A Model For Anaerobic Degradation Of Municipal Solid Waste

An Anaerobic Treatment Process Model

Anaerobic Degradation of 1,1,2,2- Tetrachloroethane and Association with Microbial Communities in a Freshwater Tidal Wetland, Aberdeen Proving Ground, Maryland

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Dynamical Modeling and Simulation of the Anaerobic Digestion Process

Biogas Production Models of Anaerobic Infection

Biogas Production Process Simulation Using Aspen Plus

Critical Evaluation of the Sugar Degradation Pathways of Anaerobic Digestion Model

An Anaerobic Treatment Process Model

This book deals with monitoring and control of biotechnological processes. Different methods are proposed which are based on the nonlinear structure of the process and do not require any a priori knowledge of the fermentation parameters. The theoretical stability and convergence properties of the proposed algorithms are analysed and their performances are illustrated by simulation results and, in many instances, by real life experiments. The concept of software sensors is introduced; these are algorithms based on the nonlinear model of the process and designed for on-line estimation of the biological variables and/or the fermentation parameters. In order to deal with process nonstationarities and parameter uncertainties, reference is made to adaptive estimation and control techniques. The book is the result of an intensive joint research effort by the authors during the last decade. It is intended as a graduate level text for students of bioengineering as well as a reference text for scientists and engineers involved in the design and optimization of bioprocesses.

Anaerobic Degradation of 1,1,2,2- Tetrachloroethane and Association with Microbial Communities in a Freshwater Tidal Wetland, Aberdeen Proving Ground, Maryland

Anaerobic digestion (AD) is one of the oldest biotechnological processes and originally referred to biomass degradation under anoxic conditions in both natural and engineered systems. It has been used for decades to treat various waste streams and to produce methane-rich biogas as an important energy carrier, and it has become a major player in electrical power production. AD is a popular, mature technology, and our knowledge about the influencing process parameters as well as about the diverse microbial communities involved in the process has increased dramatically over the last few decades. To avoid competition with food and feed production, the AD feedstock spectrum has constantly been extended to waste products either rich in...
recalcitrant lignocellulose or containing inhibitory substances such as ammonia, which requires application of various pre-treatments or specific management of the microbial resources. Extending the definition of AD, it can also convert gases rich in hydrogen and carbon dioxide into methane that can substitute natural gas, which opens new opportunities by a direct link to traditional petrochemistry. Furthermore, AD can be coupled with emerging biotechnological applications, such as microbial electrochemical technologies or the production of medium-chain fatty acids by anaerobic fermentation. Ultimately, because of the wide range of applications, AD is still a very vital field in science. This Special Issue highlights some key topics of this research field.

The Microbiology of Anaerobic Digesters Anaerobic digestion is a common process for treatment of wastewater sludge from municipal sewage systems. Volatile sulfur compounds, including volatile organic sulfur compounds (VOSCs) and hydrogen sulfide, have been reported as the most odorous compounds in digestion emissions and impurities which can damage facilities for generation, transportation, storage, and utilization of biogas. There has been no comprehensive study on biological generation and degradation kinetics of VOSC or modeling VOSC behaviors through anaerobic sludge digestion. The goal of the present study was to establish a model for VOSC conversions in anaerobic sludge digestion which could facilitate quantitative analysis of VOSC emissions in anaerobic digestion. VOSCs and methionine were employed in dosed batch tests. VOSC conversion processes in anaerobic methionine digestion have been identified. The kinetics for the identified VOSC degradation and conversion processes were determined at 35 and 55 °C respectively. Mixed-second order kinetics were found to best fit the conversion processes. A model was established based on the identified processes and estimated kinetic constants. To extend the model to VOSC release in anaerobic sludge digestion, mesophilic and thermophilic incubations were conducted with four different sludge samples. The effects of temperature and sludge source on VOSC release patterns were assessed. It was found that an unidentified DMS generation mechanism was triggered in the mesophilic incubation of activated sludge in which iron was dosed. To apply the model which was established based on methionine degradation in sludge digestion, hydrolysis of particulate materials was incorporated. The model simulations for VOSC behavior in thermophilic batch incubation were able to represent the observed VOSC releases. However, the simulations could not well fit the observed VOSC release at 35 ° because the model did not include the unidentified DMS generation mechanism. Application of the model to bench-scale digesters was lack-of-fit. It may have been due to imprecise estimation of the degradable sulfur in the feed sludge. In addition, in the batch tests and digester operation the ratios of the raw and digested sludge were different. This might have resulted in different concentrations of the microorganisms which mediated biotransformations and hence resulted in different kinetic constants.

