Fertilizer Industry

Processes, Pollution Control and Energy Conservation

CHEMICAL TECHNOLOGY REVIEW No. 123
POLLUTION TECHNOLOGY REVIEW No. 55
ENERGY TECHNOLOGY REVIEW No. 36

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FERTILIZER INDUSTRY

Processes, Pollution Control and Energy Conservation

Marshall Sittig

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FERTILIZER INDUSTRY

FOREWORD

The use of fertilizers is probably as old as agriculture itself. Cato (the Censor) recommended conservation of soil fertility to Roman landholders by crop rotation, liming acid soils, adding ground bones, fish meal and saltpeter, as well as bird and cow manure. He even knew about growing legumes which fix atmospheric nitrogen—that is, convert it to usable nitrates.

The fertilizer industry of today is primarily a chemical industry, and fertilizers are produced from chemicals known to be needed and are being made readily available to growing plants. Modern chemical fertilizers always include one or more of the three elements most important in plant nutrition: nitrogen, phosphorus and potassium.

Most nitrogen fertilizers, such as ammonium sulfate, nitrate and phosphate, as well as ammonia itself, come from the atmospheric nitrogen industry. The so-called superphosphates prepared from phosphate rock by treatment with sulfuric and phosphoric acids are more soluble than pure calcium phosphate. Potash is nowadays obtained largely from the enormous deposits found in the Saskatchewan province of Canada.

This review deals with the production and handling of fertilizers giving special consideration to pollution control and energy conservation. It contains carefully excerpted and collated data from diverse and difficult-to-locate sources. The technological information to be found here is based on studies carried out by research teams almost exclusively under the auspices of various governmental agencies. It is possible that certain portions of this book may disagree or conflict with other parts of the book. This is especially true of monetary values and opinions of future potential. We chose to include these different points of view, however, in order to make the book more valuable to the reader.

Cost figures provided are those given in the report cited, the date of which is always given. When the dates of the cost figures themselves are given, we have included them.

Advanced composition and production methods developed by Noyes Data are employed to bring these durably bound books to you in a minimum of time. Special techniques are used to close the gap between "manuscript" and "completed book." Industrial technology is progressing so rapidly that time-honored, conventional typesetting, binding and shipping methods are no longer suitable. We have by-passed the delays in the conventional book publishing cycle and provide the user with an effective and convenient means of reviewing up-to-date information in depth.

The large Table of Contents is organized in such a way as to serve as a subject index and provides easy access to the information contained in this book. The sources utilized in the preparation of this book are listed in the bibliography at the end of the volume.

Some of the illustrations in this book may be less clear than could be desired; however, they are reproduced from the best material available to us.

FERTILIZER ADDITIVES AND SOIL CONDITIONERS 1978

by M. William Ranney

Chemical Technology Review No. 116

World-wide governmental and social attention is being focused more and more on the decreasing food supply balance and the obvious need for improving crop yields. The problem is particularly severe in the developing and under-developed countries, as they strive to achieve a semblance of modern industrial and political entities.

It is known that plants require various mineral elements before they can synthesize the organic constituents needed for their growth and development. Major plant nutrients include nitrogen, phosphorus, and potassium. Among the secondary nutrient elements are calcium and sulfur. The minor or trace elements, commonly referred to as micronutrients, include the metals zinc, manganese, copper, iron and magnesium.

The development of a good soil structure by suitable synthetic conditioners with their beneficial effects on drainage, aeration, rooting and nutrient uptake is just as important as the addition of the nutrients themselves.

This book describes close to 200 processes related to the improvement of fertilizer compositions through the use of both minor, but essential, additives and complementary compositions which utilize nutrient values commonly available at low cost, hitherto considered as useless by-products and waste.

A partial and condensed table of contents follows here. Chapter headings and important subtitles are given. Numbers in parentheses indicate the number of processes per topic.

