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NUCLEAR DESALINATION LITERATURE - 5

K. O. Johnsson
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NUCLEAR DESALINATION LITERATURE – 5

K. O. Johnsson

NUCLEAR DESALINATION PROGRAM
R. P. Hammond, Director

SEPTEMBER 1970

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

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K. O. Johnsson, Director
(Phone 615/483-8611, Ext. 3-5473)
Nuclear Desalination Information Center
Oak Ridge National Laboratory
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ABSTRACT

Abstracts are given for approximately 210 published articles related to the desalination of seawater. The body of the report is a copy of information stored in a computerized storage and retrieval system for the Nuclear Desalination Information Center (NDIC) at the Oak Ridge National Laboratory. The abstracts are grouped in nine categories (and repeated if they fall into more than one category). An author and a keyword index to the articles referenced is provided. The keywords, which identify the content of the articles, were chosen from a thesaurus developed by NDIC.

INTRODUCTION

This indexed bibliography contains abstracts of desalination literature generally available to the public. It is the fifth such bibliography published by the Nuclear Desalination Information Center at the Oak Ridge National Laboratory. As more material is added to the Center's storage system, additional listings will be published.

The Nuclear Desalination Information Center was established in September 1966 under the sponsorship of the Division of Reactor Development and Technology of the U.S. Atomic Energy Commission as part of the Nuclear Desalination Program at the Oak Ridge National Laboratory. This program has the primary objectives of performing technical evaluation of various types of reactors for desalting plant applications, developing conceptual designs of reactors specifically for desalting applications, and developing components, systems, and technology for large-scale and prototype reactors optimized for coupling with seawater conversion plants.

The initial computer program and the system for abstracting and indexing were developed as a part of a seawater distillation literature survey conducted by ORNL for the Office of Saline Water, U.S. Department of Interior, in 1965. The Office of Saline Water continues to support the portion of the Center's information activities which deal with the distillation process. Consequently, abstracts on distillation processes will appear both here and in OSW compilations.

The bibliography list is divided into nine categories of desalination information; a single bibliographic entry may be listed in as many
as three categories. A keyword index and an author index are provided for the convenience of the user. Each bibliographic entry includes the following information: author(s), title, corporate author(s), number of pages, number of figures, number of references, publication date, document number or journal reference, an informative abstract of less than 200 words, and a list of selected keywords to describe the contents. The keywords are assigned by NDIC personnel to serve as coordinate indexing terms for storage and future retrieval of information. The most significant keyword terms for each bibliographic entry are indicated with an asterisk. The keywords are included with this bibliography since they can, through the keyword index, be of aid to the reader in locating related items of interest. Many readers, however, will prefer to scan the categories most closely related to their field of interest.

CATEGORIES

Nine subject categories have been established initially to organize information under specific areas of technology and interest. Since many reports cover information in more than one area, the abstracts for these reports will be found listed in two, or sometimes three, categories. Although categories have been established for several desalination processes, the distillation process is the only one specifically covered at the present time. The other processes may be included at some future date. Some reports may not appear, from the title, to be appropriate for inclusion here; however, they are included because information or data contained in the document was found to be of use in studies of some phase of nuclear desalination. The categories and their general coverage are:

10 ENERGY SOURCES

This category covers information on sources of energy under consideration for desalination plants. Primarily this will consist of reactor studies, but some other sources such as fossil fuels will be included when they are considered as alternatives to nuclear energy. In general, solar energy, geothermal energy, etc. are not included in the scope of the Center's activities.
20 ENERGY UTILIZATION (COUPLING)

This category covers information on the coupling of an energy source to a desalting plant. It includes the relationship between the design and economics of nuclear desalting plants as a function of the principal parameters. The evaluation of the various methods whereby nuclear dual-purpose plants can be designed and operated so as to provide the flexibility needed to adjust to various load conditions is included.

30 SEAWATER DISTILLATION PROCESSES

This category covers information on the various distillation processes, plants, and equipment (such as long-tube vertical evaporators, flash evaporators, and evaporator components). Also included are information related to materials of construction, heat transfer, fabrication methods, and design information useful in the development of distillation processes. (The basic chemical, physical, and thermodynamic data on seawater are listed under category 99.)

40 OTHER DESALTING PROCESSES

This category covers information on desalting processes other than distillation. These will include hyperfiltration, freeze process, ion exchange processes, etc. In general, this category is not in use at present; however, some entries will appear when they contain information which is of direct use for studies of the distillation process.

50 OVERALL PLANT STUDIES

This category covers studies on the overall or integrated desalting plant. This, in effect, is a combination of categories 10, 20, and 30 or 40. If the study is primarily on the design of a distillation process, it will be in category 30, even though an energy source may be specified to establish a basis for heat costs. However, if the design considers the effect of various heat sources and coupling parameters on the design, the information will be listed in category 50.

60 SITING CONSIDERATIONS

This category covers information on the factors involved in the choice of a site for a desalting plant. This includes the safeguards necessary due to the use of a nuclear energy source, construction problems because
CATEGORIE 10 - ENERGY SOURCES

10-01094 COSENTINO JO + CSKJ BJ + QUILLIAPT OA + SABATO JA
EXPERIENCE GAINED IN CONSTRUCTING ARGENTINAS NUCLEAR POWER STATION
COMISION NACIONAL DE ENERGIA ATOMICA, BUENOS AIRES, ARGENTINA
PREPRINT OF PAPER SM-126/1 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 8 P
THE PLANNING AND CONSTRUCTION OF THE ATUCHA NUCLEAR POWER STATION, WHICH WILL GO INTO OPERATION IN 1972, IS ANALYZED FROM THE ECONOMIC AND FINANCIAL POINT OF VIEW, COMMENTS ARE MADE ON THE METHODS AND RESULTS OBTAINED IN THE STAGES PRIOR TO STARTING THE WORK. DETAILS ARE GIVEN FOR THE INSTALLATION COST OF THE STATION, THE CONTRIBUTION MADE BY ARGENTINE INDUSTRY AND THE EFFECT ON THE TECHNOLOGICAL DEVELOPMENT OF THE COUNTRY. THE STATION WILL PRODUCE 319 MW(E) (NET) OF POWER AND USES A NATURAL URANIUM, HEAVY WATER COOLED AND MODERATED REACTOR. THE TOTAL COST IS ESTIMATED TO BE $105,000,000 WHICH INCLUDES $70,000,000 FOR CONSTRUCTION, $35,000,000 FOR HEAVY WATER, AND $3,000,000 FOR URANIUM FUEL. (IN SPANISH)
*CONSTRUCTION COSTS * DESIGN CRITERIA * NUCLEAR ENERGY SOURCES * PLANT CONSTRUCTION + ARGENTINA + CONVERTER REACTORS + COST BREAKDOWNS + DESIGN + ECONOMIC EVALUATIONS + HEAVY-WATER REACTORS + INTEREST + NUCLEAR DESIGN + 0-500 MW(E) REACTORS

10-01096 BARTH J
EXPECTED REDUCTIONS IN THE COST OF NUCLEAR STATIONS DUE TO THE EFFECT OF SERIAL PRODUCTION
ALTOM, PARIS, FRANCE
PREPRINT OF PAPER SM-126/3 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 12 P
IN ORDER TO COMPETE EFFECTIVELY WITH CONVENTIONAL THERMAL PLANTS, THE BUILDERS OF NUCLEAR POWER STATIONS HAVE HAD TO CHARGE, FROM THE VERY OUTSET, PRICES LOWER THAN THE ACTUAL COST FOR THE FIRST ONE IN A SERIES, IN ANTICIPATION OF SELLING A CERTAIN NUMBER OF FACILITIES OF THE SAME TYPE. AN EFFORT IS MADE TO DETERMINE THE EFFECT OF A SERIES PRODUCED IN APPRECIABLY LARGER NUMBERS THAN ARE REGARDED AS CERTAIN TO BE SOLO. IN PART 1 OF THE PAPER, A BREAKDOWN IS MADE OF THE TOTAL COST OF A NUCLEAR POWER STATION INTO ITS MAIN COMPONENTS. IN PART 2 A REVIEW IS PRESENTED OF THE ELASTICITY OF COSTS OF DIFFERENT COMPONENTS AS A FUNCTION OF THE NUMBER OF FACILITIES OF THE SAME TYPE WHICH ARE PLANNED TO BE BUILT, PART 3 DISCUSSES TO WHAT EXTENT THE PRECEDING RULES ARE APPLICABLE IN THE IMPORTANT CASE WHERE THE BUILDER HAS TO WORK IN COLLABORATION WITH LOCAL INDUSTRY. (IN FRENCH)
*COMPONENT COSTS + COST BREAKDOWNS + NUCLEAR ENERGY SOURCES + ECONOMIC EVALUATIONS + ENERGY SOURCES

10-01097 GALSSENS J
CRITERIA OTHER THAN COST FACTORS FOR THE SELECTION OF NUCLEAR STATIONS
COMMISARIAT A L ENERGIE ATOMIQUE, PARIS, FRANCE
PREPRINT OF PAPER SM-126/4 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 13 P, 1 FIG 1 REF
THESE CRITERIA ARE EITHER FINANCIAL (RATE OF INTEREST, FOREIGN TRADE) OR INDUSTRIAL (POSSIBILITY OF LOCAL INDUSTRIES) OR ELSE THEY RELATE TO THE NECESSITY OF ASSURED FUEL SUPPLIES OR PROMOTION OF SCIENTIFIC ACTIVITIES (PARTICIPATION IN DECISION MAKING, CONCERNING THE TYPE AND OPERATING CHARACTERISTICS OF NUCLEAR POWER STATIONS). THE FIRST PART OF THE PAPER DEFINES THE ECONOMIC IMPORTANCE OF THESE CRITERIA FOR A GIVEN COUNTRY. IN THE SECOND PART, REFERENCE IS MADE TO THE THEORY OF SELECTION IN USING MULTIPLE CRITERIA. PARTICULAR EXAMPLES TAKEN FROM FRENCH EXPERIENCE ARE CITED. IN THE THIRD PART, A BRIEF DESCRIPTION IS GIVEN OF A MODEL DECISION REGARDING CHOICES TO BE MADE AT SOME UNKNOWN FUTURE DATE. THIS MODEL MAKES IT POSSIBLE TO TAKE DECISIONS ON A RATIONAL BASIS, DESPITE THE TECHNICAL OR ECONOMIC UNCERTAINTIES, AFFECTING BOTH POWER STATIONS AND THEIR ECONOMIC ENVIRONMENT (SHORT- AND LONG-TERM COSTS OF REACTORS AND THEIR FUELING, ETC.).
*ECONOMIC EVALUATIONS + NUCLEAR ENERGY SOURCES + ENERGY SOURCES + INTEREST + INVESTMENT (FIXED) + SITE SELECTION CRITERIA

10-01099 HAYWARD J + THIERRY L
INFLUENCE OF LOCAL CONDITIONS ON THE INSTALLATION OF LOW-POWER NUCLEAR STATIONS
CENTRE D ETUDES NUCLEAIRES DE FONTENAY-AUX-ROSES, FRANCE
PREPRINT OF PAPER SM-126/7 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 21 P, 3 REF
*ECONOMIC EVALUATIONS + NUCLEAR ENERGY SOURCES + DESIGN + NUCLEAR FUEL CYCLE COSTS

10-01100 SCHLOSSER J + SCHROEDER E
ECONOMICS OF HIGH TEMPERATURE REACTORS
BROWN BOVERI/KRUPP REAKTORGEBAU GMBH, MANNHEIM, GERMANY
PREPRINT OF PAPER SM-126/8 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 19 P, 2 FIG 5 REF
A SHORT DESCRIPTION IS PRESENTED OF THE TYPICAL DESIGN OF A COMMERCIAL HIGH TEMPERATURE GAS REACTOR. THE MAIN COMPONENTS ARE DISCUSSED AND COMPARED WITH THOSE OF THE THORIUM HTTR, A 300-MW(E) PROTOTYPE TO BE BUILT IN 1969. EXPECTED TOTAL GENERATING COSTS ARE GIVEN. CAPITAL COSTS AS WELL AS FUEL CYCLE COSTS ARE PRESENTED ON THE BASIS OF VARIOUS ECONOMIC GROUND RULES, ESPECIALLY, ECONOMY OF SIZE IS CONSIDERED. FUEL COSTS ARE BASED UPON BOTH THE URANIUM

ACCESSION NUMBER 10-01094 TO 10-01100
10-01100  
*CONTINUED*
AND THE THORIUM CYCLE. THEIR IMPLICATION FOR REFABRICATION FACILITIES, URANIUM AND SEGMENTATION WORK CONSUMPTION ARE DESCRIBED. THESE COSTS AND OTHER CHARACTERISTIC DATA OF THE HIGH TEMPERATURE REACTOR ARE COMPARED WITH THOSE TYPICAL OF THE LIGHT WATER REACTOR, SHOWING THE POTENTIAL OF THE HTR.  
*ECONOMIC EVALUATIONS + *NUCLEAR ENERGY SOURCES + CAPITALIZED COSTS + CONVERTER REACTORS + DESIGN DATA + FUEL COSTS + GROUND RULES + HIGH-TEMPERATURE GAS-COOLED REACTORS + 0-500 MW(e) REACTORS + 500 PLUS MW(e) REACTORS

10-01121  
MERLIN HB  
ENERGY CONSUMPTION - ITS GROWTH AND PATTERN  
ATOMIC ENERGY OF CANADA LTD., CHALK RIVER, ONT.  
AECL-3293 (MAR.1969), 30 P, 15 FIG, 18 REF  
PAST DEMANDS FOR ENERGY AND THE CONTRIBUTIONS BY THE MAJOR SOURCES ARE SHOWN FOR THE WORLD AND CANADA. THREE FORECASTS FOR FUTURE DEMANDS ARE PRESENTED. WORLD PRODUCTION OF ELECTRICITY IN 2000 WILL BE ALMOST THE SAME AS ELECTRICITY PRODUCED IN THE WORLD TODAY. THE AMOUNT OF FUEL CONSUMED IN GENERATING THIS ELECTRICITY WILL DEPEND UPON THE TYPES AND MIX OF REACTORS INSTALLED. THE HEAVY WATER REACTORS ALONG OR IN CONJUNCTION WITH FAST BREEDERS AND LIQUID FUELED REACTORS ARE THE MOST EFFICIENT USERS OF URANIUM AND THORIUM RESOURCES. HEAVY WATER REACTORS ARE THE MOST EFFICIENT PRODUCERS OF PLUTONIUM. WORLD, REGIONAL AND CANADIAN FORECASTS ARE GIVEN FOR TOTAL ELECTRICITY GENERATED AND FOR ELECTRICITY GENERATED IN NUCLEAR STATIONS.  
*ENERGY SOURCES + BREEDER REACTORS + ENERGY COSTS + FOSSIL FUELS + HEAVY-WATER/ORGANIC-COOLED REACTORS + NUCLEAR ENERGY SOURCES

10-01132  
ONAGA Y + OOMACHI S  
NUCLEAR ENERGY COSTS IN JAPAN - PRESENT AND NEAR FUTURE  
MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY, TOKYO, JAPAN  
ONE 166 MW(e) NUCLEAR POWER PLANT IS OPERATING IN JAPAN, AND 5 UNITS TOTALING 2406 MW(e) ARE UNDER CONSTRUCTION. IT IS EXPECTED THAT THE TOTAL NUCLEAR POWER GENERATING CAPACITY WILL BE ABOUT 40,000 MW(e) BY 1985. THE ONE PLANT NOW OPERATING IS NOT ECONOMICALLY IN THE NORMAL SENSE BECAUSE OF ITS R&D CHARACTERISTICS AS THE FIRST COMMERCIAL-SCALE NUCLEAR PLANT. ESTIMATED POWER COSTS FOR THE PLANTS UNDER CONSTRUCTION ARE IN THE 6- TO 7-MILL RANGE, AND IT IS EXPECTED THAT THE NUCLEAR POWER COSTS WILL SOON BE COMPETITIVE WITH THOSE OF OIL-FIRED PLANTS. REASONS FOR LOCAL INTEREST RATES, VARIOUS RESTRICTIONS ON PLANT LOCATION, AND DEPRECIATION METHODS, THE COST OF NUCLEAR POWER IN JAPAN DIFFERS CONSIDERABLY FROM OTHER COUNTRIES. AN ECONOMIC EVALUATION OF NUCLEAR POWER IN JAPAN MIGHT ALSO TAKE INTO ACCOUNT FUTUROLOGICAL PROGRESS, REDUCTION OF CONSTRUCTION COSTS DUE TO INCREASES IN SIZE OF PLANTS, AND THE TREND OF FUEL CYCLE COSTS. THIS PAPER DEFINES THESE VARIOUS FACTORS INFLUENCING THE COST OF NUCLEAR POWER STATIONS OF THE YEAR 2000 WILL BE ALMOST THREE TIMES THE SEPARATION WORK CONSUMPTION ARE DESCRIBED. THESE COSTS AND OTHER CHARACTERISTIC DATA OF ELECTRICITY IN NUCLEAR STATIONS. THE HEAVY WATER REACTORS ALONG OR IN CONJUNCTION WITH FAST BREEDERS AND LIQUID FUELED REACTORS ARE THE MOST EFFICIENT USERS OF URANIUM AND THORIUM RESOURCES. HEAVY WATER REACTORS ARE THE MOST EFFICIENT PRODUCERS OF PLUTONIUM. WORLD, REGIONAL AND CANADIAN FORECASTS ARE GIVEN FOR TOTAL ELECTRICITY GENERATED AND FOR ELECTRICITY GENERATED IN NUCLEAR STATIONS.  
*ENERGY SOURCES + BREEDER REACTORS + ENERGY COSTS + FOSSIL FUELS + HEAVY-WATER/ORGANIC-COOLED REACTORS + NUCLEAR ENERGY SOURCES

10-01134  
KIKUCHI T  
LONG-TERM NUCLEAR FUEL CYCLE AND ITS ECONOMICS RELATING TO PLUTONIUM UTILIZATION  
ATOMIC ENERGY BUREAU, TOKYO  
AN EVALUATION BY SYSTEMS ANALYSIS OF THE EFFECT OF PLUTONIUM UTILIZATION ON THE NUCLEAR FUEL CYCLE AND ITS ECONOMICS. THE CALCULATION MODEL DEVELOPED HERE CAN BE USED FOR THE FOLLOWING STUDIES: (1) PLUTONIUM THERMAL USAGE UP TO THE INTRODUCTION OF THE FAST BREEDER REACTOR INTO THE NUCLEAR POWER GENERATING SYSTEM, (2) SUCCESSFUL DEVELOPMENT OF PLUTONIUM SELF-SUSTAINING-TYPE REACTORS, (3) PLUTONIUM IMPORTING, AND (4) THE INTRODUCTION OF URANIUM-LOADING FBRS DUE TO PLUTONIUM DEFICIENCY AFTER THE INCLUSION OF FBRS IN THE NUCLEAR POWER SYSTEM.  
*ECONOMIC EVALUATIONS + *NUCLEAR FUEL CYCLE COSTS + ENERGY COSTS + ENERGY SOURCES + NUCLEAR ENERGY SOURCES

10-01135  
TAKE M + SUZUKI S + WATANABE H  
EVALUATION OF THE GROWTH OF NUCLEAR POWER IN THE FUTURE POWER SYSTEM  
INSTITUTE OF ENERGY ECONOMICS, TOKYO  
*ECONOMIC EVALUATIONS + *NUCLEAR ENERGY SOURCES + *SYSTEMS ENGINEERING + ECONOMIC CONDITIONS +
COST EXPERIENCE AND TRENDS IN THE COST OF PRESSURIZED WATER REACTORS
WRIGHT JH
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
PREPRINT OF PAPER SM-126/14 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 6 P, 7 TABLES, 3 FIG.

FACTORS AFFECTING THE COST OF NUCLEAR PLANTS, SUCH AS EQUIPMENT ENGINEERING, CRAFT LABOR, EQUIPMENT AND MATERIALS, ARE EXAMINED IN DETAIL AND CURRENT EXPERIENCE ON FOSSIL PLANTS. WIDE VARIATIONS IN PLANT COSTS ARE BEING EXPERIENCED FROM ONE LOCATION TO ANOTHER, LARGELY AS A RESULT OF CRAFT LABOR RATES AND PRODUCTIVITY. THIS STUDY REVEALS THAT THE NUCLEAR PLANT COST PROBLEMS, COMPARED TO FOSSIL PLANTS, ARE LARGELY ASSOCIATED WITH THE LONGER SCHEDULE FOR NUCLEAR PLANTS. THE FIELD LABOR CONTENT IS ACTUALLY SMALLER FOR A NUCLEAR PLANT DUE TO ITS MUCH HIGHER SHOP FABRICATION CONTENT. INFLATIONARY FACTORS ARE ALSO APPLIED TO NUCLEAR AND FOSSIL FUEL COSTS TO SHOW THE SIGNIFICANCE OF THE TOTAL EFFECT. RESULTS OF PRESENT EXPERIENCES AND TRENDS SUGGEST THAT COMPETITION BETWEEN NUCLEAR AND FOSSIL POWER PLANTS WILL CONTINUE TO BE VIGOROUS IN THE YEARS AHEAD.

*COST ALLOCATION + *NUCLEAR ENERGY SOURCES + *PRESSURIZED-WATER REACTORS + ECONOMIC CONDITIONS + ECONOMIC EVALUATIONS + ENERGY SOURCES

NUCLEAR POWER - A BASIS FOR REGIONAL ECONOMIC DEVELOPMENT
ODCINELL AJ + LICCIARDO RBA
BECHEL CORP., SAN FRANCISCO, CALIF.

THE SIX NATIONS OF THE WESTERN PACIFIC BASIN (NEW ZEALAND, AUSTRALIA, PHILIPPINES, TAIWAN, SOUTH KOREA, AND JAPAN) WERE SELECTED FOR DEMONSTRATION OF AN INTEGRATED NUCLEAR FUEL COMPLEX ON A MULTINATIONAL REGIONAL BASIS, WHEREBY THEY WOULD POOL THEIR INTERESTS FOR FINANCING, CONSTRUCTION, AND OPERATION OF THE SEVERAL PROCESS OPERATIONS REQUIRED TO SUPPORT THEIR NUCLEAR POWER INSTALLATIONS. IT WAS ASSUMED THAT THESE COUNTRIES WOULD NOT HAVE TO DEPEND ON OUTSIDE NUCLEAR FUEL CYCLE SERVICES BEYOND 1975, WITH THE POSSIBLE EXCEPTION OF ENRICHMENT FACILITIES. BY 1980 ABOUT 30,000 MWE WILL BE GENERATED BY NUCLEAR POWER STATIONS PLANNED BY THE SIX COUNTRIES. NUCLEAR FUEL REQUIREMENTS FOR THIS CAPACITY WOULD REQUIRE INVESTMENT OF ABOUT $700 MILLION IN FACILITIES FOR CONVERSION OF URANIUM OXIDE TO URANIUM HEXAFLUORIDE, FOR ENRICHMENT, FOR FUEL FABRICATION AND FUEL REPROCESSING. ANNUAL OPERATING COSTS WILL BE ABOUT $350 MILLION. WITH THE EXCEPTION OF JAPAN, THESE COUNTRIES WOULD BE UNABLE TO SUPPORT INDIVIDUAL NUCLEAR FUEL CYCLE FACILITIES TO MEET THEIR OWN NATIONAL NEEDS AT THAT TIME. THE ECONOMIC, INDUSTRIAL DEVELOPMENT, AND EMPLOYMENT OPPORTUNITIES OF THE INTEGRATED, COOPERATIVE CONCEPT SEEM TO OFFER SUBSTANTIAL INCENTIVES TO THESE AND OTHER REGIONS OF THE WORLD WHERE THIS CONCEPT IS FEASIBLE.

*NUCLEAR ENERGY SOURCES + *CAPITALIZED COSTS + CONSTRUCTION COSTS + ENERGY SOURCES + FUEL COSTS + NUCLEAR FUEL PROCESSING STUDIES + OPERATING COSTS

ECONOMIC ASPECTS OF NUCLEAR POWER IN TURKEY
UNAL HC
CEMKME NUCLEAR RESEARCH AND TRAINING CENTER, ISTANBUL


*ENERGY SOURCES + *NUCLEAR ENERGY SOURCES + *POWER GROWTH SURVEYS + ECONOMIC CONDITIONS + ECONOMIC EVALUATIONS + ENERGY COSTS + TURKEY

SHORT-TERM PROSPECTS FOR CONVENTIONAL AND NUCLEAR POWER GENERATION COSTS IN TURKEY
AYBERS N
TECHNICAL UNIVERSITY OF ISTANBUL, TURKEY


*COST BREAKDOWNS + *ENERGY SOURCES + CAPITALIZED COSTS + ECONOMIC CONDITIONS +
**PREPRINT OF PAPER SM-126/18 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, MIDDLE EAST TECHNICAL UNIVERSITY, ANKARA, TURKEY**

**ECONOMIC ASPECTS OF NUCLEAR FUEL FABRICATION AND REPROCESSING IN TURKEY**

10-01145 DINCLER G + BOBBLEGER G + KOCAKUSAK G

PREPRINT OF PAPER SM-126/18 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 19 P, 6 FIG, 18 REF

A COMPARISON OF HYDRO, THERMAL, AND NUCLEAR POWER COSTS AND CAPACITIES IN TURKEY UP TO YEAR 2000 IS PRESENTED. PLANS ARE DISCUSSED FOR INCLUDING LARGE RESERVES OF RECENTLY FOUND LOW-ENERGY LIGNITE IN THE INTERCONNECTED ELECTRICITY SYSTEM OF TURKEY. TIMING AND PLANNED GROWTH OF NUCLEAR POWER NEEDS IN TURKEY ARE DISCUSSED. FUEL MANUFACTURING AND VARIOUS REACTOR TYPES AND PROBLEMS OF REPROCESSING FUEL ELEMENTS ARE CONSIDERED, TAKING LOCAL CONDITIONS INTO ACCOUNT. TURKISH URANIUM RESERVES AND THEIR ECONOMICS ARE BRIEFLY DISCUSSED. ACTUAL AND PLANNED ENERGY NEEDS FOR THE PERIOD 1961-1982, ESPECIALLY FOR CHEMICAL INDUSTRIES, ARE DIAGRAMMED, WITH ENERGY REQUIREMENTS TO YEAR 2000 EXTRAPOLATED. PROBLEMS OF TRANSPORTATION OF URANIUM ORES TO FUEL MANUFACTURING PLANTS AND OF USED FUEL TO THE REPROCESSING FACTORY ARE EXPLORIED, AND A SCHEMATIC MAP IS PRESENTED SHOWING ASSUMED LOCATION OF NUCLEAR ENERGY PLANTS, FUEL MANUFACTURE AND REPROCESSING PLANTS, AND ENERGY LINES OVER THE COUNTRY. THE CAPACITY OF THE REPROCESSING PLANT IS EVALUATED ON THE BASIS OF PLANS FOR THE INCREASE OF NUCLEAR ENERGY PRODUCTION.

**ECONOMIC EVALUATIONS + *ENERGY SOURCES + *FUEL COSTS + *NUCLEAR FUEL CYCLE COSTS + ECONOMIC CONDITIONS + *NUCLEAR ENERGY SOURCES + TURKEY**

**PREPRINT OF PAPER SM-126/19 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ENERGoprojekt, Beograd, Yugoslavia**

10-01146 MANDEI D + NOVOLJIĆ L

ANALYSIS OF THE CONDITIONS AFFECTING THE INTRODUCTION OF NUCLEAR POWER PLANTS INTO YUGOSLAVIA'S ELECTRIC POWER SYSTEM IN THE COMING DECADES

PREPRINT OF PAPER SM-126/19 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 14 P, 2 FIG, 4 REF

A LONG-TERM PREDICTION OF POWER CONSUMPTION AND UTILIZATION OF HYDRO POWER POTENTIAL, BASED ON DEVELOPMENT OF THE ELECTRICAL POWER INDUSTRY IN THE PAST DECADE AND PLANNED GROWTH FOR THE NEXT FEW YEARS, IS PRESENTED. AN OPTIMIZATION PROCEDURE DEVELOPED FOR ANALYSIS OF A SYSTEM WITH APPRECIABLE HYDRO POWER GENERATION IS APPLIED TO DETERMINE CONDITIONS FOR COMPETITIVE INTRODUCTION OF NUCLEAR PLANTS. THE PRESENT WORTH OF COSTS IS USED AS THE ECONOMIC CRITERION THROUGHOUT THE COUNTRY. FOR PREDICTED FUTURE COST OF LIGNITE AND NUCLEAR FUEL, THE PROCEDURE GIVES THE UPPER LIMIT OF INVESTMENTS IN NUCLEAR PLANTS RELATIVE TO INVESTMENTS IN LIGNITE-FIRED PLANTS, WHICH MAKES THE NUCLEAR PLANT COMPETITIVE. THE LOAD FACTOR FOR THERMAL AND NUCLEAR PLANTS IS ALSO INDICATED AND THE NUCLEAR FUEL CYCLE POLICY IS EXPLORED. FOR LIGHT- AND HEAVY-WATER REACTORS, REPROCESSING REQUIREMENTS, PLUTONIUM PRODUCTION, CAPACITIES IN FUEL INDUSTRY WHICH MIGHT BE JUSTIFIED IN THE COUNTRY, AND FOREIGN CURRENCY EXPENDITURE INCURRED BY THE ASSESSED NUCLEAR PROGRAM, THE STUDY IS CONFINED TO AN OVERALL PICTURE AND DOES NOT TAKE INTO ACCOUNT THE CONDITIONS FOR PARTICULAR REGIONS WITHIN THE COUNTRY.

**ENERGY SOURCES + *NUCLEAR ENERGY SOURCES + *NUCLEAR FUEL CYCLE COSTS + ECONOMIC CONDITIONS + ECONOMIC EVALUATIONS + YUGOSLAVIA**

**PREPRINT OF PAPER SM-126/24 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ENERGoprojekt, Beograd, Yugoslavia**

10-01147 IYER PA + CHU C

SUBMERGED COMBUSTION

REPT. 70-8, UCLA ENG. DEPT. (JAN. 1970), 16 P, 6 TABLES, 2 FIG, 13 REF

SUBMERGED COMBUSTION CAN BE USED ADVANTAGEOUSLY TO HEAT AND EVAPORATE SALINE WATER AND TO CONCENTRATE CORROSIVE AND SCALE-FORMING LIQUIDS. THE PRINCIPAL ADVANTAGE LIES IN THE HIGH EVAPORATION AND COMBUSTION EFFICIENCIES OBTAINED. THIS WORK INVESTIGATES THE EFFECTS OF PERCENTAGE EXCESS AIR, TOTAL GAS FLOW RATE AND SUBMERGENCE ON THESE EFFICIENCIES, AS AN INCREASE IN PERCENTAGE EXCESS AIR TENDS TO IMPROVE BOTH THE EVAPORATION AND COMBUSTION EFFICIENCIES. AN INCREASE IN TOTAL GAS FLOW RATE INCREASES THE EVAPORATION EFFICIENCY BUT DECREASES COMBUSTION EFFICIENCY. SUBMERGENCE HAS A SLIGHTLY NEGATIVE EFFECT ON EVAPORATION EFFICIENCY BUT NO SIGNIFICANT EFFECT ON COMBUSTION EFFICIENCY. IN THE SHORT RANGE USED IN THIS WORK.

**DIRECT CONTACT HEAT EXCHANGE + DISTILLATION PROCESSES + ENERGY SOURCES + HEAT TRANSFER**

**PREPRINT OF PAPER SM-126/26 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ENERGoprojekt, Beograd, Yugoslavia**

10-01148 LEPECKI WPS

THE INFLUENCE OF NUCLEAR ENERGY ON THE DEVELOPMENT OF BRAZIL

INSTITUTO DE PEQUISAS RADIOACTIVAS, BELO HORIZONTE, BRAZIL

PREPRINT OF PAPER SM-126/26 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 11 P, 5 TABLES, 5 FIG, 12 REF

A SURVEY OF NUCLEAR ENERGY REQUIREMENTS IN BRAZIL WAS MADE, AND IT INDICATES THAT ABOUT 1000 MW OF NUCLEAR POWER GENERATING CAPACITY WILL NEED TO BE ADDED EACH YEAR FOR THE NEXT 30 YEARS IN THE SOUTHCENTRAL REGION ALONE (THE MOST DEVELOPED REGION OF THE COUNTRY). BASED ON THESE FORECASTS, AN ESTIMATE IS MADE OF INDUSTRIAL REQUIREMENTS IN SEVERAL AREAS, AS OTHER CORROSIVE AND SCALE-FORMING LIQUIDS. A SURVEY OF THE IMPACT OF THE NUCLEAR PROGRAM ON THE GENERAL TECHNOLOGICAL AND SCIENTIFIC RESEARCH LEVEL AND ON THE ECONOMY AS A WHOLE WAS MADE, INDICATING THAT YEARLY EXPENDITURES IN THE NUCLEAR PROGRAM WILL RISE FROM ABOUT $60 MILLION PER YEAR IN 1975-80 TO MORE THAN $1,000 MILLION PER YEAR IN 1995-2000.