Anaerobic Digestion Batch experiments were performed to investigate the effect of particulate protein particle size on the hydrolysis of casein in anaerobic degradation. While particle size did not affect the ultimate protein degradation efficiency, the hydrolysis rate coefficient increased from 0.034 to 0.298 d-1 with the change in specific surface area from 0.01 to 0.192 m2/g. The maximum methane production rate was affected by the particle size change, although the ultimate amount of methane produced was approximately the same despite the change in specific surface area. A mathematical relationship between the hydrolysis rate coefficient and specific surface area was developed and a new hydrolysis equation was proposed and verified. Ultrasound treatment of wastewater sludges prior to anaerobic digestion disrupts the flocs and causes lysis of the bacterial cells releasing both inter and intracellular materials. Primary (PS) and waste activated sludge (WAS) were treated with different ultrasonic intensities, varying sonication time and amplitude at a constant frequency. Results showed that gas production, volatile fatty acids, ratio of soluble chemical oxygen demand to total chemical oxygen demand and soluble protein increased, while particulate protein and particle size of the sludge decreased with sonication time. An empirical model was developed to determine the economic viability of ultrasound based on electrical energy input and energy obtained from enhanced methane production. Ultrasonic pretreatment is only economically viable for primary sludge at low sonication doses. The Anaerobic Digestion Model # 1
(ADM1) was applied to the batch anaerobic digestion for sonicated and non-sonicated sludge. The model successfully simulated the experimental trends. The efficiency of ultrasound as a pretreatment method for hog manure prior to anaerobic digestion was also evaluated at specific energies of 250 to 30,000 kJ/kg total solids (TS). This study confirmed that COD solubilisation from particulates correlated well with the more labor and time intensive degree of disintegration test. The particle size distribution for hog manure was bimodal (0.6 - 2500 μm), while ultrasound primarily impacting particles in the 0.6-60 μm range. Hog manure is more amenable to ultrasound than waste activated sludge, as it took only 3000 kJ/kg TS to cause 15% more solubilization as compared to 25000 kJ/kg TS for waste activated sludge. Bound protein degradation during sonication was 13.5% at 5000 kJ/kg TS and remained constant thereafter for higher energy input. Biomass cell rupture occurred at specific energy of 500 kJ/kg TS. An economic evaluation indicated that only a specific energy of 500 kJ/kg TS was economical, with a net energy output valued at $ 4.1/ton of dry solids, due to a 28% increase in methane production. Degradation of odorous compounds in sludge during anaerobic digestion was systematically studied and simulated using the Anaerobic Digestion Model # 1 (ADM1). The degradation of various protein fractions (particulate, soluble and bound), VFAs, lipids and amino acids of PS and WAS were monitored during anaerobic digestion. Degradation kinetics of the odorous compounds namely, protein, amino acids, lipid and volatile fatty acids (VFAs) were determined. Relationships between protein fractions and volatile suspended solid were established. A strong relationship between bound protein, a major odors precursor, and volatile suspended solid degradation was found, while no statistically significant difference in bound protein reduction was observed between PS and WAS. ADM1 successfully simulated the lab scale continuous anaerobic digestion; model results with optimized parameters showed good agreement with the experimental data for methane production and all other sludge parameters including odor precursors such as lipids, VFAs and proteins.

Activated Sludge Models This volume covers the most cutting-edge pretreatment processes being used and studied today for the production of biogas during anaerobic digestion processes using different feedstocks, in the most efficient and economical methods possible. As an increasingly important piece of the "energy pie," biogas and other biofuels are being used more and more around the world in every conceivable area of industry and could be a partial answer to the energy problem and the elimination of global warming.

Anaerobic Digestion Model Interest in anaerobic digestion (AD), the process of energy production through the production of biogas, has increased rapidly in recent years. Agricultural and other organic waste are important substrates that can be treated by AD. This book is one of the first to provide a broad introduction to anaerobic digestion and its potential to turn agricultural crops or crop residues, animal and other organic waste, into biomethane. The substrates used can include any non-woody materials, including grass and maize silage, seaweeds, municipal and industrial wastes. These are all systematically reviewed in terms of their suitability from a biological, technical and economic perspective. In the past the technical competence and high capital investment required for industrial-scale anaerobic digesters has limited their uptake, but the authors show that recent advances have made smaller-scale systems more viable through a greater understanding of optimising bacterial metabolism and productivity. Broader issues such as life cycle assessment and energy policies to promote AD are also discussed.

