may be obtained from such a cell at the expense of economical geometry and operation.

Use of A-C Fields as a Source of Energy for Endothermic Reactions

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; J. McCormick, Senior.

Support: General Research Fund, Oregon State University.

Alternating current electrodes are used in conducting medium to supply heat or energy to a liquid for endothermic chemical reactions. This method of supplying energy is being compared to the more conventional method of transferring heat through the walls of a reaction vessel.

Optimum Power Generation in a Streaming Potential Cell

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; J. J. Schaer, Graduate Assistant.

Support: Engineering Experiment Station.

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

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; D. P. Clark, Graduate Assistant.

Support: U. S. Naval Ordnance Laboratory.

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.

Electrochemical Extraction of Copper and Zinc from Low-Grade Ores

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; G. W. Gleeson, Dean of Engineering; R. Rettig, J. Mackie, Seniors.

Chemical Engineering

Support: Oregon State Department of Planning and Development.

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

Electrostatic Water as a Source of Electrical Energy

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

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.

Use of Semiconductors as Anodes in Electrochemical Processes

Investigators: R. E. Meredith, Assistant Professor of Chemical Engineering; D. C. King, W. H. Brown, Seniors.

This research involves a study to determine the possibilities of employing semiconducting silicon and germanium as inert anodes in electrochemical cells. These elements are being compared with commonly used anodes of graphite and platinum.

Moving Bed Ion Exchange Recovery of Radio Cesium and Cerium

Investigators: W. Meyer, Instructor in Chemical Engineering; V. Ten Eyck, R. L. Olsen, Seniors.

Support: General Research Fund, Oregon State University.

Purpose of this work is to develop a moving bed ion exchange system and to investigate recovery of cesium and cerium from radioactive waste solutions with such a system.

Power Requirements in Mixing of Single- and Two-Phase Liquids at High Reynolds Numbers

Investigator: R. H. Moen, Assistant Professor of Chemical Engineering.

Support: National Science Foundation (Undergraduate Participation Program).

Chemical Engineering

This is a study of power requirements and mixing behavior in baffled tanks at such high Reynolds numbers that surface entrainment of gases occurs. This entrainment is due to formation of small vortices which are cut off below the surface of the liquid, thus carrying gas bubbles into the liquid phase.

Coefficients of Heat Transfer Between Liquid Metal and Dowtherm A in a Double-Pipe Heat Exchanger

Investigator: R.H. Moen, Assistant Professor of Chemical Engineering.

Support: National Science Foundation and General Research Fund, Oregon State University.

Purpose of this experiment is determination of heat transfer coefficients between a liquid metal and Dowtherm A (or other liquids) flowing parallel or countercurrent in a concentric double-pipe heat exchanger. An incidental purpose is determination of heat transfer coefficients of a fin-tube cooler used for cooling the Dowtherm A (or other liquids).

Solid-Vapor Equilibria of Metal Salts

Investigators: J.S. Walton, Head, Chemical Engineering Department; Arne Landsberg, R.J. Nelson, Graduate Assistants.

Support: National Science Foundation, Engineering Experiment Station.

Objective of this work is to eventually determine possibilities of effecting separations of metals by fractional sublimation. Before this, however, a study must be made on fundamental equilibrium data for vapor-solid mixtures.

Fractional Sublimation of Metal Salts

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

Support: National Science Foundation (Undergraduate Research Training Program).

This program is designed to provide research training and experience for undergraduates who will secure fundamental data on an experimental device for effecting separation of hafnium-zirconium

tetrachlorides and/or niobium-tantalum pentachlorides by means of fractional sublimation.

High-Temperature, Calorimetric Measurements of Ferroalloy Compounds

Investigators: C.E. Wicks, Professor of Chemical Engineering; J.R. Welty, Instructor in Mechanical Engineering.

Support: U.S. Bureau of Mines.

This project involves design of a platinum resistance furnace which can be controlled to 1°F in the 298°-1800°K range, and an adiabatic ice calorimeter. A high-temperature calorimeter has been constructed to evaluate heat content and, in turn, to obtain heat capacity data.

Kinetics of Reduction of Columbium Oxychloride

Investigators: C.E. Wicks, Professor of Chemical Engineering; F.D. Stevenson, Graduate Assistant.

Support: U.S. Bureau of Mines, Engineering Experiment Station.