**ECONOMIC CONDITIONS + *NUCLEAR ENERGY SOURCES + BRAZIL + ENERGY SOURCES**

**PREPRINT OF PAPER SM-126/27 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ENERGoprojekt, Beograd, Yugoslavia**

10-01149 BOETTCHER A + KRAMER H + WAGEMANN K

PROSPECTS OF NUCLEAR ENERGY IN COUNTRIES WITH RESTRICTED CAPITAL AND FOREIGN CURRENCY AVAILABILITY

KERNFORSCHUNGSANLAGE JULICH GMBH, GERMANY


INVESTIGATES THE EFFECTS OF PERCENTAGE EXCESS AIR, TOTAL GAS FLOW RATE AND SUBMERGENCE ON THESE EFFICIENCIES, AS AN INCREASE IN PERCENTAGE EXCESS AIR TENDS TO IMPROVE BOTH THE EVAPORATION AND COMBUSTION EFFICIENCIES. AN INCREASE IN TOTAL GAS FLOW RATE INCREASES THE EVAPORATION EFFICIENCY BUT DECREASES COMBUSTION EFFICIENCY. SUBMERGENCE HAS A SLIGHTLY NEGATIVE EFFECT ON EVAPORATION EFFICIENCY BUT NO SIGNIFICANT EFFECT ON COMBUSTION EFFICIENCY. IN THE SHORT RANGE USED IN THIS WORK.
In recent years optimization models have been developed to determine for different power plants the capacity distribution leading to cheapest power generating costs in an expanding power grid. In such strategy calculations for rapidly developing countries other optimization criteria may also be of interest. In addition to minimization of overall power generating cost, minimum capital and foreign currency requirements over a long period may be vital to the study. In this paper such calculations have been carried out for a given power grid and, from these viewpoints, different combinations of nuclear power plants are considered. Relationships between savings in capital and foreign currency requirements on the one side and increase in power generating costs are presented and correlated with the necessary capacity of the respective fuel cycle industry. It is concluded from the results that HWRS (with natural uranium as well as with Pu-recycle) and HTRs may play a significant role for such countries.

*Capita] + *Nuclear Energy Sources + *Energy Sources + *Heavy-Water Reactors

**Future Trends in Fuel Cycle Cost for Medium-Size Light Water Reactors**

Hundt, D.


The various phases of the fuel cycle (uranium concentrate extraction, plutonium, conversion, enrichment, fuel assembly fabrication, and reprocessing) are examined from an economic viewpoint, and the influence of cost changes in the various phases on the total fuel cycle costs of a 400 MWe light water reactor is calculated. Reduction of fuel cycle costs over the last decade as a result of improved core design is discussed. The result of this estimation shows that even without taking credit of further improvements in the design of light water reactors an increase of uranium prices of around 30% will not result in higher fuel cycle costs because of cost reductions forecast for other phases of the cycle due to higher fabrication quantities. At a fixed charge rate of 8%, fuel cycle costs are estimated at 1.58 mills/kWh.


**Some Aspects of Power System Expansion in Developing Countries**

Goldschmidt, K.

Electro-Watt Engineering Services Ltd., Zurich


A discussion of the factors comprising the power market and the generating plants necessary to supply the market. Particular attention is given to demand patterns, integration of large plants into restricted power systems, cost and financing considerations, and questions of staffing and long-term development. Some of the constraints which limit expansion are illustrated, as well as the conditions which favor development of nuclear power generating systems to supply power to developing countries. The conclusion is that the solutions which appear most promising are long term and that the possibility of reshaping the economy of whole regions with ample and cheap power is still more than ten years away.

*Economic Conditions + *Nuclear Energy Sources + *Power Requirements + *Economic Evaluations + Energy Costs + Energy Sources + Power Growth Surveys + Regional Planning + 0-500 MWe (E) Reactors

**The Growth of Demand for Energy and the Role of Nuclear Power**

Seaey, P. J.

U.K. Atomic Energy Authority, London


Reviewing the trend of world energy requirements, the paper considers the role of energy in several countries in widely varying stages of development and isolates some of the factors contributing to their positions and prospects. It considers the possibility of raising developing countries to a higher stage of development by increasing the supply of energy, especially nuclear energy, recognizing that the introduction of nuclear power is a complex matter affecting different countries in different ways. The main technical and economic characteristics of various nuclear reactors the UK has developed or is developing, are examined and the costs of nuclear power generation in the medium and long term are considered. The economic significance of proven and projected nuclear power systems for developing countries is discussed, with special reference to the wider economic, social, and political factors affecting the choices available to individual countries and areas.

*Economic Conditions + *Nuclear Energy Sources + *Power Requirements + *Economic Evaluations + Energy Costs + Energy Sources + Power Growth Surveys + Reactor Design + Regional Planning + 0-500 MWe (E) Reactors

**The Steam Generating Heavy Water Reactor**

Ghaliab, S.A.

The Nuclear Power Group Ltd., Knutsford, England


Taking advantage of a relatively late entry into the water reactor field, the UK has combined in the steam generating heavy water reactor the best features of earlier water reactors. The attractive economics of this system arise from these features:

1. The use of light water coolant and the direct cycle, coupled with a particularly...
FACTORS AFFECTING THE COST OF NUCLEAR FUELS AND THE SELECTION OF REACTOR FUEL CYCLES IN THE DEVELOPING COUNTRIES

KENNEDY, DONKIN, WOKING, SURREY, UK
PREPRINT OF PAPER SM-126/31 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 16 P, 3 TABLES, 7 FIG

ECONOMIC CONDITIONS IN DEVELOPING COUNTRIES HAVE A MARKED EFFECT ON SELECTION OF A SPECIFIC TYPE OF REACTOR SYSTEM WHICH CAN BE ECONOMICALLY ATTRACTIVE WHEN INTEGRATED INTO A NATIONAL NETWORK. SINCE ACCUMULATED FUEL COSTS FOR A TYPICAL PROVEN TYPE REACTOR WILL APPROXIMATELY EQUAL PLANT INVESTMENT COSTS WITHIN THE FIRST HALF OF THE DESIGNED PLANT LIFE, THE RELATIONSHIP OF FUEL COST TO THE TOTAL ENERGY COST STRUCTURE ASSUMES GREAT IMPORTANCE. THIS PAPER DISCUSSES THE VARIOUS FUEL REQUIREMENTS AND COSTS FOR PRESENT AND FUTURE REACTOR TYPES, AS WELL AS DIFFERENT SOURCES OF SUPPLY FROM OUTSIDE A DEVELOPING COUNTRY. FACTORS AFFECTING LOCAL FUEL MANUFACTURE ARE DISCUSSED, AND PREDICTABLE COSTS AND EFFECTS ON TOTAL ENERGY COST STRUCTURE ARE PRESENTED. VARIATIONS IN INTERNAL AND EXTERNAL FINANCE REQUIREMENTS AND INTEREST RATES ARE THE SUBJECT OF THE PAPER. THE SOCIAL AND ECONOMIC BENEFITS ARE DISCUSSED, AND THE INFLUENCE OF NUCLEAR FUEL COSTS ON THE TOTAL COST STRUCTURE IS INVESTIGATED.

*FUEL COSTS + NUCLEAR FUEL CYCLE COSTS + REGIONAL PLANNING + AGRO-INDUSTRIAL COMPLEXES + MODELS FOR ECONOMIC CONSIDERATIONS ON THE INTRODUCTION OF NUCLEAR ENERGY

FAUDE D + JANSEN P + SEETZEN J
PREPRINT OF PAPER SM-126/32 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, GESELLSCHAFT FUR KERNFORSCHUNG M.B.H., KARLSRUHE, GERMANY

INTRODUCTION OF NUCLEAR ENERGY RESULTS IN REDUCTION IN ENERGY GENERATING COSTS AND THUS DIRECTLY BENEFITS A NATIONAL ECONOMY. NUCLEAR ENERGY WILL BE INTRODUCED IN TWO STEPS - (I) PROVEN REACTOR TYPES WILL BE INSTALLED, ESPECIALLY LIGHT WATER MODERATED AND HEAVY WATER MODERATED THERMAL CONVERTERS. THESE TYPES WILL BE DOMINANT IN THE 1970S. THEY ARE, HOWEVER, CHARACTERIZED BY POOR NUCLEAR FUEL UTILIZATION, AND EXCLUSIVE USE OF THESE TYPES WOULD DENY EXHAUST CHAIN URANIUM SOURCES. HIGHER URANIUM PRICES WOULD INCREASE ENERGY GENERATING COSTS BEFORE THE END OF THIS CENTURY. ADVANCED REACTOR TYPES, ESPECIALLY SODIUM-COOLED FAST BREEDERS, WILL BE DEVELOPED AND WILL BE USED INCREASINGLY IN THE 1980S. THEY WILL PROBABLY CONSTITUTE THE LONG-TERM SOLUTION.

*ECONOMIC CONDITIONS + NUCLEAR ENERGY SOURCES + NUCLEAR FUEL CYCLE COSTS + DUAL-PURPOSE PLANT + ECONOMIC CONDITIONS + ECONOMIC EVALUATIONS + NUCLEAR DESALINATION + REVIEWS

BOWERS HI + HICHNER RP
PREPRINT OF PAPER SM-126/33 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, OAK RIDGE NATIONAL LABORATORY, TENN

TRANSMISSION COSTS VERSUS NEAR-LOAD SITING COSTS FOR INLAND REGIONS DEFICIENT IN COOLING WATER

ISTANBUL, TURKEY, OCT. 20-24, 1969, 19 P, 8 FIG, 9 REF

A GENERAL STUDY WAS MADE OF THE COSTS OF SUPPLYING POWER TO AN INLAND CITY WITH AN OFFSHORE GENERATING PLANT AS COMPARED TO POWER COSTS FROM A NEAR-LOAD FACILITY. IT WAS ASSUMED THAT COOLING WATER WAS IN SHORT SUPPLY NEAR THE CITY, NECESSITATING USE OF A DRY COOLING TOWER FOR THE NEAR-LOAD PLANT, RESULTING IN HIGHER COSTS AND LOWER THERMAL EFFICIENCY. THE OFFSHORE SITE HAD THE ADVANTAGE OF REQUIREING LOMER SAFEGUARDS COSTS AND THE DISADVANTAGES OF HIGHER SITE PREPARATION COSTS AND HIGHER LABOR COSTS DURING CONSTRUCTION. THE STUDY INDICATES THAT THE COST OF ENERGY AT THE BUS BAR WOULD BE LOWER FOR THE OFFSHORE PLANT BY 0.1 MILL/KWHR FOR A 1000 MW(E) BREEDER REACTOR WITH PUBLIC FINANCING AND UP TO 0.5 MILL/KWHR FOR A 10,000 MW(E) LIGHT-WATER REACTOR WITH PRIVATE FINANCING. THESE SAVINGS IN THE COST OF POWER GENERATION WERE THEN APPLIED TO THE COST OF TRANSMITTING POWER TO THE INLAND CITY. IT WAS FOUND THAT, WHEN COMPARING PLANTS OF EQUAL CAPACITY, TRANSMISSION DISTANCES OF 4 TO 80 MILES COULD BE ACCOMMODATED FROM THE SAVINGS ON GENERATION COSTS, ASSUMING PRESENT-DAY TRANSMISSION TECHNOLOGY. WHEN IT IS ASSUMED THAT LARGE (100,000 MW) OFFSHORE PLANTS SUPPLY SMALLER (1000 MW) INLAND LOADS, ALLOWABLE TRANSMISSION DISTANCES RANGED FROM 100 TO 400 MILES.

*TRANSMISSION COSTS + POWER TRANSMISSION COSTS + SITE PREPARATION COSTS + AEC SPONSORED + BREEDER REACTORS + CONVERTER REACTORS + COOLING TOWERS + SITE PREPARATIONS
CATEGORY 20 - ENERGY UTILIZATION (COUPLING)

20-00977 LAGOWSKI JP
NUCLEAR-POWER SEA-WATER CONVERSION PLANT
ATOMIC ENERGY COMMISSION, WASHINGTON
U.S.PAT. 3,303,098 (7-19-65/2-7-67), 5 FIG, 12 REF
A METHOD OF COUPLING A WATER COOLED NUCLEAR REACTOR TO A SEAWATER DISTILLATION PLANT.
THE REACTOR IS LOCATED AT THE BOTTOM OF A PIT, 130 FT OR MORE IN DEPTH, WITH COOLANT
ABOVE THE REACTOR SUFFICIENT TO SUPPRESS THE BOILING OF THE COOLANT AT A TEMPERATURE
SUFINIENTLY HIGH TO OPERATE THE FLASH DISTILLATION PLANT. A SECOND PIT ADJACENT TO
THE REACTOR PIT CONTAINS THE BRINE HEATER. DEMINERALIZED WATER TRANSFERS HEAT
FROM THE REACTOR TO THE BRINE HEATER.
*COUPLING (REACTOR-DESALTING PLANT) + NUCLEAR ENERGY SOURCES + PRESSURIZED-WATER REACTORS +
AEC SPONSORED + BREEDER REACTORS + DISTILLATION PROCESSES + ENERGY SOURCES + FLASH EVAPORATION +
FLOWSHEETS + MULTISTAGE FLASH DISTILLATION + PATENTS

20-01065 BIONDI L + PANSERI D + PIERAZZI L
THE ROVI REACTOR - SELECTION OF THE FUEL ELEMENT AND RELATED PROBLEMS
MONTECATINI EDISON, BREDA + CEN, ITALY
P. 311-18 IN NUCLEAR DESALINATION - PROG. IAEA SYMP., MADRID, NOV. 1968, ELSEVIER, 1969. WAS PAPER
SM-113/2 AT SYMP.
The organic cooled and moderated ROVI reactor has a capacity of 100 MWh(+1) and is
intended for use with a water-only 13 MGD plant. Advantages and disadvantages of each
of several solutions under consideration for the core and fuel element are discussed.
The reference solution selected is one using uranium carbide clad with SAP (sintered
alluminum powder). This solution gives rise to problems related to the behavior of SAP
under creep conditions due to the swelling of the uranium carbide. Several
technological solutions are described, with particular attention to those which so far
appear to offer the most advantages and greatest safety. (In Italian)
*CONVERTER REACTORS + NUCLEAR ENERGY SOURCES + REACTOR DESIGN + CLADDING + ENERGY SOURCES +
REACTOR DYNAMICS + SAFETY + 0-50 MGD PLANT

20-01085 JOHNSON KO
ABSTRACTS OF LITERATURE ON THE DISTILLATION OF SEAWATER AND ON THE USE OF NUCLEAR ENERGY FOR
DESALTING - 1
OAK RIDGE NATIONAL LABORATORY, TENN.
ORNL-IM-2491 (NOV.1969), 216 P
Abstracts are given for approximately 900 published articles related to the
desalination of seawater. The body of the report is a copy of information stored in a
computerized storage and retrieval system on desalination at the Oak Ridge National
Laboratory. The abstracts are grouped in nine categories. Author and keyword indexes
to the articles referenced are provided. The keywords which identify the content of
the articles were chosen from a thesaurus developed at ORNL.
*BIBLIOGRAPHIES + AEC SPONSORED + ORNL SPONSORED
DESIGN AND CONSTRUCTION OF THE WORLD'S LARGEST FLASH TYPE DESALTING PLANT AT TIJUANA, MEXICO

A $7,000,000 TURNKEY CONTRACT HAS BEEN AWARDED TO AQUA-CHEM BY THE MEXICAN GOVERNMENT FOR THE CONSTRUCTION OF THE DESALTING PLANT. THE PLANT WILL BE OF THE LONG-TUBE MULTISTAGE FLASH TYPE WITH A PERFORMANCE RATIO OF 10. IT WILL CONSIST OF TWO 3.75-MGD, 44-STAGE MODULES OPERATING ON A BRINE RECIRCULATING CYCLE WITH A MAXIMUM BRINE TEMPERATURE OF 235 DEG F. IN THAT THE SPECIFICATIONS AND CONTRACT WERE FOR A TURNKEY PLANT, AQUA-CHEM WAS GIVEN FREEDOM TO COORDINATE ALL OF THE VARIABLES TO PRODUCE A PLANT CONFORMING WITH THE PERFORMANCE SPECIFICATIONS. IT HAS BEEN FOUND THAT VERY EFFECTIVE DROPWISE CONDENSATION ON CONDENSER SURFACES MAY BE ACHIEVED BY THE USE OF SOLID SILVER OR BY COATING ANOTHER METAL WITH SILVER.

USE OF GOLD SURFACES TO PROMOTE DROPWISE CONDENSATION

IT HAS BEEN FOUND THAT VERY EFFECTIVE DROPWISE CONDENSATION ON CONDENSER SURFACES MAY BE ACHIEVED BY THE USE OF GOLD. THE GREATEST EFFICIENCY IS OBTAINED WHEN THE UNIT IS ALMOST UNWORKABLE - FOR EXAMPLE, TO HAVE ONE FIRM DESIGN THE PLANT, ANOTHER FIRM MANUFACTURE IT, AND A THIRD FIRM INSTALL IT WOULD ONLY LEAD TO CHAOS. NO ONE COULD RIGHTFULLY BE EXPECTED TO GUARANTEE PERFORMANCE UNDER SUCH A SITUATION.

DESIGN + CONSTRUCTION + CAPITALIZED COSTS + DISTILLATION PROCESSES + FLASH EVAPORATION + FLOWSHEETS + WATER COSTS ESTIMATE

A COMPLETE DESIGN OF THE PLANT IS THAT IN THE FINAL ANALYSIS THE CUSTOMER MUST LOOK TO SOMEONE TO GUARANTEE THAT THE PLANT WILL MEET THE SPECIFIED PERFORMANCE. ANY OTHER PLAN IS ALMOST UNWORKABLE - FOR EXAMPLE, TO HAVE ONE FIRM DESIGN THE PLANT, ANOTHER FIRM MANUFACTURE IT, AND A THIRD FIRM INSTALL IT WOULD ONLY LEAD TO CHAOS. NO ONE COULD RIGHTFULLY BE EXPECTED TO GUARANTEE PERFORMANCE UNDER SUCH A SITUATION.
CATEGORìE 30 - SEAWATER DISTILLATION PROCESSES

30-00964 • CONTINUED


• EXTENDED HEAT TRANSFER SURFACES • HEAT TRANSFER IMPROVEMENTS • CONDENSERS • DISTILLATION PROCESSES • EVAPORATORS • HEAT TRANSFER COEFFICIENT • HEAT RECOVERY • STEAM JET EJECTORS • SYSTEM DESCRIPTIONS • DISTILLATION PROCESSES • FLOWSHEETS • HEAT BALANCE • PATENTS

30-00965 KEMPER CA + HARPER GF + BROWN GA

MULTIPLE-PHASE EJECTOR DISTILLATION APPARATUS AND DESALINATION PROCESS

JOSEPH KAYE AND CO., CAMBRIDGE, MASS.

U.S. PAT. 3,288,665 (8-17-62/11-29-66), 1 FIG, 11 REF


• HEAT RECOVERY • STEAM JET EJECTORS • SYSTEM DESCRIPTIONS • DISTILLATION PROCESSES • FLOWSHEETS • HEAT BALANCE • PATENTS

30-00966 GUERRIERI SA + BOGART MJP

MULTIPLE-EFFECT EVAPORATION UTILIZING SUBMERGED COMBUSTION HEAT

LUMNUS CO., NEW YORK


A PROCESS IN WHICH CONCENTRATED BRINE FROM A MULTIEFFECT EVAPORATION SYSTEM IS PASSED TO A FURTHER CONCENTRATION UNIT FOR FURTHER CONCENTRATION. THE SUBMERGED COMBUSTION UNIT IS FILTERED TO REMOVE THE SOLIDS CONTENT AND THE MOTHER LIQUOR RETURNED TO THE SUBMERGED COMBUSTION UNIT. THE HEAT CONTENT OF THE STEAM AND COMBUSTION PRODUCTS FROM THE SUBMERGED COMBUSTION UNIT PROVIDE THE HEAT REQUIREMENTS FOR OPERATION OF THE MULTIEFFECT EVAPORATION SYSTEM. THE SOLID RESIDUE WITHDRAWN FROM THE FILTERING STEP IS THEN DISPOSED OF IN ANY SUITABLE MANNER.

• DIRECT CONTACT HEAT EXCHANGE • MULTIPLE EFFECT DISTILLATION • SYSTEM DESCRIPTIONS • DISTILLATION PROCESSES • FLOWSHEETS • HEAT BALANCE • HEAT TRANSFER • PATENTS • WASTE DISPOSAL

30-00967 ZIMMERMANN FJ

WATER VOLATILIZATION-CONDENSATION PURIFICATION PROCESS USING INERT GAS

STERLING DRUG, INC., NEW YORK

U.S. PAT. 3,285,833 (6-19-64/11-15-66), 7 FIG, 5 REF

A PROCESS FOR OBTAINING PURE WATER FROM WATER CONTAINING SALT OR OTHER NONVOLATILE MATERIAL. THE STEPS CONSIST OF (1) CONTINUOUSLY MIXING WITH THE SEAWATER A NONCONDENSABLE GAS AT 500 TO 1000 PSI, (2) PASSING THE LIQUID AND GASEOUS PHASE AS A CONCURRENT FLOWING INTIMATE MIXTURE THROUGH A HEAT EXCHANGER, (3) THEN PASSING THE GASEOUS PHASE OF THE HEATED MIXTURE OBTAINED FROM THE HEAT EXCHANGE ZONE IN COUNTERCURRENT SEPARATE HEAT EXCHANGE WITH THE MIXTURE IN THE HEAT EXCHANGER, (4) SUPPLYING ENERGY TO GASEOUS PHASE OF THE HEATED MIXTURE OBTAINED FROM THE HEAT EXCHANGER PRIOR TO RETURNING IT TO THE HEAT EXCHANGER. THE TEMPERATURE OF THE GASEOUS PHASE IS RAISED TO ABOUT 365 TO 450 DEG F SO THAT WHEN IT IS RETURNED TO THE HEAT EXCHANGER ABOUT 75% OF THE WATER IN THE LIQUID PHASE IN THE HEAT EXCHANGER IS VAPORIZED. THE TEMPERATURE OF THE GASEOUS PHASE IN THE HEAT EXCHANGER IS COOLED SUFFICIENTLY IN THE REGION WHERE THE FEEDWATER ENTERS SO THAT PRODUCT WATER CONDENSES.

• DIRECT CONTACT HEAT EXCHANGE • HUMIDIFICATION PROCESSES • SYSTEM DESCRIPTIONS • CONDENSERS • DISTILLATION PROCESSES • EVAPORATORS • FLOWSHEETS • HEAT BALANCE • HEAT TRANSFER • PATENTS

30-00968 HERBERT LS + STERNS UJ

METHOD FOR PREVENTING SCALE DEPOSITION

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, EAST MELBOURNE, AUSTRALIA

U.S. PAT. 3,293,152 (8-14-63/12-20-66), 4 FIG, 3 REF

A METHOD TO PREVENT THE FORMATION OF SCALE IN DISTILLATION OR EVAPORATION APPARATUS. AN ORGANIC POLYMER, SUCH AS POLYACRYLIC ACID, IS ADDED TO THE SALINE WATER TO THE EXTENT OF 0.1 TO 3 PPB. THE POLYMER IS CAPABLE OF FORMING AT THE HEAT TRANSFER SURFACES A FILM OR SHEATH WHICH EITHER EXCLUDES THE SCALE FROM THE SURFACES OR IS CODEPOSITED WITH THE SCALE. WHEN THE FILM INCREASES TO A CRITICAL THICKNESS IT BREAKS AWAY FROM THE SURFACE. THE SURFACE SUBSTANTIALLY LEAVE THE SCALE. THE FILM IS REDEPOSITED ON THE CLEAN SURFACE AND AGAIN BREAKS AWAY. THE OVERALL EFFECT BEING THAT

ACCESsION NUMBER 30-00964 TO 30-00968
**CATEGORY 30 - SEAWATER DISTILLATION PROCESSES**

**30-00968** CONTINUED

*The heat transfer surfaces are automatically maintained essentially free of scale.*

**30-00969**

GUNThER DA

**PROCESS FOR PREVENTING THE FORMATION OF BOILER SCALE**

AMERICAN STERILIZER CO., ERIE, PA.

U.S.PAT. 3,308,062 (3-24-65/3-7-67), 7 REF

**THE PROCESS RELATES TO AN EFFECTIVE MEANS OF PREVENTING SCALE FORMATION IN BOILERS, EVAPORATORS AND THE LIKE BY A CONTROLLED ADDITION OF GLUCONIC ACID TO THE FEED WATER.**

A METERING DEVICE IS USED TO MAINTAIN A PH OF 8.5 IN THE BOILING EVAPORATOR AND PERIODIC SAMPLING IS DONE TO MAINTAIN THE PROPER PH LEVEL.

**30-00970**

LCBEEl FA

**METHOD OF SCALE CONTROL IN SEA WATER EVAPORATION**

AQUA-CHEm INC., WIS.

U.S.PAT. 3,305,455 (2-6-63/2-21-67), 1 FIG, 9 REF

**A METHOD RELATED TO SCALE CONTROL ON EVAPORATOR TUBES BY UTILIZING THE FORMATION OF WATER SOLUBLE CALCIUM SULFATE. DURING THE EVAPORATION CYCLE, SEA WATER AT BRINE CONCENTRATION OF ABOUT 100,000 PPM IS HEATED TO A PRESELECTED TEMPERATURE OF ABOUT 215 DEG F AND A PRESSURE OF ABOUT 15 PSIA. UNDER THESE CORRELATED CONDITIONS, MAJOR PORTION OF THE SCALES FORMED IS THE WATER SOLUBLE CALCIUM SULFATE ALONG WITH SMALL PORTIONS OF WATER INSOLUBLE MAGNESIUM HYDROXIDE AND CALCIUM CARBONATE. FOR REMOVAL OF THE WATER SOLUBLE SCALE, THE EVAPORATION CYCLE IS INTERRUPTED AT CONVENIENT INTERVALS, REMOVAL OF BOTH WATER SOLUBLE AND INSOLUBLE SCALES IS ACCOMPLISHED BY SPRAYING FRESH WATER FROM THE CONDENSATE STORAGE ON THE SCALED SURFACES- THE SOLUBLE SCALES ARE DISSOLVED AND THE INSOLUBLE CONSTITUENTS ARE MECHANICALLY BROKEN UP AND WASHED AWAY.**

**30-00971**

KEECE EC + WALKER EC

**METHOD AND APPARATUS FOR DEGASSING AND DISTILLING LIQUID**

SALINE WATER CONVERSION CORP., NEW YORK

U.S.PAT. 3,302,524 (7-29-64/10-3-67), 4 FIG, 4 REF

**A TECHNIQUE AND APPARATUS FOR HANDLING LIQUIDS AND THE GASES RELEASED FROM THEM WHEN THEY ARE SUBJECTED TO REDUCED PRESSURES. THE SYSTEM INVOLVES WITHDRAWING FROM THE LIQUID THE GASES RELEASED, PROCESSING THE LIQUID AT THE REDUCED PRESSURE, AND THEN REINGESTING THE GASES BACK INTO THE LIQUID AS IT RETURNS TO A REGION OF HIGHER PRESSURE. THE REINGESTION OF THE GASES BACK INTO THE LIQUID SOLUTION IS MADE POSSIBLE BY CAUSING THE LIQUID TO FLOW AT A HIGH VELOCITY FROM ITS LOW PRESSURE REGION TO A REGION OF HIGHER PRESSURE AND THEN INJECTING THE GASES IN THE FORM OF BUBBLES INTO THIS LIQUID FLOW AT A POINT OF LOW PRESSURE. IF THE FLOW IS RAPID ENOUGH, THE INJECTED BUBBLES WILL BE CARRIED BY THE LIQUID TOWARD THE HIGHER PRESSURE REGION.**

**30-00972**

THERSEN AM

**METHOD OF PROCESSING SEA WATER**

U.S.PAT. 3,147,072 (1-4-61/9-1-64), 1 FIG, 9 REF

**A technique is provided for producing steam from an electricity producing gas turbine by extracting heat from exhaust gases by countercurrenting seawater with the gases released from them when they are subjected to reduced pressures. The system involves withdrawing from the liquid the gases released, processing the liquid at the reduced pressure, and then reinjecting the gases back into the liquid as it returns to a region of higher pressure.**

**30-00973**

LYNAM JP

**SEA WATER CONVERSION APPARATUS**

U.S.PAT. 3,152,853 (7-26-60/10-6-64), 1 FIG, 4 REF


**30-00974**

KAYS DD + ROGERS CG + AKERLOW RW

**MODULAR MULTIPLE-EFFECT FALLING-FILM EVAPORATOR**

STEARS-ROGER CORP., DENVER, COLO.

U.S.PAT. 3,322,648 (4-29-66/5-30-67), 6 FIG, 2 REF

**THE DESIGN OF A MULTIEFFECT EVAPORATOR SYSTEM IN WHICH ALL OF THE PROCESSING STEPS, INCLUDING HEATING, EVAPORATING, CONDENSING, AND COOLING, ARE HANDLED BY SEPARATE MODULES.**
30-00974 *CONTINUED*

*COMPONENT DESIGNS + #EVAPORATOR-CONDENSER SYSTEM DESIGNS + FALLING FILM EVAPORATION + MODULAR CONSTRUCTION + #MULTIPLE EFFECT DISTILLATION + CONDENSGERS + DESIGN + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + EVAPORATORS + FILM EVAPORATION + FLASH CHAMBERS + PATENTS

30-00975 MOCK AE
 DIRECT CONTACT FLASH DISTILLATION WITH AIR AND STEAM 
U.S. PAT. 3,326,778 (12-27-62/6-20-67), 1 FIG. 
THE INVENTION INVOLVES THE RAPID PASSAGE OF DRY GAS, USUALLY AIR, AT EXTREMELY HIGH TEMPERATURE THROUGH A BODY OF IMPURE WATER WHOSE SURFACE IS EXPOSED TO A GAS ENVIRONMENT OF RELATIVELY HIGH PRESSURE, WITH THE TEMPERATURE OF THE BODY OF IMPURE WATER BEING MAINTAINED JUST BELOW ITS BOILING POINT FOR THE PRESSURE EVEN THOUGH THE TEMPERATURE OF THE AIR IS SUBSTANTIALLY HIGHER THAN THIS BOILING POINT. THE AIR IS SATURATED WITH WATER VAPOR WHICH IN TURNO CAN BE EXTRACTED BY CONDENSATION. THE TEMPERATURE OF THE BODY OF WATER IS MAINTAINED BELOW ITS BOILING POINT BY ADDING FEEDWATER TO THE BODY AS WELL AS WITHDRAWING CONCENTRATED BRINE FROM IT. THIS PROCEDURE IS FURTHER REFINED BY SENDING THE CONCENTRATED BRINE TO A FLASH EVAPORATOR SO THAT ITS HEAT IS NOT WASTED. THE APPARATUS FOR THIS PROCESS IS ALSO DESCRIBED. IN PARTICULAR, A STEAM JET EJECTOR IS EMPLOYED TO COMPRESS HOT DRY AIR PRIOR TO ITS INJECTION INTO THE BODY OF WATER. THE RESULT IS AN AIR-STEAM MIXTURE WHICH IS INTRODUCED INTO THE BODY OF WATER. 

*DIRECT CONTACT HEAT EXCHANGE + #FLASH EVAPORATION + #STEAM JET EJECTORS + DISTILLATION PROCESSES + EVAPORATORS + HEAT EXCHANGERS + HEAT RECOVERY + HEAT TRANSFER + HUMIDIFICATION PROCESSES + PATENTS

30-00976 STANDFORD FC
 FALLING FILM EVAPORATOR 
M.I. BADGER ASSOCIATES, INC., ANN ARBOR, MICH. 
U.S. PAT. 3,303,106 (12-21-62/7-7-67), 3 FIG., 10 REF. A MULTIPLE EFFECT FALLING FILM EVAPORATOR SYSTEM HAVING VAPOR-LIQUID DISENGAGING CHAMBERS OF SUCCESSIVE EFFECTS STACKED BELOW OTHER IN ORDER OF DECREASING BOILING POINT FROM TOP TO BOTTOM. THE METHOD OPERATING CONSISTS OF SPLITTING THE FEED INTO TWO SIDE BY SIDE STEAMS OR FLOW PATHS. THE FIRST STEAM PASSES TO THE HIGHEST EFFECT ALONG THE FIRST FLOW PATH AND THE SECOND STEAM PASSES TO THE HIGHEST EFFECT IN THE SECOND FLOW PATH. THE UNEVAPORATED LIQUID FROM THE FIRST EFFECT IN EACH FLOW PATH PASSES TO THE SECOND HIGHEST EFFECT IN THE CORRESPONDING FLOW PATH. THE UNEVAPORATED LIQUID FROM A HIGHER PRESSURE EFFECT CAN BE FLASHED, PRIOR TO ITS PASSAGE TO THE NEXT LOWER EFFECT, TO PROVIDE HEATING VAPOR FOR THE NEXT LOWER EFFECT IN THE SAME PATH. ALSO THE FIRST PATH CAN OPERATE IN COUNTERFLOW WITH RESPECT TO VAPOR FLOW AND THE SECOND PATH BE SUBDIVIDED INTO TWO VERTICAL RANKS OF MULTIPLE EFFECT FOWARD FLOW EVAPORATOR EFFECTS. 

