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Water Current

Millard W. Hall, Director
Volume 9, Number 4

Karen E. Stork, Editor
July/August 1977

GUEST EDITORIAL

University to Assist Legislature in Consideration of Water Policy Alternatives

by

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Department of Agricultural Economics
University of Nebraska-Lincoln

Officials of the University of Nebraska-Lincoln have come to a preliminary understanding with the Public Works Committee on a committee study of Nebraska water policy alternatives. The study will be broken down into two major components. The first year's study will be a discussion of water law alternatives on issues for which significant data are available. This discussion, prepared by UNL Water Law Specialist Dave Aiken, will be in four reports, examining (1) statutory authority for surface water administration of the Department of Water Resources, (2) statutory authorities for controlling groundwater withdrawals of Natural Resources Districts, (3) riparian rights, and (4) other issues. The reports will be made publicly available, and may be used by the Committee to prepare water law proposals for the next legislative session.

The second major component will be an outline of research needs to analyze alternate state water policies. This research will be multidisciplinary, including components from hydrology, geology, law, economics, engineering, and biology. The purpose of this research is to provide the technical information not currently available to analyze policy alternatives regarding, e.g., transbasin diversion, minimum streamflows, and conjunctive management of ground and surface waters. The preparation of this research proposal will be coordinated by the UNL Water Resources Center. The information derived from these studies will be available to assist the Legislature in fashioning a state water plan.



NEBRASKA WATER RESOURCES CENTER

The studies are also relevant in light of proposed federal water policy changes. One federal policy being discussed is tying the availability of federal grants for water development and water quality control to reform of state water laws. According to this view, state water laws often do not reflect or accomodate environmental values; do not address disputes between surface and groundwater users, or facilitate the conjunctive management of ground and surface waters; do not encourage water conservation; and are too rigid to permit most effective water management. If this option were pursued, a state would not be able to receive federal water grants until certain water law reforms had been accomplished.

Analysis of the federal criticisms and what Nebraska's response might be will be a significant portion of the first year water law studies.

ON THE HOMEFRONT

CONFERENCE ON DECISION MAKING IN WATER RESOURCES

The Nebraska Water Resources Center is planning its annual fall conference for November 29-30, 1977 at the Villager Motel in Lincoln, Nebraska. The theme of this year's conference will be "A Question of Values: Decision Making in Water Resources Management."

Topics to be discussed include: value judgements in planning and management; the technology of decision making; public involvement; values definition; multiple use, and others. Speakers are currently being contacted, and a complete program should be available by September 15, 1977.

For further information on the conference, contact: Millard W. Hall, Director, Nebraska Water Resources Center, 310 Ag. Hall, University of Nebraska, Lincoln, Nebraska 68583.

CONTRACT AWARDED BY CORPS OF ENGINEERS

The U. S. Army Corps of Engineers has awarded the Water Resources Center a \$14,000 contract for the collection and analysis of urban flood damage data in the Blue River Basin in Nebraska. The project, to be finished by November 1, 1977, also involves the modification of various computer programs, the computer processing of flood damage and hydrologic data for the town of Beatrice, and the preparation of a report on the results of the computer processing of the data.

Field survey teams will be used to collect data on potential flood damages in the towns of Crete, Wilber, Seward, Barneston and York, Nebraska. After all tasks have been completed, a report will be made to the Nebraska Natural Resources Commission for use in the basin flood control phase of its State Water Plan.

WATER RESOURCES IN NEBRASKA

NEBRASKA WATER LEVELS DECLINE

The impact of the recent three-year drought is reflected in a new survey entitled, "Groundwater Levels in Nebraska, 1976," which reports that average water levels for fall 1976 were lower than those for fall 1975 in 91 of Nebraska's 93 counties.

Published by the Conservation and Survey Division of the Institute of Agriculture and Natural Resources, the University of Nebraska--Lincoln, the new report states that groundwater declines for 1976 averaged less than one foot in 49 counties and more than one foot in 42 counties. In two counties, the average water levels rose less than one foot.

The greatest declines, according to the report, occurred in Chase, Fillmore, and Perkins counties where the average water-level change was more than three feet. Even though water-level declines were recorded in two previous years, the average water-level declines were greater in 54 counties between fall 1975 and fall 1976 than those of a comparable period a year earlier.