Anaerobic Digestion Processes in Industrial Wastewater Treatment

A Simplified Model of Hydrolysis Controlled Anaerobic Digestion

Anaerobic Digestion Processes The necessity for sustainable development has stimulated interest in technologies that will lessen the impact of society on the planet. With anaerobic processes, as occurring in nature, organic material and pollutants are converted into (bio)gas, organic fertiliser and minerals, end-products that can be recycled. Interest in anaerobic processes is further enhanced by the worldwide...
concern over the ever-increasing consumption of fossil energy and the consequent drive for alternative sources of energy, such as biomass. As a result, the development of anaerobic processes is the result of a push by the technology and a pull by society. Politicians ask what role anaerobic processes can play in their plans for the future. The papers selected from this congress should make a major contribution to such a dialogue by presenting the latest work from research and development programmes which are linked up with political and strategic targets. The 9th Anaerobic Digestion Congress presented a comprehensive picture of the various activities in this field all over the world in universities, institutes and industry. From the hundreds of oral and poster presentations 58 papers covering basic research and applied processes have been selected for these proceedings. Topics addressed include: microbiology; modelling and kinetics (featuring the newly launched IWA Anaerobic Digestion Model No 1); reactor technology; wastewater treatment; solid waste; integrated concepts; and post-treatment. These proceedings constitute an invaluable and genuinely authoritative survey of anaerobic digestions’s present status and future prospects.

Mathematical Modeling of Biofilms Over 90% of bacterial biomass exists in the form of biofilms. The ability of bacteria to attach to surfaces and to form biofilms often is an important competitive advantage for them over bacteria growing in suspension. Some biofilms are "good" in natural and engineered systems; they are responsible for nutrient cycling in nature and are used to purify waters in engineering processes. Other biofilms are "bad" when they cause fouling and infections of humans and plants. Whether we want to promote good biofilms or eliminate bad biofilms, we need to understand how they work and what works to control them. Mathematical Modeling of Biofilms provides guidelines for the selection and use of mathematical models of biofilms. The whole range of existing models - from simple analytical expressions to complex numerical models - is covered. The application of the models for the solution of typical problems is demonstrated, and the performance of the models is tested in comparative studies. With the dramatic evolution of the computational capacity still going on, modeling tools for research and practice will become more and more significant in the next few years. This report provides the foundation to understand the models and to select the most appropriate one for a given use. Mathematical Modeling of Biofilms gives a state-of-the-art overview that is especially valuable for educating students, new biofilm researchers, and design engineers. Through a series of three benchmark problems, the report demonstrates how to use the different models and indicates when simple or highly complex models are most appropriate. This is the first report to give a quantitative comparison of existing biofilm models. The report supports model-based design of biofilm reactors. The report can be used as basis for teaching biofilm-system modeling. The report provides the foundation for researchers seeking to use biofilm modeling or to develop new biofilm models. Scientific and Technical Report No.18

Anaerobic Digestion IX A simulation of Biogas Digestion process has been carried out through Aspen Plus. The anaerobic metabolism, its inhibitions and its parameters have been studied. Then a model of digestion has been performed using the information found in IWA Anaerobic Digestion Model No. 1 and Angelidaki et al. 1998 model of anaerobic digestion where Acidogenic, Acetogenic and Methanogenic step has been implemented following the reactions shown in both models, also amino-acid degradation reactions have been implemented. Ammonia, hydrogen, long-chain fatty acids, pH, etc inhibitions and temperature dependence have been implemented through Fortran statements in Aspen Plus calculation Blocks.

Anaerobic Digestion Model No.1 (ADM1) The use of trace elements to promote biogas production features prominently on the agenda for many biogas-producing companies. However, the application of the technique is often characterized by trial-and-error methodology due to the ambiguous and scarce basic knowledge on the impact of trace elements in anaerobic biotechnologies under different process conditions. This book describes and defines the broad landscape in the research area of trace elements in anaerobic biotechnologies, from the level of advanced chemistry and single microbial cells, through to engineering and bioreactor technology and to the fate of trace elements in the environment. The book
results from the EU COST Action on ‘The ecological roles of trace metals in anaerobic biotechnologies’. Trace elements in anaerobic biotechnologies is a critical, exceptionally complex and technical challenge. The challenging chemistry underpinning the availability of trace elements for biological uptake is very poorly understood, despite the importance of trace elements for successful anaerobic operations across the bioeconomy. This book discusses and places a common understanding of this challenge, with a strong focus on technological tools and solutions. The group of contributors brings together chemists with engineers, biologists, environmental scientists and mathematical modellers, as well as industry representatives, to show an up-to-date vision of the fate of trace elements on anaerobic biotechnologies.