Mechanisms of reduction of columbium oxychloride to columbium pentachloride are being evaluated. Nature of compounds involved requires development of special handling equipment to provide an inert atmosphere.

CIVIL ENGINEERING

G. W. Holcomb, Department Head

RESEARCH ACTIVITIES

Cement Stabilization of Dune Sands Prevailing in Oregon Coastal Areas

Investigators: G. W. Beecroft, Assistant Professor of Civil Engineering; G. W. Holcomb, Head, Civil Engineering Department; Arlen L. Borgen, Research Assistant.

Support: Engineering Experiment Station.

This investigation concerns feasibility of using Portland cement to stabilize fine, uniformly-graded sand occurring in various localities along the Oregon coast. Desirability of determining an economical method of stabilizing sands for highway base course construction arises from the fact that in certain coastal areas suitable aggregates for highway construction are not available.

An Exploratory Study of Flow Patterns Resulting from Intersection of Two Supercritical Flow Rectangular Open Channels

Investigators: C. E. Behlke, Associate Professor of Civil Engineering; H. D. Pritchett, Instructor in Civil Engineering.

Support: Civil Engineering Department, Engineering Experiment Station, Oregon State System of Higher Education.

The objectives of this work are to make an exploratory study which may suggest an analysis method that can be used to design supercritical flow in open channel confluences. The study is being carried out on a small-scale model in order to obtain criteria for construction of larger models.

An Analytical and Experimental Study of Two-Dimensional Enclosed Flow Division

Investigators: C. E. Behlke, Associate Professor of Civil Engineering; H. D. Pritchett, Instructor in Civil Engineering.

Support: Engineering Experiment Station.

Civil Engineering

This is a study of the mechanics of flow division with possible eventual use in manifold design. The research is aimed toward a basic study with applications not being considered.

Criteria for Intersection Open Channels Under Supercritical Flow Conditions

Investigators: C.E. Behlke, Associate Professor of Civil Engineering; H.D. Pritchett, Instructor in Civil Engineering; Gary Larsen, Senior.

Support: National Science Foundation (Undergraduate Participation Program).

An attempt is made to program the equations involved in describing model parameters to facilitate computations by use of an electronic computer.

Physical-Chemical Aspects of Deep Trickling Filters

Investigators: F.J. Burgess, Associate Professor of Civil Engineering; C.M. Gilmour, Professor of Bacteriology; F. Merryfield, 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 involved. The relative impact of the factors, however, is incompletely understood.

Waste Water Lagoon Criteria for Maritime Climates

Investigators: F.J. Burgess, Associate Professor of Civil 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.

Ecological Studies of a Polluted Experimental Stream

Investigators: F.J. Burgess, Associate Professor of Civil Engineering; C.E. Warren, Associate Professor of Fish and Game Management; 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.

A Study of Design Criteria for Waste Water Lagoons

Investigators: F.J. Burgess, Associate Professor of Civil Engineering; Harold Sawyer, William Ryan, Richard Brown, John Worley, Seniors.

Support: National Science Foundation (Undergraduate Participation Program).

Objectives of this research are to determine effect of sewage slime growths upon permeability and porosity of stream gravel and to determine loading criteria for sewage oxidation lagoons.

Hydrographic Characteristics of Three Small Coastal Basins as Related to Watershed Practices

Investigators: F.J. Burgess, Associate Professor of Civil Engineering; Ronald Hayden, Raymond Small, Seniors.

Support: National Science Foundation (Undergraduate Participation Program).

The aims of this study are to relate, using gaging facilities,

flood runoff, hydrograph shape and water yield to watershed size, shape, cover, and logging practice on three small ($\pm$ 1 sq mile) coastal basins.

Effect of Slime Growths on the Permeability of a Porous Media

Investigators: J.A. Dracup, Assistant Professor of Civil Engineering; Gary M. Buford, Senior.

Support: National Science Foundation (Undergraduate Participation Program).

A study of effect of slime growths on permeability of a porous media. Amount and rate of change of the coefficient of permeability are observed as a function of rate of slime growth in a permeameter.

A Model Study of Structural Frames in Proposed Addition to Science Building at the University of Oregon

Investigators: G.W. Holcomb, Head, Civil Engineering Department; T.J. McClellan, Professor of Civil Engineering; B.J. Sabaroff, Graduate Assistant.