Six areas where large-scale use of groundwater for irrigation caused a significant water-level decline are highlighted in the report. These areas are the Big Blue River basin, Platte River valley, Mira Valley, O'Neill area, Imperial area, and the Alliance area. Two other areas--the Tri-County and the Farwell areas--are treated individually because of significant water-level rises related to the infiltration of surface water diverted for irrigation. All eight of these areas are lifted up for special attention in the report.

During 1976, installation of irrigation wells continued at an accelerated rate in Nebraska, as 4,398 irrigation wells were registered, bringing the state's total to 55,078. An estimated six million acre-feet of groundwater was pumped during 1976 to furnish water for more than 80 percent of the approximately six million acres of irrigated land in Nebraska. This amount of groundwater is many times more than the total amount pumped for domestic, livestock, municipal, and industrial use in the state.

New wells were registered in all the state's 93 counties except Arthur, Cass, Grant, and Pawnee. More than 100 wells were drilled in each of 14 counties: Holt, 190; Antelope, 144; Hall, 128; Lincoln, 122; Dodge, 122; Fillmore, 119; Pierce, 115; York, 114; Adams, 114; Custer, 113; Buffalo, 108; Merrick, 105; and Platte, 102.

Groundwater levels during 1976 were affected markedly by the dry conditions throughout the state. All eight National Weather Service divisions reported that precipitation from May 1 to the end of 1976 was significantly below normal. This in turn led to less water recharge to aquifers and to greater water use for irrigation.

The 104-page report was prepared by Michael J. Ellis of the U.S. Geological Survey and Darryll T. Pederson of the Conservation and Survey Division, IANR, UNL. Included in the report are hydrographs and well data for 66 recorder wells located in 42 counties. Copies of the report (Nebraska Water Survey Paper 44) are available at \$2.00 each plus sales tax from the Conservation and Survey Division, 113 Nebraska Hall, Lincoln, Nebraska 68588.

TEST-HOLE DRILLING BEGINS

Test-hole drilling operations for the Sioux county framework study began in July. The purpose of this project will be to correlate two classical areas of tertiary exposures, the wildcat ridge and pine ridge sections. A line of test holes three miles apart will be drilled from Mitchell to Harrison. Several additional test holes will be drilled to better define water-saturated Arikaree valley fills and channels. The information obtained in the project will be used to guide additional studies that will be required to meet the needs of water management in the area.

Twenty-two recorder wells were sampled for water quality during June and July in the southwestern and panhandle areas of Nebraska. Approximately one-third of the continuous-recorder wells in the state are sampled for water quality each year. This effort is part of the ongoing cooperative program of the Conservation and Survey Division and the U. S. Geological Survey.

FEDERAL HIGHLIGHTS

WATER RESOURCES POLICY STUDY

President Carter's May 23rd environmental message stated: "One of the pressing domestic issues facing this Administration and this Congress is establishment of a national water resources management policy." The President directed the Water Resources Council (WRC), the Office of Management and Budget and the Council on Environmental Quality to review existing water resources policy and recommend reforms within six months. Secretary of Interior, Cecil D. Andrus, in his capacity as Chairman of WRC will lead the joint study, and a Policy Committee has been established to carry it through.

The preliminary elements for consideration in the study will be: (1) revision of WRC principles and standards; (2) deauthorization of old water projects; (3) increased cost sharing by non-federal entities; (4) reforms of laws, regulations and practices governing water allocation; (5) wise use of water; (6) quantification of Indian and federal reserved water rights; (7) evaluation of water quality with conventional water resources allocation and development; (8) improved dam safety; and (9) increased water conservation.

The president's message directed that the recommendations be developed in consultation with the public and with the Congress. Thus, there will be eight regional hearings on water policy as follows: July 28-29 in Minneapolis, Denver, Boston, Atlanta and Los Angeles; and August 1-2 in Seattle, Cincinnati and Dallas.

Members of the Policy Committee, their representatives, or other policy level representatives of the Administration will attend the hearings and serve as hearing officials. Anyone wishing to present a written or oral statement may do so by notifying the hearing moderator by telephone or in writing at least two days before the hearing. (A list of meeting locations and moderators may be obtained by contacting the Nebraska Water Resources Center). At the hearings, those who have not made prior notification will also be heard as time permits. Written statements received by the moderators within one week following the hearings will be included in the record as well.