Biological Strategies to Enhance the Anaerobic Digestion Performance: Fundamentals and Process Development

The Effect of Particle Size on Hydrolysis and Modeling of Anaerobic Digestion

Current Advances in Anaerobic Digestion Technology This book is intended for introducing the

Anaerobic Biodegradation of BTEX in Aquifer Material This book contains a collection of different research activities where several technologies have been applied to the optimization of biodegradation processes. The book has three main sections: A) Hydrocarbons biodegradation, B) Biodegradation and anaerobic digestion, and C) Biodegradation and sustainability.

Bioenergy Production by Anaerobic Digestion The IWA Task Group for Mathematical Modelling of Anaerobic Digestion Processes was created with the aim to produce a generic model and common platform for dynamic simulations of a variety of anaerobic processes. This book presents the outcome of this undertaking and is the result of four years collaborative work by a number of international experts from various fields of anaerobic process technology. The purpose of this approach is to provide a unified basis for anaerobic digestion modelling. It is hoped this will promote increased application of modelling and simulation as a tool for research, design, operation and optimisation of anaerobic processes worldwide. This model was developed on the basis of the extensive but often disparate work in modelling and simulation of anaerobic digestion systems over the last twenty years. In developing ADM1, the Task Group have tried to establish common nomenclature, units and model structure, consistent with existing anaerobic modelling literature and the popular activated sludge models (See Activated Sludge Models ASM1, ASM2, ASM2d and ASM3, IWA Publishing, 2000, ISBN: 1900222248). As such, it is intended to promote widespread application of simulation from domestic (wastewater and sludge) treatment systems to specialised industrial applications. Outputs from the model include common process variables such gas flow and composition, pH, separate organic acids, and ammonium. The structure has been devised to encourage specific extensions or modifications where required, but still maintain a common platform. During development the model has been successfully tested on a range of systems from full-scale waste sludge digestion to laboratory-scale thermophilic high-rate UASB reactors. The model structure is presented in a readily applicable matrix format for implementation in many available differential equation solvers. It is expected that the model will be available as part of commercial wastewater simulation packages. ADM1 will be a valuable information source for practising engineers working in water treatment (both domestic and industrial) as well as academic researchers and students in Environmental Engineering and Science, Civil and Sanitary Engineering, Biotechnology, and Chemical and Process Engineering departments. Contents Introduction Nomenclature, State Variables and Expressions Biochemical Processes Physicochemical Processes Model Implementation in a Single Stage CSTR Suggested Biochemical Parameter Values, Sensitivity and Estimation Conclusions References Appendix A: Review of Parameters Appendix B: Supplementary Matrix Information Appendix C: Integration with the ASM Appendix D: Estimating Stoichiometric Coefficients for Fermentation Scientific & Technical Report No.13
Biomethanization of the Organic Fraction of Municipal Solid Wastes

Anaerobic digestion is a biochemical degradation process that converts complex organic material, such as animal manure, into methane and other byproducts. Part of the author's Wastewater Microbiology series, Microbiology of Anaerobic Digesters eschews technical jargon to deliver a practical, how-to guide for wastewater plant operators.

Dynamic Modeling and Simulation of the Anaerobic Digestion Process

Anaerobic Digestion of Biomass

Hundreds of million tonnes of agricultural and food waste are produced each year around the world, most of which is just that, waste. Anaerobic digestion, biogas and the heat and electricity that can be produced from it is still a nascent industry in many countries, yet the benefits of AD spread throughout the community: Gives good financial returns to farmers and eco-entrepreneurs. Helps community leaders meet various policies and legislative targets. Offers an environmentally sensitive waste disposal option. Provides a local heat and power supply, & creates employment opportunities Reduces greenhouse gas emissions, as well as providing an organic fertilizer. Although the process of AD itself is relatively simple there are several system options available to meet the demands of different feedstocks. This book describes, in simple, easy to read language the five common systems of AD; how they work, the impact of scale, the basic requirements, the costs and financial implications, and how to get involved in this rapidly growing green industry.