*FALLING FILM EVAPORATION + #MULTIPLE EFFECT DISTILLATION + #SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + EVAPORATORS + FILM EVAPORATION + FLASH EVAPORATION + FLOWPATHS + PATENTS + VERTICAL TUBE EVAPORATORS

30-00977 LAGOWSKI JP
 NUCLEAR-POWER SEA-WATER CONVERSION PLANT 
ATOMIC ENERGY COMMISSION, WASHINGTON 
U.S. PAT. 3,303,098 (7-19-62/5-7-67), 5 FIG., 12 REF. A METHOD OF COUPLING A WATER COOLED NUCLEAR REACTOR TO A SEA WATER DISTILLATION PLANT. THE REACTOR IS LOCATED AT THE BOTTOM OF A PIT, 130 FT OR MORE IN DEPTH, WITH COOLANT ABOVE THE REACTOR SUITABLE TO SUPPRESS THE BOILING OF THE COOLANT AT A TEMPERATURE SUFICIENTLY HIGH TO OPERATE THE FLASH DISTILLATION PLANT. A SECOND PIT ADJACENT TO THE REACTOR PIT CONTAINS THE BRINE HEATER. DEMINERALIZED COOLING WATER TRANSFERS HEAT FROM THE REACTOR TO THE BRINE HEATER. 

*COPULING (REACTOR-DESLATING PLANT) + #NUCLEAR ENERGY SOURCES + #PRESSURIZED-WATER REACTORS + AEC SPONSORED + BREEDER REACTORS + DISTILLATION PROCESSES + ENERGY SOURCE + FLASH EVAPORATION + FLOWPATHS + MULTISTAGE FLASH DISTILLATION + PATENTS

30-00978 WILLIAMSON WR
 DISTILLATION APPARATUS 
AMERICAN MACHINE AND FOUNDRY CO., NEW JERSEY 
U.S. PAT. 3,302,773 (7-6-62/7-7-67), 6 FIG., 11 REF. THE DESIGN OF A HORIZONTAL-TUBE VACUUM EVAPORATOR AND CONDENSER APPARATUS IN A LOWER HORIZONTAL COMPARTMENT, HEATING WATER SUPPLIED TO THE COILS SURROUNDED BY SEA WATER FEED WHICH IS STIRRED BY WATER IN THE APPARATUS. STEAM FROM THE DEMISTER LEAVES THE EVAPORATING CHAMBER AND PASSES THROUGH A WIRE MESH TO A HORIZONTAL TUBE CONDENSER PLACED ABOVE THE EVAPORATOR. IN ONE SYSTEM, THE SEA WATER USED FOR COOLING IS DRIVEN OFF THE WATER JET EJECTOR TO PROVIDE THE VAPOR FOR THE SYSTEM. THE JETTER BOTH REDUCES THE PRESSURE AND REMOVES THE NONCONDENSABLE GASES. IN ANOTHER SYSTEM, THE PRODUCT WATER IS PUMPED FROM THE CONDENSER AND THIS

ACCESSION NUMBER 30-00974 TO 30-00978
30-00978 *CONTINUED*

STEAM OPERATES THE WATER JET EJECTOR. IN THE LATTER CASE A HOLD-UP TANK IS PROVIDED
FOR THE PRODUCT WATER SO THAT THERE WILL BE SUFFICIENT LIQUID AVAILABLE TO OPERATE THE
EJECTOR. ALSO THE NONCONDENSIBLES SEPARATE IN THIS TANK.

**HORIZONTAL TUBE CONDENSERS** + **HORIZONTAL TUBE EVAPORATORS** + **WATER JET EJECTORS** +
**COMPONENT DESIGNS + CONDENSERS + DESIGN + DISTILLATION PROCESSES + EVAPORATORS + PATENTS +
SYSTEM DESCRIPTIONS + VACUUM SYSTEMS**

30-00979 ROSS GW + ROSS DS

VACUUM DISTILLATION INCLUDING PREDEGASIFICATION OF DISTILLAND

AMCODYNE AND CO., LORAIN, OHIO

U.S.PAT. 3,300,392 (6-1-62/1-24-67), 7 FIG

APPARATUS TO PROVIDE A COMBINATION OF AN EFFICIENT WATER-DEAERATION SYSTEM AND A VACUUM
DISTILLATION SYSTEM. THE DEAERATION SYSTEM IS OPERATED AT THE TEMPERATURE AT WHICH
THE FEEDWATER IS OBTAINED AND PRODUCES GAS-FREE WATER. THE DEAERATED WATER IS THEN
SENT TO A VACUUM DISTILLATION SYSTEM WHICH MAY BE OPERATED BELOW 100 DEG F WHERE MOST
OF THE WATER IS EVAPORATED AND THE VAPORS CONDENSED. A VACUUM, PRODUCED BY THE
DEAERATION SYSTEM, IS APPLIED TO THE STILL SO THAT THE DEAERATED WATER IS AT ITS
BOILING POINT. A CLOSED CYCLE GAS COMPRESSION AND EXPANSION SYSTEM IS PROVIDED IN THE
DISTILLATION SYSTEM TO SUPPLY THE LATENT HEAT OF VAPORIZATION TO THE DEAERATED
FEEDWATER AND TO CONDENSE THE VAPOR FORMED BY ABSORBING THE SAME AMOUNT OF HEAT.

**DEAERATION + VACUUM SYSTEMS + COMPONENT DESIGNS + DEAERATORS + DISTILLATION PROCESSES + PATENTS**

30-00980 HERBERT LS + STERNS UJ

REMOVAL OF SCALE IN DISTILLATION OF SEA WATER CONTAINING MAGNESIUM SALTS

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, EAST MELBOURNE, AUSTRALIA

U.S.PAT. 3,298,931 (1-15-63/1-17-67), 2 FIG, 15 REF

THE INVENTION PROVIDES A METHOD OF LOOSENING THE GELATINOUS SCALE WHICH FORMS ON THE
INSIDE WALL OF AN EVAPORATOR TUBE DURING THE SPRAY EVAPORATION OF SEAWATER. STEAM IS
PASSED THROUGH THE TUBE SO AS TO DRY OUT AND THEN LOOSEN THE SCALE. IF THE GASEOUS
CARRIER ENVIRONMENT REQUIRED TO LOOSEN THE LIQUID DROPLETS IS STEAM IT IS ONLY NECESSARY
FOR THE FEEDWATER TO BE CUT OFF AT INTERVALS, THE STEAM USED AS CARRIER BEING ALLOWED
TO CONTINUE TO PASS THROUGH THE TUBE. WHEN THE FEEDWATER IS AGAIN STARTED, THE
LOOSENED SCALE IS FLUSHED OUT OF THE TUBE. FOR EXAMPLE, IN A 7-HR RUN THE FEEDWATER
WAS CUT OFF FOR 1.5 MIN EVERY HOUR, OVER A PERIOD OF TIME THERE IS A SLOW BUILD UP OF A
CRYSTALLINE SCALE WHICH IS RESISTANT TO THE STEAM DRYING TREATMENT. THIS ADHERENT
SCALE CAN BE REMOVED BY THE INTRODUCTION OF A MINERAL ACID, A CHELATING AGENT, OR A
CHEMICAL BY-PRODUCTING AGENT.

**SCALE PREVENTION + SCALE REMOVAL + CHEMICAL ADDITIVES + DIRECT CONTACT HEAT EXCHANGE +
DISTILLATION PROCESSES + FEEDWATER TREATMENT + PATENTS + PHYSICAL CHEMISTRY OF SCALE + CALCING**

30-00981 GEIRINGER PL + TAYLOR LT

TESTS TO PROVE PERFORMANCE OF HIGH TEMPERATURE WATER JET COMPRESSOR

AMERICAN HYDROTHERM CORP., NEW YORK

OSW R&D PROGR. REPT. NO.344 (APRIL 1968) 34 P, 19 FIG

THE DESIGN, CONSTRUCTION, AND TESTING OF A HIGH TEMPERATURE WATER JET COMPRESSOR TO
PRODUCE COMPRRESSED STEAM FOR EACH LB OF SUCTION STEAM USING SATURATED STEAM AT 1010 PSIA AS A DRIVING MEDIUM WHEN COMPRESSING STEAM FROM 20.5 TO
25 PSIA. TEST RESULTS REPORTED SHOW THE ACTUAL PERFORMANCE WAS CONSIDERABLY BETTER
THAN THE ABOVE. THE TESTS PROVED THAT USING 1010 PSIA SATURATED HIGH TEMPERATURE
WATER, ONE LB OF SATURATED STEAM CAN BE COMPRESSED FROM 20.77 PSIA TO 25.46 PSIA,
WHILE USING 0.757 LB OF HIGH TEMPERATURE WATER AND PRODUCING ONLY 1.26 LB OF EXCESS
STEAM. THE CAPACITY OF THE TEST JET WAS 50,000 LB/HR OF SUCTION STEAM. IT IS
EXPECTED THAT A FURTHER REDUCTION OF 10 TO 20% IN THE AMOUNT OF DRIVING FLUID REQUIRED
CAN BE EXPECTED THROUGH A CONTINUATION OF THE TEST WORK.

**COMPRESSORS + VAPOR COMPRESSION EVAPORATION + VAPOR COMPRESSORS + COMPONENT DEVELOPMENT +
DESIGN + DISTILLATION PROCESSES + OSW SPONSORED**

30-00982 SALUTSKY ML + OUNSETH MG

RECOVERY OF TRACE ELEMENT CATIONS

W. R. GRACE AND CO., NEW YORK

U.S.PAT. 3,155,454 (11-21-62/11-3-64), 3 REF

A METHOD OF CONCENTRATING FROM SEAWATER OR BRINE CONCENTRATES TRACE ELEMENTS SUCH AS
ALUMINUM BARIUM, CALCIUM, CADMIUM, CERIUM, COBALT, COPPER, IRON, LEAD, MANGANESE,
NIQUEL, SILVER, TIN, URANIUM, AND ZINC. THE SEAWATER IS PASSED THROUGH A BED OF
MAGNESIUM AMMONIUM PHOSPHATE WHEREIN THE TRACE ELEMENTS REPLACE THE MAGNESIUM. THE
TRACE ELEMENT AMMONIUM PHOSPHATE IS THEN TREATED TO RECOVER THE TRACE ELEMENTS. THE
EFFLUENT SEAWATER IS THEN TREATED WITH PHOSPHORIC ACID OR SODIUM PHOSPHATE ALONG WITH
AMMONIA TO PRECIPITATE MAGNESIUM AMMONIUM PHOSPHATE FOR USE IN THE TREATMENT COLUMN.
THIS LATTER STEP IS COVERED IN OTHER PATENTS SUCH AS U.S.PAT. 3,042,606.

**CHEMICAL BY-PRODUCTS + FEEDWATER TREATMENT + SCALE PREVENTION + DISTILLATION PROCESSES +
FERTILIZER + PATENTS**

30-00983 HASSLER GL

MEANS AND METHOD FOR MASS AND HEAT TRANSFER

UNIVERSITY OF CALIFORNIA, BERKELEY

U.S.PAT. 3,129,145 (6-2-59/4-14-64), 5 FIG, 3 REF

THE INVENTION INVOLVES A STRUCTURE ADAPTED TO PROMOTE HEAT TRANSFER BETWEEN AN
IMPERMEABLE WALL AND A BODY OF LIQUID FLOWING OVER THE SURFACE OF THE WALL OR HEAT AND
MASS TRANSFER BETWEEN A BODY OF GAS AND A BODY OF LIQUID FLOWING IN CONTACT WITH THE
GASEOUS MASS TRANSMISSOR. THE INVENTION INVOLVES A POROUS LAYER ON AT LEAST ONE SURFACE OF THE WALL. LIQUID IS CONDUCTED IN SEQUENCE INTO CONTACT
WITH THE SURFACE OF THE POROUS LAYER CONTACTING THE WALL THROUGH THE POROUS LAYER
PARALLEL TO THE WALL AND THEN AWAY FROM THE SURFACE OF THE POROUS LAYER. A GAS

ACCESSION NUMBER 30-00978 TO 30-00983
METHOD OF REDUCING THE SCALE FORMING ELEMENT ON SURFACES OF AN EVAPORATOR

• HEAT TRANSFER + • HEAT TRANSFER SURFACES + DISTILLATION PROCESSES +

WEIR WATER TREATMENT LIMITED, ENGLAND

U.S.PAT. 3,160,585 (8-31-61/12-8-64), 2 FIG, 4 REF

ORNL-TM-2611 (JULY 1969), 94 P. PREPRINTS OF ORNL PAPERS PRESENTED AT SYMP. ENHANCED TUBES FOR SEAWATER DISTILLATION PLANTS

OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENN.

• FEEDWATER TREATMENT + • ION EXCHANGING + • REMOVAL FROM FEEDWATER, MAGNESIUM +

DOW CHEMICAL CO., MIDLAND, MICH. + TEXAS A+M, COLLEGE STATION

• FALLING FILM EVAPORATION + • HEAT TRANSFER + • HEAT TRANSFER COEFFICIENT + EVAPORATOR SYSTEM DESIGN

OSW R+D PROGR. REPT. NO.316 (JAN.1968), 491 P, 117 FIG, 442 REF

A STUDY OF THE DISPOSAL OF THE EFFLUENT FROM A LARGE DESLAINATION PLANT

EVAPORATOR-CONDENSER SYSTEM DESIGNS + HEAT TRANSFER IMPROVEMENTS + MASS TRANSFER + PATENTS
DESALINATION PLANTS ALONG ONE OF THE COASTS OF THE U.S. THE STUDY INDICATES THAT EVEN UNDER THE MOST FAVORABLE CONDITIONS THE OCEANS WILL HAVE A DETECTABLE IMPACT ON LOCAL MARINE ENVIRONMENT. HEAT, SALT, AND CONCENTRATION OF COPPER IN THE DILUTED BRINE BLOWDOWN SEEM TO BE THE MOST CRITICAL PROPERTIES. AN ECONOMIC ANALYSIS WAS MADE OF A PLANT LOCATED ON A HYPOTHETICAL BAY. PRELIMINARY DESIGNS OF INTAKE-OUTLETS WERE PREPARED AND COST ESTIMATES PREPARED.

LITERATURE SURVEYS + SEAWATER INTAKE AND DISCHARGE SYSTEMS + THERMAL POLLUTION + WASTE DISPOSAL + PATENTS + SITE SELECTION CRITERIA

FLASH CHAMBER STRUCTURE

U.S.PAT. 3,161,558 (7-5-60/12-15-64), 13 FIG, 16 REF
AQUA-CHEM, INC., WISCONSIN

APPARATUS FOR CONDUCTING FEED THROUGH FLASH EVAPORATORS

U.S.PAT. 3,192,132 (6-20-60/6-29-65), 4 FIG, 5 REF
AQUA-CHEM, INC., WISCONSIN

VACUUM DEAERATOR

U.S.PAT. 3,200,051 (9-14-61/8-10-65), 5 FIG, 4 REF
FORREST L. MURDOCK, TULSA, OKLA.

ROTARY EVAPORATOR-CONDENSER APPARATUS FOR THIN FILM DISTILLATION

U.S.PAT. 3,203,875 (8-20-62/8-31-65), 2 FIG, 10 REF
THE DESCRIPTION OF A SYSTEM TO CONVERT IMPURE TO PURE WATER BY A DISTILLATION PROCEDURE
CATEGORY 30 - SEAWATER DISTILLATION PROCESSES

30-00993 *CONTINUED*

Which utilizes waste heat from absorption type air conditioning equipment. Apparatus is provided in which the heat values evolved in various elements of the air conditioning units are transferred to circulating impure water which is then vaporized. The vapors are condensed and the pure water collected.

*HEAT RECOVERY + #SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + ENERGY SOURCES +
 heating Recovery SYSTEM + HEAT TRANSFER + PATENTS

30-00994 NEUZEBAUER FJ + LUSTENADER EL

DROPWISE CONDENSATION DISTILLATION APPARATUS
GENERAL ELECTRIC CO., NEW YORK

U.S.PAT. 3,206,381 (4-7-60/9-14-65), 5 FIG, 9 REF

A method and apparatus for distillation utilizing a wiped film evaporating surface and a dropwise condensing surface. The condensing surface consists of a smooth surface oriented in a vertical direction and means for draining mounted on the surface at various levels to collect condensed heat exchanger vapor from the surface. The draining collectors are fabricated of a material which is nonwetting with respect to the condensate and has sufficient vapor pressure to vaporize in the heat exchange vapor. The condensing surface is preferentially wetted by condensed nonwetting material rather than the condensed heat exchange vapor so that upon contact with condensing heat exchange vapor and vaporized nonwetting material the surface is coated with the nonwetting material so as to promote dropwise condensation.

*CONDENSATION PROMOTERS + DROPWISE CONDENSATION + CHEMICAL ADDITIVES + CONDENSING +
DISTILLATION PROCESSES + FILM EVAPORATION + HEAT TRANSFER IMPROVEMENTS + HEAT TRANSFER SURFACES +
PATTERNS + SYSTEM DESCRIPTIONS + WIPED FILM EVAPORATORS

30-00995 COLTON JW + MARGIOLFF IB

FLASH VAPORIZATION DISTILLATION APPARATUS
HALCON INTERNATIONAL, INC., DELAWARE

U.S.PAT. 3,207,677 (9-22-60/9-21-65), 2 FIG, 13 REF

A process for passing sensible heat from a first material to a second material in a semi-direct manner, more particularly to such a process wherein at least one component is vaporized from the first material and the resulting vapor is contacted with condensed on the second material and especially to such processes wherein both materials are liquids and the vapor is contacted with the second material in a counter-current manner and substantially adiabatically. Also the apparatus for use in carrying out such processes, and especially to such apparatus including a series of evaporative cooling zones arranged to operate at progressively lower pressures, each such zone being in vapor contact with a series of condensation warming zones arranged to operate at progressively lower pressures.

*DIRECT CONTACT HEAT EXCHANGE + HEAT TRANSFER + SYSTEM DESCRIPTIONS + CONDENSERS +
DISTILLATION PROCESSES + FILM EVAPORATION + HEAT TRANSFER IMPROVEMENTS + HEAT TRANSFER SURFACES +
PATTERNS + SYSTEM DESCRIPTIONS + WIPED FILM EVAPORATORS

30-00996 HOGAN WH + HICKMAN KC

THERMAL COMPRESSION STILL
AQUASTILLS INCORPORATED, ROCHESTER, N. Y.

U.S.PAT. 3,200,050 (4-14-60/8-10-65), 7 FIG, 11 REF

The design of a rotary vapor compression still of the type described in U.S.PAT. 2,734,023 (ABSTRACT 30-00707). This invention provides in a compression still, a phase separation barrier and heat exchanger having an integral compressor and driven at a higher speed than the barrier and heat exchanger. It also covers a still having a rotary phase separation barrier and heat exchanger consisting of a stack of annular evaporating and condensing surfaces with an integral condensing chamber and compressor. Also there can be provided a phase separation barrier and heat exchanger incorporating a stack of heat exchange surfaces in which steam is fed to the condensing surfaces through channels between the outer and inner peripheries of the stack.

*COMPONENT DESIGNS + ROTARY STILLS + VAPOR COMPRESSION EVAPORATION + CENTRIFUGATION +
DISTILLATION PROCESSES + EVAPORATORS + FILM CONDENSATION + FILM EVAPORATION + HEAT TRANSFER +
PATENTS

30-00997 KELLER E

OSCILLATORY ROTOR BLADE FOR TREATMENT OF FLUENT MATERIAL IN THIN LAYERS
LUWA A.G., ZURICH, SWITZERLAND

U.S.PAT. 3,199,575 (10-31-62/8-10-65), 14 FIG, 4 REF

The design of a wiped film, falling film type of evaporator. The apparatus consists of the usual tubular process chamber fitted with a rotor structure incorporating oscillatory rotor blades for distributing the liquid layer on the inner treating surface of the tubular process chamber. The oscillatory blade elements are hinged to assume a radial position at negligible clearance with respect to the treating surface when no liquid is in the process chamber. This oscillatory arrangement of the blade elements substantially eliminates any radial pressure effect on the liquid, and causes a thin layer spreading of the liquid at minimal clearance and with a high turbulence. Also, because the blade elements are arranged for oscillatory movement, it is not necessary to maintain the extent of clearance from the treating surface that is normally necessary in wiped blade evaporators.

*OSCILLATORY DESIGNS + DISTILLATION PROCESSES + EVAPORATORS + FALLING FILM EVAPORATION + FILM EVAPORATION + PATENTS + ROTARY STILLS

30-00998 KELLER E

FALLING FILM-EVAPORATORS AND ROTOR STRUCTURE THEREFOR
LUWA A.G., ZURICH, SWITZERLAND

U.S.PAT. 3,199,574 (11-14-60/8-10-65), 4 FIG, 7 REF

The design of a wiped film, falling film type of evaporator. The evaporator consists of
30-00998 •CONTINUED^


30-00999 LAWRANCE HR

MULTI-STAGE FLASH EVAPORATORS
BALDWIN-LIMA-HAMILTON CORP., PHILADELPHIA
U.S.PAT. 3,197,387 (5-20-63/7-27-65), 7 FIG, 5 REF
THE DESIGN OF A FLASH CHAMBER FOR A MULTISTAGE FLASH EVAPORATOR WHICH INCLUDES DIVIDING THE BRINE SECTION OF THE CHAMBER INTO AN ENTRANCE SECTION AND A RISER SECTION. SEPARATE HOT WATER PUMPING OR PRODUCT THE BRINE IS ACHIEVED BY FLASHING THE LIQUID ONLY IN THE RISER CHAMBER CAUSING A GAS LIFT EFFECT IN THE RISER CHAMBER AND LIFTING THE LIQUID-VAPOR MIXTURE OVER THE SIDE WALLS OF THE RISER CHAMBER TO ALLOW IT TO FREE FALL INTO A SEPARATE PART OF THE EVAPORATOR CHAMBER. DURING THE FREE FALL, THERE IS NO HYDROSTATIC PRESSURE ON THE LIQUID-VAPOR MIXTURE AND THE VAPOR COMPLETELY SEPARATES FROM THE LIQUID. ENGRAVED LIQUID DROPLETS ARE SEPARATED FROM THE VAPOR BY FORCE THE VAPORS TO PASS THROUGH A MIST ELIMINATOR BEFORE THEY CAN REACH THE CONDENSER.

30-01000 LOEBEL FA • LEINER OF

MULTI-STAGE FLASH EVAPORATOR WITH REMOVABLE STAGES
AQUA-CHEM, INC., WISCONSIN
U.S.PAT. 3,192,131 (6-20-60/6-29-65), 7 FIG, 16 REF
THE DESIGN OF A LONG TUBE MULTISTAGE FLASH EVAPORATOR UNIT PARTICULARLY SUITABLE FOR EASE OF CONSTRUCTION IN SMALL SIZES. THE UNIT IS DESIGNED SO THAT THE INTERNAL STRUCTURE CONSISTING OF THE INTERSTAGE BAFFLES, LONG CONDENSER TUBES, PRODUCT TRAYS, ETC. CAN BE CONSTRUCTED AS AN ASSEMBLY AND THEN INSERTED INTO AN EXTERNAL SHELL.

30-01001 LOEBEL FA

VAPOR COMPRESSION STILL FOR DISTILLING IMPURE WATER
AQUA-CHEM, INC., WIS.
U.S.PAT. 3,311,543 (9-15-67/3-26-67), 3 FIG, 8 REF
METHODS AND APPARATUS FOR USING A REFRIGERATION CYCLE IN A DISTILLATION PROCESS TO PRODUCE HOT OR COLD WATER. THE SYSTEM MAY BE ADAPTED FOR CONTROL FOR PRODUCTION OF HOT OR COLD WATER WITH THE HEATING MEANS FOR HEATING THE VAPORIZATION ZONE BEING USED TO HEAT THE HOT PRODUCT WATER AND THE COOLING MEANS FOR COOLING THE CONDENSATION ZONE MAY BE USED TO COOL COLD PRODUCT WATER. IN ONE FORM, REFRIGERANT IS USED TO HEAT THE VAPORIZATION ZONE AND COOL THE CONDENSATION ZONE. THE REFRIGERANT IS COMPRESSED PRIOR TO PASSAGE IN HEAT EXCHANGE WITH THE VAPORIZATION ZONE AND BEING EXPANDED OR VAPORIZED PRIOR TO PASSAGE IN HEAT EXCHANGE WITH THE CONDENSING ZONE, THE REFRIGERANT IS DIVERTED THROUGH PRODUCT WATER AFTER COMPRESSION TO HEAT PRODUCT WATER AND MAY ALSO BE DIVERTED THROUGH PRODUCT WATER AFTER EXPANSION TO COOL THE PRODUCT WATER.

30-01002 GLUECKAEFF E

PROCESS AND APPARATUS FOR DESALINATION OF AN AQUEOUS SOLUTION CONTAINING CALCIUM SULPHATE
U.K. ATOMIC ENERGY AUTHORITY, LONDON
U.S.PAT. 3,377,273 (2-14-66/4-9-68), 2 FIG, 5 REF
A PROCESS AND APPARATUS FOR THE DESALINATION OF SEAWATER CONTAINING CALCIUM SULPHATE BY REDUCING THE CONCENTRATION OF CALCIUM SULPHATE AND DISTILLING THE SOLUTION. THE CALCIUM SULPHATE CONCENTRATION IS REDUCED BY HEATING THE SEAWATER TO A TEMPERATURE (113 TO 167 DEG C) AT WHICH THE CONCENTRATION OF CALCIUM SULPHATE IN THE SOLUTION EXCEEDS THE SOLUBILITY OF ANHYDROUS CALCIUM SULPHATE BUT IS LESS THAN THE SOLUBILITY OF CALCIUM SULPHATE HEMIHYDRATE. THE HEATED SEAWATER IS PASSED THROUGH A BED OF ANHYDROUS CALCIUM SULPHATE PRIOR TO DISTILLATION.

30-01003 DUNSETH MG + SALUTSKY ML

PROCESS FOR DESCALING SEA WATER
W. R. GRACE AND CO., NEW YORK
U.S.PAT. 3,167,505 (9-7-62/1-26-65), 2 REF
THE SCALING CONSTITUENTS OF SEAWATER FEED ARE REMOVED BY FIRST SATURATING A PORTION OF THE FEEDWATER (3 TO 40%) WITH CALCIUM PHOSPHATE BY PASSING THE PORTION OF THE FEEDWATER THROUGH NORMAL SUPERPHOSPHATE OR TRIPLE SUPERPHOSPHATE. THIS SATURATED SOLUTION IS PASSED THROUGH A STRONGLY ACIDIC CATION EXCHANGE RESIN IN THE SODIUM FORM. THE EFFLUENT IS RECOVERED AND ADDED TO THE BULK OF THE UNTREATED FEEDWATER WITH A SUITABLE QUANTITY OF SODIUM TO PRECIPITATE SCALE FORMING METALLIC CATIONS AS METAL PHOSPHATES. THIS FORMS THE DESCALED SEAWATER FOR FEED. THE EXCHANGE RESIN IS REGENERATED WITH A SOLUTION CONTAINING AT LEAST 6% SODIUM CHLORIDE SUCH AS MAY BE
APPARATUS FOR THE VAPOR COMPRESSION DISTILLATION OF SEAWATER. THE EVAPORATION SURFACE IS A SIMPLE CYLINDER AND OPERATES NEAR ATMOSPHERIC PRESSURE OR UNDER VACUUM. THE INNER SURFACE OF THE CYLINDER IS WIPED BY A BLADE ROTATING ABOUT THE INNER SURFACE AT 10 TO 100 RPM. THIS WIPER SERVES TO distribute THE FEEDWATER OVER THE SURFACE IN A FILM, THE THICKNESS OF WHICH MAY BE ADJUSTED TO PROVIDE THE BEST OPERATION. IT IS DESIRABLE THAT THE FILM ON THE INNER SURFACE ALMOST COMPLETELY DRIES BEFORE THE NEXT WIPING BY THE BLADE. DROPWISE CONDENSATION ON THE OUTSIDE OF THE CYLINDER CAN BE PROMOTED BY THE WIPING ACTION OF A NONWETTING SURFACE SUCH AS TEFLON. VAPOR FROM THE INSIDE OF THE CYLINDER IS COMPRESSED AND USED TO HEAT THE OUTSIDE OF THE CYLINDER.

VAPOR COMPRESSION EVAPORATION • WIPED FILM EVAPORATORS • COMPONENT DESIGNS • CONDENSATION PROMOTERS • DROPWISE CONDENSATION • EVAPORATOR SYSTEM DESIGN • FILM EVAPORATION • PATENTS • ROTARY STILLS

APPARATUS AND METHOD FOR PRODUCING BOTH POTABLE WATER AND SUPERPURE WATER SUITABLE FOR BOILER FEED FROM SEAWATER. THE EVAPORATOR RECEIVES SEAWATER FROM WHICH A DISTILLATE IS TO BE PRODUCED AND IT ALSO RECEIVES STEAM FOR OUT-OF-CONTACT HEAT TRANSFER TO PRODUCE VAPORS WHICH ARE DIRECTED FROM THE EVAPORATOR TO THE CONDENSER WHEREIN AT LEAST SOME OF THE VAPORS ARE CONDENSED TO PROVIDE A POTABLE WATER. THE SEAWATER IS PUMPED THROUGH THE CONDENSER IN OUT-OF-CONTACT HEAT TRANSFER WITH THE VAPORS WHEREBY THE SEAWATER IS PREHEATED BEFORE INTRODUCTION TO THE EVAPORATOR. THE HEATING STEAM IS SUPPLIED VIA A STEAM EJECTOR AND SOME OF THE VAPOR PRODUCED IN THE EVAPORATOR IS RECIRCULATED WITH THE HEAT PRODUCING STEAM BY BEING DRAWN IN BY THE EJECTOR. THIS COMBINED STEAM FLOW HEATS THE EVAPORATOR WHEREIN IT IS CONDENSED TO PRODUCE THE SUPERPURE WATER FOR MAKE-UP FEED FOR THE BOILER.

EVAPORATOR-CONDENSER SYSTEM DESIGNS • SYSTEM DESCRIPTIONS • COMPONENT DESIGNS • DISTILLATION PROCESSES • HEAT EXCHANGERS • PATENTS • PRODUCT WATER PURITY • STEAM JET EJECTORS

THE DESIGN OF A VERTICAL TUBE, FALLING FILM EVAPORATOR IN WHICH THE TUBES OR VERTICAL EVAPORATING PLATES ARE TAPERED FROM TOP TO BOTTOM SO AS TO PROVIDE REDUCED VAPOR PASSAGE SPACE NEAR THE TOP OF THE TUBES. THIS REDUCED SPACE RESULTS IN INCREASED VAPOR VELOCITY AND MAINTAINS A TURBULENT LIQUID FILM ON THE TUBE SURFACE. THE TUBES MAY BE PLATED ON THE EXTERIOR SURFACE TO AID IN THE CONDENSATION AND HEAT TRANSFER OF THE STEAM USED AS A HEAT SOURCE.

EVAPORATOR-CONDENSER TUBES • FALLING FIlM EVAPORATION • VERTICAL TUBE EVAPORATORS • COMPONENT DESIGNS • DISTILLATION PROCESSES • EVAPORATORS • EXTENDED HEAT TRANSFER SURFACES • FILM EVAPORATION • HEAT TRANSFER IMPROVEMENTS • HEAT TRANSFER SURFACES • PATENTS

THE DESIGN OF A MULTISTAGE FLASH DISTILLATION PLANT CONSISTING OF A NUMBER OF STAGES LOCATED END-TO-END IN A SINGLE CONTINUOUS SHELL. CONDENSING MEANS FOR THE FLASHED VAPORS OF EACH STAGE ARE PROVIDED BY A NUMBER OF TUBES CONTINUOUS THROUGHOUT THE LENGTH OF THE SHELL AND PASSING THROUGH THE PARTITION WALLS SEPARATING ADJACENT STAGES. TAPERED FEED DUCTS ARE PROVIDED SO THAT AT ANY POINT ALONG THE LONGITUDINAL DIMENSIONS OF A STAGE ADEQUATE CROSS-SECTIONAL FLOW AREA IS ASSURED FOR THE FEED TO BE FLASHED AS WELL AS FOR THE EXCESS FEED OF THE PARTICULAR STAGE.