In addition, written statements may be sent directly to the Policy Committee, Water Resources Council, 2120 "L" Street, N.W., Washington, D. C. 20037. All those received by August 9, 1977 will be included for the record and consideration by the Committee.

ICWP - OWRT TECHNOLOGY TRANSFER PROJECT

The Office of Water Research and Technology recently approved a \$91,000 grant to the Interstate Conference on Water Problems (ICWP) to conduct a series of four interstate technology review seminars. This grant provides an excellent opportunity to more effectively coordinate the efforts of water research institutes with the needs of state water management agencies.

This will be accomplished through four regional seminars scheduled during 1977. These seminars are designed to:

- (1) improve communication of research needs;
- (2) increase the dissemination and utilization of research results;
- (3) provide the setting for close involvement and mutual support between water researchers and water managers;
- (4) improve the existing mechanism for determination of water research priorities;
- (5) summarize current water research and its applicability to present water management problems.

A Seminar Management Committee has been established and given overall responsibility for implementation of the OWRT grant. Specifically, this group will develop seminar content, guidelines and schedules and report to OWRT on a quarterly basis regarding progress of the grant. The members of the Seminar Management Committee are:

- (1) Clair P. Guess, Jr., Chairman
South Carolina Water Resources Commission
- (2) Jack W. Pepper (ICWP Representative)
Mississippi Board of Water Commissioners
- (3) William R. Walker (Water Research Institute Representative)
Director, Water Resources Research Center
Virginia Polytechnic Institute
- (4) Millard W. Hall (Water Research Institute Representative)
Director, Nebraska Water Resources Center
University of Nebraska-Lincoln
- (5) Earl L. Wagener (Water Industry Representative)
Dow Chemical Company

The first regional Technology Transfer Seminar has been tentatively scheduled for September 20-21, 1977 at the Buccaneer Motel, Jekyll Island, Georgia.

WATER RESEARCH BILL APPROVED BY HOUSE

The House of Representatives has recently marked up a bill for water research by the Office of Water Research and Technology (OWRT). Appropriations for the annual allotment program amounted to \$5,730,000 (\$110,000 per state institute except for \$40,000 each for the three new states); \$3,200,000 for the matching grant program; and \$2,575,000 for a Title II section which was reinstated.

Twelve million dollars was authorized for saline water research for fiscal year 1978. The original bill concerning saline water was amended to provide a more varied program. Originally, the bill was limited to the reverse osmosis process for seawater conversion. The revised version reinstates funding for the freezing process, the electrodialysis process and continues the operation of federally owned test facilities at Wrightsville Beach, North Carolina and Rosewell, New Mexico.

CONFERENCES

1977 ICWP ANNUAL MEETING

The 1977 Interstate Conference on Water Problems (ICWP) Annual Meeting will be held on August 30, 31, and September 1 in Minneapolis, Minnesota. The meeting will be held at the Radisson Hotel in Minneapolis.

Topics to be covered at the Conference will include water rights, water resources planning, the relationship between water resources programs and water quality programs, and the water/energy interface. Planning efforts are also underway to include a special session on water-related research activities. Of special interest will be the discussion of the new water management policy suggestions that have been made by Secretary of Interior, Cecil D. Andrus.

The ICWP Conference should provide an excellent forum for dialogue between the federal administration and the states. Additional information on the program will be available in the near future.

ASCE ANNUAL MEETING

The 125th Annual Convention and Exposition of the American Society of Civil Engineers (ASCE) will be held October 17-21, 1977 at the Hyatt Regency Hotel in San Francisco, California. Complete program details will be available in the July issue of the Civil Engineering magazine.

Eighty-four technical, professional and management oriented sessions will be held on such current subjects as: construction management; highway traffic and safety; commuting trade off; surveying; recreational development; water and wastewater technology and facility planning; water resources systems, planning and operations; structural analysis and design; environmental impacts, problems and implications; and urban development. Seventeen ASCE continuing education courses will also be offered.