Biodegradation

Recent advances in technology to recover bioenergy from various feedstocks make them suitable alternatives to fossil fuel. This book contains several scientific discussions regarding microbes involved in biogas production, the anaerobic digestion process, their operation, and application for sustainable development. The book provides in-depth information about anaerobic digestion for researchers and graduate students. The editor sincerely thanks all the contributors, whose efforts have brought this book to fruition.

Anaerobic Degradation of the Plant Sugar Sulfoquinovose Concomitant With H2S Production

Anaerobic Co-Digestion of Lignocellulosic Waste

A Kinetic Model for Anaerobic Digestion of Waste Activated Sludge

Experimental and Modeling Approaches to Evaluating Anaerobic Biodegradation of Petroleum-contaminated Groundwater

There have been many significant microbiological, biochemical and technological advances made in the understanding and implementation of anaerobic digestion processes with respect to industrial and domestic wastewater treatment. Elucidation of the mechanisms of anaerobic degradation has permitted a greater control over the biological parameters of waste conversion and the technical advances achieved have reduced the time and land area requirements and increased the cost-effectiveness and efficiency of the various processes presently in use. By product recovery in the form of utilisable methane gas has become increasingly feasible, while the development of new and superior anaerobic reactor designs with increased tolerance to toxic and shock loadings of concentrated effluents has established a potential for treating many extremely recalcitrant industrial wastestreams. The major anaerobic bioreactor systems and their applications and limitations are examined here, together with microbiological and biochemical aspects of anaerobic wastewater treatment processes. London, June 1986 S. M. Stronach T. Rudd J. N. Lester v Table of Contents 1 The Biochemistry of Anaerobic Digestion 1 1. 1 Kinetics of Substrate Utilisation and Bacterial Growth 3 1. 1. 1 COD Fluxes and Mean Carbon Oxidation State 3 1. 2 Bacterial Growth and Bio kinetics 4 1. 1. 2. 1 Growth and Single Substrate Kinetics 4 1. 2 Multi substrate Systems . 8 1. 2 Kinetics and Biochemistry of Hydrolysis 8 1. 3 Kinetics and Biochemistry of Fermentation and J1-Oxidation . 11 1.

Numerical Modelling of Anaerobic Digestion Processes in Agricultural Biogas Plants

Describes the
application of micro-organisms to what is still the largest biotechnology industry - waste treatment. In this text, the scientist working on one aspect of digestion aims to find information on other applications of the process.

A Mathematical Model and Computer Program for Anaerobic Digestion

Trace Elements in Anaerobic Biotechnologies

Biomethanation I In this study, a structured model based on the three-stage theory of methane fermentation was developed and applied to anaerobic treatment processes. The model is based on 16 variables including six biomass components, six substrate components, CO$_2$ and CH$_4$, total carbonic species and pH. The Monod relationship was utilized to express the growth rate of acidogens and was modified to reflect the inhibitory effect of high substrate level to the growth rates of butyrate degraders, propionate degraders and acetoclastic methanogens. Material balance equations were established by considering the system as a completely mixed suspended growth reactor. The model was mathematically expressed and solved numerically based on the 15 ordinary differential equations plus one chemical equilibrium equation. FORTRAN programs were developed to solve the mathematical model numerically by using the GEAR subroutine. The resulting model contains 24 kinetic and 14 stoichiometric parameters. Both published literature data and calculated data based on thermodynamics were used to establish default values and realistic ranges for the parameter values. Model calibration was performed by adjusting the Monod kinetic parameter values in accordance with the sequence of anaerobic degradation of organics. The calibration criteria was to minimize the standard deviation between observed and simulated results on VS, soluble complex COD, three VFA species, gas and methane production and hydrogen partial pressure. Model calibration was conducted with data collected from two systems, a pilot-scale anaerobic digester fed with waste activated sludge and a full-scale anaerobic fluidized-bed reactor fed with thermal sludge conditioning liquor. The results demonstrated that the model was able to reasonably simulate behavior for the two systems. The calibration and simulation results demonstrated that the model could be utilized to predict system performance for start-up, response to shock loadings, recovery from shock loadings, and biomass retention. Conditions leading to system failure could also be simulated by using the model. The modeling approach was useful in understanding the mechanisms of anaerobic digestion and the interactions among the different biomass. The key parameters for model calibration were hydrolysis constant and the Monod kinetic parameters for the biomass including the maximum substrate degradation and half-velocity constant.

