IGCS BULLETIN

From the Editors' Desk





Dear Readers,

We bring to you a packed bulletin as IGCS has been brimming with major activities in the past three months. Most importantly, the IGCS Conference and 5th Anniversary Celebrations were held in February. With some 150 delegates attending, the conference was a great success and proved to be a place of sharing ideas around key sustainability themes. The conference was enriched by the IGCS Winter School on "Sustainable Application of Liquid Fuels" which was ongoing at the same time, with 30 participants from India and Germany.

man Consulate General Chennai, a third major event "Beyond Disasters in Chennai – Risk Management and Sustainable Urban Development" sought to contribute to the ongoing vital debate about Chennai's water conditions in the aftermath of the floods.

Our feature article discusses composting options of septic tank waste management to prevent disposal of untreated septage into land and water bodies, which can lead to serious health threats and environmental pollution.

Thanking you, B S Murty and Christoph Woiwode Editors

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Prof. B. S. Murty

Prof. Chr. Woiwode

In collaboration with the Ger-

IGCS NEWS

Indo German Conference on Sustainability and

IGCS 5th Anniversary Celebrations

The Indo German Center for Sustainability celebrated by Maschinenfabits 5th Anniversary with an Indo German Conference rik on Sustainability. The first scheduled dates of the (MR), conference was Dec 5 - 6th, 2015, which unfortu- was also inaugunately could not happen due to inclement weather rated as part of



Prof. Ernst Schmachtenberg

was inaugurated on 27th February 2016 at the ICSR and Urban Devel-Auditorium in IIT Madras. The programme was presided jointly by Prof Bhaskar Ramamurthi, Director, IIT Madras and Prof Ernst Schmachtenberg Rector, RWTH Aachen University. The inaugural session was Head, attended by Mr.Achim Fabig, Honourable Consul Technology, Mas-General of the Federal Republic of Germany in Chen- chinenfabrik Reinnai, Dr Akhilesh Gupta, Scientist G and Head SPLICE- hausen



Prof. Sudhir Chella Rajan

nai, India. Therefore the Conference was rescheduled to Feb. 27 – 28th, 2016 and was held at ICSR Building, at IIT Chennai, Madras, India.

conference Int. The

Germany, conditions at Chen- the conference. The main theme of the conference "Exploring was planetary boundaries and their chal-



Prof. Bhaskar Ramamurthi

lenges and opportunities". The conference included three key note lectures by Prof. P.P. Mujumdar, Chairman, Interdisciplinary Centre for Water Research, IISc, Bangalore., Prof. Dr.-Ing. Peter Gotsch,

Cooperation ΤU opment, Darmstadt and Dr. Uwe Kaltenborn Corporate GmbH. Change Germany. A total

DST, of 56 presenta-



Prof. Rafig Azzam

Heike Mock, Direc- in three parallel sessions spread over two days, by tor, DAAD, Region- researchers from Germany and India on various isal Office, New Del- sues pertaining to sustainable development in the hi. A Research Fa- back drop of climate change. These presentations cility under IGCS focused on latest developments in sustainable man-Pro- agement of wastewater and solid waste, land use gramme on Sus- management in the context of urbanization, and Power innovations in development of alternative energy Engineering, funded sources, including biofuels and solar energy.

April 2016



Photo (l.t.r.): Dignitaries on the dais Prof. Kolar, Prof. Azzam, Hon. Consul Mr. Fabig, Ms. Mock, Prof. Ramamurthi, Prof. Schmachtenberg, Dr. Gupta, Prof. Rajan, Dr. Uwe Kaltenborn

sues. 22 presentations were made by researchers as a celebration of the fifth Anniversary of the IGCS from Germany while 34 presentations by researchers proved to be an enlivening experience. The Proceedfrom India. Researchers were drawn from both aca- ings is prepared as a soft copy version so that it can demia and industry. A special poster session high- be searchable and the manuscripts are hyperlinked lighted the research being carried out under IGCS- from the Table of Contents arranged in the same DST program.

The conference saw lively discussions in the sessions with approximately 150 delegates, including research students from various universities in India and Germany participating in the discussions. Three best Further details including the proceedings can be paper awards were also presented, one in the area downloaded from <u>http://www.igcs-chennai.org/?</u> of sustainable power/energy management, one in p=4721 the area of sustainable waste management and one in the area of sustainable land resource management.

Some of the presentations also discussed policy is- A cultural programme on the evening of the first day order as that of the sessions conducted. IGCS hops that this conference record finds use as a source of material for continuing research in the areas of sustainability, to which IGCS is dedicated.