"NON-POINT SOURCES OF POLLUTION FROM FORESTED LAND"

A special 208 symposium on Non-Point Sources of Pollution from Forested Land will be held on October 19-20, 1977 at Southern Illinois University-Carbondale. Topics will include: (1) the impact of forestry activities on the quality of water in the nation's streams; and (2) the effect of future legislation on the forestry industry. Three main goals of the program are: to define problems relating to non-point pollution from forestry activities, to consider possible solutions, and to discuss the potential impact of P.L. 92-500 on the individual landowner and the forestry industry.

The symposium will feature 24 speakers from across the nation who will discuss with the public various aspects of forest resource management and how they relate to Section 208 of P.L. 92-500. The law requires each state to develop a master plan to eliminate the discharge of pollutants into the nation's waters by 1985 and to provide "swimmable" and "fishable" streams by July 1, 1983. The program is associated with the 72-member task force organized by the Illinois Environmental Protection Agency to evaluate agricultural non-point sources of pollution and their effect on water quality. Recommendations will be considered by the state in formulating its master plan.

The registration fee for the symposium is \$30.00 and attendance is limited to 300 persons. Additional information is available from: G. M. Aubertin, Symposium Organizer and Associate Professor, Department of Forestry, Southern Illinois University, Carbondale, Illinois 62901. Telephone: (618) 453-3341.

SYMPOSIUM ON LAKE MANAGEMENT

A special symposium on Lake Water Quality and Quantity Management is being sponsored by the Water Quality Committee of the Hydrology Section of the American Geophysical Union. The symposium is scheduled for the 1977 Fall Annual Meeting, to be held at San Francisco on December 5-9, 1977.

Widespread deterioration of water quality in natural and man-made lakes as well as recent dry weather conditions have resulted in much concern, political pressure, and action to maintain or to restore lakes to conditions which render them useful as places for recreation, wildlife habitat, water supply, or flood retention to name but a few. The objective of the symposium is to exchange information on recent scientific findings regarding lake behavior, simulation techniques for planning, and limnological and engineering techniques applied to lake water quality restoration and lake water conservation. State-of-the-art presentations by leading researchers and practitioners are planned. Contributions of broad interest are invited.

Abstracts are to be submitted by August 15, 1977 to: Dr. Robert C. Averett, U.S. Geological Survey, WRD, Denver Federal Center, Mail Stop #406, Box 25046, Denver, Colorado 80225, or: Dr. Heinz Stefan, University of Minnesota, St. Anthony Falls Hydraulic Laboratory, 3rd Avenue S.E. and Mississippi River, Minneapolis, Minnesota 55414.

SYMPOSIUM ON SWELLING SOILS

A symposium on "Water Movement and Equilibrium in Swelling Soils" is being organized by the Committee on Water in the Unsaturated Zone of the Section of Hydrology of the American Geophysical Union (AGU). The symposium will take place on December 6, 1977, at the Jack Tar Hotel in San Francisco, California, in conjunction with the annual fall meeting of AGU. Papers will be given on all aspects of the behavior of water in expansive and shrinking soils, including laboratory and field measurements of water movement and soil deformation, instrumentation for investigating water in expansive soils, and theoretical or computer studies of water equilibrium and transport.

For further information, please contact: Dr. James K. Mitchell, Department of Civil Engineering, University of California, Berkeley, California 94720.

POSITIONS AVAILABLE

INTERGOVERNMENTAL PERSONNEL ACT POSITION

The Library and Information Services Division (LISD), D82, of the National Oceanic and Atmospheric Administration (NOAA), has a position open under the Intergovernmental Personnel Act (IPA).

LISD is seeking applicants who are professionals in library and/or information service and who are interested in participating in the information process in a federal agency (NOAA) with national and international responsibility. In general, applicants should have academic backgrounds in mathematics, science, or technology, preferably the oceanic and/or atmospheric sciences, plus library and/or information science/service. Typically, applicants would be employees of libraries or other information centers.

The nature of the position will vary somewhat depending upon the specific qualifications of the successful applicant and the time to be spent with LISD. Appointments range from six months to two years, but renewal is possible.

Interested persons should send applications to: Chief of LISD, Elizabeth J. Yeates, National Oceanic and Atmospheric Administration, D82, Rockville, Maryland 20852.