Anaerobic Digestion – Making Biogas – Making Energy The ADG held its first International Symposium at Churchill College, Cambridge, in July 1979. The second symposium was also held at Churchill College on 30-31 July, 1981, and this, the third, took place at the same college on 30-31 July, 1983. The meeting was structured in a format which we hoped would appeal to the full range of our membership. The philosophy of the ADG is that medical microbiologists, veterinarians, toxicologists and dental bacteriologists have much to learn from each other and can best be achieved by bringing these various disciplines together frequently and in informal surroundings. Again the symposium was very generously sponsored by May and Baker Limited who met all costs of the meeting and entertained us splendidly. David Jackson and Donald Bedford were responsible for coordinating with the ADG on behalf of May and Baker and, as usual, gave us their full cooperation. This book contains the full-length papers, followed by the posters presented at the meeting. This book also serves as a vehicle for the abstracts of the first meeting of the Society for Intestinal Microbial Ecology and Disease, SIMED, held in Boston, Massachusetts. An introduction to this new society by its President, Sydney M. Finegold, M.D., precedes the abstracts. M.J. Hill VI CONTENTS Preface v List of contributors VIII Introduction to the Anaerobe Discussion Group M.J. Hill XI A guinea-pig model demonstrating synergy between Escherichia coli and Bacteroides fragilis in infected surgical wounds.
Access Free A Model For Anaerobic Degradation Of Municipal Solid Waste

Anaerobic Digestion Some terms, such as eco-friendly, circular economy and green technologies, have remained in our vocabulary, because the truth is that mankind is altering the planet to put its own subsistence at risk. Besides, for rationalization in the consumption of raw materials and energy, the recycling of waste through efficient and sustainable processes forms the backbone of the paradigm of a sustainable industry. One of the most relevant technologies for the new productive model is anaerobic digestion. Historically, anaerobic digestion has been developed in the field of urban wastes and wastewater treatments, but in the new challenge, its role is more relevant. Anaerobic digestion is a technologically mature biological treatment, which joins bioenergy production with the efficient removal of contaminants. This issue provides a specialized, but broad in scope, overview of the possibilities of the anaerobic digestion of lignocellulosic biomass (mainly forestry and agricultural wastes), which is expected to be a more promising substrate for the development of biorefineries. Its conversion to bioenergy through anaerobic digestion must solve some troubles: the complex lignocellulosic structure needs to be deconstructed by pretreatments and a co-substrate may need to be added to improve the biological process. Ten selected works advance this proposal into the future.

On-line Estimation and Adaptive Control of Bioreactors This book presents new application processes in the context of anaerobic digestion (AD), such as phosphorus recovery, microbial fuel cells (MFCs), and seaweed digestion. In addition, it introduces a new technique for the modeling and optimization of AD processes. Chapters 1 and 2 review AD as a technique for converting a range of organic wastes into biogas, while Chapter 3 discusses the recovery of phosphorus from anaerobically digested liquor. Chapters 4 and 5 focus on new techniques for modeling and optimizing AD. Chapters 6 and 7 then describe the state of the art in AD effluent treatment. The book’s final three chapters focus on more recent developments, including microbial fuel cells (MFCs) (Chapter 8), seaweed production (Chapter 9), and enzyme technologies (Chapter 10).

Benchmarking of Control Strategies for Wastewater Treatment Plants

A Mathematical Model for Process Control of the Anaerobic Digestion Process Anaerobic digestion is a major field for the treatment of waste and wastewater. Lately the focus has been on the quality of the effluent setting new demands for pathogen removal and for successful removal of unwanted chemicals during the anaerobic process. The two volumes on Biomethanation are devoted to presenting the state of art within the science and application of anaerobic digestion. They describe the basic microbiological knowledge of importance for understanding the processes of anaerobic bioreactors along with the newest molecular techniques for examining these systems. In addition, the applications for treatment of waste and wastewaters are presented along with the latest knowledge on process control and regulation of anaerobic bioprocesses. Together these two volumes give an overview of a growing area, which previously has never been presented in such a comprehensive way.