This study involves construction and testing of scale model of a proposed addition to the Science Building at the University of Oregon. Model is instrumented with SR-4 strain gages so that strains may be determined in the model. It is proposed to continue the research to measure strains in the actual prototype.

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 soil samples in a single block and obtaining graphs of the differentials for various classifications of soils.

Study of Hydraulic Characteristics of Testing Machines

Investigators: O. Kofoid, Associate Professor of Civil Engineering; B.J. Sabaroff, Graduate Assistant.

Support: Engineering Experiment Station.

Civil Engineering

The objectives of this study are to eliminate all leakage both during and after load applications, control the rate of loading by full pump displacement for various rates without by-passing, and design a 300,000-pound machine with these features for the Department of Civil Engineering.

An Investigation of Prestressed Steel Beams

Investigators: O. Kofoid, Associate Professor of Civil Engineering; Hong Shik Kims, Senior.

An analytical investigation of strength increases obtainable by prestressing various shapes of steel beams, followed by tests on steel I-beams, which verify theory.

Velocity Angles and Magnitudes Versus Manifold Diameter and Velocity

Investigators: H. D. Pritchett, Instructor in Civil Engineering; James Morrow, Richard Roy, Seniors.

Support: National Science Foundation (Undergraduate Participation Program).

This research involves the construction of a plastic model and a study of the parameters of the variables involved in the system.

Creep Characteristics of Light-Weight Concrete

Investigators: T. J. McClellan, Professor of Civil Engineering; D. A. Bucy, Instructor in General Engineering; J. L. Gray, Associate Professor of General Engineering.

Support: Empire Building Materials Corporation, Engineering Experiment Station.

This is a long-term study of creep characteristics of prestressed concrete beams. Prestressed 5- by 5- by 108-inch light-weight beams are loaded to approximately 1600 psi.

Soil Survey

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

Support: Oregon State Highway Department.

Civil Engineering

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.

Effect of Height-Diameter Ratio on the Shear Strength of Soils

Investigators: G. L. Martin, Instructor in Civil Engineering; Gary M. Buford, Miles L. Skinner, Seniors.

Quick triaxial shear tests will be performed on a series of samples with H-D ratios of 2, and closed system, nondestructive triaxial tests will be performed on "identical" samples with H-D ratio of 1/2.

Investigation of the Swelling Characteristics of Bentonite Under Static Loads

Investigators: G. L. Martin, Instructor in Civil Engineering; Billy J. Thomas, Senior.

Support: Bentonite material courtesy of National Lead Company.

Samples of Bentonite at a known void ratio and moisture content are subjected to various static loads. After load is applied, the samples are subjected to a head of water and the rate of change in void ratio and moisture content are determined, along with ultimate values.

Variation in Grain Size Analysis as a Function of Dispersion Apparatus and Agents

Investigators: G. L. Martin, Instructor in Civil Engineering; T. Edick, Nancy Layman, Seniors.

Support: National Science Foundation (Undergraduate Participation Program).

A number of soils are being treated by three different dispersion agents and three different types of dispersion apparatus to determine their effect on the variation of the grain size distribution curve.

Civil Engineering

Suspended Plates on Flexible Cable

Investigator: S. L. Pan, Associate Professor of Civil Engineering.

Support: General Research Fund, Oregon State University.

The flutter problem that exists for a plate suspended by two cables has previously been analyzed thoroughly. This system corresponds to the suspension of a bridge on two cables. Present study involves aerodynamic response of a horizontally-suspended plate on a single cable and will extend the previous analytical work done on plates supported by two cables.

ELECTRICAL ENGINEERING

L. N. Stone, Department Head

Transistor Curve Tracer

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

Support: General Research Fund, Oregon State University.

This study involves investigation, design, construction, and testing of a device for visually displaying transistor characteristics on a conventional cathode-ray oscilloscope.

Low-Level D-C to A-C Conversion

Investigators: J. C. Looney, Assistant Professor of Electrical Engineering; Aage Teien, Graduate Assistant.

Support: Electric Scientific Industries Fellowship.

An investigation of devices and circuits which will convert a low-level d-c signal (10^{-5} volts) to an amplitude-modulated a-c signal. The a-c signal can be amplified by conventional means to obtain a useful output.

Investigation of Active Linear Network Synthesis with the Aid of Matrix Transformation Theory

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

Support: Oregon State System of Higher Education.