ISBN 0-8155-0721-6

301 pages

GRANULATED FERTILIZERS 1976

by Robert A. Hendrie

Chemical Technology Review No. 58

During the past 15 years consumption of fertilizers has more than doubled, and mixed fertilizer has become the principal form used by the farmer. Mixed fertilizers contain all three major plant nutrients: nitrogen (N), available phosphate (calculated as P_2O_5), and potassium (expressed as K_2O).

With an increase of these analytical percentages, problems of caking became serious, and the mixed product was difficult to distribute evenly. Granulation, however, lessened or prevented caking in storage and facilitated uniform application of the fertilizer. From a technological viewpoint, therefore, the most significant development was the change to granulation processes.

Granular fertilizers flow readily from a bag or storage bin. In addition they are hard and strong enough to stand mechanical handling in farm equipment.

The desirable slow release of plant nutrients is best accomplished by covering the fertilizer granules with water-resistant or almost impervious coatings which in turn may contain micronutrients. Coated fertilizers with suitable barrier layers slowly release the plant nutrients over a period of several months. This prevents leaching losses early in the growing season and subsequent deficiencies as the crop approaches maturity.

This book describes over 260 processes providing several hundred examples of production methods relating to the technology of granulated fertilizers. As such it constitutes an in-depth review of the many important worldwide process developments in the fertilizer industry. A condensed table of contents follows with numbers of processes in ( ).

ISBN 0-8155-0602-3 **339 pages**

ENERGY-SAVING TECHNIQUES FOR THE FOOD INDUSTRY 1977

edited by M. E. Casper

Energy Technology Review No. 13
Food Technology Review No. 42

The aim of this book is to promote increased energy efficiency in the food industry as a whole and to define sensible improvement targets.

Detailed findings for 47 named individual food industry segments are presented together with the proposed component goals for the year 1980 and the concomitant energy efficiency improvement potentials.

The methods used in the study are fully described. Detailed descriptions of each component of the food industry, as well as the energy conservation measures are also included. For a selected few categories, information concerning the geographic variances in energy and types of energy used, has been added.

Each particular food industry was analyzed and summarily reported in the following manner:

ISBN 0-8155-0663-5

657 pages

EUROPEAN TECHNOLOGY FOR OBTAINING ENERGY FROM SOLID WASTE 1978

Edited by D.J. De Renzo

Energy Technology Review No. 34

Pollution Technology Review No. 54

The recovery of energy through the combustion of municipal solid waste is by now a well recognized and established technique for conserving energy. Combustion units can produce electricity, hot water for domestic use and steam for district heating and for industrial processes or for the drying of sewage sludge.

Western Europe is definitely the leader in this field. Energy recovery from waste began, in a small way, in France, Denmark, and Italy before the second world war. During the 1950s it was introduced on a large scale in West Germany, France and Holland. The largest single furnace is located in Paris-Ivry and has a capacity of 50 metric tons/hr, while the largest European plant near Rotterdam has 6 units of 20 metric tons/hr.

Much can be learned from these European waste-to-energy systems. For each country a national overview is given, followed by a description of particularly significant developments and case histories: Household sorting and collection methods, combustors, furnaces, incinerators, air pollution control, latest plant designs, operation and economics.

A summary of key findings is also included. Serious study of this book should make it possible to reveal and identify solid waste/energy processes (both existing and under development) that appear to offer potential advantages over processes currently employed in the U.S. Maps and a tabulation of the European systems are included. This book is based on several studies produced under contract for EPA and ERDA (now DOE). A summarized table of contents follows here:

ISBN 0-8155-0730-5 **281 pages**

ENERGY FROM BIOCONVERSION OF WASTE MATERIALS 1977

by Dorothy J. De Renzo

Energy Technology Review No. 11
Pollution Technology Review No. 33

One of the chief gaseous products of the anaerobic decomposition of organic matter is methane, CH_4. This is how natural gas was formed in prehistoric times along with other fossil fuels.