ENVIRONMENTAL ENGINEERING AND WATER RESOURCES POSITIONS

The Civil Engineering Department at the University of Maine at Orono has two staff openings for the fall semester beginning September 1977 or to be filled as soon as possible, fall 1978 at the latest. The faculty positions are as follows: Environmental Engineering - must have a background in water chemistry and research interests appropriate to the study of inland and marine waters; and Water Resources/Environmental - must have a background in estuary hydrodynamics or coastal processes. The Department will also consider a one year visiting Professorship in either of the above areas for a senior faculty member.

Appointments will be at the Assistant or Associate Professor level. Duties shall include undergraduate and graduate teaching and participation in University research. Candidates should have an earned doctorate and a basic engineering degree.

Applicants are requested to submit their resume and the names of three references to: Dr. Richard F. Dominguez, Chairman, Department of Civil Engineering, University of Maine, 103 Boardman Hall, Orono, Maine 04473.

The University of Maine is an Equal Opportunity Employer.

ASSISTANT/ASSOCIATE PROFESSOR

The Department of Earth Resources is seeking a Ph.D. in forest meteorology for a teaching/research position in forest meteorology/snow hydrology/bioclimatology. The appointment is a one year temporary. Duties include undergraduate/graduate teaching and advising and research.

Send complete resume and references to: Dr. W. D. Striffler, Department of Earth Resources, Colorado State University, Fort Collins, Colorado 80523.

Colorado State University is an equal opportunity employer and complies with Title IX requirements. Complaints should be filed with the Office of Equal Opportunity, Student Services Building.

RESEARCH REVIEW

PROJECT TITLE: CORROSION IN IRRIGATION WATER DISTRIBUTION SYSTEMS*

PRINCIPAL INVESTIGATOR: Donald L. Johnson, Professor of Mechanical Engineering, Metallurgy Program, University of Nebraska - Lincoln

* Paper to be presented at Virginia Polytechnic Institute, Oct. 10, 1977

Introduction

The corrosion kinetics of iron base alloys in oxidizing solutions such as ammonium nitrate has been reported for relatively high solute concentrations. However, no such work is reported at the very low concentrations that are of particular interest in the study of corrosion in irrigation distribution systems. In several Mid-western states, center pivot distribution systems are used extensively for irrigation of crops and it is also becoming common to spread fertilizers and herbicides in liquid form through such systems. Nitrogen-carrying compounds such as ammonium nitrate are injected into the water stream at concentrations up to about 1000 ppm. Slight to severe corrosion has been observed externally on piping and structures and internally in piping, nozzles and valves. The purpose of this investigation is to develop a better understanding of corrosion in these systems and provide information useful in corrosion prevention, materials selection, and design.

Experimental

The initial experimental test system consisted of an Alpha Research Model 621 potentiostat that was modified with a drive motor for coupling to a data acquisition system. This system, set up by Schroeder (1975), included a HP (Hewlett-Packard) minicomputer, digital voltmeter and x-y plotter. The system was completely automated for direct plotting of potential versus log (current density). A PAR (Princeton Applied Research) system was later acquired which included a model 175 Universal Programmer, Model 376 logarithmic converter and Model 173 potentiostat and x-y plotter. This system was likewise automated so that one technician could operate two systems simultaneously, compare duplicate runs and periodically monitor the stability of both systems using ASTM Standard G-5-72.

Six materials have been examined in detail during this investigation. These include Ferrovac "E" iron, SAE 1010, 1018, 1020, 1050, and 1095 carbon steel. The carbon steel specimens were in the normalized condition. Each specimen was machined from bar stock into cylindrical specimens approximately 0.48 cm in diameter and 2.55 cm long. After machining the surface of each specimen was ground, polished and degreased.

The test solutions were prepared from analytical reagent grade ammonium nitrate crystals according to the following compositions in w/o (weight percent): 0.00, 0.005, 0.01, 0.05 and 0.10. The compositions correspond to the maximum range of concentrations utilized in center pivot systems.

Results and Discussion

Kinetic studies concerning solution concentration, carbon content in

steel, temperature dependence and velocity effects were carried out to ascertain the important variables in the corrosion process.