Modeling Volatile Organic Sulfur Compounds in Anaerobic Digestion Over the last decade much progress has been made in anaerobic digestion of solid waste: advances in research and development, construction of new plants, more favourable legislation. Key features of this progress are reported in these proceedings. While the selected papers cover a wide range of work on ‘solid’ organic wastes, there is a particular focus on the organic fraction of Municipal Solid Waste (MSW). Many landfills are set to close and there is a significant increase in separate collection of MSW. Biological treatments can maximise recycling and recovery of its components; anaerobic digestion, with its high energy recovery and limited environmental impact, is frequently the most cost-effective of these treatments. The future of anaerobic digestion of solid wastes is increasingly seen in the integration of this unique unit process in overall sustainable waste treatment. In Life Cycle Analysis anaerobic digestion offers several interesting features: energy recovery (a particularly important factor in third world countries); and a significantly lower contribution to global warming. Problems remain (as for all types of wastes treatments), particularly concerning the fate of micro-pollutants and overall end-product quality, but anaerobic digestion offers
Anaerobic Digestion of Solid Waste II

Biogas Production This book has been produced to give a total overview of the Activated Sludge Model (ASM) family at the start of 2000 and to give the reader easy access to the different models in their original versions. It thus presents ASM1, ASM2, ASM2d and ASM3 together for the first time. Modelling of activated sludge processes has become a common part of the design and operation of wastewater treatment plants. Today models are being used in design, control, teaching and research. Contents ASM3: Introduction, Comparison of ASM1 and ASM3, ASM3: Definition of compounds in the model, ASM3: Definition of processes in the Model, ASM3: Stoichiometry, ASM3: Kinetics, Limitations of ASM3, Aspects of application of ASM3, ASM3C: A Carbon based model, Conclusion ASM 2d: Introduction, Conceptual Approach, ASM 2d, Typical Wastewater Characteristics and Kinetic and Stoichiometric Constants, Limitations, Conclusion ASM 2: Introduction, ASM 2, Typical Wastewater Characteristics and Kinetic and Stoichiometric Constants, Wastewater Characterization for Activated Sludge Processes, Calibration of the ASM 2, Model Limitations, Conclusion, Bibliography ASM 1: Introduction, Method of Model Presentation, Model Incorporating Carbon Oxidation Nitrification and Denitrification, Characterization of Wastewater and Estimation of Parameter Values, Typical Parameter Ranges, Default Values, and Effects of Environmental Factors, Assumptions, Restrictions and Constraints, Implementation of the Activated Sludge Model Scientific and Technical Report No.9

Models of Anaerobic Infection Wastewater treatment plants are large non-linear systems subject to large perturbations in wastewater flow rate, load and composition. Nevertheless these plants have to be operated continuously, meeting stricter and stricter regulations. Many control strategies have been proposed in the literature for improved and more efficient operation of wastewater treatment plants. Unfortunately, their evaluation and comparison – either practical or based on simulation – is difficult. This is partly due to the variability of the influent, to the complexity of the biological and biochemical phenomena and to the large range of time constants (from a few minutes to several days). The lack of standard evaluation criteria is also a tremendous disadvantage. To really enhance the acceptance of innovative control strategies, such an evaluation needs to be based on a rigorous methodology including a simulation model, plant layout, controllers, sensors, performance criteria and test procedures, i.e. a complete benchmarking protocol. This book is a Scientific and Technical Report produced by the IWA Task Group on Benchmarking of Control Strategies for Wastewater Treatment Plants. The goal of the Task Group includes developing models and simulation tools that encompass the most typical unit processes within a wastewater treatment system (primary treatment, activated sludge, sludge treatment, etc.), as well as tools that will enable the evaluation of long-term control strategies and monitoring tasks (i.e. automatic detection of sensor and process faults). Work on these extensions has been carried out by the Task Group during the past five years, and the main results are summarized in Benchmarking of Control Strategies for Wastewater Treatment Plants. Besides a description of the final version of the already well-known Benchmark Simulation Model no. 1 (BSM1), the book includes the Benchmark Simulation Model no. 1 Long-Term (BSM1_LT) – with focus on benchmarking of process monitoring tasks – and the plant-wide Benchmark Simulation Model no. 2 (BSM2). Authors: Krist V. Gernaey, Technical University of Denmark, Lyngby, Denmark, Ulf Jeppsson, Lund University, Sweden, Peter A. Vanrolleghem, Université Laval, Quebec, Canada and John B. Copp, Primodal Inc., Hamilton, Ontario, Canada

Biogas Process Simulation Using Aspen Plus

Critical Evaluation of the Sugar Degradation Pathways of Anaerobic Digestion Model