COMPONENT DESIGNS • EVAPORATOR-CONDENSER SYSTEM DESIGNS • BRINE FLOW • DESIGN • DISTILLATION PROCESSES • FLASH EVAPORATION • FLOW CONTROL • HORIZONTAL TUBE CONDENSERS • MULTISTAGE FLASH DISTILLATION • PATENTS
30-01009 MULFORD SF
EVAPORATOR CONSTRUCTION
BALDWIN-LEMA-HAMILTON CORP., PHILADELPHIA
U.S.PAT. 3,172,824 (4-25-61/3-9-65), 11 FIG, 8 REF
*COMPONENT DESIGNS + *EVAPORATORS + *INTERSTAGE SEALS + *ORIFICES + BAFFLES + BRINE FLOW + DESIGN + DISTILLATION PROCESSES + FLASH CHAMBERS + FLASH EVAPORATION + FLOW CONTROL + MULTISTAGE FLASH DISTILLATION + PATENTS

30-01010 WILLIAMS A
SUBMERGED COMBUSTION AND FLASH EVAPORATION SYSTEM AND PROCESS
SUBMERGED COMBUSTION, INC., HAMMOND, IND.
U.S.PAT. 3,165,452 (6-15-59/1-12-65), 1 FIG, 6 REF
A NEW AND IMPROVED EVAPORATOR AND METHOD FOR THE EVAPORATION OF LIQUIDS. THE APPARATUS CONSISTS OF (1) A HEATING UNIT IN WHICH THE LIQUID TO BE EVAPORATED IS LOCATED AND WHICH IS PROVIDED WITH A SUBMERGED COMBUSTION BURNER IN WHICH THE FLAME OF THE BURNER BURNS IN DIRECT CONTACT WITH THE LIQUID BELOW THE LIQUID LEVEL, (2) MEANS FOR REMOVING UNDISEDOLVED COMBUSTION GASES FROM THE HEATING ZONE, (3) MEANS TO TRANSFER THE HOT LIQUID DIRECTLY FROM THE HEATING UNIT TO A SERIES OF FLASH EVAPORATORS WHERE PART OF THE LIQUID FLASHES INTO Vapor, (4) MEANS TO TRANSFER THE FLASHED VAPORS FROM ABOVE THE LIQUID TO CONDENSERS, (5) MEANS TO RECOVER THE CONDENSATE, AND (6) MEANS TO REMOVE THE RESIDUAL LIQUID FROM THE LAST EVAPORATOR IN THE SERIES. IN OPERATION, THE FEEDWATER TO THE BURNER UNIT IS PASSED THROUGH THE CONDENSERS BEFORE IT IS INTRODUCED INTO THE BURNER UNIT, COOLING THE VAPORS FROM THE FLASH EVAPORATOR WHILE PREHEATING THE FEEDWATER. A STRIPPING TOWER IS PROVIDED TO REMOVE NONCONDENSABLE GASES FROM THE BURNER UNIT.
*DIRECT CONTACT HEAT EXCHANGE + *EVAPORATOR SYSTEM DESIGN + COMPONENT DESIGNS + DISTILLATION PROCESSES + EVAPORATORS + FLASH EVAPORATION + FLOW SHEETS + PATENTS

30-01011 SALUTSKY ML + DUNSETH MG
PROCESS OF DESCALING SEAWATER
W. R. GRAFE & CL., NEW YORK
U.S.PAT. 3,163,599 (1-21-63/12-29-64), 1 FIG, 2 REF
A CYCLIC PROCESS FOR THE PRODUCTION OF CHLORINE AND METAL PHOSPHATE FERTILIZER MATERIAL FROM SEA WATER AND FOR THE DESCALING OF SEAWATER FOR EVAPORATOR FEED. WASTE DESCALING SEA WATER OR CONCENTRATED WASTE BRINE IS FIRST ELECTROLYZED IN A SUITABLE ELECTROLYTIC CELL. CHLORINE GAS IS COLLECTED AT ONE ELECTRODE AND HYDROGEN AT THE OTHER, LEAVING BEHIND, AS THE CELL LIQUOR, DILUTE SOLUTION OF SODIUM HYDROXIDE AND SODIUM CHLORIDE. THEN PHOSPHORIC ACID IS ADDED TO THE CELL LIQUOR UNTIL ALL OF THE SODIUM HYDROXIDE HAS BEEN CONVERTED TO DISODIUM PHOSPHATE. THE RESULTING MIXURE OF DISODIUM PHOSPHATE AND SODIUM CHLORIDE IS THEN ADDED DIRECTLY TO A SUITABLE QUANTITY OF SEAWATER FEED, ALONG WITH AMMONIA, TO PRECIPITATE CALCIUM PHOSPHATE AND METAL AMMONIUM PHOSPHATES. THE DESCALED SEA WATER IS THEN SUITABLE FOR EVAPORATOR FEED. A FEW PERCENT OF THE RESIDUAL CONCENTRATED DESCALING BRINE LEFT IN THE EVAPORATOR IS RETURNED TO THE ELECTROLYTIC CELL TO BECOME THE STARTING MATERIAL FOR THE NEXT CYCLE. THE ACTUAL QUANTITY WILL DEPEND UPON THE CONCENTRATION OF THE ORIGINAL CALCIUM AND MAGNESIUM TO BE REMOVED.
*FEEDWATER TREATMENT + *SCALE PREVENTION + *CHEMICAL ADDITIVES + *CHEMICAL BY-PRODUCTS + CHEMICAL PRODUCTION + DISTILLATION PROCESSES + FERTILIZER + FLOW SHEETS + PATENTS + REMOVAL FROM FEEDWATER, CALCIUM + REMOVAL FROM FEEDWATER, MAGNESIUM

30-01012 CHAMPE WF
DISTILLATION APPARATUS FOR CONVERTING SALT WATER INTO FRESH WATER
U.S.PAT. 3,163,597 (12-13-60/12-29-64), 4 FIG, 16 REF
*FILM EVAPORATION + #ROTARY STILLS + COMPONENT DESIGNS + DISTILLATION PROCESSES + PATENTS + SPRAY NOZZLES

30-01013 DENKER BL + LORENZINI RA
APPARATUS FOR DISTILLATION OF SALINE WATER TO PRODUCE FRESH WATER
FOSTER WHEELER CORP., NEW YORK
U.S.PAT. 3,120,620 (5-14-62/10-6-65), 2 FIG, 17 REF
APPRATUS AND METHOD FOR THE DISTILLATION OF SALINE WATER UTILIZING A HEAT EXCHANGER WITH A MOVEABLE REGENERATIVE MASS. HEAT IS SUPPLIED BY HOT EXHAUST GASES AS FOUND IN THE PROCESS INDUSTRY. THE APPARATUS CONSISTS OF AN ENDLESS METALLIC BELT PASSING THROUGH A HEATING ZONE AND AN EVAPORATION ZONE. IN THE HEATING ZONE, HOT EXHAUST GAS HEATS THE BELT. IN THE EVAPORATION ZONE, PREHEATED SALINE WATER IS SPRAYED ONTO THE BELT FORMING VAPOR. THE VAPOR IS DIRECTED TO AN EXTERNAL CONDENSER WHERE IT IS CONDENSED TO FORM PRODUCT WATER. SEAWATER IS USED TO COOL THE CONDENSER AND AT THE SAME TIME IS PREHEATED TO BE USED AS FEEDWATER TO THE EVAPORATOR.

ACCESSION NUMBER 30-01009 TO 30-01013
THE DESIGN OF A FALLING FILM TYPE EVAPORATOR CONSISTING OF A NUMBER OF VERTICAL, PARALLEL, TWO-PLATE HOLLOW HEATING ELEMENTS LOCATED IN A ROW EXTENDING PERPENDICULARLY TO THE PARALLEL HEATING PLANES OF THE PLATES. THE HEATING ELEMENTS HAVE THEIR OUTER HEATING SURFACES EXTENDING STRAIGHT VERTICALLY TO PROVIDE FOR THE SMOOTH FLOW OF A CONTINUOUS LIQUID FILM. THE CONFRONTING HEATING SURFACES OF SUCCESSIVE HEATING ELEMENTS ARE SPACED TO PROVIDE CHANNELS WHICH ARE OPEN AT BOTH VERTICAL EDGES OF THE HEATING ELEMENTS. A MEANS IS PROVIDED TO DISTIBUTE FEED AT THE UPPER EDGES OF THE HEATING ELEMENTS AND A MEANS TO INTRODUCE AND REMOVE A HEATING FLUID FROM WITHIN THE HEATING ELEMENTS. A CASING IS PROVIDED WITH A VAPOR RECEIVING SPACE AT EACH VERTICAL EDGE OF THE HEATING ELEMENTS SO AS TO READILY PERMIT THE REMOVAL OF VAPORS.

*COMPONENT DESIGNS + *EVAPORATOR SYSTEM DESIGN + *FALLING FILM EVAPORATION + *DISTILLATION PROCESSES + *EVAPORATOR-CONDENSER SYSTEM DESIGNS + *EVAPORATORS + *FILM CONDENSATION + *FILM EVAPORATION + *EVAPORATORS + *VERTICAL TUBE EVAPORATORS

A METHOD FOR CONCENTRATING SEAWATER, THE IMPROVEMENT CONSISTING OF ADDING TO THE SEAWATER AT LEAST ONE ADDITIVE FROM THE GROUP CONSISTING OF SILICA, SILICIC ACID, ALUMINA, AN ALUMINOSILICATE, ACID CLAY, KAOLIN, AND BENTONITE SO AS TO REDUCE SCALE FORMATION. ALSO A SCALE REDUCING METHOD CONSISTING OF ADDING ONE OF THE ABOVE ADDITIVES PLUS CALCIUM CHLORIDE OR CALCIUM CHLORATE WHERE THE SCALE FORMATION IS REDUCED AND SULFATE IONS ORIGINALLY PRESENT IN THE SEAWATER ARE CONVERTED TO A SODIUM SULFATE-CALCIUM SULFATE DOUBLE SALT.

*FEEDWATER TREATMENT + *SCALE PREVENTION + *CHEMICAL ADDITIVES + *CHEMICAL BY-PRODUCTS + *DISTILLATION PROCESSES + *PATTERNS + *SCALE REMOVAL + *SCALING

THE DESIGN OF AN IMPROVED ARRANGEMENT FOR DISTRIBUTING LIQUID FEED ONTO THE EVAPORATOR PLATES OF HEAT EXCHANGE APPARATUS. BRIEFLY, THERE IS PROVIDED LIQUID EVAPORATING APPARATUS WITH A NUMBER OF EVAPORATOR PLATES IN HORIZONTALLY SPACED SIDE-BY-SIDE RELATION WITH EACH OTHER AND INCLINED WITH THE HORIZONTAL, SPRAY NOZZLE STRUCTURE FOR SPRAYING PRESSURIZED FEED ONTO THE PLATE MEMBERS, AND MEANS FOR CYCLICALLY VARING THE SPRAY PATTERN SO THAT FEED IS SPRAYED ONTO EACH OF THE PLATE MEMBERS IN A DETERMINED SEQUENCE.

*EVAPORATOR SYSTEM DESIGN + *FALLING FILM EVAPORATION + *SPRAY NOZZLES + COMPONENT DESIGNS + DISTILLATION PROCESSES + EVAPORATORS + FILM EVAPORATION + HEAT EXCHANGERS + PATENTS


*BY-PRODUCT MANUFACTURING PROCESSES + *FEEDWATER TREATMENT + *SCALE PREVENTION + *CHEMICAL ADDITIVES + *CHEMICAL BY-PRODUCTS + *CHEMICAL PRODUCTION + DISTILLATION PROCESSES + FLOWSHEETS + PATENTS + SCALING
30-01018 CONTINUED

DROPLETS. WATER DROPLETS FORMING AT THE CONDENSATION SURFACE DROP FREELY UNDER THE INFLUENCE OF GRAVITY WITHOUT MERGING INTO A LIQUID FLOW. SEPARATION OF THE DROPLETS IS ACCOMPLISHED BY APPLYING CYCLICAL SHOCKS TO THE WATER VAPOR IN THE CONDENSATION CHAMBER AND BY SURFACE TREATMENT OF THE SURFACE SUCH AS WITH A SILICONE COATING.

*COMPONENT DESIGNS + *EVAPORATOR-CONDENSER SYSTEM DESIGNS + *HEAT TRANSFER SURFACES + *DEAERATION PUMPS + *DEAERATION PRODUCTIONS + *DROPWISE CONDENSATION + DISTILLATION PROCESSES + PATENTS + VAPOR COMPRESSION EVAPORATION + VAPOR REHEAT PROCESSES

30-01019

WIRTH LF, JR.

PROCESS FOR SCALE PREVENTION IN SALINE WATER EVAPORATOR

NALCO CHEMICAL CO., CHICAGO

U.S.PAT. 3,203,673 (3-15-62/8-31-65), 3 FIG, 7 REF

U.S.PAT. 3,195,978 (11-14-61/7-20-65), 5 REF

L.W. GRACE AND CO., NEW YORK

METHOD OF RECOVERING POTASSIUM VALUES FROM BRINES

U.S.PAT. 3,195,978 (11-14-61/7-20-65), 5 REF

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.

U.S.PAT. 3,418,214 (2-16-67/12-24-68)

INTEGRAL MAKE-UP DEAERATOR FOR FLASH EVAPORATOR

U.S.PAT. 3,418,214 (2-16-67/12-24-68)

CANE D

INTEGRAL MAKE-UP DEAERATOR FOR FLASH EVAPORATOR

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.

U.S.PAT. 3,418,214 (2-16-67/12-24-68)

DAVIAU JG

HYDRAULIC SALT WATER CONVERSION UNIT

U.S.PAT. 3,206,380 (3-10-60/9-14-65)

A DESCALATION SYSTEM CONSISTING OF A VESSEL FOR FRESH WATER, AN INLET PIPE FOR RELATIVELY COOL SALT WATER EXTENDING INTO THE VESSEL, A RECEPTACLE WITHIN THE VESSEL, AND A PERFORATED CONDUIT IN THE RECEPTACLE CLOSED AT ONE END AND COMBINING AT ITS OTHER END WITH THE INLET PIPE. THERE IS A HEAT EXCHANGE TUBE WITHIN THE PERFORATED CONDUIT WITH OPEN ENDS EXTENDING OUTWARDLY FROM THE RECEPTACLE AND COMMUNICATING WITH THE INTERIOR OF THE VESSEL. THE RECEPTACLE HAS AN UPPER WALL WITH MEANS FOR ASPIRATING INCORPORATED. THERE IS A CIRCULATING PUMP IN THE VESSEL ARRANGED TO FORCE FRESH WATER FROM THE VESSEL THROUGH THE ASPIRATOR TO REDUCE THE PRESSURE IN THE RECEPTACLE AND TO INDUCE FLOW OF SALT WATER THROUGH THE INLET PIPE FOR DISCHARGE THROUGH THE RECEPTACLE. THE HIGH VELOCITY FRESH WATER FURTHER CONDENSES THE ASPIRATED VAPOR AND FORCES WATER FROM THE VESSEL THROUGH THE HEAT EXCHANGE TUBE TO INCREASE THE TEMPERATURE OF THE SALT WATER IN THE PERFORATED CONDUIT TO FURTHER INCREASE EVAPORATION.

*COMPONENT DESIGNS + *EVAPORATOR-CONDENSER SYSTEM DESIGNS + DISTILLATION PROCESSES + *DEAERATION SYSTEM DESIGN + DEAERATORS + PATENTS
30-01023  POTTHART, JR.
COMBINED EVAPORATOR AND BOILER
U.S. PAT. 2,456,732 (2-19-49/6-12-68)
The design of an evaporator structure consisting of an outer enclosure, a bank of tubes in which the solution to be evaporated is maintained, a heating chamber through which the tubes extend, a second bank of tubes extending through the heating chamber and through which hot gases travel, and a baffle extending upwardly from the floor of the heating chamber and separating the lower portions of the two banks of tubes. Means is provided for maintaining a supply of liquid in the portion of the chamber walled off by the baffle and surrounding the second bank of tubes. The liquid is boiled by the hot gases and the steam flows over the baffle and evolves vapors from the solution in the first bank of tubes. There is also means for withdrawing from the evaporator the vapors and for withdrawing from the chamber the condensate from the steam.

*Components designs * Evaporator-condenser system designs * Distillation processes * Evaporator system design * Evaporators * Patents * Vertical tube evaporators

30-01024  OTHERH OF
METHOD FOR COOLING VOLATILE LIQUIDS
U.S. PAT. 3,063,346 (11-3-62)
The method of cooling a first liquid steam containing a volatile liquid by (1) passing it through a series of three or more stages, each of a successively lower temperature which results in the flash evaporation of the volatile liquid and cooling of the steam, (2) passing a second liquid stream through the stages in counter-current flow and in the form of droplets or a film, the second liquid stream condenses substantially all of the vapors formed by the flash evaporation in each stage and heats the second liquid stream. The second liquid stream is pumped between stages.

*Condensers * Direct contact heat exchange * Distillation processes * Evaporator-condenser system designs * Heat exchangers * Patents

30-01025  WILLIAMSON JR.
MULTISTAGE EVAPORATOR WITH EVACINATED VENTURI INLET FOR EACH STAGE
AMERICAN MACHINE AND FOUNDARY COMPANY, N. J.
U.S. PAT. 3,148,213 (3-17-65/12-24-68)
A stage for a multistage flash distillation unit having an entrance surrounded by a venturi flow device comprising an upward wall and a horizontally extending wall defining between them a narrow unobstructed opening across the stage causing the incoming fluid to flow in a horizontal sheet across the bottom wall.

*Baffles * Component designs * Flash chambers * Multistage flash distillation * Brine flow * Distillation processes * Flow distribution * Patents

30-01026  POTTHART JR.
PLATE-TYPE HEAT EXCHANGER
U.S. PAT. 3,404,733 (6-21-67/10-8-68)
A heat exchanger including a plurality of identical, generally rectangular, flat flow plates, each plate having a lip extending around its perimeter and a gasket secured to the lip of each plate. To secure the gaskets, the plate may have a plurality of spaced integral gasket keys and the gaskets have mating apertures. The gaskets have flow apertures which mate with the flow apertures in the plate and barriers surrounding each flow aperture. Slits are provided in a mating pair of barriers to permit flow from one end to the other. The gasket is provided with fingers which form a tortuous path from the inlet end to the outlet end, the flow being from one end of the plate to the other end.

*Components designs * Heat exchangers * Distillation processes * Feedwater heating * Heat transfer * Patents

30-01027  BROWN KD
DISTILLATION APPARATUS WITH ULTRASONIC FREQUENCY AGITATION
U.S. PAT. 3,175,405 (10-21-65/6-2-67)
A liquid purification system consisting of an evaporating chamber, a closed tank for containing a body of purified liquid, means including a pump for producing a low pressure in the evaporating chamber and for delivering evaporated liquid to the tank, means for supplying feedwater to the chamber, means for heating the feedwater, and an ultrasonic energy transducer mounted in the chamber above the liquid level, and means for directing liquid supplied to the chamber onto the surface of the transducer. The transducer is energized and at least a portion of the liquid flowing onto the transducer is evaporated by ultrasonic energy thus increasing the rate of evaporation in the chamber. The pump for producing low pressure and for delivering evaporated liquid is a combined liquid-vapor pump arranged in the tank with one inlet for withdrawing vapor from the chamber and a second inlet for circulating liquid in the tank. Heat produced by the operation of the pump is used for heating the liquid.

*Agitation * Evaporator system design * Sound (acoustical) * Distillation processes * Evaporators * Patents

30-01028  GEIRINGER PL
MULTI-EFFECT EVAPORATION SYSTEM
AMERICAN HYDOTHERM CORP., N. Y.
U.S. PAT. 3,433,739 (2-10-65/6-10-68)
A multi-effect evaporation system wherein each effect is enclosed in a separate casing having a plurality of flat surfaces a portion of which is inclined, and the casing contains an upper interior portion for collecting vapor. The liquid inlet and outlets are comprised of a plurality of orifices in the casing, with the casings of adjacent effects being in abutting relation with each other in a manner such that the orifices are aligned so that liquid can flow from one effect to another. The tubes are enclosed in a separate compartment and are parallel to the inclined portion of the casing. The vapor

Accession number 30-01023 to 30-01028
**CATEGORY 30 - SEAWATER DISTILLATION PROCESSES**

**30-01028** CONTINUED

*GENERATED IN THE TUBES IS COLLECTED IN THE SECOND INTERIOR PORTION WHICH IS PROVIDED WITH AN OUTLET FOR EFFECTING PASSAGE THEREOF TO THE HEATING COMPARTMENT OF THE NEXT ADJACENT EFFECT.*

**MULTIPLE EFFECT DISTILLATION + SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + PATENTS**

**30-01029** SPRAY CL

PRODUCTION OF FRESH WATER FROM SALT WATER

*HEAT EXCHANGE APPARATUS FOR EVAPORATING AND CONCENTRATING SALINE WATER TO PRODUCE WATER INSOLUBLE SALTS IN THE FORM OF SCALE PARTICLES WHICH ARE REMOVED BY STRAINING. THE SALINITY OF THE CONCENTRATE IS SENSED AND THE CONCENTRATE IS BLOWN DOWN WHEN ITS SALINITY EXCEEDS A PREDETERMINED VALUE. A TIMER LIMITS BLOWDOWN TO PERIODIC INTERVALS.*

**SYSTEM DESCRIPTIONS + BRINE SYSTEM DESIGNS + CONTROL SYSTEMS + DISTILLATION PROCESSES + FLOWSHOTS + MULTIPLE EFFECT DISTILLATION + PATENTS + SCALE PREVENTION**

**30-01030** LINDSAY WT, JR.

WATER CONVERSION PROCESS AND APPARATUS

*WESTINGHOUSE ELECTRIC CORP., PITTSBURGH*

U.S.PAT. 3,401,094 (4-21-66/9-10-68)

*A PROCEDURE FOR REMOVING SCALE-FORMING SALT (CALCIUM SULFATE) IN AN EVAPORATOR SYSTEM FOR RECOVERING FRESH WATER FROM MINERAL-CONTAINING WATER, WHEREBY SEED PARTICLES OF THE MINERAL TO BE REMOVED ARE ADDED TO THE MINERAL-CONTAINING WATER AFTER WHICH THE WATER IS HEATED TO A PREDETERMINED TEMPERATURE LEVEL AND HELD IN A PASSIVE CONDITION FOR A SUFFICIENT TIME TO ENABLE THE SCALE-FORMING SALT IN SOLUTION IN THE WATER TO COMBINE WITH THE SEED PARTICLES AND PRECIPITATE OUT OF THE SOLUTION.*

**SCALE PREVENTION + SEEDING PROCESSES + DISTILLATION PROCESSES + FEEDWATER TREATMENT + FLASH EVAPORATION + MULTISTAGE FLASH DISTILLATION + PATENTS + REMOVAL FROM FEEDWATER, CALCIUM + SCALING**

**30-01031** MURPHY RG

SALT WATER CONVERSION SYSTEM

*U.S.PAT. 3,318,784 (11-1-53/5-9-67)*

*A SALT WATER CONVERSION SYSTEM CONSISTING OF A FEEDWATER RESERVOIR OPEN TO ATMOSPHERIC PRESSURE AND AN EVAPORATOR ABOVE THE RESERVOIR. THE EVAPORATOR HAS A NUMBER OF COMPARTMENTS CONNECTED IN SERIES AT THE BOTTOM, MEANS FOR REMOVING WATER VAPOR FROM THE COMPARTMENTS INTO THE RESERVOIR AND A PIPE FROM THE BOTTOM OF THE FIRST COMPARTMENT. THE EVAPORATOR IS HIGH ENOUGH ABOVE THE RESERVOIR SO THAT THE WATER-LEG REDUCES THE PRESSURE IN THE FIRST COMPARTMENT AND CAUSES BOILING IN THE COMPARTMENT. THE WATER LEVEL IN THE SUCCESSIVE COMPARTMENTS IS ELEVATED WITH RESPECT TO EACH PRECEDING COMPARTMENT SO THAT BOILING OCCURS. VAPOR IS WITHDRAWN FROM EACH COMPARTMENT WITH A WATER EJECTOR.*

**COMPONENT DESIGNS + EVAPORATOR-CONDENSER SYSTEM DESIGNS + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + EVAPORATORS + PATENTS + VACUUM SYSTEMS + WATER JET EJECTORS**

**30-01032** SOOD RK

METHOD OF DEAERATING SEA WATER

*ATOMIC ENERGY COMMISSION, WASHINGTON*

U.S.PAT. 3,456,972 (9-11-68/8-5-69)

*IN THIS METHOD OF REMOVING DISSOLVED GASES FROM SEA WATER, TWO ADJACENT DEAERATION CHAMBERS ARE PROVIDED BOTH OF WHICH ARE MAINTAINED AT SUBATMOSPHERIC PRESSURES. SEAWATER HEATED IN THE FINAL CONDENSER OF AN EVAPORATOR SYSTEM IS INTRODUCED INTO THE FIRST CHAMBER, WHEREIN IT IS CONTACTED WITH STEAM FROM THE SECOND CHAMBER, WHEREIN IT IS CONTACTED WITH STEAM FROM THE FIRST CHAMBER. DEAERATED SEAWATER IS INTRODUCED IN A COMMON SUMP AND COLLECTED.*

**DEAERATION + DEAERATORS + FEEDWATER TREATMENT + CARBON DIOXIDE REMOVAL + COMPONENT DESIGNS + DIRECT CONTACT HEAT EXCHANGE + DISTILLATION PROCESSES + MULTIPLE EFFECT DISTILLATION + MULTISTAGE FLASH DISTILLATION + NONCONDENSABLE REMOVAL + PATENTS**

**30-01033** POTTHARST JE, JR.

EVAPORATOR

*U.S.PAT. 2,509,108 (6-11-45/5-23-50)*


**COMPONENT DESIGNS + EVAPORATORS + DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + PATENTS**

**30-01034** POTTHARST JE, JR.

HEAT EXCHANGER

*U.S.PAT. 2,713,996 (10-23-52/7-26-55)*

*A HEAT EXCHANGER CONSISTING OF A NUMBER OF CONCENTRICALLY MOUNTED INNER AND OUTER SHELLS.*

**ACCESSION NUMBER 30-01028 TO 30-01034**
30-01034 *CONTINUED*

TUBES, CONNECTING MEANS BETWEEN THE ENDS OF PAIRS OF OUTER TUBES, CONNECTING MEANS BETWEEN THE ENDS OF PAIRS OF INNER TUBES, THREADED MEANS ADJUSTABLE TO PRODUCE RELATIVE AXIAL MOVEMENT BETWEEN THE INNER AND OUTER TUBES TO SECURE THE OUTER TUBES, AND THE OUTER TUBE CONNECTING MEANS ASSOCIATED THEREWITH IN FLUID TIGHT RELATIONSHIP AND TO EXERT TENSION ON INNER TUBES.*

*FABRICATION METHODS * HEAT EXCHANGERS * CONDENSERS * DISTILLATION PROCESSES * EVAPORATORS * PATENTS * TUBING (METAL)

30-01035 POTTHARST JE, JR.
FORCED CIRCULATION EVAPORATOR
U.S.PAT. 3,192,130 (2-8-60/6-29-65)
A DISTILLATION APPARATUS CONSISTING OF A HOUSING WITH A VAPORIZATION CHAMBER WHICH HAS AN UPPER VAPOR SECTION AND A LOWER LIQUID SECTION. IN THE CENTER OF THE LIQUID SECTION THERE IS LOCATED AN IMPPELLER WHICH CAUSES THE LIQUID TO FLOW DOWN IN THE CENTER AND UPWARD AROUND THE OUTER WALLS. A VERTICAL TUBE HEAT EXCHANGER IS LOCATED AROUND THE OUTER WALLS. THE TUBE BUNDLE IS IN THE FORM OF A DOUGHNUT SO THAT THE LIQUID FLOWS UP THROUGH THE TUBES. HEATED BRINE IS SUPPLIED TO THE LIQUID SECTION. IN THE UPPER SECTION OF THE HOUSING, VAPOR IS SEPARATED FROM LIQUID DROPLETS AND THE VAPOR PASSES ON THE OUTSIDE OF THE TUBES OF THE DOUGHNUT SHAPED TUBE BUNDLE. HERE IT CONDENSED TO FORM PRODUCT WATER AND AT THE SAME TIME HEATS ADDITIONAL BRINE WITHIN THE TUBES.

*COMPONENT DESIGNS * EVAPORATOR-CONDENSER SYSTEM DESIGNS * VERTICAL TUBE EVAPORATORS * DISTILLATION PROCESSES * EVAPORATORS * PATENTS * TURBULENT FLOW

30-01036 RCE RC + LICHTENSTEIN J.
MULTI-CELL FLASH DISTILLATION SYSTEM
SALINE WATER CONVERSION CORP., N. Y.
U.S.PAT. 3,330,739 (6-5-64/7-11-67)
A FRESH WATER RECOVERY DEVICE CONSISTING OF A NUMBER OF VERTICAL EVAPORATOR PLATES CLOSELY POSITIONED, FACE-TO-FACE, WITH A CONDENSER MEANS POSITIONED BETWEEN THE PLATES. FEEDWATER IS DISTRIBUTED DOWNWARDLY OVER THE SURFACE AREA OF THE PLATES, THE EXTERIOR SURFACES OF THE EVAPORATOR PLATES AND CONDENSER MEANS BEING EXPOSED WITHIN VERTICALLY ALIGNED PRESSURE ISOLATED EVAPORATOR CELLS. THIS ISOLATION PERMITS CONTINUOUS AND UNINTERRUPTED FLOW OF BRINE DOWNWARDLY FROM ONE CELL TO THE NEXT. THERE IS MEANS FOR COLLECTING THE PURIFIED WATER WHICH FORMS ON THE EXTERNAL SURFACES OF THE CONDENSER IN EACH CELL.

*COMPONENT DESIGNS * EVAPORATOR-CONDENSER SYSTEM DESIGNS * DISTILLATION PROCESSES * EVAPORATOR SYSTEM DESIGN + FLASH CHAMBERS + FLASH EVAPORATION + MULTISTAGE FLASH DISTILLATION + PATENTS

30-01037 HAMMEND RP
MULTISTAGE FLASH EVAPORATOR
ATOMIC ENERGY COMMISSION, WASHINGTON
U.S.PAT. 3,545,697 (7-28-64/9-19-67)
A MULTISTAGE-MULTILEVEL EVAPORATOR INCLUDING A CONCRETE SHELL, A NUMBER OF TRAYS STACKED VERTICALLY AND IN ROWS IN A CHAMBER, AND MEANS FOR DISTRIBUTING HEATED BRINE TO EACH OF THE TRAYS TO FLOW FROM ONE END TO THE OTHER OF THE CHAMBER. CONDENSER TUBES ARE IN BANKS ARE LOCATED ON OPPOSITE SIDES FROM THE TRAYS AND EXTEND FROM ABOVE THE TOPMOST TRAY ROW TO ABOVE THE BOTTOMMOST TRAY ROW. COOLING SEAWATER IS PUMPED THROUGH THE TUBES TO CONDENSE VAPORS. THERE ARE VERTICAL BAFFLES TO DIVIDE THE CHAMBER INTO A SERIES OF COMPARTMENTS OF GRADUALLY DECREASING TEMPERATURE AND PRESSURE. THE BAFFLES EXTEND BELOW THE NORMAL LIQUID LEVEL IN THE TRAYS. THERE ARE ALSO BAFFLES FROM THE BOTTOM OF THE TRAYS SO AS TO FORM WEIRS. THERE IS MEANS FOR COLLECTING BRINE FROM THE DOWNSTREAM ENDS OF THE TRAYS FOR PARTIAL RECYCLING AND MEAN TO COLLECT CONDENSED WATER.

*MULTILEVEL PLANTS * MULTISTAGE FLASH DISTILLATION * DISTILLATION PROCESSES * EVAPORATOR SYSTEM DESIGN + FLASH CHAMBERS + FLASH EVAPORATION + MULTISTAGE FLASH DISTILLATION + PATENTS + TURBULENT FLOW

30-01038 KUN LC + CZIKK AM
SURFACE FOR BOILING LIQUIDS
UNION CARBIDE CORP., N. Y.
U.S.PAT. 3,454,081 (5-14-68/7-8-69)
A BOILING SURFACE LAYER IS FORMED ON A THERMALLY CONDUCTIVE WALL COMPRISING A PLURALITY OF RIDGES SEPARATED BY GROOVES PROVIDED AT MICROSCOPIC DENSITY, WITH OUTER SECTIONS OF THE RIDGES PARTLY DEFORMED INTO ADJACENT GROOVES TO PROVIDE SUB-SURFACE CAVITIES WITH RESTRICTED OPENINGS TO THE OUTER SURFACE AND SUB-SURFACE, OPENINGS BETWEEN SOME OF THE CAVITIES.

*EXTENDED HEAT TRANSFER SURFACES * HEAT TRANSFER IMPROVEMENTS + DISTILLATION PROCESSES + FILM ROILING + HEAT TRANSFER SURFACES + HEATER - CONDENSER TUBES + HEATER - EVAPORATOR TUBES + PATENTS + TUBING (METAL) + VERTICAL TUBE EVAPORATORS

30-01039 GCELDNER RW + LEITNER GF
MULTISTAGE FLASH EVAPORATOR DISTILLATION APPARATUS AND METHOD AND CONDENSER WITH SPRAY FILM EFFECTS
AQUA-CHER, INC., WISCONSIN
U.S.PAT. 3,388,045 (10-12-64/6-11-68)
A DISTILLATION SYSTEM WITH A MULTISTAGE FLASH EVAPORATOR AND TWO SPRAY FILM EVAPORATORS FOR FEEDWATER HEATING. DUAL CONDENSER TUBES ARE LOCATED IN THE MULTISTAGE FLASH STAGE AND IN THE FIRST SPRAY FILM EVAPORATOR. WATER TO BE EVAPORATED IS PASSED SEQUENTIALLY THROUGH ONE OF THE CONDENSERS IN EACH OF THE MSF STAGES AND THEN INTO THE CONDENSER IN THE FIRST SPRAY FILM EVAPORATOR. THE LIQUID IS THEN SPRAYED INTO THE SECOND FILM EVAPORATOR. HEATING STEAM IS USED TO HEAT THE SECOND SPRAY FILM
**CONTINUOUS**

Evaporator to evaporate part of the sprayed liquid. The water vapor from the second spray film evaporator is used to heat the first spray film evaporator. The unevaporated liquid from the second spray film evaporator is sprayed into the first spray film evaporator. A portion of the water unevaporated in the first spray film evaporator passes sequentially through the MSF stages. Part of the water unevaporated after passing through the flash chambers goes to waste and the remaining portion passes sequentially through the second condenser assembly of each stage of the flash evaporator and then through the second condenser of the first spray film evaporator. The water then is reintroduced sequentially through the flash chambers.