This investigation involves ways to partition and solve electrical feedback networks with the aid of the digital computer. Special attention is being given to partitioning of networks not having ideal isolation points (minimizing loading effects).

Programing Subroutines on the ALWAC III-E Computer to Perform Matrix Transformations Involving Polynomials in the Computer Variable "S"

Investigators: H. J. Oorthuys, Associate Professor of Electrical Engineering; R. H. Hicks, Student Assistant.

Electrical Engineering

The objective of this project is to provide a set of subroutines programed on the ALWAC III-E digital computer to perform matrix transformations involving polynomials in the complex variable "S".

Aspects of Corona Formation and Radio Interference

Investigator: L. N. Stone, Head, Electrical Engineering.

Support: Bonneville Power Administration

This work is in its sixth year of operation. It presently consists of the following four phases:

1. An investigation of radio-noise characteristics, including magnitudes and attentuation of high-voltage transmission lines.
2. An investigation of corona formation and the associated radio-influence voltage caused by various surface projections on high-voltage conductors and devices.
3. An investigation of nature and characteristics of insulator corona, its radio-influence voltage characteristics, and its effect on radio-noise level of transmission lines.
4. Correlation of laboratory and transmission line measurements with the objective of predicting transmission line radio-noise levels from measurements made in the laboratory.

INDUSTRIAL ENGINEERING AND INDUSTRIAL ARTS

G.B. Cox, Department Head

Cutting of Aluminum, Magnesium, and Stainless Steel by the Gas-Shielded Non-Restricted Tungsten Arc (TIG) Process

Investigator: Asa A. Robley, Associate Professor of Industrial Engineering and Industrial Arts.

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.

MECHANICAL ENGINEERING

L. Slegel, Department Head

Effects of Waste Sulfite Liquor Derivatives on Properties of Portland Cement Concrete

Investigators: C.O. Heath, Professor of Engineering Materials; D.W. Glennie, Chief Chemist OFRC.

Support: Engineering Experiment Station and General Research Fund.

Waste sulfite liquors serve as a base for many concrete admixtures intended to increase strength, reduce mixing water required, and retard set. This project is an attempt to evaluate effects of various constituents normally found in these liquors.

Improvement of Combustion in Low-Grade Waste Woods

Investigators: A. D. Hughes, Professor of Mechanical Engineering; A. Wynans, Graduate Assistant.

This research involves a study to determine the best ways to burn high-moisture waste woods such as hemlock, tamarack, wet bark, and sander dust. Various methods to be studied involve forced draft, preheated air, and predrying of the wood with exhaust gases.

Oil Resistant Gasket Material

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

This study involves research for flexible tubing and sponge-type gasket material resistant to peppermint and spearmint oils.

Use of Solar Energy for Production of Mechanical Power

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

A study of use of a model hot-air engine and of attempts to operate it on solar energy.

Effects of Oscillations on Heat Transfer from a Cylinder to a Liquid

Investigators: M.B. Larson, Associate Professor of Civil Engineering; Vernon Swanson, Graduate Assistant.

Mechanical Engineering

Previous work by others has shown that the experimental work by Martinelli to evaluate the heat transfer rate from oscillating cylinders 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

Investigators: M. B. Larson, Associate Professor of Civil Engineering; C. O. Morris, Graduate Assistant.

Support: Standard Oil Company of California Fellowship.

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.

Pure Torsion of a Slotted Channel Section

Investigators: M. Levinson, Assistant Professor of Mechanical Engineering; G. Benedetti, Research Assistant.

Support: Engineering Experiment Station.

The torsional behavior of open thin-walled sections without cutouts is well known. Little is known, however, about the behavior of such members with cutouts. Object of this investigation is to obtain an analytical solution of one such problem and then to check the analysis with the results of experimental work to be performed.

Application of Heat-Balance Integral and Related Methods to Problems in Curvilinear Coordinates and Problems in Two Dimensions

Investigator: M. Levinson, Assistant Professor of Mechanical Engineering.

Support: Engineering Experiment Station.

Exact solutions of complicated heat conduction problems are virtually impossible to obtain; approximate numerical and analytical methods must be used. The heat-balance integral method of Goodman has thus far been applied to one-dimensional problems in rectangular coordinates. It is desired to obtain solutions of more complicated problems by this and related methods.

Mechanical Engineering

Creep Tests of Aluminum Conductor Cable

Investigators: 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.