An analysis of the corrosion rate data in Table I show that the rate in a stirred or agitated dilute 0.05 w/o NH_4NO_3 solution is nearly constant or slightly lower than it is in an unstirred solution. This observation suggests the non-diffusive character of the process.

Table I
Corrosion Rate as a Function of Degree
of Agitation in 0.05 w/o NH_4NO_3
for SAE 1018 Carbon Steel

Stirring Rate	i_{corr} ($\mu\text{A cm}^{-2}$)	Corrosion Rate (mdd)
None	950	2375
Low rpm	700	1750
Intermediate rpm	600	1500
High rpm	510	1275

Analysis of corrosion rate data as a function of NH_4NO_3 concentration in Table II suggests that diffusion through the diffusion layer has an influence on the corrosion rate since the rate goes up with increase in NH_4NO_3 concentration.

Table II
Corrosion Rate as a Function
of NH_4NO_3 Concentration
for SAE 1018 Carbon Steel

NH_4NO_3 Con- centration (w/o)	i_{corr} (A cm^{-2})		Corrosion Rate (mdd)	
	HP minicomputer system	PAR system	HP minicomputer system	PAR system
.001	30	63	75	158
.005	100	140	250	350
.01	220	250	550	625
.05	450	950	1125	2375
.10	1010	1100	2525	2750

In order to better elucidate the roll of diffusion in the boundary layer, the dependence between temperature and the overall corrosion rate was determined at 21, 28, 35, and 42°C. The logarithm of the corrosion rate is linear with reciprocal absolute temperature as shown in Figure 1 and the resulting value of the activation energy for a 0.05 w/o solution without agitation was found to be about 21,000 J mole^{-1} (5000 cal mole^{-1}). This value corresponds to processes which are non-diffusive in character and lends support to the idea that corrosion of iron in dilute ammonium nitrate solutions depends on both diffusion and chemical reaction rates.

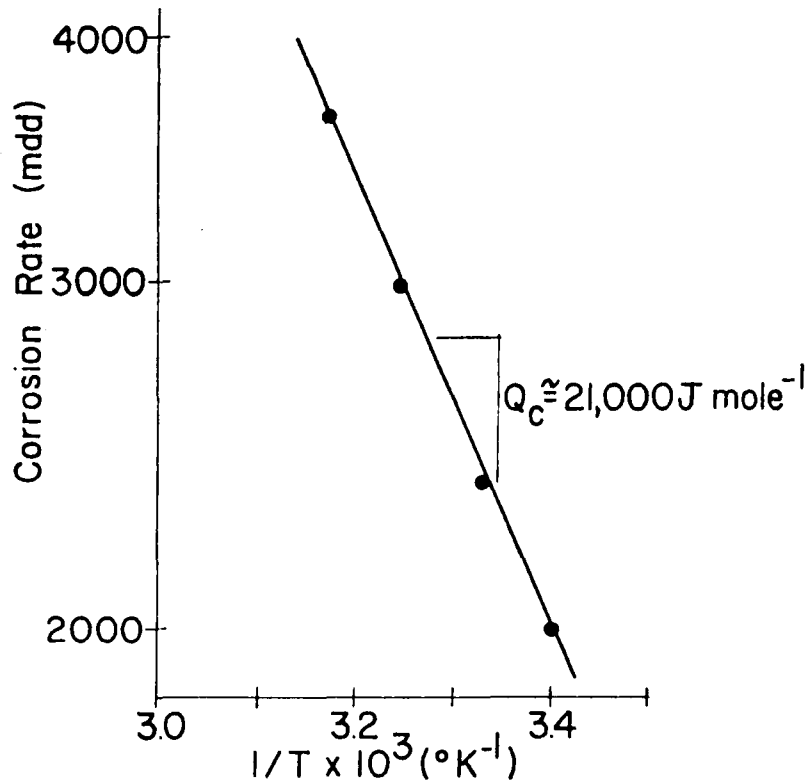


FIGURE 1: LOG (CORR RATE) AS A FUNCTION
OF $T^{-1}(^\circ K^{-1})$ FOR SAE 1018
STEEL IN 0.005 w/o NH_4NO_3

Another aspect of the process that was studied was the effect of metallurgical structure on the corrosion rate. Corrosion rates were obtained on several carbon steels in the normalized condition for varying carbon contents. For concentrations below about 0.05 w/o NH_4NO_3 , carbon content (cementite-ferrite ratio) had no effect on the rate indicating the diffusional nature of iron dissolution whereas at or above about 0.05 w/o NH_4NO_3 , carbon content affects the rate indicating a transition to partial control by a surface reaction. The effect of ammonium nitrate concentration on corrosion rate as a function of carbon concentration in steel is shown in Figure 2.