**MULTISTAGE FLASH DISTILLATION + SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + EVAPORATOR-CONDENSER SYSTEM DESIGNS + FEEDWATER HEATING + FILM EVAPORATION + FLASH EVAPORATION + FLOWSHEETS + PATENTS + SPRAY NOZZLES**

**ROSENBLAD AE**

**ROSENBLAD CORP., PRINCETON, N. J.**

**MULTISTAGE FLASH DISTILLATION + SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + FEEDWATER HEATING + FILM EVAPORATION + SPRAY NOZZLES**

**ACCESSION NUMBER 30-01039 TO 30-01044**
30-01044 •CONTINUED•

OPPOSED SHEET METAL SECTIONS SPACED IN VERTICAL SIDE BY SIDE RELATIONSHIP TO FORM AN ELONGATED ROW. ONE OF THE VERTICAL EDGES OF EACH SECTION IS JOINED TO THE OPPOSITE EDGE OF THE ADJACENT SECTION TO FORM A PLEATED STRUCTURE PROVIDING A NUMBER OF SIMILAR INTERSPACES BETWEEN THE SECTIONS. THE INTERSPACES ALTERNATELY OPEN TO ONE VERTICAL SIDE AND THEN THE OTHER SIDE OF THE STRUCTURE. THE STRUCTURE IS DIVIDED INTO A SERIES OF CHAMBERS EACH CHAMBER HAVING A VAPOR SPACE ON EACH SIDE OF THE PLEATED HEAT EXCHANGE WALL. IN THE FIRST CHAMBER, HEATING STEAM IS FED TO ONE SIDE OF THE PLEATED STRUCTURE AND BRINE DISTRIBUTED ON THE OPPOSITE SIDE TO FORM AN EVAPORATING FALLING FILM. THE VAPOR FORMED FROM THE EVAPORATING BRINE IN THE FIRST CHAMBER IS USED AS THE HEATING STEAM FOR THE SECOND CHAMBER AND THIS CONTINUES FOR A NUMBER OF STAGES. THE PURE WATER CONDENSATE FROM EACH CHAMBER IS COLLECTED AND USED TO HEAT THE BRINE FEEDWATER.

MEANS ARE PROVIDED TO REMOVE NON-CONDENSABLE GASES.

#EVAPORATOR-CONDENSER SYSTEM DESIGNS • FALLING FILM EVAPORATION • SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES • EVAPORATORS + FILM EVAPORATION • FLASH CHAMBERS • HEAT EXCHANGERS + PATENTS

30-01045 MILTON RM

HEAT EXCHANGE SYSTEM

LUHMUS CO., NEW YORK

U.S.PAT. 3,348,954 (5-12-64/5-21-68), 7 FIG, 7 REF

A SPECIAL HEAT EXCHANGE SURFACE TO IMPROVE THE RATE OF HEAT TRANSFER. THE APPARATUS HAS A THERMALLY CONDUCTIVE HEAT EXCHANGE WALL WITH A POROUS BOILING LAYER BONDED TO ONE SIDE OF THE WALL. THE POROUS BOILING LAYER IS CONSTRUCTED OF THERMALLY CONDUCTIVE PARTICLES BONDED TOGETHER TO FORM INTERCONNECTED PORES OF CAPILLARY SIZE HAVING AN EQUIVALENT PORE RADIUS LESS THAN ABOUT 4.5 MILS. BRINE COVERS THE POROUS LAYER AT LEAST AS A FILM AND THE OTHER SIDE OF THE WALL IS HEATED WITH STEAM OR WARM FLUID. VAPOR BUBBLES ARE FORMED WITHIN THE POROUS LAYER BY HEAT TRANSFER AND EMERGE INTO THE LIQUID FILM COVERING THE POROUS LAYER. SPACE IS PROVIDED FOR VAPOR REMOVAL.

#HEAT TRANSFER IMPROVEMENTS + #HEAT TRANSFER SURFACES + BOILING PROMOTION + DISTILLATION PROCESSES + EVAPORATORS + EXTENDED HEAT EXCHANGE SURFACES + FILM BOILING • HEAT EXCHANGERS • HEAT TRANSFER COEFFICIENT + PATENTS

30-01046 MILTON RM

METHOD FOR REMOVING SCALE-FORMING CONSTITUENTS FROM SEA WATER AND OTHER SOLUTIONS WHICH FORM SCALE

U.S.PAT. 3,408,294 (6-7-67/10-30-68), 7 FIG, 7 REF

SOME SOLUBLE MATERIALS, PRINCIPALLY SALTS, IN SEA WATER AND OTHER HARD WATERS, FORM HARD, DENSE CRYSTALLINE DEPOSITS OR SCALES ON SURFACES WHEN THE SOLUTION IS HEATED TO AN ELEVATED TEMPERATURE AND TIME IS ALLOWED FOR CRYSTALLIZATION TO TAKE PLACE. A METAL WIRE MESH MAY FILL A PART OF THE VOLUME OF A VESSEL IN WHICH THE HEATED SOLUTION IS MAINTAINED FOR 1 TO 200 MINUTES AND SCALE IS ALLOWED TO FORM DURING THIS TIME ON THE SURFACES OF THE WIRE WHICH MAKES UP THE MESH. CHANGING THE BULK VOLUME OF THE METAL MESH BY COMPRESSION OR EXPANSION DUE TO AN EXTERNAL MECHANICAL FORCE, CAUSES THE WIRE IN THE MESH TO FLEX, AND THE SCALE TO CRACK THEREFROM, IN SOLID PARTICLES WHICH MAY READILY BE REMOVED FROM THE WATER, NOW COMPARETIVELY SOFT. IF THE WATER THEN IS TO BE EVAPORATED, THE PARTICLES MAY REMAIN IN THE LIQUID FOR FURTHER CRYSTALLIZATION THEREON AS THE CONCENTRATION PROCEEDS.

#FEEDWATER TREATMENT + #SCALE PREVENTION • DISTILLATION PROCESSES + PATENTS + SCALE REMOVAL + SCALING + SEEDING PROCESSES

30-01047 BAUER HV

DISTILLATION OF A SOLUTE-SOLVENT MIXTURE IN SUCCESSIVELY REDUCED PRESSURE STAGES WHILE IN DIRECT CONTACT AND CONCURRENT FLOW WITH A HEAT TRANSFER MEDIUM

LUMUS CO., NEW YORK

U.S.PAT. 3,298,932 (4-25-62/1-17-67), 1 FIG, 11 REF


#DIRECT CONTACT HEAT EXCHANGE + #SYSTEM DESCRIPTIONS + VAPOR COMPRESSION EVAPORATION + COMPONENT DESIGNS • DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + HEAT TRANSFER + MULTIPLE EFFECT DISTILLATION + PATENTS

30-01049 LLSTENADER EL

WATER DEMINERALIZING APPARATUS

GENERAL ELECTRIC CO., NEW YORK

U.S.PAT. 3,196,087 (3-28-61/7-20-65), 7 FIG, 7 REF

AN APPARATUS FOR DEMINERALIZING WATER IN WHICH THE EVAPORATION AND CONDENSATION OCCUR AT ATMOSPHERIC PRESSURE. A SERIES OF DISCS ROTATE BETWEEN PARALLEL PLATES WITH THE DISCS CONTINUOUSLY PASSING THROUGH A HEATED SALINE FEEDWATER IN A SUMP, BECAUSE OF THE PARTIAL PRESSURE GRADIENT BETWEEN THE HEATED FEED IN THE SUMP AND THE CONDENSING SURFACE OF PLEATED HEAT EXCHANGE WALLS, A FILM OF PURE WATER FORMS ON THE WALLS AND IS COLLECTED.

#ROTARY STILLS + COMPONENT DESIGNS + DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + PATENTS
CATEGOR 30 - SEAWATER DISTILLATION PROCESSES

30-01048 CONTINUED
FILM EVAPORATION + HEAT TRANSFER SURFACES + PATENTS

30-01049 WILLIAMSON WR
MULTI-STAGE PROCESS AND APPARATUS FOR DISTILLING SEA WATER
AMERICAN MACHINE AND FOUNDRY COMPANY, INC., NEW YORK
U.S.PAT. 3,155,600 (5-16-60/11-3-64), 2 FIG, 5 REF

METHOD AND APPARATUS FOR A COMBINED DISTILLATION PLANT COUPLING A MULTIEFFECT SECTION WITH A MULTISTAGE FLASH DISTILLATION SECTION. THE FIRST OR OUT-OF-CONTACT EVAPORATING PHASE OF THE SYSTEM CONSISTS PRIMARILY OF A NUMBER OF FLASH EVAPORATORS WHICH ARE INTERCONNECTED AND OPERATED AS TO PROVIDE DOUBLE EFFECT OPERATION. THE SECOND PHASE OF THE SYSTEM CONSISTS PRIMARILY OF A NUMBER OF FLASH EVAPORATORS WHICH ARE INTERCONNECTED TO PROVIDE A CASCADE RELATIONSHIP. SEPARATE MEANS ARE PROVIDED FOR EACH PHASE FOR THE REMOVAL OF NONCONDENSABLE GASES. THE NONCONDENSABLE REMOVAL IS MADE IN SUCH A MANNER THAT DESIRED PRESSURE DIFFERENTIALS BETWEEN THE STAGES ARE OBTAINED AND THE GASES ARE REMOVED FROM EACH STAGE AT A RATE SUFFICIENT TO PREVENT THE ACCUMULATION OF AN UNDUE AMOUNT OF NONCONDENSABLES IN THE STAGE.

*MULTIPLE EFFECT DISTILLATION + MULTISTAGE FLASH DISTILLATION + NONCONDENSABLE REMOVAL + SYSTEM DESCRIPTIONS + CONDENSERS + DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + EVAPORATORS + FLASH EVAPORATION + PATENTS

30-01050 RIS KB + GARDNER WA + RYAN JM
EVAPORATOR CONSTRUCTION
Baldwin-Lima-Hamilton Corp., Philadelphia
U.S.PAT. 3,194,747 (11-8-61/7-13-65), 4 FIG, 11 REF


*COMPONENT DESIGNS + EVAPORATORS + CONDENSERS + DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + MULTISTAGE FLASH DISTILLATION + DEAERATION + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + EVAPORATORS + FEDER WATER HEATING + FLASH EVAPORATION + FLOWSHETS + PATENTS + SYSTEM DESCRIPTIONS

30-01051 CHALMERS TM + FRANKEL A + CRAIG HRM
MULTI-STAGE FLASH EVAPORATOR WITH HEAT RECOVERY
Richardsons, Westgarth and Co., Ltd., England
U.S.PAT. 3,144,177 (11-3-60/8-25-64), 2 FIG, 4 REF

THE DESIGN OF A MULTISTAGE FLASH DISTILLATION SYSTEM EVAPORATOR. THE EVAPORATOR CONSISTS OF A GROUP OF TWO OR MORE FLASH CHAMBERS, EACH OF WHICH IS CONNECTED TO AN ASSOCIATED CONDENSER BUNDLE FOR THE HEATING OF THE LIQUID TO BE EVAPORATED IN THE FLASH CHAMBERS. THE FLASH CHAMBERS IN THE GROUP ARE CONNECTED TOGETHER IN SERIES WHILE AT LEAST TWO OF THE CONDENSER TUBE BUNDLES ARE CONNECTED TOGETHER IN PARALLEL SO THAT, IN OPERATION, THE LIQUID TO BE EVAPORATED IS DIVIDED INTO A NUMBER OF PARALLEL STREAMS PRIOR TO ITS ENTRY INTO THE HEATER-CONDENSERS.

*EVAPORATOR-CONDENSER SYSTEM DESIGNS + MULTISTAGE FLASH DISTILLATION + SYSTEM DESCRIPTIONS + CONDENSERS + DISTILLATION PROCESSES + EVAPORATORS + FLASH CHAMBERS + FLASH EVAPORATION + FLOWSHETS + PATENTS

30-01052 KOGAN A
PROCESS AND APPARATUS FOR EFFECTING HEAT TRANSFER
U.S.PAT. 3,242,975 (5-5-64/3-29-66)


*COMPONENT DESIGNS + DIRECT CONTACT HEAT EXCHANGE + HEAT EXCHANGERS + HEAT TRANSFER + DISTILLATION PROCESSES + PATENTS

30-01053 BROWN CE
AMBIENT TEMPERATURE VAPOR COMPRESSION DESALINATION SYSTEM
Hydronautics, Inc., Laurel, Md.
U.S.PAT. 3,450,601 (4-4-67/6-17-69)

MEANS FOR PREPARING A TREATED LIQUID HAVING A DESIRED PH BY ADDING SULFURIC ACID TO A SALT WATER REMOVED TO SUBSTANTIALLY ELIMINATE THE CARBONATES. THEREAFTER DISTILLING THE TREATED LIQUID IN A DISTILLING APPARATUS ADAPTED TO HANDLE TREATED LIQUIDS HAVING THE DESIRED PH, AND INCLUDING A PLURALITY OF ANNULAR HORIZONTALLY ARRANGED FALLING FILM HEAT EXCHANGE UNITS, THE UNITS BEING VERTICALLY SPACED AND HAVING SEPARATE COMPARTMENTS THEREBETWEEN WHICH RECEIVE THE BLADES OF A ROTARY COMPRESSOR, THE COMPRESSOR BEING THE ONLY MOVABLE PART IN THE APPARATUS.

*COMPONENT DESIGNS + EVAPORATOR-CONDENSER SYSTEM DESIGNS + FALLING FILM EVAPORATION + PATENTS

ACCESSION NUMBER 30-01048 TO 30-01053
HEINZ W.

**METHOD AND APPARATUS FOR HEATING AND DISTILLING SALINE WATER USING HEATED PEBBLES**

U.S. Pat. 3,442,769 (10-22-65/5-6-69)

A method of transferring heat to a solution in which solid matter is deposited upon the heat transfer means, comprising the steps of (1) heating a flow of solid particles, (2) causing the heated solid particles to contact the solution to be heated in counterflow whereby solid matter from the solution is deposited upon the surfaces of the solid particles, (3) abrading and impacting the solid particles to loosen the deposited solid matter, (4) causing the abraded and impacted solid particles to contact incoming solution in counterflow to wash the loosened deposited solid matter from the solid particles, and (5) reheating the cleaned solid particles for further contact with a solution to be heated.

**SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + HEAT TRANSFER + PATENTS + SCALE PREVENTION + SYSTEM DESCRIPTIONS**

RANNENBERG GC

**COMBINED HEAT LOAD COOLER AND SEA WATER DESALINATION STILL**

UNITED AIRCRAFT CORP., EAST HARTFORD, CONN.

U.S. Pat. 3,440,147 (7-14-66/4-22-69)

Sea water or contaminated water is divided into a first stream which is partially vaporized and the residue discarded, and a second stream which condenses the produced vapor by indirect heat exchange therewith. The vaporization is brought about by a closed heat transfer loop in which heat is indirectly absorbed from a heat load at one loop point and the heat absorbed surrendered to said vaporization at another loop point.

**SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + FLOWSHEETS + HEAT TRANSFER + PATENTS**

LOUH JA

**DESALINATION METHOD AND APPARATUS WITH PLURAL VAPORIZATION CHAMBER CONTAINING SHALLOW LAYERS OF LIQUID**

U.S. Pat. 3,440,146 (5-2-66/4-22-69)

A desalination method and apparatus includes a number of series-connected heat exchangers each including an evaporation chamber and a condensation chamber. A number of spaced-apart heat-conductive members extend into the evaporation chamber through the major portion of the depth of a shallow horizontal layer of saline water in the chamber. The pressure of the condensing vapor and the saline water in relation to the depth of the saline water layer is regulated so that the major portion of the surface of each heat-conductive member is in contact with boiling water.

**SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + EVAPORATORS + Flash Chambers + Flash Evaporation + Heat Transfer Surfaces + PATENTS**

SAAVEDRA MA

**SYSTEM FOR CONVERSION OF SEA WATER INTO FRESH WATER**

FARBWERKE HOECHST AKTIENGESELLSCHAFT, GERMANY

U.S. Pat. 3,438,869 (1-13-67/4-15-69)

This invention relates to a method and apparatus for producing fresh water from sea water wherein hydrogen and oxygen are burned at a pressure less than atmospheric pressure to completely vaporize a brine solution. The vapors are then passed through coils maintained in a vacuum and are then passed into a condensation chamber maintained at reduced temperature and pressure to condense liquid water containing the impurities, and separate said liquid containing impurities from the pure water vapor. The fresh water is recovered by condensation.

**SYSTEM DESCRIPTIONS + DISTILLATION PROCESSES + ENERGY SOURCES + FEEDWATER HEATING + Flash Evaporation + Multistage Flash Distillation + PATENTS**

LAURENTY F.

**SPRAY TYPE FLASH EVAPORATOR**

U.S. Pat. 3,434,522 (9-21-66/3-25-69)

An evaporator vessel has a delivery pipe in its upper section, comprising a horizontal, circular tubular section, and a tubular spout whose lower face is upwardly inclined with respect to the axis of the tubular section. The spout has a top portion which is flat and disposed in a horizontal plane tangent to the uppermost element of the tubular section. The inclined bottom portion of the spout has a series of discharge nozzles therealong.

**COMPONENT DESIGNS + EVAPORATORS + FLASH EVAPORATION + DISTILLATION PROCESSES + EVAPORATOR SYSTEM DESIGN + PATENTS + SPRAY NOZZLES**

RALSTON PH

**SCALE INHIBITING**

CALGON CORP.

U.S. Pat. 3,434,969 (8-11-67/3-25-69)

Compounds containing a plurality of methylene phosphonated amine groups having at least three nitrogens connected by ethylene groups are disclosed to inhibit the formation of scale, such as calcium, barium and magnesium carbonate, silicate and sulphate scales, from aqueous solutions, even at relatively high temperatures, at threshold inhibitor concentrations.

**CHEMICAL ADDITIVES + FEEDWATER TREATMENT + SCALE PREVENTION + DISTILLATION PROCESSES + PATENTS + SCALE INHIBITION**

ACCESSION NUMBER 30-01053 TO 30-01059
A vapor compression plant having a multi-stage flash evaporator serving as a brine preheater for a vapor compression evaporation system can be divided into a heat rejection section and a heat regenerative section. A heat exchanger serves to preheat make-up water by extracting heat from the distillate prior to adding the preheated make-up water to an intermediate stage of the multi-stage flash evaporator. The preheated water entering the vapor compression evaporator substantially increases the distillate producing capacity of the plant.

A method for evaporating brine which consists of passing preheated feedwater downwardly as a flowing film over a heat exchange wall, passing steam into contact with the opposite side of the wall at 3 to 15 deg F above the temperature of the flowing film, and condensing at least a portion of the steam as a film on the opposite side. The condensate film is maintained at a downward velocity at the uppermost heat transfer level of the wall at least equivalent to the velocity achieved by a free falling film on a smooth vertical wall after a fall of about 3 ft. Brine is evaporated at the rate of 10 to 30 lb/hr sq ft of heat transfer wall.

A 1-MGD desalting plant operating since 1965 in conjunction with a 6700 kw steam generating station in Eilat is described. Specifications for the plant required production of 8 lbs of steam with less than 25 ppm TDS for each lb of steam used in the brine heater. Maximum temperature of the recycle steam was to be 200 deg F and calcium carbonate scale was to be controlled with sodium polyphosphate. This scale control method proved unsatisfactory in operation. However, and conversion was made to a more satisfactory acid treatment system. From December 1965 to December 1966, the plant produced 349 million gallons of product water, or 93% of the design capacity, on a continuous basis. From January 1967 to the present, the plant has averaged about 105% of design. During one short period, it was demonstrated that this plant could be operated at 230 deg F, producing more than 1.25 MGD.

The U.S. Government desalting program includes (1) basic and applied research, (2) design, construction, and operation of pilot plants of 75,000 GPD or less, (3)
30-01066 *CONTINUED*
OPERATION OF 1-MGD TEST BEDS. (4) CONSTRUCTION AND OPERATION OF LARGE WATER PLANT
MODULES, AND (5) DEVELOPMENT OF SUPPORTING TECHNOLOGY IN SUCH AREAS AS MATERIALS,
WATER PRETREATMENT, AND BRINE DISPOSAL. TEST FACILITIES INCLUDE A 1-MGD MSF TEST BED
PLANT, A 2-MGD TEST BED PLANT, A 1-MGD VFE TEST BED PLANT, A 250,000-GPD ELECTRODIALYSIS TEST
BED PLANT, A MATERIALS TEST CENTER, A BRACKISH WATER TEST CENTER, AND A NUMBER OF PILOT
PLANTS FOR DEVELOPMENT OF DISTILLATION, MEMBRANE, AND CRYSTALLIZATION PROCESSES. UNDER
CONSIDERATION NOW IS A 4-MGD VFE MODULE USING MSF BRINE PREHEATING. IN ADDITION TO ITS
BASIC FUNCTION OF ACCELERATING DEVELOPMENT AND DEMONSTRATION OF DESALTING TECHNOLOGY
IN THE U.S., PROGRAM POLICY PERMITS PROMPT AND FREE FLOW OF INFORMATION TO ALL OTHER COUNTRIES; ENCOURAGES
ADVANCEMENT OF DESALTING ON AN INTERNATIONAL BASIS. IT IS BELIEVED THAT THE U.S. PROGRAM HAS
CONTRIBUTED SIGNIFICANTLY TO BRINGING DESALTING TECHNOLOGY TO THE POINT WHERE ECONOMIC
SITUATION MAY ALLOW UNLIMITED AGRICULTURAL APPLICATIONS ARE SERIOUSLY CONSIDERED.
*PILOT PLANT OPERATIONS + *REVIEWS + DESIGN + DEVELOPMENT + DISTILLATION PROCESSES +
OPERATING EXPERIENCE + OSW SPONSORED + PLANT CONSTRUCTION + STATUS REPORTS

30-01067 FLINT D
SCALES FROM PHOSPHATE TREATED SEA WATER
U.K. ATOMIC ENERGY AUTHORITY, HARWELL, ENGLAND
DESALINATION 6(3), 319-34 (1969), 3 FIG, 12 REF
AS A STEP TOWARD IMPROVED EFFICIENCY OF DESALINATION PLANTS, A STUDY WAS MADE OF THE
COMPOSITION, STRUCTURE, AND MODE OF GROWTH OF HEAT BARRIERS SUCH AS SCALES, SLIMES,
AND SLUDGES ON HEAT TRANSFER SURFACES. THE REACTION OF SEAWATER WITH SODIUM
TRI-POLYPHOSPHATE, A COMPOUND FOUND IN MAGEE SEAWATER PHOSPHATE ADDITIVE, WAS
EXAMINED. THE PRECIPITATES, IN FRESH AND FULLY HYDROLYSED FORMS, WERE EXAMINED BY
X-RAY POWDER DIFFRACTION ANALYSIS. Constituent compounds were identified in the
powder patterns and compared with patterns of industrial phosphate scales and sludges.
The powder pattern for or diffuse halo commonly associated with such scales was
re-examined and found to contain detail sufficient to show that the composition of the
Composition of the Ca-P and Mg-P scales likely to be encountered is predominately a natural form of
Calcium phosphophate, beta-calcium orthophosphate, or whitlockite.
HEAT TRANSFER + PHYSICAL CHEMISTRY OF SCALE + #PRECIPITATES + #PRECIPITATION + #SCALING +
#SEAWATER CHEMICAL ANALYSIS + FEEDWATER TREATMENT + HEAT TRANSFER IMPROVEMENTS +
HEAT TRANSFER SURFACES + REACTIONS (CHEMICAL) + #SCALE PREVENTION + #SCALE REMOVAL

30-01068 ZUCKERMAN N
THE EILAT 1,000,000 GPD MULTI-STAGE FLASH DISTILLATION PLANT - THIRD YEAR OF OPERATION
THE ISRAEL ELECTRIC CORP., LTD., HAIIFA
DESALINATION 6(3), 309-17, 5 FIG, 3 TABLES
A DESCRIPTION OF THE THIRD YEAR OF OPERATION OF THE EILAT PLANT. OPERATING PARAMETERS
WERE KEPT NEAR THE VALUES DETERMINED BY EARLIER TESTS (95-97 DEG C TOP BRINE
TEMPERATURE AND 1800-1810 TONS/HR RECYCLE FLOW), MAKING IT POSSIBLE TO KEEP THE BRINE
PH VALUE AT 7.2 AVERAGE, WITH RESULTING LOW CORROSION FIGURES AND LITTLE FOULING.
REMARKABLY GOOD OPERATING RESULTS WERE OBTAINED, THE PLANT YEARLY AVAILABILITY FACTOR
BEING 95%, YEARLY LOAD FACTOR 100.4% AND OUTPUT FACTOR 105.7%. SALINITY WAS
CONSISTENTLY BELOW 3 PPM. CHEMICAL CLEANING ON RECYCLE CUT CLEANING TIME TO A FEW
HOURS. AVERAGE CORROSION WAS MEASURED BY CORRATOR CELL AND BY ULTRASONICS. CASES OF
LOCAL CORROSION AND PERFORATIONS ARE DESCRIBED, AS WELL AS SELF CLEANING OF TUBES BY
SAND DURING SEA STORMS. PLANS FOR THE FUTURE ARE OUTLINED. INTENDED EXPERIMENTS AND
IMPROVEMENTS INCLUDE (1) CATHODIC PROTECTION OF THE WATER BOXES, (2) STUDY OF
PROTECTIVE COATINGS, (3) REMOVAL FOR INSPECTION OF SAMPLE CONDENSER TUBES, AND (4) EXPERIMENTATION WITH OTHER TUBE MATERIALS.
*ISRAEL + MULTISTAGE FLASH DISTILLATION + OPERATING EXPERIENCE + 40-50 MGD PLANT + BRINE FLOW +
CORROSION + CORROSION CONTROL + DISTILLATION PROCESSES + FLASH EVAPORATION + FOULING +
LOAD FACTOR + OPERATIONAL PROBLEMS + PH CONTROL + PITTING (CORROSION) + PLANT FACTOR +
SCALE REMOVAL

30-01069 PORTEOUS A
A LOW TEMPERATURE MODEL FOR EQUILIBRATION RATES IN FLASHING FLOW AND ITS DESIGN
IMPLICATIONS
UNIVERSITY OF GLASGOW, SCOTLAND
DESALINATION 6(3), 337-47, 4 FIG, 8 REF
THE RATE AT WHICH FLASHING BRINE ATTAINS EQUILIBRIUM IS EXAMINED AND A MODEL DEVELOPED
FROM PREVIOUSLY PUBLISHED DATA ON BRINE FLASHING RATES. THE MODEL PREDICTS THAT
FLASHING IS AN EXPONENTIAL DECAY PROCESS AND CORRELATES EXISTING DATA FOR BRINE
TEMPERATURES OF 100 TO 150 DEG C. FLASH CHAMBER DESIGN IS EXAMINED ON THE BASIS OF
THE MODEL AND A NOVEL CONCEPT IN PLANT DESIGN OBTAINED, BASED ON THE PRINCIPLE OF
UNEQUILIBRATED BRINE FLOW, WHICH LEADS TO MUCH SHORTER STAGE LENGTHS FOR THE SAME
STAGE YIELD.
*BRINE SYSTEM DESIGNS + #DESIGN + #DESIGN DATA + #FLASH CHAMBERS + BRINE FLOW + DESIGN CRITERIA +
DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + EVAPORATORS + EVAPORATORS +
FLASH EVAPORATION

30-01071 BELL WE + BRAMER HC
MATERIALS EVALUATION PROGRAM
CYRUS W. RICE AND CO., PITTSBURGH, PA.
OSW R+D PROGR. REP'T. NO.308 (NOV.1967), 75 P, 13 FIG, 7 TABLES, 6 REF
MATERIALS PERFORMANCE BY VISUAL, NONDESTRUCTIVE, AND DESTRUCTIVE TEST METHODS WERE
EVALUATED ON THE EXTENDED PREPRODUCT PLANT OUTAGE. EVAPORATION TUBES OF CUPRONECKEL
(90/10), TITANIUM, AND 316 SS CAN BE EXPECTED TO GIVE LONG-TERM FAILURE-FREE SERVICE.
ALUMINUM BRASS PERFORMED WELL AT LOW AND HIGH TEMPERATURES BUT PITTED AT INTERMEDIATE
TEMPERATURES OF 100 TO 150 DEG C. FLASH CHAMBER DESIGN IS EXAMINED ON THE BASIS OF
THE MODEL AND A NOVEL CONCEPT IN PLANT DESIGN OBTAINED, BASED ON THE PRINCIPLE OF
UNEQUILIBRATED BRINE FLOW, WHICH LEADS TO MUCH SHORTER STAGE LENGTHS FOR THE SAME
STAGE YIELD.
*BRINE SYSTEM DESIGNS + #DESIGN + #DESIGN DATA + #FLASH CHAMBERS + BRINE FLOW + DESIGN CRITERIA +
DISTILLATION PROCESSES + EVAPORATOR-CONDENSER SYSTEM DESIGNS + EVAPORATORS + EVAPORATORS +
FLASH EVAPORATION

ACCESSION NUMBER 30-01066 TO 30-01071
TUBES IN LOW-TEMPERATURE AERATED SEAWATER SHOWED THINNING BUT SCALED AT HIGH TEMPERATURES. CUPRONICKEL (90/10) TUBES EXHIBITED NO FAILURES IN EXCHANGERS. SEVERAL COPPER TUBES SHOWED GOOD BEHAVIOR. SCALE ANALYSES WERE MADE ON DEPOSITS FROM NUMEROUS TUBES. WATER BOX LINERS OF 316 SS AND CUPRONICKEL (90/10) WERE IN EXCELLENT CONDITION. UNPROTECTED OR EPOXY-COATED STEEL WATER BOXES AND TUBE SHEETS CORRODED AND PITTED SEVERELY. CATHODIC PROTECTION OF STEEL HEAT-EXCHANGER WATER BOXES MINIMIZED CORROSION. POLYPROPYLENE EVAPORATOR WEIRS EXHIBITED MINOR DETERIORATION. STEEL BRINE SUMPS SHOWED MODERATE CORROSION AND PITTING WHICH DECREASED IN INTENSITY WITH DEEPER TANKS. EPOXY-COATED STEEL DEAEATOR PINCHED DEEPLY AT THE LIQUID-GAS INTERFACE. SEAWATER AND BRINE STEEL PIPING WERE SCARED BUT CORROSION WAS UNIFORM.

PROCEDURES FOR HANDLING, STORING, AND RETREIVING MATERIALS PERFORMANCE DATA WERE

• CATHODIC PROTECTION • COPPER ALLOYS • CORROSION PROBLEMS • FREEPORT PLANT • IRON ALLOYS • TUBING (METAL) • EQUIPMENT FAILURES • HEAT EXCHANGERS • OSS SPONSORED • PHYSICAL CHEMISTRY OF SCALE • Pitting (Corrosion) • PROTECTIVE COATINGS • STAINLESS STEELS • SYNTHETIC RESINS (PLASTICS) • TITANIUM


DEAERATION • OPERATIONAL EXPERIENCE • OPERATIONAL PROBLEMS • PILOT PLANT OPERATIONS •oosewell FLUORINATION • CARBON DIOXIDE REMOVAL • COATINGS • COMPONENT TESTING • CORROSION PROBLEMS • DEAEATORS • EXPERIMENTAL DATA • FEEDWATER TREATMENT • INSTRUMENTATION • ION EXCHANGERS • MAINTENANCE • OSS SPONSORED • SCALE PREVENTION • SEEDING PROCESSES • TEMPERATURE MEASURING INSTRUMENTS • VAPOR COMPRESSORS

EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT INTERNATIONAL HARVESTER CO., SAN DIEGO, CALIF.

DEPOSITION OF TITANIUM COATINGS ON LOW-CARBON STEELS WAS ACCOMPLISHED BY BOTH ELECTROLYTIC AND NONELECTROLYTIC TECHNIQUES. NONELECTROLYTIC COATINGS WERE DEPOSITED AT 1700 DEG F AND ELECTROLYTIC COATINGS WERE APPLIED AT 1550 DEG F AND 1.0 AMPERE/SQ. IN. CURRENT DENSITY. THE SURFACE CONCENTRATION OF THE 0.003-IN. THICK COATINGS WAS 95% OR GREATER TITANIUM AND 5% OR LESS IRRON. BOILING SEAWATER, AERATED, ROOM TEMPERATURE SEAWATER, AUTOCLAVE (280 DEG F) AND VELOCITY EFFECTS CORROSION TESTS SHOWED THE NONELECTROLYTIC 0.003-IN.-THICK COATING TO POSSESS A CORROSION RESISTANCE ESSENTIALLY EQUAL TO THAT OF PURE (A-70) TITANIUM. THE RATE OF COATING DEPOSITION WAS FOUND TO BE OF PRINCIPAL IMPORTANCE IN DETERMINING CORROSION RESISTANCE BECAUSE THE DEPOSITION RATE LARGELY CONTROLS THE DEPOSITION COMPOSITION (ALLOY VERSUS INTERMETALLIC COMPOUND).