By applying this principle today in environmentally acceptable fashion it is possible to bioconvert municipal solid sewage, animal manure, agricultural and other organic wastes into substitute natural gas (95% CH_4). In its simplest essentials the process consists of loading the material into a digester (a closed tank with a gas outlet). Given favorable thermal and chemical conditions, the appropriate biological processes will then take their course.

The bioconversion of waste materials to methane provides at least partial solutions not only to the energy problem, but also to the solid waste disposal problem. The harvesting of heretofore undesirable vegetations, such as algae, water hyacinths, and kelp as "energy crops" offers unconventional opportunities for supplementary utilization of natural resources.

This book describes practical methods for the bioconversion of waste matter. It is based on reports of academic and industrial research teams working under government contracts. A partial and condensed table of contents follows here. Chapter headings and important subtitles are given.

Note: Each chapter is followed by bibliographic reference lists in order to provide the reader with easy access to further information on these timely topics.

ISBN 0-8155-0656-2

223 pages

UNIT OPERATIONS FOR TREATMENT OF HAZARDOUS INDUSTRIAL WASTES 1978

Edited by D. J. De Renzo

Pollution Technology Review No. 47

This book describes ways of combating pollution from hazardous waste materials through the use of basic unit operations common to chemical engineering processes, These unit operations are either physical, such as neutralization and precipitation, or biological, e.g. treatment with suitable enzymes.

There exists an urgent and immediate need for treatment processes which can detoxify, destroy or apply recovery principles to industrial wastes. This study examines over 40 unit engineering processes for their applicability to treating hazardous wastes.

For each potentially applicable method there are given, in depth, the:

Technical characteristics
Underlying physical, chemical, or biological principles
Operating characteristics
- **Physical and chemical properties of suitable feed streams**
- **Mode of operation**
- **Physical and chemical properties of the output streams**

Operating experience
- **Principal current applications**
- **Potential applications to hazardous wastes**

Capital and operating costs
Environmental impacts
Energy requirements
Outlook & development needs

A condensed table of contents follows here:

In order to make all of the information readily available and useful, the section on TREATMENT TECHNIQUES is preceded by a series of reference tables to be used when screening processes for application to an individual waste stream. These tables are so organized as to provide a method for screening out processes that do not have any potential for the waste in question.

ISBN 0-8155-0717-8 **$42** **920 pages**

PRACTICAL TECHNIQUES FOR SAVING ENERGY IN THE CHEMICAL, PETROLEUM AND METALS INDUSTRIES 1977

by Marshall Sittig

Energy Technology Review No. 12
Chemical Technology Review No. 90

The above-captioned industries were selected for coverage in this book because they are the three largest consumers of energy in the U.S. economy. They constitute an interacting group: they use many common raw materials and are simultaneously feeding products and by-products to one another.

Practical thinking about industrial energy conservation requires interceptive calculations of such material transfers to produce positive energy savings.

The major conservation approaches are arranged as follows:

1. **Waste Utilization**
2. **Process Integration**
3. **Process Modification**
4. **Design Modification**
5. **Maintenance and Insulation**
6. **Market Modification**

The three major industries are subdivided into 39 individual processing industries. The following discussions and proposals are presented for practically every processing industry:

1. **Process Technology Involved**
2. **Major Energy Conservation Options to 1980**
3. **Goal Year (1980) Energy Use Targets**
4. **Some Projections beyond 1980 to 1990**

INDIVIDUAL PROCESSING INDUSTRIES

As can be seen from this large and impressive table of contents, entries have been arranged in an encyclopedic manner whenever possible.

To be found at the end of the book is a complete and detailed list of reports and references cited throughout the work. In this list titles are complete with their publishers and other sources of procurement and are never abbreviated.

Under the Energy and Conservation Act, the U.S. Federal Energy Administration was required to set energy conservation targets for the most energy-intensive manufacturing industries. Goals to be attained by Jan. 1, 1980 were established by the end of 1976. Major contributions to the manuscript are acknowledged from the energy target documents, particularly from those on the chemical, petroleum, and metals industries.

ISBN 0-8155-0657-0

524 pages

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