Present and Future Work

Studies are continuing to clarify the mechanism occurring between iron and ammonium nitrate in dilute solutions. Preliminary experiments with low alloy steels, copper base alloys and aluminum base alloys are also in progress.

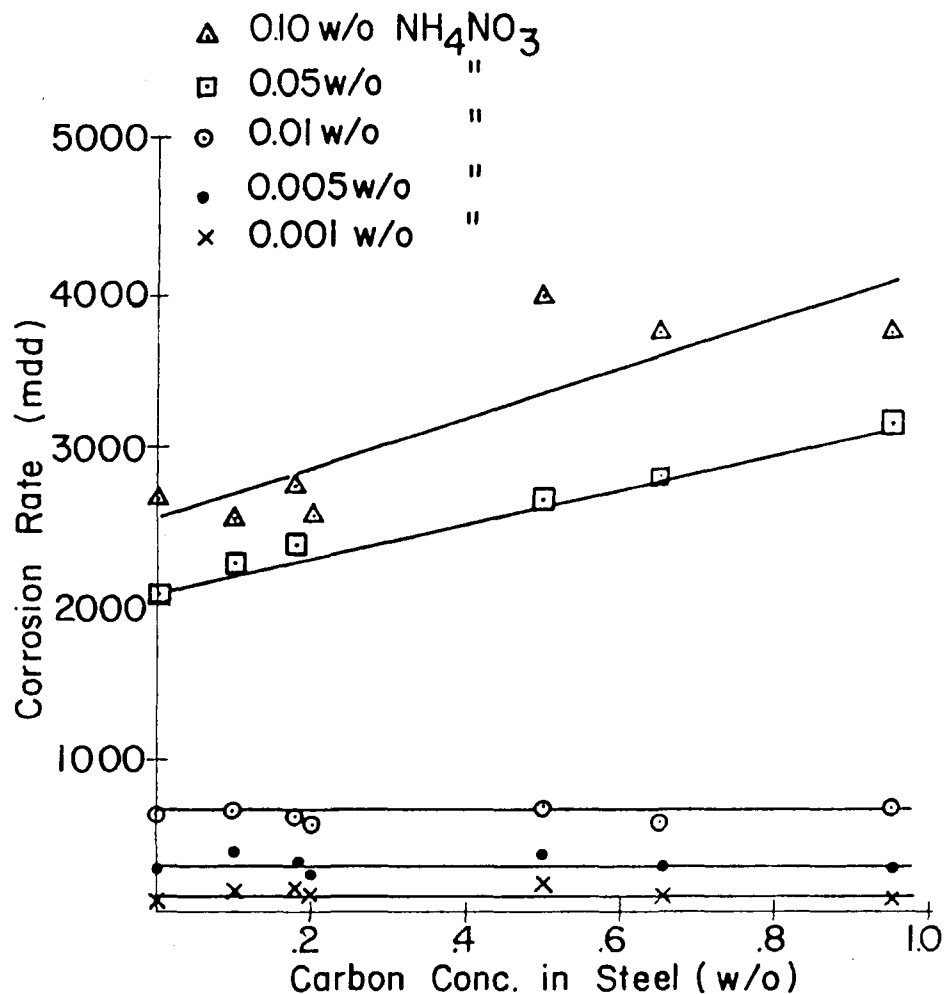


FIGURE 2: EFFECT OF NH_4NO_3 CONCENTRATION ON CORROSION RATE AS A FUNCTION OF CARBON CONTENT IN STEEL

Acknowledgements

This work is supported by the Nebraska Water Resources Center, Nebraska Engineering Research Center and Valmont Industries. The assistance of Valmont Industries and Reinke Mfg. Co. in acquiring test materials is also acknowledged.

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