TITANIUM • Fabrication • Amenities • PLANTS AND SUPPLIES COSTS • OSS SPONSORED • TITANIUM ALLOYS

SCALE CONTROL WITH GRAPHITE HEAT-TRANSFER TUBES OF CONTROLLED PERMEABILITY TO STEAM - PHASE II UNION CARBIDE CORP., PARMA, OHIO.

STUDIES WERE CONDUCTED TO EVALUATE THE ABILITY OF GRAPHITE TUBES WITH CONTROLLED PERMEABILITY TO PREVENT SCALE FORMATION IN LONG TUBE VERTICAL EVAPORATORS. A 2-IN.-D. BY 1.5-IN.-I.D. TUBE WAS TESTED AT VAPOORIZATION TEMPERATURES OF 212 DEG F AND 265-271 DEG F. COMPARISON OF DATA AND PHYSICAL OBSERVATION OF THE TUBES REVEALED A REDUCTION OF CALCIUM SULFATE SCALE FORMATION WAS OBTAINED WITH THE POROUS GRAPHITE TUBE AS COMPARED TO AN IMPERVIOUS TUBE. THERE WAS NO REDUCTION IN THE FORMATION OF ALKALINE SCALE (CALCIUM CARBONATE AND MAGNESIUM HYDROXIDE).

GRAPHITE • EAT TRANSFER • POROUS MATERIALS • SCALE PREVENTION • EXPERIMENTAL DATA • FALLING FILM EVAPORATION • HEAT TRANSFER IMPROVEMENTS • HEATER • EVAPORATOR TUBES • OSS SPONSORED • VERTICAL TUBE EVAPORATORS

SCALE CONTROL IN SALINE WATER EVAPORATORS - A REVIEW OF CURRENT STATUS UNIV. OF CALIFORNIA, LOS ANGELES, OFFICE OF SALINE WATER, WASHINGTON.

CONDITIONS FOR SCALE-FREE OPERATION ARE NOTED BASED ON OPERATING EXPERIENCE AT FREEPORT, TX., SAN DIEGO, CALIF., AND WRIGHTSVILLE BEACH, N.C. CURRENTLY OPERATING LIMITATIONS ARE SET BY THE SOLUBILITY OF CALCIUM SULFATE. THE MULTIEFFECT FALLING FILM DESIGN HAS DEMONSTRATED THAT THIS HARDWARE CAN ALSO BE OPERATED SCALE-FREE. METHODS FOR CHEMICAL CLEANING OF VARIOUS TYPES OF SCALE AND AREAS WHERE SCALE PROBLEMS STILL EXIST ARE DISCUSSED. THIS POINTS OUT THE NEED FOR OPTIMUM METHODS OF CHEMICAL CLEANING.

SCALE PREVENTION • SCALE REMOVAL • BRINE CONCENTRATION RATIO • EVAPORATORS • FEEDWATER TREATMENT • FREEPORT PLANT • HEAT TRANSFER • ION EXCHANGERS • OSS SPONSORED • PHYSICAL CHEMISTRY OF SCALE • POINT LOMA PLANT • PROPERTIES OF SCALE • REVIEWS • ROSEWELL PLANT • WRIGHTSVILLE BEACH PLANT

ACCESSION NUMBER 30-01071 TO 30-01080
30-01082  MORAN FJ
THE FABRICATION OF SMOOTH TUBES FOR LARGE MULTISTAGE FLASH EVAPORATOR DESALINATION PLANTS
OAK RIDGE NATIONAL LABORATORY, TENN.
ORNL-TM-2750 (NOV.1969), 169 P, 8 FIG

THIS REPORT COVERS THE STATE OF THE ART OF TUBING FABRICATION, INDUSTRIAL CAPACITY TO
PRODUCE TUBES, AND POSSIBLE IMPROVEMENTS IN TECHNOLOGY TO REDUCE COSTS. THE PRESENT
COPPER TUBING OUTPUT IS ABOUT ONE BILLION LB/YR AND IS PRODUCED WITH HIGH-SPEED TUBE
REDUCERS AND BULL BLOCKS. COPPER-ALLOY TUBES FOR CONDENSER SERVICE AMOUNT TO 150
MILLION LB/YR, GENERALLY PRODUCED WITH SLOWER AND LESS ECONOMICAL BENCH DRAWING
PRODUCTION TESTS DEMONSTRATED THE FEASIBILITY OF PROCESSING COPPER-NICKEL TUBES
ON THE SAME FACILITIES USED TO PRODUCE COPPER TUBING. PRESENT FABRICATION COSTS
FOR SEAMLESS COPPER-NICKEL TUBING AVERAGE WELL ABOVE $5.00/LB WITH BENCH DRAWING
EQUIPMENT, BUT COULD PROBABLY BE REDUCED TO APPROXIMATELY $2.20/LB IN AN
ADVANCED-TECHNOLOGY FACILITY PRODUCING THREE MILLION POUNDS OF TUBING PER MONTH.
COPPER-NICKEL TUBES CAN BE FABRICATED BY WELDING FLAT STRIPS INTO TUBULAR SHAPE BUT
OVER THE LONG TERM, SEAMLESS TUBING WILL PROBABLY BE CHEAPER. THE FABRICATION OF
THIN-WALL SEAMLESS TITANIUM TUBES BY COLD REDUCTION IS UNECONOMICAL, AND
HIGH-FREQUENCY WELDING OF FLAT STRIPS INTO TUBULAR SHAPE IS MORE PROMISING. EDDY
CURTAIN TESTING WAS RELIABLE FOR DETECTION OF FLAWS IN SEAMLESS TUBES. MORE WORK,
HOWEVER, IS NEEDED TO IMPROVE THE RELIABILITY OF THE TEST AS APPLIED TO WELDED TUBES.

*COPPER ALLOYS + *FABRICATION METHODS + *HORIZONTAL TUBE EVAPORATORS + *TITANIUM +
*TUBING (METAL) + COMPONENT COSTS + ECONOMIC EVALUATIONS + METAL DRAWING + METAL ROLLING +
OSW SPONSORED + WELDING

30-01084  JOHNSSON KD
INDEX TO RESEARCH AND DEVELOPMENT PROGRESS REPORTS PUBLISHED BY THE OFFICE OF SALINE WATER
OAK RIDGE NATIONAL LABORATORY, TENN.
ORNL-TM-2348 (REV.1), DEC.1969, 72 P

INDEXED INDEX OF THE TITLES, AUTHORS, COMPANIES, AND NUMBERS OF THE APPROXIMATELY
475 RESEARCH AND DEVELOPMENT PROGRESS REPORTS ISSUED BY THE OFFICE OF SALINE WATER,
AID OF A COMPUTER AND IS PRESENTED IN THE FORM OF COMPUTER PRINTOUT.

*BIBLIOGRAPHIES + LITERATURE SURVEYS + OSW SPONSORED

30-01085  JOHNSSON KD
ABSTRACTS OF LITERATURE ON THE DISTILLATION OF SEAWATER AND ON THE USE OF NUCLEAR ENERGY FOR
DESALTING - I
OAK RIDGE NATIONAL LABORATORY, TENN.
ORNL-TM-2691 (NOV.1969), 216 P

ABSTRACTS ARE GIVEN FOR APPROXIMATELY 900 PUBLISHED ARTICLES RELATED TO THE
DESALINATION OF SEAWATER. THE BODY OF THE REPORT IS A COPY OF INFORMATION STORED IN A
COMPUTERIZED STORAGE AND RETRIEVAL SYSTEM ON DESALINATION AT THE OAK RIDGE NATIONAL
LABORATORY. THE ABSTRACTS ARE GROUPED IN NINE CATEGORIES. AUTHOR AND KEYWORD INDEXES
TO THE ARTICLES REFERENCED ARE PROVIDED. THE KEYWORDS, WHICH IDENTIFY THE CONTENT OF
THE ARTICLES, WERE CHOSEN FROM A THESAURUS DEVELOPED AT ORNL.

*BIBLIOGRAPHIES + AEC SPONSORED + OSW SPONSORED

30-01086  HICKMAN K + NAA JR + HARRIS PF + DAVIDHAZY A
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION
ROCHESTER INSTITUTE OF TECHNOLOGY, NEW YORK

OSW R+D PROGR. REPT. NO.392 (NOV.1969), 80 P, 56 FIG, 3 TABLES, 34 REF

THREE EXPERIMENTAL TECHNIQUES FOR INVESTIGATING THE TRANSPORT PROPERTIES OF LIQUID
SURFACES ARE DESCRIBED. THE JET TENSIO METER, A DEVICE FOR MEASURING THE CONDENSATION
AND EVAPORATION COEFFICIENTS OF LIQUIDS, CONSISTS OF A RECIRCULATING LOOP CONTAINING A
FREE JET REGION IN WHICH THE RECIRCULATING LIQUID IS EXPOSED FOR VERY SHORT INTERVALS
TO ITS OWN VAPOR AT EITHER HIGHER OR LOWER TEMPERATURES. THE CONTINUOUS BOULE MAKER
IS A DEVICE PRODUCING BOULES (DROPS OF A LIQUID SUSPENDED BY A THIN LAYER OF ITS
OWN SUPERHEATED VAPOR ABOVE A POOL OF THE SAME LIQUID). THE BOULE MAKERS ARE USED TO
STUDY THE SURFACE STRUCTURE OF PURE WATER AND OF WATERS CONTAINING TRACE IMPURITIES
AND 50 PPM OF BICARBONATE ION ADDED TO THE SEAWATER, (5) 1100, 3003, 5554 AND 6061
ALUMINUM CAN BE USED WITH PH CONTROL

*CONDENSING + *EVAPORATOR DYNAMICS + CONDENSATION PROMOTERS + CONDENSORS + DISTILLATION PROCESSES +
EVAPORATORS + FILM BOILING + HEAT TRANSFER + OSW SPONSORED + SURFACE BOILING + THERMODYNAMICS

30-01092  LEGAULT RA
SEA WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION
DOW CHEMICAL CO., FREEPORT, TEX.

OSW R+D PROGR. REPT. NO.438 (APR.1959), 115 P, 49 FIG, 29 TABLES, 26 REF

CORROSION TESTS IN HG (250 DEG F) SEA WATER INDICATE (1) 5052 ALUMINUM CAN BE USED.
DISSOLVED OXYGEN IS NOT DETRIMENTAL, (2) MILD STEEL CAN BE USED PROVIDED OXYGEN IS
EXCLUDED, (3) MILD STEEL CAN BE USED IN PRESENCE OF OXYGEN IF 50 PPM OF A BINARY
PHOSPHATE-CINHROMATE INHIBITOR IS ADDED. (4) 1100 ALUMINUM CAN BE USED WITH PH CONTROL
AND 50 PPM OF BICARBONATE ION ADDED TO THE SEAWATER, (5) 1100, 3003, 5554 AND 6061
ALUMINUM CAN BE USED WITH 100 PPM OF CHROMATE ION ADDED TO THE SEAWATER. DISSOLVED
OXYGEN DOES NOT NOTICIABLY AFFECT THE CORROSION OF ALUMINUM. THE CORROSION OF
ALUMINUM (PITTING) IS SENSITIVE TO THE PH OF THE SEAWATER. ALL TESTS WERE
GALVANICALLY ISOLATED. FURTHER STUDIES FOR LONGER TIME PERIODS UNDER DYNAMIC
CONDITIONS OF DESALINATION CONDITIONS ARE RECOMMENDED.

*ALUMINA ALLOYS + *CARBON STEELS + CARBON STEELS + CHEMICAL ADDITIVES + CHEMICAL CORROSION CONTROL +
CORROSION + CORROSION TESTS + DEAEATION + EXPERIMENTAL DATA +

ACCESSION NUMBER 30-01082 TO 30-01092
30-01092 CONTINUED
FABRICATION MATERIALS + HUMIDIFICATION PROCESSES + IMMERSION TESTS (CORROSION) + OSM SPONSORED + OXIDATION + PH CONTROL

30-01095 KOHL AL + SHIMAZAKI TT + WETCH JR + ELEVENFEU LL
DEVELOPMENT OF DIRECT CONTACT CONDENSATION MULTISTAGE FLASH (DCC-MSF) DISTILLATION PROCESS - PHASE I + FINAL REPORT
ATOMICS INTERNATIONAL, CANDOGA PARK, CALIF.

THE FEASIBILITY OF THE ATOMICS INTERNATIONAL DIRECT CONTACT CONDENSATION MULTISTAGE FLASH (DCC-MSF) DISTILLATION PROCESS WAS INVESTIGATED BY THE CONDUCT OF ANALYTICAL AND EXPERIMENTAL STUDIES ON A DIRECT CONTACT CONDENSATION MODULE AND A PLASTIC FILM HEAT EXCHANGER. THE STUDIES INDICATED THE PROCESS TO BE FEASIBLE. DIRECT CONTACT CONDENSATION OF STEAM ONTO THE SURFACE OF WATER FLOWING IN OPEN CHANNELS WAS ACCOMPLISHED WITH HEAT TRANSFER COEFFICIENTS GREATER THAN 2000 BTU/HR SQ FT (1) BY PROVIDING A HIGH CROSS FLOW STEAM VELOCITY TO DISTURB THE WATER SURFACE, AND (2) BY THE USE OF SIMPLE VANE TYPE TURBULENCE PROMOTERS IN THE WATER SYSTEM. LONG TERM STRENGTH, CREEP RATE, AND RESISTANCE TO HGT BRINE OF PVF FILMS WERE FOUND TO BE ABOVE THE REQUIREMENTS FOR HEAT EXCHANGERS. A PLASTIC FILM HEAT EXCHANGER WAS DESIGNED, FABRICATED, TESTED, AND OPERATED. NO OPERATIONAL PROBLEMS WERE ENCOUNTERED. A TECHNIQUE WAS DEvised FOR FABRICATING LAP WELDED, PLASTIC FILM TUBES.

*CONDENSING + DIRECT CONTACT HEAT EXCHANGE + HEAT EXCHANGERS + SYNTHETIC RESINS (PLASTICS) + MULTISTAGE FLASH DISTILLATION + OSM SPONSORED + TURBULENCE PROMOTERS

30-01108 FABUSS BM + BORSANYI AS + LU CH
INVESTIGATION OF CALCIUM SULFATE PRECIPITATION
MONSANTO RESEARCH CORP., EVERETT, MASS.
OSW R&D PROGR. REPT. NO.183 (MAY 1966), 40 P, 17 FIGS, 8 TABLES, 3 REF

AN INVESTIGATION OF THE PRECIPITATION OF CALCIUM SULFATE FROM DISTILLED WATER BY CONSTANT VOLUME HEATING AND CONSTANT TEMPERATURE EVAPORATION. THE CONCENTRATION OF CALCIUM SULFATE WAS FOLLOWED BY CONDUCTIVITY AND TITRATION. BREAK POINTS, IN THE CONDUCTIVITY RECORDS, WERE MATCHED WITH THE DEHYDRATION AND HEMIHYDRATE SOLUBILITY CURVES, AT OR BELOW 100 DEG C, SHIFITING TOWARD THE ANHYDRITE CURVE AS THE TEMPERATURE INCREASED, IN THE CONSTANT VOLUME HEATING EXPERIMENTS. IN THE CONSTANT TEMPERATURE EVAPORATION TESTS THE BREAK POINTS WERE Slightly PRECIPITATION OCCURRED AFTER THE BREAK POINT. PRECIPITATION WITH RESPECT TO ANHYDRITE WAS SLOW, AND SUBSTANTIAL PRECIPITATION OCCURRED ONLY WHEN THE HEMIHYDRATE CURVE WAS APPROACHED. INITIAL PRECIPITATION OCCURRED CLOSER TO THE ANHYDRITE CURVE AS THE TEMPERATURE INCREASED.

*PHYSICAL CHEMISTRY OF SCALE + FEEDWATER TREATMENT + OSM SPONSORED + SCALE PREVENTION + SCAVENGING

30-01109 SCALE CONTROL FOR SALINE WATER CONVERSION DISTILLATION PLANTS
BALDWIN-LIMA-HAMILTON CORP., PHILADELPHIA
OSW R&D PROGR. REPT. NO.183 (MAY 1966), 18 P, 23 FIG, 11 TABLES

TESTS WERE PERFORMED TO EVALUATE SIX SCALE CONTROL METHODS. FIVE WERE USED WITH A SIX-STAGE FLASH PLANT - (1) PROPRIETARY ANTI-SCALING COMPOUNDS, (2) CALCIUM CARBONATE SLUDGE RECOMBINATION, (3) CALCIUM SULFATE SLUDGE RECOMBINATION, (4) SULFATE-REACTED CALCIUM SULFATE SLUDGE RECOMBINATION, AND (5) PH CONTROL. THE SIXTH METHOD, PH CONTROL WITH HOT-END CALCIUM SULFATE SLUDGE ADDITION, WAS TESTED IN A LONG TUBE VERTICAL EVAPORATOR. METHOD (1) RESULTED IN SOFT DEPOSITS ON HEAT EXCHANGE SURFACES (2) 1.5 - 2.0 WEIGHT PERCENT CALCIUM CARBONATE AT SIX FEET PER SECOND VELOCITY PREVENTED LOSS IN HEAT TRANSFER UP TO 285 DEG F (3) NOT SUCCESSFUL (4) NOT SUCCESSFUL (5) LONG TERM OPERATION WITHOUT SCALE (6) OPERATED SUCCESSFULLY.

*FEEDWATER TREATMENT + SCALE PREVENTION + CHEMICAL ADDITIVES + MULTISTAGE FLASH DISTILLATION + OSM SPONSORED + SEEDING PROCESSES + VERTICAL TUBE EVAPORATORS

30-01110 AN INVESTIGATION OF THE SOLUBILITY OF CALCIUM SULFATE IN SEAWATER CONCENTRATES AT TEMPERATURES FROM AMBIENT TO 65 DEGREES C
AMERICAN MACHINE AND FOUNDARY CO., SPRINGDALE, CONN.
OSW R&D PROGR. REPT. NO.191 (MAY 1966), 77 P, 14 FIG, 6 TABLES, 12 REF

AN INVESTIGATION OF THE CRYSTALLIZATION OF SOLIDS FROM CONCENTRATED SEAWATER BRINES. CONCLUSIONS WERE (1) CALCIUM SULFATE DIHYDRATE PRECIPITATES AS DECARBONATED SEAWATER IS EVAPORATED AT 35-60 DEG C, (2) THE MOLAL SOLUBILITY PRODUCT OF DIHYDRATE IS 0.00151 AT 20 DEG C, 0.00164 AT 40 C, AND 0.00156 AT 60 C, (3) THE SOLUBILITY PRODUCT OF DIHYDRATE AT 40 DEG C IS 0.00164 IN NORMAL SEAWATER, 0.00342 IN 3X SEAWATER AND 0.000358 IN 6X SEAWATER, (4) IN 6X SEAWATER THE SOLUBILITY PRODUCT INCREASES WITH TEMPERATURE FROM 0.00358 AT 20 DEG C TO 0.00385 AT 40 DEG C AND TO 0.00441 AT 60 DEG C.

*PHYSICAL CHEMISTRY OF SCALE + FEEDWATER TREATMENT + OSM SPONSORED + SCALE PREVENTION + SCAVENGING

30-01110 DEVELOPMENT OF PRECIPITATION PROCESSES FOR REMOVAL OF SCALE FORMERS FROM SEAWATER
W. R. GRACE AND CO., CLARKSVILLE, MD.
OSW R&D PROGR. REPT. NO.192 (MAY 1966), 467 P, 148 TABLES, 94 FIG, 23 REF

SEAWATER SOFTENING PROCESSES EMBODYING THE REMOVAL OF SCALE FORMERS BY PRECIPITATION WITH PHOSPHATE-AMMONIA AND WITH LIME-MAGNESIUM-CARBONATE ARE DETAILED. EXPERIMENTAL WORK, BOTH LABORATORY AND PILOT PLANT SCALE, IS DISCUSSED. APPRAISALS OF BOTH PROCESSES, BOTH ECONOMIC AND OPERATIONAL ARE MADE. CAPITAL AND OPERATING COST ESTIMATES ARE PRESENTED. THE ECONOMICS OF THE PHOSPHATE-AMMONIA PROCESS REQUIRE SALE OF A HIGH QUALITY BY-PRODUCT FERTILIZER AT A 10 TO 20% PREMIUM. IN ADDITION ABOUT 200 PPM OF AMMONIA REMAIN IN THE PRODUCT WATER. THE LMC PROCESS HAD A PROJECTED OPERATING COST OF 9.9 CENTS/1000 GAL OF FRESH WATER WITH FURTHER DEVELOPMENT THE PROJECTED COST DROPPED TO 7.0 CENTS/1000 GAL.

*FEEDWATER TREATMENT + PRECIPITATION + REMOVAL FROM FEEDWATER; CALCIUM + SCALE PREVENTION + BY-PRODUCT ECONOMICS + CAPITALIZED COSTS + CHEMICAL BY-PRODUCTS + ECONOMIC EVALUATIONS + FEASIBILITY STUDY + FERTILIZER + OPERATING COSTS + OSM SPONSORED

ACCESSION NUMBER 30-01092 TO 30-01111
30-01112 RESEARCH AND DEVELOPMENT ON THE HORIZONTAL SPRAY FILM EVAPORATOR

AQUA-CHEM, INC., WAUKESHA, WIS.

OSW R&D PROGR. REPT. NO.299 (NOV.1964), 81 P, 28 FIG, 4 TABLES, 9 REF

- FRESH WATER AND SEAWATER HEAT TRANSFER EXPERIMENTS WERE CONDUCTED USING A HORIZONTAL SPRAY FILM EVAPORATOR. HEAT TRANSFER COEFFICIENTS OF 1125 BTU/HR-DEG-F-SQ FT WERE OBTAINED WITH COPPER-NICKEL TUBES, 5/8 IN. O.D., AND ZNOO BTU/HR-DEG-F-SQ FT WITH COPPER TUBES, 1/2 IN. O.D., THE COEFFICIENT WAS INDEPENDENT OF SUBMERSION. DROPWISE CONDENSATION PROMOTION USING MONTAN WAX INCREASED THE COEFFICIENT BY 20%.

- THE EVAPORATOR WAS FOUND SUITABLE FOR MULTISTAGE OPERATION AT SHELL TEMPERATURE LEVELS FROM 230 TO 80 DEG F. A VARIATION ANALYSIS OF THE VARIOUS OPERATING PARAMETERS IS PRESENTED.

*FILM EVAPORATION + *HEAT EXCHANGERS + CONDENSATION PROMOTERS + HEAT TRANSFER COEFFICIENT + HORIZONTAL TUBE EVAPORATORS + OSW SPONSORED + VAPOR COMPRESSION EVAPORATION

30-01113 STEEL CN CONDENSATION MECHANISMS

SIGMATRON INC.

OSW R&D PROGR. REPT. NO.251 (MAR.1967), 151 P, 62 FIG, 11 TABLES, 18 REF

- A STUDY OF THE EFFECTS OF VARYING THE STEAM, TUBING, SHELL, PUMP AND POWER, AND WATER TREATMENT AND SUPPLY COSTS ON A MSF PLANT DESIGN. LABOR AND FIXED CAPITAL COSTS, OTHER THAN THE ABOVE, WERE ESTIMATED AS 10 AND 6.5 CENTS/1000 GAL RESPECTIVELY AND WERE ASSUMED INVERSE WITH PLANT DESIGN. THE OPTIMIZATION CONSISTED OF CALCULATING WATER COST FOR A GIVEN SET OF INPUT COST DATA WHILE VARYING THE PLANT PARAMETERS UNTIL A MINIMUM WATER COST WAS OBTAINED.

- FOR CONVENIENCE, THE EFFECT OF VARIATIONS IN PAIRS OF THE UNIT COSTS, WHILE HOLDING THE OTHER THREE CONSTANT, WAS INVESTIGATED RATHER THAN ALLOWING ALL FIVE TO VARY INDEPENDENTLY. THE COMPUTER PROGRAM USED IS LISTED.

*CONDENSING + CONDENSERS + HEAT TRANSFER + OSW SPONSORED

30-01114 DEWINTER F + SADEK SE + REYNOLDS JM

PARAMETRIC COST STUDIES OF THE MULTISTAGE FLASH PROCESS

DYNATECH CORP., CAMBRIDGE, MASS.

OSW R&D PROGR. REPT. NO.251 (MAR.1967), 151 P, 62 FIG, 11 TABLES, 18 REF

- A STUDY OF THE EFFECTS OF VARYING THE STEAM, TUBING, SHELL, PUMP AND POWER, AND WATER TREATMENT AND SUPPLY COSTS ON A MSF PLANT DESIGN. LABOR AND FIXED CAPITAL COSTS, OTHER THAN THE ABOVE, WERE ESTIMATED AS 10 AND 6.5 CENTS/1000 GAL RESPECTIVELY AND WERE ASSUMED INVERSE WITH PLANT DESIGN. THE OPTIMIZATION CONSISTED OF CALCULATING WATER COST FOR A GIVEN SET OF INPUT COST DATA WHILE VARYING THE PLANT PARAMETERS UNTIL A MINIMUM WATER COST WAS OBTAINED.

- FOR CONVENIENCE, THE EFFECT OF VARIATIONS IN PAIRS OF THE UNIT COSTS, WHILE HOLDING THE OTHER THREE CONSTANT, WAS INVESTIGATED RATHER THAN ALLOWING ALL FIVE TO VARY INDEPENDENTLY. THE COMPUTER PROGRAM USED IS LISTED.

*COST BREAKDOWNS + *PARAMETRIC STUDIES + *PROGRAMS (COMPUTERS) + CONSTRUCTION COSTS + ECONOMIC EVALUATIONS + ENERGY COSTS + FIXED COSTS + MATHEMATICAL MODELS + MULTISTAGE FLASH DISTILLATION + OPERATING COSTS + OSW SPONSORED

30-01115 FIFTH ANNUAL REPORT, SALINE WATER CONVERSION DEMONSTRATION PLANT NO. 1, FREEPORT, TEXAS

STEARNS-ROGER MANUFACTURING CO., DENVER

OSW R&D PROGR. REPT. NO.289 (OCT.1957), 42 P, 9 FIG, 8 TABLES, 5 REF


- EVALUATION OF THE PROCESS, EQUIPMENT, CORROSION, MATERIAL OF CONSTRUCTION, ACTUAL CAPITAL AND OPERATING COSTS, PRODUCTION, ECONOMY RATIOS, COST AVERAGES AND MAINTENANCE PROBLEMS ARE INCLUDED. EVALUATION OF ADVANCED DESIGN EQUIPMENT AND HIGH ACCURACY INSTRUMENTATION IS MADE. FINDINGS PERTINENT TO THE DECISION FOR INCREASING THE TRAIN TO 17 EFFECTS ARE INCLUDED.

*FREEPORT PLANT + *OPERATING EXPERIENCE + COST BREAKDOWNS + ECONOMIC EVALUATIONS + INSTRUMENTATION + MAINTENANCE + OSW SPONSORED + VERTICAL TUBE EVAPORATORS

30-01116 ENNIS E + GELBLUM GP + PECHEINICK W

EVALUATION OF BRINE DESALTING PROCESS AS APPLIED TO DESALINATION, PHASE 1

CATALYTIC CONSTRUCTION CO., PHILADELPHIA

OSW R&D PROGR. REPT. NO.289 (OCT.1957), 42 P, 9 FIG, 8 TABLES, 5 REF

- A STUDY WAS MADE OF THE FEASIBILITY OF APPLYING THE BUREAU OF MINES SULFATE REMOVAL PROCESS TO THE DESALTING OF FEED SEA WATER. THE PROCESS CONSISTS OF PRECIPITATING THE SULFATE IN SEA WATER WITH AN ION EXCHANGE RESIN IN THE BARIUM FORM. THE BARIUM SULFATE IS RECOVERED, ROASTED WITH CARBON, AND LEACHED. THE LEACHANT IS USED TO REFORM THE RESIN. IY-PRODUCT SODIUM SULFIDES AND HYDROXIDES ARE RECOVERED AND SOLD AFTER CONVERSION TO SODA ASH, CAUSTIC SODA, AND SULFURIC ACID. AN ECONOMIC ANALYSIS OF THE PROCESS AS APPLIED TO A 50 MGD DESALTING PLANT INDICATES THAT THE DESULFATING PROCESS, WHEN INTEGRATED WITH THE DESALTING PLANT, WILL REDUCE OR EVEN ELIMINATE THE COST OF CONVERTING SEA WATER TO FRESH WATER.

*BY-PRODUCT MANUFACTURING PROCESSES + *ECONOMIC EVALUATIONS + *FEEDWATER TREATMENT + CHEMICAL BY-PRODUCTS + CHEMICAL PRODUCTION + ION EXCHANGING + OSW SPONSORED + REMOVAL FROM FEEDWATER, SULFATE + SCALE PREVENTION

30-01117 DEVELOPMENT REPORT NO. 5 - SALINE WATER CONVERSION DEMONSTRATION PLANT NO. 1, FREEPORT, TEXAS

STEARNS-ROGER CORP., DENVER

OSW R&D PROGR. REPT. NO.297 (SEPT.1957), 49 P, 15 TABLES, 5 FIG

- THE RESULTS OF DEVELOPMENT RUNS NO. 6 AND 7. RUN 6 CONFIRMED THAT PLANT PRODUCTIVITY WAS LIMITED BY PUMPING CAPACITY. RUN 7 SHOWED SCALE FREE OPERATION AT 280 DEG F (HEATING STEAM TEMPERATURE) USING 30%LESS EVAPORATOR SURFACE. AT THIS LEVEL, THE PLANTS POTENTIAL PRODUCTIVITY IS 1.52 MGD WITH A COST OF 90.8 CENTS/1000 GALL.

- THE ANHYDRITE SCALING LIMIT IN CLEAN FIRST-EFFECT TUBES WITH 3.52% TDS FEED WAS BETWEEN 292 AND 282 DEG F. AFTER INITIAL SCALING THE LIMIT IS LESS THAN 275 DEG F. ANHYDRITE SCALE REMOVAL WAS DIFFICULT. POLYPHOSPHATE PREVENTED GYPSUM SCALE DEPOSITION UP TO A BLOWDOWN CONCENTRATION OF 3.06 TIMES NORMAL SEA WATER.

ACCESSION NUMBER 30-01112 TO 30-01117
30-01117 CONTINUED
- FREEPORT PLANT + PILOT PLANT OPERATIONS + HEAT TRANSFER + OPERATING COSTS + OPERATING EXPERIENCE + OPERATIONAL PROBLEMS + OSM SPONSORED + SCALE REMOVAL + SCALING

30-01119 LU CH + FABUSS DM + KOROSI A + MIDDLETON TR + DEMINGO JP
BASIC STUDIES OF SCALE CONTROL
MONSANTO RESEARCH CORP., EVERETT, MASS.
OSW R&D PROGR. REPT. NO.461 (MAR.1969), 52 P, 15 TABLES, 17 FIG, 11 REF.
(1) THE SOLUBILITY OF CALCIUM SULFATE ANHYDRITE IN ROSWELL WATER WAS DETERMINED OVER
THE TEMPERATURE RANGE FROM 176 TO 235 DEG F AT CONCENTRATION FACTORS FROM 1 TO 4. THE
KINETIC DATA AND THE DISSOLUTION AND PRECIPITATION OF CALCIUM SULFATE WERE CORRELATED
BY RATE EQUATIONS FOR USE IN SCALE CONTROL. INDICATIONS WERE THAT SATURATION WAS
ATTAINED WITHIN ONE HALF HOUR. (2) LABORATORY TESTS WERE CONDUCTED ON THE SLURRY
SEEDING PROCESS FOR CONTROL OF CALCIUM SULFATE SCALE. THE MAIN RESULTS WERE (A)
CRYSTAL GROWTH WAS SLOW (B) OPERATING CONDITIONS WERE NOT AT EQUILIBRIUM (C) TOTAL
PRODUCTION OF CALCIUM SULFATE INCREASED WITH TEMPERATURE AND SEAWATER QUANTITY. THE
PRESENCE OF SEEDS IN A FLUIDIZED BED HEATER IMPROVED THE HEAT TRANSFER COEFFICIENT AND
REUCED SCALING.

30-01124 ELLIOTT MN
THE PRESENT STATE OF SCALE CONTROL IN SEA WATER EVAPORATORS
ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, ENGLAND
AERE-R-5820 (SEP,1969), 21 P, 1 TABLE, 7 FIG, 50 REF. ALSO PRESENTED AT EUROPEAN INST. CHEM.
ENGINEERING FLUSHING, MAY 1968
THE CONTROL OF SCALE IS IMPORTANT TO THE FURTHER DEVELOPMENT OF EVAPORATORS FOR THE
DESALEMINZATION OF SEAWATER. THE METHODS OF SCALE CONTROL USED AT PRESENT ARE DISCUSSED,
TOGETHER WITH ALTERNATIVES WHICH ARE UNDER STUDY OR HAVE BEEN PROPOSED. ASSUMING THAT
IMPROVED ADDITIVES CAN BE DEVELOPED, THE ADDITIVE TREATMENT IS MORE ATTRACTIVE THAN
ALTERNATIVE METHODS SUCH AS ION EXCHANGE OR PRECIPITATION WHICH SIGNIFICANTLY INCREASE
THE CAPITAL COST OF THE EVAPORATOR.