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, 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 pretreatment, and an evaluation of possibility of occurrence of ground water contamination from irrigation disposal of mill effluents.

Characteristics of Pulpmill Bleach Plant Effluents

A study of sanitary characteristics of bleach plant effluents from a number of pulp mills, including measurement of color content and organic strength, in order to permit prediction of effects of discharge on receiving streams.

Relationship Between Pulp and Papermill Effluents and Receiving Stream Characteristics and Incidence of Stream Bottom Growth

A field study of various factors that may be correlated with occurrence of stream bottom growth below papermill outfalls. Included are field measurements of bottom growth location and extent, hydrographic features of receiving streams, and type, quantity, and method of discharge of effluents involved.

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.

PUBLICATIONS OF THE ENGINEERING STAFF
1960-1961

Beam, B.H., "An Exploratory Study of Thermoelectrostatic Power for Space Flight Applications," NASA Tech Note D-336 (1960).

Beecroft, G.W., "Creep and Shrinkage of Two Lightweight Aggregate Concretes," paper presented at 40th annual meeting of Highway Research Board, Jan 10, 1961, and submitted to this Board for publication.

Bonnicksen, L.W., "The Determination of the Structural Failure and Its Use in the Design of Economical and Safe Structures," Tech Paper No. 1367 of Oregon Agricultural Experiment Station.

Booster, D.E., "Cleaning Seed Electrically," Pyramid of Sigma Tau, 43(2), 14-19, summer 1960.

Booster, D.E., "Oregon Press Seeder," Circular of Information No. 605 of Oregon Agricultural Experiment Station.

Faruqui, A.A. and J.G. Knudsen, "Rates of Heat Transfer from Short Sections of an Isothermal Pipe," Chemical Engineering Progress Symposium Series No. 32, 57, 96(1961). (Oregon State University Engineering Experiment Station Reprint No. 62.)

Hyder, D.N., D.E. Booster, F.A. Sneva, W.A. Sawyer, and J.B. Rodgers, "Wheel Track Planting on the Sagebrush-Bunchgrass Range," Tech Paper No. 605 of Oregon Agricultural Experiment Station.

Johnson, L.E., "Coupled Diaphragm Safety Device for Power Reactors," AEC Research and Development Report, NAA SR-4434, Jan 1960.

Jones, A.M. and J.G. Knudsen, "Drag Coefficients at Low Reynolds Numbers for Flow Past Immersed Bodies," AIChE Journal 7, 20(1961). (Oregon State University Engineering Experiment Station Reprint No. 63.)

Larson, M.B., "A Study of Effects of Ultrasonic Vibrations on Convective Heat Transfer in Liquids," Tech Report No. 48, Department of Mechanical Engineering, Stanford University, Sept 30, 1960.

Lee, K.S. and J.G. Knudsen, "Local Shell-Side Heat Transfer Coefficients and Pressure Drop in a Tubular Heat Exchanger with Orifice Baffles," AIChE Journal 6, 669 (1960). (Oregon State University Engineering Experiment Station Reprint No. 61.)

Levinson, M., "Thermal Stresses in Idealized Wing Structures Found by Means of an Approximate Two-Dimensional Heat Conduction Analysis," paper presented at annual meeting of Institute of Aero Space Sciences, New York, Jan 24, 1961. Submitted for publication in Journal of Aero Space Sciences.

Looney, J.C., "Designing Amplifiers with Nonlinear Feedback," Electronics 34, No. 13, 46-49, March 31, 1961.

Looney, J.C., "The ESIAC Potential Plane Analog Computer," Automatic Control, May 1961.

Meredith, R.E. and C.W. Tobias, "Resistance to Potential Flow Through a Cubical Array of Spheres," Journal of Applied Physics 31, 1270 (1960) and 32, 132 (1961).

Meredith, R.E. and C.W. Tobias, "Conductivities in Emulsions," Journal of Electrochemical Society, 108, 286 (1961).

Mrazek, R.V. and H.C. VanNess, "Heats of Mixing: Alcohol-Aromatic Binary Systems at 25°, 35°, and 45°C," AIChE Journal, 7, 190 (1961).

Myer, W., "Continuous Measurement of Liquid and Ion Exchange Resin Flow Rates with a Photometer and Magnetic Flowmeter," Hanford Atomic Products Operation, HW-66624, Aug 26, 1961.