30-01127 ELLIS RD
SCALE ABATEMENT IN SALINE WATER DISTILLATION BY INJECTION OF CARBON DIOXIDE
ENGINEERING DEPT., UNIV. CALIF., LOS ANGELES
REPT. 69-61, UCLA ENG. DEPT. (OCT.1969), 113 P, 7 TABLES, 21 FIG, 39 REF. (SUMMARY IS GIVEN IN
REPT. 70-11 M.S. THESIS. TO DETERMINE THE EFFECT OF CARBON DIOXIDE ON THE RATE OF SCALE
DEPOSITION, A SMALL-SIZED HEATING LOOP WAS CONSTRUCTED. OVER AN OUTLET WATER
TEMPERATURE RANGE FROM 187 TO 247 DEG F, IT WAS POSSIBLE TO FORM MAGNESIUM HYDROXIDE SCALE
IN THE LOOP AFTER ONLY ONE HOUR OF OPERATION. INJECTION OF CARBON DIOXIDE INTO THE
FEED SEAWATER RESULTED IN THE FORMATION OF CARBONIC ACID, CAUSING AN IMMEDIATE
DECREASE IN PH. PRODUCTION OF HYDROGEN ION WAS APPROXIMATELY LINEARLY RELATED TO THE
ADDITION CONCENTRATION. CARBON DIOXIDE ADDED AT RATES FROM 10 TO 20 PPM WAS
SUFFICIENT TO CAUSE A DRAMATIC REDUCTION IN THE RATE OF SCALE GROWTH. ALKALINE SCALE
WAS COMPLETELY AVOIDED UP TO A TEMPERATURE OF 285 DEG F BY MAINTAINING THE FEED PH
BELOW 6.4 WITH THE INJECTION OF 64 PPM CARBON DIOXIDE. IN A SINGLE FLASH CHAMBER
PROVIDED AFTER THE HEAT EXCHANGER, BOTH THE HYDROXIDE AND A FRACTION OF THE SCALE
LIBERATED FROM CARBONATE BREAKDOWN WERE RAPIDLY EVOLVED.

30-01140 MULTISTAGE FLASH DISTILLATION DESALTING STATE-OF-THE-ART (1968)
HITTMAN ASSOCIATES, INC., COLUMBIA, MARYLAND
OSW R&D PROGR. REPT. NO.490 (OCT.1959), 138 P, 24 TABLES, 40 FIG, 48 REF.
MULTISTAGE FLASH EVAPORATION PLANTS CAN CURRENTLY BE BUILT WITH PERFORMANCE RATIOS IN
EXCESS OF 14. HOWEVER, STEAM ECONOMY, WHICH IS RELATED TO REDUCED OPERATING COSTS, IS
COUNTERACTED BY INCREASES IN THE PLANT CAPITAL COST. FOR MOST CURRENT APPLICATIONS,
PLANT PERFORMANCE RATIOS OF ABOUT 9-11 POUNDS PER 1000 BTU RESULT IN MINIMUM WATER
COST. THE EVAPORATOR TUBE BUNDLES AND SHELL COMPRSS THE MAJOR PORTION (APPROXIMATELY
40-60%) OF THE INSTALLED PLANT CAPITAL COST. CURRENTLY 0.75 INCH 90-10 CUNI TUBES AND
STEEL SHELLS ARE BEING SPECIFIED IN MOST MSF PLANT APPLICATIONS. TECHNOLOGY EMPLOYED
IN THE MSF PROCESS IS RELATIVELY MATURE WHEN COMPARED TO OTHER DESALTING PROCESSES.
MOST OF THE FUTURE REDUCIONS IN WATER COST FROM THIS PROCESS WILL COME FROM IMPROVEMENTS IN MATERIAL AND PROCESS DESIGN AS A RESULT OF INCREASED OPERATING AND
DESIGN EXPERIENCE.

30-01141 BROUGHTON DB
MULTIPLE EFFECT EVAPORATION PROCESS
UNIVERSAL OIL PRODUCTS CO., DES PLAINES, ILL.
ACCESSION NUMBER 30-01117 TO 30-01141
A BODY OF SALINE SOLUTION IS MAINTAINED AT ITS EVAPORATION TEMPERATURE IN CONTACT WITH AND SUPERIMPOSED UPON A BODY OF LIQUID HEAT TRANSFER MEDIUM WHICH IS INSOLUBLE IN THE SALINE SOLUTION BUT WHICH IS MAINTAINED AT AND CAPABLE OF VOLATILIZING AT THE EVAPORATION TEMPERATURE. SEVERAL HALOGENATED ORGANIC COMPOUNDS SUCH AS P-DICHLOROBENZENE AND PERCHLOROETHYLENE ARE SUITABLE HEAT EXCHANGE MEDIA. THE VAPORS OF THE WATER AND HEAT TRANSFER MEDIUM RISE INTO THE EVAPORATION ZONE AND ARE THEN REMOVED AND COMPRESSED, BUT NOT LIQUEFIED, TO AN EXTENT CORRESPONDING TO A CONDENSING TEMPERATURE DIFFERENCE OF ABOUT 10 DEG F ABOVE THE BOILING TEMPERATURE OF THE SALINE SOLUTION. THE COMPRESSED MIXED VAPORS ARE THEN SUBJECTED TO INDIRECT HEAT EXCHANGE WITH THE BODY OF LIQUID HEAT TRANSFER MEDIUM IN THE EVAPORATION ZONE TO CONDENSE LIQUID WATER AND LIQUID HEAT TRANSFER MEDIUM. SINCE THE LATTER TWO LIQUIDS ARE IMMISCIBLE, THEY CAN BE EASILY SEPARATED - THE WATER AS PRODUCT AND THE HEAT TRANSFER MEDIUM RETURNED TO THE MAIN BODY OF SALINE WATER IN THE EVAPORATION ZONE.

HIGH-PERFORMANCE SURFACES TO ILLUSTRATE THE RANGE OF OPTIONS IN SURFACE SHAPE AND THE MAGNITUDE OF POTENTIAL IMPROVEMENTS AVAILABLE TO THE DISTILLATION PLANT DESIGNER.

THE OVERALL HEAT TRANSFER COEFFICIENT BETWEEN CONDENSING STEAM AND WATER FLOWING IN A VERTICAL ALUMINUM TUBE WAS INCREASED TO VALUES 2.5 TO 4 TIMES THE VALUE FOR SMOOTH TUBES BY COMBINING RECTANGULAR FINS ON THE CONDENSING SIDE AND TWISTED TAPE INSERT ON THE FLOWING WATER SIDE. THE HEAT TRANSFER COEFFICIENT INCREASED WITH INCREASING WATER VELOCITY AND DECREASING HEAT FLUX. THE MAXIMUM HEAT TRANSFER COEFFICIENT WAS 5400 BTU/HR SQ FT DEG F (COMPARED WITH 1300 FOR THE SMOOTH TUBE) WHEN THE WATER VELOCITY WAS 20 FT/SEC AND THE HEAT FLUX WAS 20,000 BTU/HR SQ FT. THE OVERALL HEAT TRANSFER COEFFICIENT BETWEEN CONDENSING STEAM AND A THIN FILM OF EVAPORATING WATER WAS INCREASED TO VALUES 3 TO 10 TIMES THE VALUE FOR SMOOTH TUBES BY COMBINING RECTANGULAR FINS ON THE EVAPORATING AND CONDENSING SIDE. THE PERFORMANCE OF THE DOUBLE FINNED TUBE DECREASED WITH INCREASING HEAT FLUX. THE MAXIMUM VALUE OF THE HEAT TRANSFER COEFFICIENT, 5000 BTU/HR SQ FT DEG F, WAS OBSERVED AT A HEAT FLUX OF 10,000 BTU/HR SQ FT.

HIGH-PERFORMANCE HEAT TRANSFER SURFACES

THE FORCED HYGROMETRIC PROCESS CONSISTS OF VAPORIZATION OF SEAWATER IN THE PRESENCE OF HOT AIR. WATER SPRAYERS ARE USED TO FACILITATE THE SATURATION OF THE AIR (100% RELATIVE HUMIDITY) AT ESTABLISHED PRESSURE AND TEMPERATURE CONDITIONS. THE AIR STREAM SATURATED WITH WATER VAPOR IS THEN PUMPED TO THE CONDENSER WHERE ITS TEMPERATURE IS LOWERED TO THE DEW POINT AND THE EXCESS WATER VAPOR IS DEPOSITED IN THE DRIED WATER CONTAINER. BY MEANS OF A CLOSED AIR CIRCUIT AND OPTIMIZATION OF PRESSURE AND TEMPERATURE CONDITIONS, HIGHER SAVINGS AND LOWER COSTS MAY BE OBTAINED THAN WITH OTHER SYSTEMS. ADVANTAGES OF THE HYGROMETRIC PROCESS OVER THE MULTISTAGE FLASH PROCESS, THE MOST ECONOMICAL PROCESS PRESENTLY IN USE ARE - (1) IT OPERATES AT LOW PRESSURES, A LITTLE ABOVE 1 ATM, (2) NO CORROSION PROBLEMS ARE INVOLVED, AS THE SALT WATER DOES NOT FLOW THROUGH MOST OF THE CIRCUIT COMPONENTS, (3) NO PROBLEM OF SCALING ON EVAPORATOR WALLS IS PRESENT, AS THE SALT WATER IS AT LOW TEMPERATURE AND NO BOILER IS USED IN THE SYSTEM, (4) PUMPING POWER REQUIREMENTS ARE LOW, AND (5) FRESH WATER COSTS ARE LOW, EVEN WHEN SMALL REACTORS ARE USED.

DUAL-PURPOSE PLANT + *HUMIDIFICATION PROCESSES + *NUCLEAR ENERGY SOURCES + DUAL-PURPOSE PLANT ECONOMICS + ECONOMIC CONDITIONS + ECONOMIC EVALUATIONS + ENERGY SOURCES + NUCLEAR DESALINATION
CATEGORY 30 - SEAWATER DISTILLATION PROCESSES

30-01158 • CONTINUED


*CORROSION + FABRICATION MATERIALS + COPPER ALLOYS + DISTILLATION PROCESSES + PUMPS + REVIEWS

30-01159 SCHREIBER CF + OSBORN O + COLEY FH

CORROSION OF METALS IN DESALINATION ENVIRONMENTS

DOW CHEMICAL CO., FREEPORT, TEX. + OFFICE OF SALINE WATER, WASHINGTON

MATER. PROTECT. 7(10), 20-24 (1968), 9 FIG, 9 REF

THE PRELIMINARY RESULTS OF A LABORATORY INVESTIGATION OF THE CORROSION BY SEAWATER OF FIVE COPPER ALLOYS STUDIED AT THE OSW FREEPORT, TEX., TEST FACILITY. THE ALLOYS TESTED WERE PHOSPHOROUS DEOXIDIZED COPPER (ALLOY 122), IRON-MODIFIED 90/10 COPPER-NICKEL (ALLOY 706), IRON-MODIFIED 70/30 COPPER-NICKEL (ALLOY 715), ALUMINUM BRASS (ALLOY 687), AND ARSENIC-INHIBITED ADAMALTY (ALLOY 443). AT THIS STAGE OF THE STUDY SEVERAL POINTS MAY BE CONCLUDED (1) DISSOLVED OXYGEN CONCENTRATION HAS PROBABLY THE GREATEST SINGLE AND INTERACTIVE EFFECT ON COPPER ALLOY CORROSION IN HOT SEAWATER, (2) IN CONTRAST TO AERATED SEAWATER, VELOCITY IS NOT A MAJOR FACTOR IN DETERMINING CORROSION RATE WITH DEAERATED SEAWATER, (3) INCREASED RESIDENCE TIME IN A CIRCULATED SYSTEM DECREASES CORROSION RATE WHEN THE OXYGEN CONCENTRATION IS IN THE RANGE OF 20 TO 100 PARTS PER BILLION. AT LOWER OXYGEN LEVELS, INCREASED RESIDENCE TIME INCREASES CORROSION, (4) AT EXTREMELY LOW OXYGEN LEVELS (LESS THAN 5 PARTS PER BILLION) ALL THE COPPER ALLOYS, REGARDLESS OF COMPOSITION, HAVE LOW CORROSION RATES, AND (5) STEADY STATE CORROSION RATES (FOR LOW OXYGEN CONDITIONS) ARE ACHIEVED WITHIN THE FIRST FEW HOURS OF EXPOSURE.

*CORROSION + CORROSION TESTS + FABRICATION MATERIALS + ALUMINUM BRASSES + COPPER ALLOYS + DISTILLATION PROCESSES + EVAPORATORS + HEAT EXCHANGERS + NICKEL ALLOYS + OSW SPONSORED

30-01160 CASTLEBERRY JR

MATERIALS FOR DESALINATION EQUIPMENT TO BE STUDIED

MATER. PROTECT. 7(10), 17-19 (1968)


*CORROSION + FABRICATION MATERIALS + CORROSION TESTS + MULTISTAGE FLASH DISTILLATION + VERTICAL TUBE EVAPORATORS

ACCESSION NUMBER 30-01158 TO 30-01160
CATEGORY 50 - OVERALL PLANT STUDIES

50-00959  BRICE DB
DESLATING - STATE OF THE ART
CALIFORNIA DEPT. WATER RESOURCES, SACRAMENTO
BULLETIN NO. 134-69, DEPT. WATER RESOURCES, STATE OF CALIFORNIA (JUNE 1969), 56 P, 30 FIG, 3 TABLES, 30 REF


*DISTILLATION PROCESSES + *NUCLEAR DESALINATION + *REVIEWS + DUAL-PURPOSE PLANT ECONOMICS + ENERGY SOURCES + FLOWSHEETS + METROPOLITAN WATER DISTRICT + MULTISTAGE FLASH DISTILLATION + NUCLEAR ENERGY SOURCES + SINGLE-PURPOSE PLANT ECONOMICS + SOUTHWEST UNITED STATES + SYSTEM DESCRIPTIONS + WATER COSTS ESTIMATE + WATER SOURCES + WATER UTILIZATION

50-01106  FIRST UNITED NATIONS DESALINATION PLANT OPERATION SURVEY
UNITED NATIONS, N.Y.
ST/EGA/112 (1969), (UN SALES NO. E.69.II.B.17), 122 P, 70 TABLES

THE SURVEY INCLUDES ALL PLANTS ENGAGED IN COMMERCIAL PRODUCTION FOR WHICH IT WAS POSSIBLE TO OBTAIN RECORDS OF OPERATION THROUGHOUT 1965. PLANTS WITH A CAPACITY OF LESS THAN 10,000 GPD, SPECIALIZED FEED-WATER PLANTS, AND EXPERIMENTAL PLANTS WERE EXCLUDED. EIGHTY-SEVEN PLANTS IN 21 COUNTRIES WERE SURVEYED, DATA WERE OBTAINED ON THE MLT, LTE, SUBMERGED-TUBE, AND VC DISTILLATION PROCESSES AND THE ELECTRODIALLYSIS PROCESS. THE TOTAL PRODUCIVE CAPACITY OF THESE PLANTS IS 24,994,000 GPD. MSF PLANTS ACCOUNT FOR MORE THAN TWO-THIRDS OF THE TOTAL PRODUCTION CAPACITY OF PLANTS OF ALL SIZES-BUILT SINCE COST RATION WAS COMPLETED. TABLES ARE GIVEN COVERING THE ECONOMIC ANALYSIS, TECHNOLOGY, OPERATION, AND PRODUCTION AND STORAGE CAPACITIES FOR EACH OF THE PLANTS.

*DISTILLATION PROCESSES + *ELECTRODIALLYSIS PROCESS + *OPERATING COSTS + *WATER COSTS ACTUAL + COST BREAKDOWNS + ECONOMIC EVALUATIONS + OPERATING EXPERIENCE + REVIEWS

ACCESSION NUMBER 50-00959 TO 50-01106
ENVIRONMENTAL IMPACT OF BRINE EFFLUENTS ON GULF OF CALIFORNIA

UNIVERSITY OF ARIZONA, TUCSON


AN EXTENSIVE REVIEW OF ALL AVAILABLE DATA AND INFORMATION ON THE NORTHERN GULF OF CALIFORNIA IS PRESENTED. SECTIONS INCLUDE GEOGRAPHY, GEOLOGY, METEOROLOGY, OCEANOGRAPHIC TEMPERATURE, SALINITY AND OXYGEN, TIDES, CURRENTS, WAVE ACTION, BATHYMETRY, SEDIMENTATION, RIVER FLOW, TURBIDITY, BIOLOGICAL FEATURES AND COMMERCIAL FISHERIES. PROBABLE EFFECTS OF THE EFFLUENT FROM A LARGE NUCLEAR DESALINATION AND POLLUTION PLANT ARE CONSIDERED. HOWEVER, LACK OF SUFFICIENT INFORMATION ON THE PROBABLE DISTRIBUTION AND MIXING OF THE BRINE EFFLUENT LEADS TO UNCERTAIN RESULTS. RECOMMENDATIONS FOR FURTHER STUDY ON METEOROLOGY, GEOLOGY, OCEANOGRAPHY, AND EFFLUENT DISCHARGE ARE MADE.

*ECOLOGY + OCEANOGRAPHY + SITING SURVEYS + WASTE DISPOSAL + WATER BIOLOGY + CLIMATOLOGY + GEOGRAPHY + GEOLGY + LITERATURE SURVEYS + MAPS + METEOROLOGY + MIXING + OSW SPONSORED + OXYGEN ANALYSIS + POLLUTION + SITE SELECTION CRITERIA + SOUTHWEST UNITED STATES

DISPOSAL OF THE EFFLUENTS FROM DESALINATION PLANTS INTO ESTUARINE WATERS

DOW CHEMICAL CO., MIDLAND, MICH.

OSW R&D Progr. Rept. No. 415 (Mar. 1969), 140 P, 10 TABLES, 14 Fig, 177 REF

THIS STUDY (1) EVALUATES THE QUANTITIES AND CHARACTERISTICS OF EFFLUENTS FROM DESALINATION PLANTS, (2) EVALUATES INCREMENTAL CHANGES IN ESTUARINE ENVIRONMENTS DUE TO EFFLUENTS, (3) DESCRIBES THE BIOLOGICAL EFFECTS OF THESE WASTES ON ESTUARIES AND IDENTIFIES LIMITING FACTORS, (4) IDENTIFIES ASPECTS OF EFHFULMENT RESEARCH AND DEVELOPMENT NEEDS, (5) DESCRIBES CASE STUDIES, (6) DESCRIBES METHODS OF PREVENTION OF EFFLUENTS BY DESALINATION PLANTS, EQUATIONS ARE DEVELOPED FOR MIXING AND DIFFUSION OF EFFLUENTS, EFFECTS DUE TO TEMPERATURE, SALINITY, TURBIDITY, REDUCTION OF DISSOLVED OXYGEN, ALKALINITY, COPPER AND PHOSPHORUS ARE DISCUSSED.

*POLUTION + WASTE DISPOSAL + WATER BIOLOGY + COPPER + DIFFUSION + DISTILLATION PROCESSES + OCEANOGRAPHY + FREEZE PROCESSES + MEMBRANE PROCESSES + OXYGEN ANALYSIS + PH CONTROL + POINT LOMA PLANT + SALINE CONTRACTION

THE FEASIBILITY OF DEEP-WELL INJECTION OF BRINE FROM INLAND DESALTING PLANTS

OAK RIDGE NATIONAL LABORATORY, TENN.

OSW R&D Progr. Rept. No. 432 (Mar. 1969), 76 P, 7 FIG, 9 TABLES, 144 REF

A REVIEW OF DEEP-WELL INJECTION OF BRINE EFFLUENTS TO BE TECHNICALLY FEASIBLE WITH PROPER PRETREATMENT. THE BRINE MUST BE FREE OF SUSPENDED SOLIDS AND CHEMICALLY STABLE SO THAT PRECIPITATES WILL NOT PLUG THE WELL. TREATMENT TO PREVENT POLLUTION OF NEIGHBORING POTABLE WATER. DETAILED GEOLOGIC AND HYDROLOGIC INVESTIGATIONS ARE REQUIRED OF INDIVIDUAL SITES. DETAILS OF EXISTING WELLS, GEOLOGY AND TREATMENT ARE GIVEN WITH AN ECONOMIC ANALYSIS AND RECOMMENDATIONS.

*WASTE DISPOSAL + CHEMICAL ADDITIVES + CLARIFICATION + ECONOMIC EVALUATIONS + INLAND SITING + LITERATURE SURVEYS + OSW SPONSORED + OXYGEN ANALYSIS + PH CONTROL + POINT LOMA PLANT + SALINE CONTRACTION

DISPOSAL OF BRINE EFFLUENTS FROM INLAND DESALTING PLANTS - REVIEW AND BIBLIOGRAPHY

BUREAU OF RECLAMATION, DENVER

OSW R&D Progr. Rept. No. 454 (July 1969), 211 P, 870 REF

PART 1 OF AN 8-PART PROGRAM ON SURFACE FACILITIES FOR DISPOSAL OF DESALTING PLANT EFFLUENTS. METHODS MENTIONED ARE: (1) PREPARING A STATE-OF-THE-ART BIBLIOGRAPHY AND A REVIEW, (2) TEST SOIL SAMPLES FROM A PROPOSED BRINE EVAPORATION POND SITE, (3) LABORATORY TESTS ON POND LINING MATERIALS AND SOIL SEALANTS, (4) DEVELOP A MONITORING SYSTEM FOR SEEPAGE LOSS MEASUREMENT, (5) DEVELOP TECHNIQUES FOR INCREASING EVAPORATION RATES, (6) CONDUCT FIELD TESTS OF POND LININGS AND DEVELOP OPTIMUM APPLICATION METHODS, (7) PREPARE A MANUAL ON SURFACE FACILITIES FOR DISPOSAL OF DESALTING PLANT EFFLUENTS, AND (8) CONDUCT AN ECONOMIC STUDY OF SALT DISPOSAL. THE TECHNICAL LITERATURE WAS REVIEWED FOR INFORMATION ON ALL PARTS OF THE PROGRAM. A SURVEY OF 50 STATES AND THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION ON WATER POLLUTION REGULATIONS PERTAINING TO SURFACE FACILITIES FOR DISPOSAL OF DESALTING PLANT EFFLUENTS IS APPENDED TO THE REVIEW. REFERENCES ARE INDEXED AND CROSS-REFERENCED ACCORDING TO 18 SUBJECT AREAS.

*BIBLIOGRAPHIES + WASTE DISPOSAL + CHEMICAL PRODUCTION + LITERATURE SURVEYS + OSW SPONSORED + POLLUTION + SURFACE FACILITIES + SOIL STRUCTURE + WASTES

ECONOMIC VALUE OF ENGINEERED SAFETY FEATURES IN SITING OF DUAL-PURPOSE DESALTING PLANTS

OAK RIDGE NATIONAL LABORATORY, TENN.


CONSTRUCTION OF LARGE DUAL-PURPOSE NUCLEAR DESALTING PLANTS WILL REQUIRE LARGE SITING DISTANCES OR EXTENSIVE USE OF ENGINEERED SAFETY FEATURES AT INCREASED CAPITAL COST TO REDUCE SITING DISTANCES. ECONOMICAL SITING OF NUCLEAR POWER DESALTING PLANTS THUS INVOLVES A BALANCE BETWEEN COSTS FOR SITING AND CONVEYING PRODUCTS TO LOAD CENTERS AND THE COSTS OF PROVIDING SUFFICIENT ENGINEERED SAFETY FEATURES TO REDUCE SITING DISTANCES FROM PRODUCT LOAD CENTERS. THIS REPORT COVERS A STUDY OF THE EFFECTIVENESS OF ENGINEERED SAFETY FEATURES IN REDUCING SITING DISTANCES, THE COST OF SITE ACQUISITION AND THE COST OF CONVEYING AND TRANSMITTING PRODUCT WATER AND ELECTRICITY IN VARIOUS QUANTITIES AS A FUNCTION OF DISTANCE, AND INVESTIGATION OF SEVERAL EXAMPLES BETWEEN ENGINEERED SAFETY FEATURES AND SITING COSTS.

*DUAL-PURPOSE PLANT + ENGINEERED SAFEGUARDS + NUCLEAR ENERGY SOURCES + REACTOR SITING + BOILING-WATER REACTORS + ECONOMIC EVALUATIONS + ENERGY SOURCES + EXCLUSION ZONES

ACCESSION NUMBER 60-01076 TO 60-01126
CATEGORY 60 - SITING CONSIDERATIONS

60-01126  *CONTINUED*
HIGH-TEMPERATURE GAS-COoled REACTORS + INLAND SITING + LIQUID-METAL FAST-BREEDER REACTORS +
MAXIMUM CREDIBLE ACCIDENT + NUCLEAR SAFETY PROBLEMS + OFFSHORE ISLAND SITING +
POWER TRANSMISSION COSTS + REAL ESTATE COSTS + SITE SELECTION CRITERIA + WATER CONVEYANCE COSTS +
3000 PLUS MW(i) REACTORS

60-01129  JASKE RT + KARR MH + TCHIILL C J
MULTIPLE PURPOSE USE OF THERMAL CONDENSER DISCHARGES FROM LARGE NUCLEAR SYSTEMS TO SUPPLEMENT
INTER-REGIONAL WATER SUPPLY
BMI-PACIFIC NORTHWEST LABORATORY, RICHLAND, WASH.
BNWL-SA-2738 (FEB.1970), 17 P., 3 TABLES, 2 FIG., 7 REF. PRESENTED AT A.I.C.H.E. MEETING, ATLANTA,
FEB.1970
A SOLUTION TO THE DILEMMA OF RISING NUCLEAR STATION COSTS, INCREASING OPPORTION TO
HYDRO DEVELOPMENT WHICH FLOODS USEFUL LAND AND CAUSES UNMANAGEABLE WATER FLOW
FLUCTUATIONS WOULD BE THE CREATION OF A SYSTEM OF CANALS OF RELATIVELY LARGE SIZE - UP
TO 10,000 CFS - WHICH WOULD BE USED AS ELONGATED COOLING PONDS FOR THE DISSIPATION OF
CONDENSER HEAT OF LARGE NUCLEP-XYPE STATIONS.
* THERMAL POLLUTION + COOLING TOWERS + POLLUTION + SITE SELECTION CRITERIA

60-01130  JASKE RT + FLETCHER JF + WISE KR
A NATIONAL ESTIMATE OF PUBLIC AND INDUSTRIAL HEAT REJECTION REQUIREMENTS BY DECADES THROUGH THE
YEAR 2000 AD
BMI-PACIFIC NORTHWEST LABORATORY, RICHLAND, WASH.
BNWL-SA-3052 (FEB.1970), 23 P., 3 TABLES, 9 FIG., 10 REF. PRESENTED AT A.I.C.H.E. MEETING, ATLANTA,
FEB.1970
A NATIONAL APPRAISAL OF THE IMPACT OF HEAT REJECTION REQUIREMENTS FOR REGIONAL STUDIES OF THE
ECONOMIC PROCESSES THAT WILL GOVERN THE TYPE AND LOCATION OF INDUSTRIAL DEVELOPMENT,
THE REPORT GIVES ESTIMATES OF REGIONAL HEAT REJECTION REQUIREMENTS AND EMPHASIZES THE
MAJOR SOURCES OF HEAT, SUCH AS ELECTRIC POWER, TRANSPORTATION, AND CONVERSION
INDUSTRIES. THE PROJECTED RATES OF GROWTH SHOW THAT BY THE YEAR 2000 THE U.S. WILL
REJECT HEAT AT 3 TIMES THE PRESENT RATE. IN SOME AREAS, SUCH AS BETWEEN BOSTON AND
WASHINGTON, THIS WILL AMOUNT TO 15 TO 50% OF THE SOLAR ENERGY INCIDENT ON THE AREA.
* THERMAL POLLUTION + DEMOGRAPHY + FEASIBILITY STUDY + POLLUTION + SITE SELECTION CRITERIA

ACCESSION NUMBER 60-01126 TO 60-01130
Nuclear Energy Centers - The Problems of Implementation
Oak Ridge National Laboratory, Tenn.

This analysis of the implementation of large nuclear-powered agro-industrial complexes in developing regions of the world attempts to identify those potential problem areas which could jeopardize the success of the project if not given sufficient attention during the planning, construction, or operating phases of the project. These areas include political, economic, institutional, sociological, and technical.

Most of the thoughts presented were obtained from studies of large projects undertaken in various parts of the world and were gained both from the literature and from personal interviews with the participants in these endeavors. The content of this discussion is based on reality of experience rather than pure speculation. No amount of technical feasibility will ensure the success of an agro-industrial complex unless and until the problems of implementation have been met and solved. This was true in the past concerning development projects, and even more true today, and can be expected to be increasingly true in the future. Recommendations are made to initiate studies on marketing and pricing particularly in connection with a study for a particular site. The ability to consider specifics rather than generalities would aid understanding and should also provide a model for possible reference where other sites are considered.

Agriculture + *Agro-industrial complexes + *Regional planning + AEC sponsored + Demography + Feasibility study + Site selection criteria + Water utilization

Generalized capital and operating costs for power-intensive and allied industries
Oak Ridge National Laboratory, Tenn.
ORNL-4296, ORNL-4297 (Oct. 1969), 71 p., 37 tables

This report supplements Chap. 5 of ORNL-4290, Nuclear Energy Centers - Industrial and Agro-industrial complexes, by providing the reader with sufficient information to duplicate the cost results given in Chap. 5 and to make additional independent cost studies on the 17 chemical and metallurgical products considered. The report includes (1) all of the equations and constants used in determining the various building block manufacturing cost components, (2) a brief description of the computer program with the data sheets, and (3) a set of data tables for easily and quickly obtaining component costs at all of the reference values of all parameters used in the studies. A number of worked examples are given at the end of the report to illustrate use of these data, first for industrial building block cost determinations and then for both United States and non-Unites States industrial complexes.

*Agro-industrial complexes + *Capitalized costs + *Regional planning + AEC sponsored + Chemical production + Cost breakdowns + Investment (Fixed) + Multipurpose plant + Operating costs + Programs (computers)

An experimental agricultural station for demonstration purposes in combination with a desalting facility
Centre d Etudes Nucléaires de Grenoble, France

If an agro-industrial complex is to be economic, the high cost of water must be offset by a maximum yield of agricultural products. Since it is not easy to obtain the maximum yield in agriculture without considering local agronomic and human factors, it is suggested that, before embarking on ambitious projects in countries of limited resources, an experimental station be established alongside multipurpose desalting facilities. The station with a staff of 10 research workers and the necessary technical personnel at about 4 hectares should have the functions (1) adaptation of known agronomic data to local conditions, (2) selection of appropriate crops and market research to determine the best production conditions, (3) commercial calculations on the basis of actual yield at the site, and (4) training of specialized local personnel to relieve the initial staff. The layout of such a station is described with an outline balance sheet and program of work. The economic development potential of a facility of this type is discussed. (In French)

*Agriculture + *Agro-industrial complexes + Agronomy + Design + Economic conditions + Layout + Multipurpose plant + Water costs estimate

Production of potable water and sea salt
Chem. Process Eng., 49(6), 59-60 (1968), 6 fig., 3 tables

A plant built in Kuwait for the production of water and common salt is described. The brine discharge from a water distillation plant is fed into a 3-stage vacuum evaporator plant. Gypsum crystallizes in the first two stages and sodium chloride in the third. A separator between stages 2 and 3 separates the gypsum from the brine. To prevent scaling in the first two evaporators, gypsum crystals are recycled to the feed solution. The salt crystals from the third evaporator are centrifuged, dried, classified, treated with magnesium carbonate, and boxed. The distillate from the evaporators is combined with the potable water from the water plant.

*By-product manufacturing processes + By-product economics + Chemical by-products + Distillation processes + Evaporators + Kuwait + Scale prevention + Seeding processes

Economic impact of nuclear power and desalination in developing countries
Bhabha Atomic Research Centre, Bombay
A report reviews methods of recovery of chemicals from desalting plant effluents, and indicates areas of research relevant to the economical recovery of valuable materials from sea or brackish water brines. In determining which chemicals can be recovered profitably, a number of factors need to be considered, such as the abundance of the chemicals in the brine, technical feasibility of the recovery process, and the market supply and demand. It is shown that (1) six elements, or five compounds - sodium, chlorine, sodium sulfate, magnesium, and potassium chloride - represent approximately 90% of the total mineral value to be found in seawater, and (2) a mineral recovery process must include at least one of these substances (or a closely related substitute, such as potassium sulfate in place of potassium chloride) to be economically important to a saline-water conversion process. The value of the major constituents of a 3 to 1 brine effluent from a 10 MGD desalination plant is estimated to be about $14,000,000. The value of water from the plant (at 40,50 per 1000 gal) is $1,650,000. Hence, the major industrial opportunities in seawater conversion from a large plant will arise from the recovery and sale of chemical products, not water.

Recent developments in ORNL's agro-industrial complex studies have emphasized the importance of incorporating the many site factors, such as rainfall and nearness to industrial raw materials, in determining the cost and benefit characteristics of such complexes.

An analysis has given the comparative importance of fuel costs, capital costs and other components of energy and water costs. The effect of such parameters as plant size, interest rate, cost escalation, and level of technology is presented. Those areas which offer most for reducing water cost are discussed, including the advantages of scale and of improved technology. The influence of cost escalation and of higher interest rates on desalting projects is compared to their influence on the cost of alternative water sources. Surface water developments, which are most capital intensive and have the longest construction time, are hurt most by rising money costs. Groundwater projects, which generally have low capital cost and short construction time, are least affected.