Page, G.E., "The Influence of Nozzle Size, Type, and Degree of Hardness of Water and Wetting Agents on Spray Drift," Tech Paper No. 1340 of Oregon Agricultural Experiment Station.

Slegel, L., "One-Way Output from Speed Reducers," Product Engineering, April 17, 1961.

ADVANCED DEGREES IN ENGINEERING
June 1961

W.P. Allen..... MS IE

Statistical Determination of Safety Stocks and Lead Times for an Economic Order Quantity Electronic Data Processing Inventory Control System. (W.F. Engesser*)

W.J. Bailey ..... MS ME

Investigation of Plutonium-Bearing Fuel Elements for Plutonium Recycle Test Reactor. (E.A. Daly)

K.H. Banko ..... MS EE

Transfer Function Analysis of Strain Gages. (L.N. Stone)

J.E. Berney..... MS AE

Optimum Sprinkler Application Rates on Soils of Low Infiltration Rate. (J.W. Wolfe)

A.L. Borgen ..... MS CE

Cement Stabilization of Oregon Coastal Dune Sands. (G.W. Beecroft)

J.K. Carswell..... MS CE

Persulfate Oxidizable Carbon as an Engineering Measure of Organic Pollutants in Water. (F.J. Burgess)

I.C. Chang ..... MS EE

Synthesis of Multiterminal RC Networks with the Aid of a Matrix Transformation. (H.J. Oorthuys)

H.N. Chien ..... MS EE

Variation of Delta Method for Solution of Second Order Nonlinear Differential Equations Arising in Servomechanisms. (H.J. Oorthuys)

R.L. Dickenson ..... MS ChE

Vapor-Liquid Equilibria Using an Improved Othmer Still. (C.E. Wicks)

*Thesis adviser.

C.H. Fullman..... MS ME

The Design of a Mechanism for Tensile Testing in a Liquid Helium Dewar. (R.D. Olleman)

G.L. Heimbigner..... MS EE

A High-Speed, Transistorized, Voltage Analog-to-Digital Converter. (L.J. Weber)

L.H. Hildebrandt ..... MS IE

Forecasting Demand in a Seasonal Industry. (W.F. Engesser)

J.W. Hyden ..... MS CE

A Schwartz-Christoffel Analysis of Cavitating Flow in a Two-Dimensional Mitered Elbow. (R.H. Shoemaker)

H.S. Kim ..... MS CE

An Investigation of Prestressing Steel Beams. (O. Kofoid)

D.A. Lauritsen ..... MS Gen Sci

Humphrey's Spiral Beneficiation of Sulfide Ores from the Bohemia District Musick Mine. (W.E. Caldwell)

G.L. Martin ..... MS CE

A General Solution for Active and Passive Pressures on a Vertical Plane in a Sloping Earth Mass of Infinite Length. (M.P. Coopey)

E. Moustakas ..... MS EE

A Method for Regulating Alternating and Direct Voltages. (A. L. Albert)

R.J. Nelson ..... MS ChE

Phase Equilibria of Solid Metal Salts and Their Vapors. (J. S. Walton)

L.E. Poole..... MS CE

Design of Gabled and Multistory Frames by Plastic Moment Distribution. (T.J. McClellan)

H.D. Pritchett ..... MS CE

A Two-Dimensional Manifold Study. (C.E. Behlke)

R.P. Romig ..... MS ChE

Investigation of the Performance Characteristics of a Mixer-Settler Extractor. (C.E. Wicks)

B.J. Sabaroff ..... MS CE

An Investigation of Stress Distributions in a Timber Hyperbolic-Paraboloid Shell. (T.J. McClellan)

J.D. Smith ..... MS CE

Application of Ultrasonics to Particle Sedimentation in Water. (F. Merryfield)

P.S. Williams ..... MS ChE

Heat Transfer and Pressure Profiles in the Vicinity of Annular Orifices. (J.G. Knudsen)

J.E. Worth ..... MS CE

Establishment of Velocity Profiles in a Liquid Downstream from a Sudden Pipe Contraction. (R.H. Shoemaker)

E.E. Yoder ..... MS AE

Composite Beam Action Between Roofing Material and Framework When Using Solid Bridging of Purlins in Pole-Type Construction. (L.W. Bonnicksen)

G.L. Young ..... MS EE

Transit Time Characteristics of Multiplier Phototubes Under Pulse Conditions. (L.N. Stone)