Recent studies of possible coastal desert locales have emphasized the importance of incorporating the many site factors, such as rainfall and nearness to industrial raw materials, in determining the cost and benefit characteristics of such complexes.
CATEGORY 70 - INDUSTRIAL APPLICATIONS

70-01164 *CONTINUED* DESALTING PROJECTS ARE INTERMEDIATE. THE ADVANTAGES AND DISADVANTAGES OF DUAL-PURPOSE PLANTS ARE DISCUSSED AND A DESCRIPTION IS GIVEN OF PRESENTLY FEASIBLE ROUTES TO WATER-ONLY PLANTS. THESE INCLUDE THE VAPOR COMPRESSION PROCESS AND HIGH TEMPERATURE EVAPORATORS. FOR WIDELY USEFUL, LOW-COST DESALTING PLANTS TO BE AVAILABLE, SUCCESS MUST BE ACHIEVED IN SCALING UP PLANT SIZE AND ALSO IN IMPROVING AREAS OF TECHNOLOGY. THE STATUS OF DEVELOPMENTS ALONG THESE LINES IS DISCUSSED.

*AGRO-INDUSTRIAL COMPLEXES + COST BREAKDOWNS + ENERGY COSTS + NUCLEAR DESALINATION + AEC SPONSORED + DUAL-PURPOSE PLANT + NUCLEAR ENERGY SOURCES + OWS SPONSORED + SINGLE PURPOSE PLANT + WATER COSTS ESTIMATE

70-01165 YEE WC
INDUSTRIAL COMPLEXES BASED ON NUCLEAR DESALTING WASTE BRINES
OAK RIDGE NATIONAL LABORATORY, TENN.
WASTE BRINES DISCHARGED FROM DUAL-PURPOSE NUCLEAR DESALINATION PLANTS CAN FORM THE BASIS FOR AN INDUSTRIAL COMPLEX. LOCATION OF SUCH PLANTS IN ARID COASTAL DESERT AREAS IMPLIES AN ABUNDANCE OF SOLAR ENERGY WHICH CAN BE USED TO SEQUENTIALLY SEPARATE OUT PRIMARY PRODUCTS SUCH AS GYPSUM, SOLAR SALT, POTASH AND MAGNESIUM CHLORIDE BY FRACTIONAL CRYSTALLIZATION. SECONDARY PRODUCT PRODUCTION INVOLVES USING ELECTRICAL AND STEAM ENERGY FROM THE DUAL-PURPOSE PLANT TO OBTAIN SULFURIC ACID AND CEMENT FROM GYPSUM, CAUSTIC SODA AND CHLORINE FROM SOLAR SALT, AND MAGNESIUM METAL FROM MAGNESIUM CHLORIDE. INTERNALLY, CAUSTIC SODA AND CHLORINE (AS HYDROCHLORIC ACID) CAN BE USED TO REMOVE BICARBONATE ION FROM SEAWATER PRIOR TO FRESH-WATER PRODUCTION. CAUSTIC SODA AND CHLORINE ARE ALSO THE BASIC CHEMICALS FOR A WHOLE ARRAY OF TERTIARY PRODUCTS SUCH AS PULP AND RAYON FROM GRAIN WASTES OF A NUCLEAR-POWERED AGRO-INDUSTRIAL COMPLEX, AND PVC PLASTICS AND CHLORINATED HYDROCARBONS WHEN A SOURCE OF PETROLEUM IS AVAILABLE. THE ECONOMICS OF EACH PROCESS BUILDING BLOCK ARE DISCUSSED IN THE ORDER OF THEIR SENSITIVITY TO THE COST OF ELECTRIC POWER. THIS IS FOLLOWED BY SEVERAL ILLUSTRATIONS OF COMPLEXES BASED ON THESE BUILDING BLOCKS.

*AGRO-INDUSTRIAL COMPLEXES + BY-PRODUCT MANUFACTURING PROCESSES + DUAL-PURPOSE PLANT + NUCLEAR DESALINATION + AEC SPONSORED + BY-PRODUCT ECONOMICS + CHEMICAL BY-PRODUCTS + CHEMICAL PRODUCTION + SOLAR ENERGY SOURCES + WASTE DISPOSAL

70-01166 KROCMKJE R + HOLMES JK + MICHEL JW
THE ROLE OF ELECTRICITY-INTENSIVE INDUSTRIES IN THE ECONOMICS OF NUCLEAR POWER
OAK RIDGE NATIONAL LABORATORY, TENN.
NUCLEAR POWER REACTORS ARE STRONGLY DEPENDENT ON BASE LOAD OPERATION FOR PRODUCTION OF CHEAP ELECTRICITY. AS THE ROLE OF NUCLEAR POWER IN NATIONAL ENERGY PRODUCTION INCREASES, IT BECOMES MORE DIFFICULT TO MAINTAIN HIGH LOAD FACTORS ON INDIVIDUAL REACTORS WITH THE WIDE VARIABILITY OF ELECTRICITY DEMANDS. ELECTRICITY-INTENSIVE INDUSTRIES NEAR POWER GENERATING CENTERS MIGHT BE UTILIZED EITHER AS VARIABLE LOAD LOADS OR AS INSTANT LOAD-SHEDDING DEVICES TO SMOOTH OUT ELECTRICITY DEMAND AND ENABLE EFFICIENT UTILIZATION OF CAPITAL-INTENSIVE GENERATING FACILITIES. THE POSSIBLE ROLE ELECTROLYTIC HYDROGEN PRODUCTION MIGHT PLAY IS EXAMINED IN DETAIL BY COMPARING TOTAL ANNUAL COSTS OF A NUCLEAR POWER STATION AND ELECTROLYTIC AMMONIA PLANT WITH THE SAME POWER STATION OPERATING AT A LOWER LOAD FACTOR. BOTH STATIONS PRODUCE THE SAME AMOUNT OF FIRM POWER FOR A HYPOTHETICAL GRID SYSTEM. FOR A 1000-ME NUCLEAR POWER STATION AND A 300-TON/DAY AMMONIA PLANT A CREDIT OF $3/TON FOR OXYGEN AND $48/TON FOR AMMONIA ENABLES THE LOAD-LEVELING PLANT TO PRODUCE POWER FOR THE SAME TOTAL ANNUAL COSTS AS THE POWER PLANT ALONE OPERATING AT A LOAD FACTOR OF 79%. ADAPTABILITY OF OTHER ELECTRICITY-INTENSIVE INDUSTRIAL PROCESSES SUCH AS CHLORINE-CAUSTIC, ALUMINUM, MAGNESIUM METAL, ARC PRODUCTION OF ACETYLENE, ELECTRIC IRON, AND ELEMENTAL PHOSPHORUS AS LOAD-LEVELING DEVICES IS BRIEFLY DISCUSSED. A POTENTIAL NEAR TERM APPLICATION OF WATER ELECTROLYSIS AS A LOAD-LEVELING DEVICE IN INDIA IS ALSO PRESENTED.

*AGRO-INDUSTRIAL COMPLEXES + CHEMICAL PRODUCTION + MULTIPURPOSE PLANT + MULTIPURPOSE PLANT ECONOMICS + AEC SPONSORED + BASE-LOAD + CHEMICAL BY-PRODUCTS + INDIA + NUCLEAR ENERGY SOURCES

ACCESSION NUMBER 70-01164 TO 70-01166
CATEGORY 80 - WATER UTILIZATION

80-01083 BURLEY MJ & CLARKE JC
THE USE OF DESALINATION IN CONJUNCTION WITH CONVENTIONAL WATER SUPPLIES
WATER RESEARCH ASSOC., MEDENHAM, ENGLAND, AND U.K. ATOMIC ENERGY AUTHORITY, RISLEY, ENGLAND

THE USE OF DESALINATION PLANT IN CONJUNCTION WITH CONVENTIONAL FRESH-WATER RESOURCES IS REPORTED. THE INFREQUENT OPERATION OF DESALINATION IS USED TO MAINTAIN THE RELIABILITY OF A CONVENTIONAL WATER RESOURCE WHILE EFFECTIVELY INCREASING THE YIELD OF CONVENTIONAL WATER SUPPLY. BY THE PRODUCTION OF VERY EXPENSIVE DESALTED WATER IN DROUGHT PERIODS ONLY, AN ADDITIONAL QUANTITY OF ALMOST FREE WATER CAN BE TAKEN FROM AN IMPounding RESERVOIR FOR THE REMAINDER OF THE TIME. THE OVERALL EFFECT IS TO PROVIDE THE INCREASED SUPPLY AT COSTS SOMETIMES AS LOW AS 50% OF THOSE ASSOCIATED WITH BASE-LOAD DESALINATION. COMPUTER ANALYSIS OF HYDROLOGICAL DATA HAS BEEN USED TO DEVELOP EFFICIENT OPERATING RULES FOR THE DESALINATION PLANT. A NUMBER OF EXISTING RESERVOIRS ARE CONSIDERED, AS ARE SEVERAL TYPES OF DESALINATION. BOTH SINGLE- AND DUAL-PURPOSE DISTILLATION AND ELECTRODIALYSIS ARE STUDIED FOR SUCH APPLICATIONS AND THE PARTICULAR CASE OF SUMMER-ONLY USAGE OF STEAM FROM DUAL-PURPOSE PLANT FOR DISTILLATION PURPOSES IS CONSIDERED.

*ECONOMIC EVALUATIONS * WATER STORAGE * WATER UTILIZATION * DUAL-PURPOSE PLANT * FEASIBILITY STUDY * SINGLE-PURPOSE PLANT * WATER SOURCES

80-01098 LE CHATELIER J & CHARIUT P
MANAGEMENT OF THE WATER RESOURCES - AN ESSENTIAL FACTOR IN THE DEVELOPMENT OF A COUNTRY
SOPRED, PARIS, FRANCE
PREPRINT OF PAPER SM-126/5 PRESENTED AT IAEA SYMP. NUCL. ENERGY COSTS AND ECONOMIC DEVELOPMENT, ISTANBUL, TURKEY, OCT. 20-24, 1969, 9 P, 6 REF

IN COASTAL REGIONS WHERE SEAWATER PROVIDES AN INEXHAUSTIBLE SOURCE OF FRESH WATER WHERE NECESSARY TREATMENT CAN BE ACCOMPLISHED AT REASONABLE COST, WORK MUST BE DIRECTED TO SUIT LOCAL CONDITIONS, WITH CONSIDERATION GIVEN TO USE OF (1) SOLAR ENERGY FOR SMALL-SCALE PRODUCTION AND (2) NUCLEAR ENERGY FOR LARGE-SCALE DESALTING BY EVAPORATION AS WELL AS FERTILIZER MANUFACTURE. THESE TWO ASPECTS ARE EXAMINED ON THE BASIS OF THE FOLLOWING - (1) THE WORK CARRIED OUT BY SOPRED AT THE CENTRE DE FOS-SUR-MER DES SALINS DU MIDI IN COLLABORATION WITH THE CENTRE HELIO-TECHNIQUE DE MARSEILLE, RELATING MAINLY TO STUDY OF SOLAR ENERGY COLLECTORS CONNECTED WITH FLASH EVAPORATORS OR EVAPORATORS WITH LONG VERTICAL TUBES, AND (2) WORK BEING DONE BY ALSTHOM IN KUWAIT. CHARACTERISTICS AND PERFORMANCE DATA ARE EXAMINED ASSUMING - (1) AN INCREASE IN PRODUCTION, (2) NUCLEAR POWER SUPPLY, AND (3) JOINT WORK WITH A LOCAL CHEMICAL CONCERN. (IN FRENCH)

*NUCLEAR ENERGY SOURCES * SOLAR ENERGY SOURCES * WATER SOURCES * WATER UTILIZATION * AGRICULTURE * EVAPORATORS * FERTILIZER * FLASH EVAPORATION * INDUSTRIES * NUCLEAR DESALINATION * VERTICAL TUBE EVAPORATORS

80-01133 OBRIEN JJ
OPPORTUNITIES FOR AUGMENTING WATER SUPPLIES THROUGH DESALTING
BUREAU OF RECLAMATION, WASHINGTON
PAPER PRESENTED AT A.I.C.H.E. MEETING, ATLANTA, FEB. 15-18, 1970

DURING THE NEXT 15 YEARS, WE SHOULD SEE A PROLIFERATION OF SMALL-SCALE DESALTING APPLICATIONS AS WELL AS THE INITIAL STEPS IN CONSTRUCTION AND OPERATION OF MODERATE-SIZED PLANTS THAT WILL BE THE BUILDING BLOCK MODULES FOR THE VERY LARGE SIZED PLANTS OF THE FUTURE. A DESALTING PLANT COULD PROVIDE Drought-Proofing FOR AN INTERIM PERIOD AS ONE ALTERNATIVE THAT COULD BE INTEGRATED INTO ANY PLAN OF DEVELOPMENT TO MEET LONG-RANGE WATER NEEDS OF AN AREA WHETHER IT INCLUDES FURTHER DESALTING OR NOT. IT IS MISLEADING TO CONSIDER PRODUCTION COSTS AS THE TRUE COST OF DESALTED WATER WHEN CONSIDERING DESALTING TO AUGMENT ANOTHER WATER SUPPLY. MANY PLANNERS EXAMINE DESALTING AS AN ALTERNATIVE WOULD SAY THAT IF THE SUPPLEMENTAL SUPPLY WAS PROVIDED BY DESALTING, THE UNIT PRODUCTION COST WOULD BE REPRESENTED BY TOTAL ANNUAL COSTS DIVIDED BY THE SUPPLEMENTAL SUPPLY. HOWEVER, THE UNIT COST SHOULD BE COMPUTED AS THE ANNUAL COST DIVIDED BY THE TOTAL INCREASE IN CAPABILITY OF A REGIONAL SUPPLY WHICH WOULD INCLUDE WATER FROM OTHER SOURCES EVEN WHEN THE DESALTING PLANT WAS NOT OPERATING. THIS IS SIMILAR TO THE JUSTIFICATION AND AMORTIZATION OF THE COST OF A DAM BY THE TOTAL INCREASE IN CAPABILITY BROUGHT ABOUT BY VIRTUE OF ITS AVAILABILITY.

*AMORTIZATION CRITERIA * WATER SOURCES * WATER STORAGE * WATER UTILIZATION * COST ALLOCATION * ECONOMIC EVALUATIONS * SINGLE-PURPOSE PLANT ECONOMICS

ACCESSION NUMBER 80-01083 TO 80-01133
99-01070  EVALUATION OF CONCRETE AND RELATED MATERIALS FOR DESALINATION PLANTS
OSW R&D PROG. REP. NO. 345 (MAY 1968), 38 P, 21 FIG, 2 TABLES
A TEST PROGRAM SUMMARY REPORT ON (1) THE EVALUATION OF CONCRETE UNDER A VARIETY OF TEMPERATURE, PRESSURE AND BRINE CONCENTRATION CONDITIONS, (2) CONCRETE PANEL AND MODEL STRUCTURAL STUDIES, (3) COLLECTION AND EVALUATION OF PROTECTIVE COATINGS, SEALANTS AND POLYMERIC PRODUCTS, (4) CONCRETE REINFORCEMENT MATERIALS, AND (5) CONCRETE MICROSTRUCTURAL INVESTIGATIONS. TEST DATA IS PRESENTED ON COMPRESSIVE STRENGTHS, MODULI OF ELASTICITY, POISSON'S RATIO, TEMPERATURE DISTRIBUTION THROUGH WALLS IN THERMAL CYCLING, DEFORMATION, DEPTH OF SURFACE ALTERATION, CORROSION OF REINFORCING BARS AND EVALUATION OF COATINGS AND POLYMERS.

*COATINGS + *CONCRETE CONSTRUCTION + *DESIGN DATA + *IMMERSION TESTS (CORROSION) + CORROSION + CORROSION TESTS + *ELECTROMETERS + *EVAPORATOR SYSTEM DESIGN + EXPERIMENTAL DATA + *OSW SPONSORED + PHYSICAL PROPERTIES + REINFORCEMENT + STRUCTURAL DESIGNS + SYNTHETIC RESINS (PLASTICS) + THERMAL CYCLING

99-01072  GUNAJI NN + KEYES CG JR
DISPOSAL OF BRINE BY SOLAR EVAPORATION
NEW MEXICO STATE UNIVERSITY
OSW R&D PROG. REP. NO. 351, 213 P, 62 FIG, 38 TABLES, 65 REF
STUDIES OF THE EFFECT OF SALINITY AND DYES ON SOLAR EVAPORATION. TO DETERMINE EVAPORATION ACCURATELY, THE (1) MASS TRANSFER METHOD, (2) THE ENERGY BUDGET METHOD, AND (3) THE WATER BUDGET METHOD WERE INVESTIGATED. THE WATER BUDGET METHOD WAS SHOWN TO BE MORE RELIABLE THAN THE ENERGY BUDGET METHOD IN A MODIFIED CUMMINGS RADIATION INTEGRATOR. THE PROGRAM OBSERVED THE EFFECT OF BISMARCK BROWN, CONGO RED, METHYLENE BLUE, NAPTHOL GREEN AND NIGROSINE DYES ON SOLAR EVAPORATION OF BRINE. USING THE WATER BUDGET METHOD, CALCULATIONS SUPPORTED THE HYPOTHESIS THAT THE NAPTHOL GREEN DYE WILL INCREASE THE EVAPORATION OF BRINE MORE THAN THE OTHER DYES. A PLOT OF THE REDUCTION IN DOWNS RATIO IS GIVEN FOR VARIOUS SALINITIES.

*HUMIDIFICATION PROCESSES + *SOLAR ENERGY SOURCES + *WASTE DISPOSAL + CHEMICAL ADDITIVES + EVAPORATORS + *EXPERIMENTAL DATA + *OSW SPONSORED + PROGRAMS (COMPUTERS)

99-01074  MANNING JJ + PERTER DJ
SOIL SEALING CHEMICALS AND TECHNIQUES
DIAMOND SHAMROCK CORP., PAINESVILLE, OHIO
OSW R&D PROG. REP. NO. 381 (JUNE 1968), 30 P, 4 FIG, 11 TABLES
OVER 160 FORMULATIONS USING SOME 25 MATERIALS AND ADDITIVES WERE TESTED TO FIND MATERIALS TO RENDER SOILS IMPERVIOUS TO DESALINATION WASTE BRINE AND TO PERMIT SAFE IMPOUNDMENT OF SUCH WASTES. FOUR CLASSES OF ADDITIVES RENDERED LOCAL SOIL SUITABLY IMPERVIOUS TO WASTE BRINE FROM THE ROSELLE, N.M., DEMONSTRATION PLANT - (1) LIGNIN OXIDIZED WITH SODIUM CHROMATE OR ALUM, (2) CARBOXY METHYL CELLULOSE WITH ALUM, (3) PETROLEUM EMULSIONS, AND (4) AN ATTAPULGITE CLAY FORMULATION. SOIL PERMEABILITY WAS FOUND TO BE QUITE SENSITIVE TO ITS MOISTURE CONTENT WHEN COMPACTED. TREATMENT COSTS FOR SEEPAGE OF LESS THAN 6 INCHES PER YEAR WITH 20 FOOT BRINE DEPTH WERE ESTIMATED AS LOW AS $500/ACRE.

*SOIL STRUCTURE + *WASTE DISPOSAL + CANALS + CHEMICAL ADDITIVES + *ECONOMIC EVALUATIONS + ORGANIC COMPOUNDS + *OSW SPONSORED + ROSELLE PLANT

99-01075  FABUSS BM + KOROSI A
PROPERTIES OF SEA WATERS AND SOLUTIONS CONTAINING SODIUM CHLORIDE, POTASSIUM CHLORIDE, SODIUM SULFATE AND MAGNESIUM SULFATE
MONSANTO RESEARCH CORP., EVERETT, MASS.
OSW R&D PROG. REP. NO. 384 (1968), 139 P, 113 TABLES

*BOILING POINT ELEVATION + *PHYSICAL PROPERTIES + *SEAWATER CHEMICAL ANALYSIS + *WASTE DISPOSAL + *LIMESTONE + *ECONOMIC EVALUATIONS + *SALT DEPOSITION + *OSW SPONSORED + PROGRAMS (COMPUTERS)

99-01077  PESSALL N + HULL FC + MICHAEL N + LIU C
DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
OSW R&D PROG. REP. NO. 394 (JAN 1969), 79 P, 30 FIG, 8 TABLES, 27 REF
BINARY TO MULTICOMPONENT IRON-BASE ALLOYS WERE PREPARED BY LEVITATION MELTING. LOOP TESTS AT 250 DEG F WITH DEAERATED SEA WATER PLUS ANODIC POLARIZATION CURVES WERE USED TO EVALUATE RELATIVE CORROSION BEHAVIOR. FOR EVALUATION THE ELECTROCHEMICAL METHOD IS PREFERRED. THE BEST CORROSION RESISTANT IRON ALLOYS ARE INDICATED TO BE MULTICOMPONENT, SINGLE PHASE ALLOYS CONTAINING CHROMIUM AND/OR ALUMINUM. ADDITIONS OF COBALT, MOLYBDENUM, NICKEL, NIOBium, SILICON, TUNGSTEN, SILVER, ZIRCONIUM, VANADIUM, AND TITANIUM ALL SHOW POTENTIAL FOR IMPROVING THE CORROSION RESISTANCE OF IRON-CHROMIUM AND IRON-ALUMINUM ALLOYS. STUDIES INDICATE THAT THE MELTING PRACTICE, PROCESSING PROCEDURE, ORIENTATION AND TRACE ELEMENTS HAVE LITTLE EFFECT ON CORROSION. FUTURE STUDIES AREItemListED.

*CORROSION + *CORROSION TESTS + *IRON ALLOYS + ALUMINUM + CHEMICAL ADDITIVES + CHROMIUM + GALVANIC CORROSION + *OSW SPONSORED + PITTING (CORROSION) + STRESS CORROSION

99-01081  BURNAM CW + HOLLOWAY JA + DAVIS NF
THERMODYNAMIC PROPERTIES OF WATER TO 1,000 DEGREES C AND 10,000 BARS
ACCESSION NUMBER 99-01070 TO 99-01081
99-01099  BEHRENS H * MARTIN F  * OSBORN D  * RICE L * RUSSELL W * SCHRIEBER C * WILLIAMS J

SEA WATER DEPOSITION TEST PROGRAM
DOW CHEMICAL CO., FREEPORT, TX.

OSW R&D PROGR. REPT. NO. 417 (MAR. 1969), 29 REF., 108 P., 45 FIG., 6 TABLES

PHYSICAL PROPERTIES + THERMAL PROPERTIES + THERMODYNAMICS + OSMW SPONSORED

99-01090  EL-SWAIFY SA  * SWINOALE LD  * UEHARA G

NEWTON JR * ATKINS ME

OSW R&D PROGR. REPT. NO. 419 (MAR. 1969), 74 REF., 49 P., 15 FIG., 14 TABLES

PHYSICAL PROPERTIES

UNIVERSITY OF HAWAII, HONOLULU

REPORT ON SEA WATER DESALINATION ANALYTICAL PROCEDURES
OFFICE OF SALINE WATER, WRIGHTSVILLE BEACH, N.C.

OSW R&D PROGR. REPT. NO. 450 (MAY 1969), 133 P., 66 REF., 23 FIG

ANALYTICAL PROCEDURES ARE GIVEN FOR SEAWATER AND FOR SCALE. SEAWATER ANALYSES INCLUDE
ALKALINITY, BORON, BROMIDE, CALCIUM, MAGNESIUM, CARBON DIOXIDE, RESIDUAL CHLORINE, CHLOROSITY, COLIFORM, COPPER, DISSOLVED OXYGEN, FLUORIDE, IRON, LEAD, MANGANESE, NICKEL, OIL AND GREASE, PHOSPHATES, SILICA, SULFATES, IODINE, SURFACTANTS AND VOLATILE HYDROCARBONS. SCALE ANALYSES INCLUDE CALCIUM, MAGNESIUM, CARBONATE, COPPER, DIFFERENTIAL THERMAL ANALYSIS, IGNITION LOSS, IRON, SILICA AND SULFATES.

PHYSICAL CHEMISTRY OF SCALE + SEAWATER CHEMICAL ANALYSIS + CARBON DIOXIDE ANALYSIS + OSMW SPONSORED + PH CONTROL + WATER UTILIZATION

99-01102  LUDERT JA * VAN STEEDEL AG

WATER DESALINATION PROCESSES

FILTRATION SEPARATION 5(6), 541-44 (1968), 2 FIG., 1 TABLE

THE EFFICIENCY AND ECONOMICS OF THREE DESALINATION PROCESSES, EVAPORATION, ELECTRODIALYSIS AND REVERSE OSMOSIS ARE DISCUSSED. DISTILLATION REQUIRES 12-15 KWH PER CUBIC METER, ELECTRODIALYSIS APPROXIMATELY 40 AND REVERSE OSMOSIS 8-4 KW PER CUBIC METER AND REVERSE OSMOSIS TO 3.5 TO 4 WHEN BRACKISH WATER IS FED. THE SITUATION IN HOLLAND AS REGARDS FRESH WATER IS ALSO DISCUSSED.

REVIEWS + DISTILLATION PROCESSES + ELECTRODIALYSIS PROCESS + MEMBRANE PROCESSES + GSOMS + WATER UTILIZATION

99-01108  HICKER WA

NEW CONCEPTS FOR DESALTING BRACKISH WATER
J. AM. WATER WORKS ASSOC. 60(8), 869-81 (1968), 9 FIG., 3 TABLES, 15 REF

A NUMBER OF DESALTING PROCESSES ARE DESCRIBED, AMONG THEM DISTILLATION, VAPOR COMPRESSION, ELECTRODIALYSIS, REVERSE OSMOSIS, ION EXCHANGE, FREEZING, AND HYDRATE FORMATION. APPROXIMATE COSTS OF PRODUCT WATER FROM EACH PROCESS IS GIVEN WHERE AVAILABLE.

REVIEWS + DISTILLATION PROCESSES + ECONOMIC EVALUATIONS + ELECTRODIALYSIS PROCESS + FLASH EVAPORATION + FREEZE PROCESSES + HYDRO PROCESSES + ION EXCHANGING + MEMBRANE PROCESSES +

ACCESSION NUMBER 99-01081 TO 99-01103
DETERMINATION OF THE FEASIBILITY OF DESALTING SEAWATER

A METHOD IS PRESENTED FOR DETERMINING THE COST OF A DESALTING PLANT BASED INITIALLY ON (1) PLANT CAPACITY, (2) PLANT OPERATING FACTOR, AND (3) ECONOMY RATIO. FOUR NOMOGRAPHS ARE GIVEN FROM WHICH (1) THE UNIT CAPITAL COST, (2) THE UNIT FIXED COST COMPONENT, (3) THE UNIT FUEL COST, AND (4) THE UNIT LABOR COST MAY BE DETERMINED.

SUMMATION OF THE FIXED, LABOR, FUEL AND CHEMICAL UNIT COSTS RESULTS IN THE UNIT COST OF WATER. CHEMICAL COSTS ARE ESTIMATED AS 8 CENTS/1000 GAL OF PRODUCT WATER. TABLES SHOWING THE CONVEYING COST OF PRODUCT WATER AND EXAMPLES OF CAPITAL AND UNIT COSTS ARE PRESENTED.

*ECONOMIC EVALUATIONS * CAPITALIZED COSTS * FEASIBILITY STUDY * FUEL COSTS * OPERATING COSTS * SINGLE-PURPOSE PLANT ECONOMICS * WATER CONVEYANCE COSTS

CONCRETE-POLYMER MATERIALS

BROOKHAVEN NATIONAL LABORATORY, UPTON, N.Y. + BUREAU OF RECLAMATION, DENVER, COLO.

CONCRETE-POLYMER MATERIALS were shown to have advantages over traditional concrete in terms of durability and cost-effectiveness. This study also highlighted the potential for these materials in communities with high costs of desalination.

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS

THE LISTING INCLUDES THE 420 U.S. COMMUNITIES IN 29 STATES WHICH FIT INTO THE TITLE DESCRIPTION. ONE LIST IS GIVEN BY STATES AND A SECOND LIST BY WATER RESOURCE REGION.

WATER SOURCES + BRACKISH WATER + CONTAMINANTS + OSW SPONSORED + PRODUCT WATER PURITY + SALINE CONTAMINATION + WATER UTILIZATION

WHY WATER DESALTING WILL EXPAND


REVIEWS + DISTILLATION PROCESSES * DUAL-PURPOSE PLANT * ELECTRODIALYSIS PROCESS * ENERGY SOURCES * FREEZE PROCESSES * MEMBRANE PROCESSES + WATER COSTS ESTIMATE
*CONTINUED*

WATER DEMINERALIZATION BY MEANS OF A SEMIPERMEABLE MEMBRANE, (2) MASS TRANSPORT OF ELECTROLYTES IN MEMBRANES, (3) SCALE CONTROL STUDIES, (4) SUBMERGED COMBUSTION, (5) DYNAMIC SEPARATION OF LIQUID SOLUTIONS, (6) HEAT AND MASS TRANSFER STUDIES, (7) CORROSION STUDIES, (8) ECONOMIC STUDY OF DESALINATION.

CARBON DIOXIDE ADDITION PROCESS + CORROSION + ECONOMIC EVALUATIONS + HEAT TRANSFER + MEMBRANE PROCESSES + SCALE PREVENTION + SCALING + STATUS REPORTS

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.

OSW R&D PROGR. REP. NO. 478 (SEPT. 1969), 76 P, 5 TABLES, 40 FIG, 39 REF

IRON-BASE ALLOYS, RANGING FROM BINARY ALLOYS OF IRON-CHROMIUM TO MULTICOMPONENT ALLOYS BASED ON IRON-CHROMIUM-MOLYBDENUM, HAVE BEEN PREPARED BY LEVITATION MELTING. THE RELATIVE RESISTANCES OF THE ALLOYS TO PITTING CORROSION IN DEAEERATED SYNTHETIC SEAWATER, AT TEMPERATURES UP TO 250 DEG F, HAVE BEEN EVALUATED ON THE BASIS OF CRITICAL PITTING POTENTIALS, E(CRIT), OBTAINED FROM ANODIC POLARIZATION MEASUREMENTS. BASED ON STUDIES OF SYNERGISTIC INTERACTIONS, THE MOST PROMISING FERRITIC STEELS FOR USE IN AQUEOUS CHLORIDE ENVIRONMENTS HAVE BEEN FOUND IN THE IRON-CHROMIUM-MOLYBDENUM-COBALT ALLOY SYSTEM. A TENTATIVE CORRELATION BETWEEN E(CRIT) AND D-SHELL CHARACTER OF THE COMPONENT ELEMENTS OF QUATERNARY ALLOYS BASED ON IRON-CHROMIUM-MOLYBDENUM SUGGESTS THAT MULTICOMPONENT FERRITIC STEELS, CONTAINING CHROMIUM AND MOLYBDENUM AS MAJOR ADDITIVES IN COMBINATION WITH SMALL CONCENTRATIONS OF MOLYBDENUM, CHROMIUM, NICKEL, AND/OR COPPER, WILL HAVE EXCEPTIONALLY HIGH RESISTANCE TO PITTING ATTACK IN AQUEOUS CHLORIDE MEDIA.

*CORROSION + *FABRICATION MATERIALS + *IRON ALLOYS + CORROSION MECHANISMS + CORROSION TESTS + OSW SPONSORED

A CHEMICAL ENGINEERS GUIDE TO SEAWATER

DOW CHEMICAL CO., FREEPORT, TEX.

CHEM. ENG. 75(24), 81-86 (1969), 76(25), 251-56 (1969), 5 FIG, 8 TABLES, 13 REF

A GENERAL REVIEW OF THE PHYSICAL AND CHEMICAL PROPERTIES OF SEAWATER COVERING MATERIAL OF INTEREST TO CHEMICAL ENGINEERS FACED WITH THE DESIGN AND OPERATING PROBLEMS INVOLVING SEAWATER. THE PHYSICAL PROPERTIES OUTLINED INCLUDE SALINITY, SPECIFIC GRAVITY, VAPOR PRESSURE, FREEZING POINT, BOILING POINTS, OSMOTIC PRESSURE, SPECIFIC HEAT, THERMAL CONDUCTIVITY, SURFACE TENSION, AND VISCOSITY. THE CHEMICAL PROPERTIES COVERED INCLUDE COMPLEXATION, ORGANIC CONTENT, FOAMING, TURBIDITY, DEPOSITION OF SOLIDS, MARINE LIFE, BORERS, FOULING, SULFATE REDUCTION, AND DISPOSAL OF WASTE WATERS.

*CHEMICAL PROPERTIES + *PHYSICAL PROPERTIES + *SEAWATER CHEMICAL ANALYSIS + CHEMICAL PRODUCTION + REVIEWS
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K. O. Johnsson

INDEXED BIBLIOGRAPHY OF NUCLEAR DESALINATION LITERATURE - 5

Oak Ridge National Laboratory, Tenn.

ORNL-NDIC-7 (September 1970), 68 p

Abstracts are given for approximately 210 published articles related to the desalination of seawater. The body of the report is a copy of information stored in a computerized storage and retrieval system for the Nuclear Desalination Information Center (NDIC) at the Oak Ridge National Laboratory. The abstracts are grouped in nine categories (and repeated if they fall into more than one category). An author and a keyword index to the articles referenced is provided. The keywords, which identify the content of the articles, were chosen from a thesaurus developed by NDIC.

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