IGCS Winter School 2016 at IIT Madras on "Sustainable Application of Liquid Biofuels"

cation of Liquid Biofuels' was successfully organized at IIT Madras from February 22 to March 5, 2016 in collaboration with OWI (Oel-Waerme-Institut GmbH Aachen). The participants of the winter school included 15 students each from Germany and India with academic background of engineering, environmental and social sciences. While the Indian contingent comprise of research students from IIT Bombay (2), IIT Gawahati (2), IIT Madras(2), NIT Calicut (2), IIT Hyderabad, IIT Indore, IICT-CSIR Hyderabad, ICT Mumbai, SVNIT Surat and NIT Roourkela, the German group of 3 Ph D, 11 Masters and 2 B S students were drawn from TU Berlin, BAM, University of Freiberg, Kiel(2), Weimar(6), and Aachen(4). The school was inaugurated on 22 February by Professor Sudhir Chella Rajan, Centre Coordinator IGCS IITM and Professor Krishna Vasudevan, IGCS Area Cordinator- Energy followed up with an Inaugural Lecture on Energy Scenario in India and Germany by Professor Ajit Kumar Kolar, Former Energy Area Cordina-

The IGCS Winter School 2016 on 'Sustainable Applitor, IGCS. In his lecture, the speaker highlighted the cation of Liquid Biofuels' was successfully organized at IIT Madras from February 22 to March 5, 2016 in collaboration with <u>OWI (Oel-Waerme-Institut GmbH</u> Aachen). The participants of the winter school included 15 students each from Germany and India with academic background of engineering, environty and members of IGCS with each other.

> From Sustainability, environmental impact and energy security standpoint the biofuels are emerging as alternative fossil fuels used in combustion systems such as burners, engines etc. This IGCS Winter School focused on production, characterization and the utilization of liquid biofuels covering related fundamentals, technological implications and policy issues during 16 lectures delivered by experts from India and Germany working in the related fields. The topics covered in the lectures include Opportunities and Challenges of Biofuels of different generations, German and European Perspective of Biodiesel Research and Development in Automotive and Heating Industry, Chemistry and Analysis of Biofuels and their pro-



duction, characterization and applications, Sustaina- Beside lectures, the schedule of this Winter School bility and Life cycle analysis of Biofuels, XTL Technol- included short focused team projects and visits to ogies - How Feedstock Characteristics affect Liquid biofuel related sites around Chennai. of group activi-Properties. In these lectures, a comprehensive in- ties by formulating project definitions. sight on the scope, production and utilization of liq- groups worked on topics related to the theme of the uid biofuels including idea of tailor-made fuel of dis- Winter School involving engine testing using biotinct molecular components with optimized physico- diesel ethanol blends, characterization of bio-fuels, chemical properties for future combustion systems is combustion reaction kinetics and studies on environprovided. Besides the technical challenges a number mental, life cycle and sustainability aspects. On the of economical and environmental questions are dis- last day, the students made brief presentations of cussed with respect to the conversion of biomass their project outcome to all the mentors and organizinto liquid hydrocarbon fuels. On basis of type of ers of the Winter School.



fuel, feedstock and process used for extraction, regional factors, upstream feedstock production, soil carbon factors and economic considerations are discussed to explain how the LCA results for a given context may be usefully developed for helping policymakers. The need for replacing fossil fuel with biodiesel and its impact on system performance and environmental impact are discussed. The significance of a composition based analysis for biodiesel fuels are brought out.

In all 7



The 3 site visits undertaken by the participants during the Winter School include visit to "Mahindra Research Valley, Alternative Fuel Division", "Plant visit to Southern Railways Bio-Diesel Production Centre", and "Plant visit to OfERR Algae Farm, Navallur". In the end the feedback of the students was very positive and encouraging to look back at smoothly organized IGCS Winter School. The Winter School was coordinated by Professor Pramod S Mehta from IIT Madras and Dr Roy Hermanns of OWI, Aachen.



Indo German Exchange on

"Beyond Disasters in Chennai – Risk management and Sustainable Urban Development", 7-9 April 2016

The 2015 rains resulted in widespread inundation tain the momentum towards making tangible recomand enormous human and economic losses in wide mendations to benefit the city," said visiting faculty areas of Tamil Nadu, especially in the metropolis of at IGCS Dr. Franziska Steinbruch and Dr. Christoph Chennai. Even though lessons learned from previous Woiwode. The key note was delivered by Dr. Mohan floods have triggered changes towards better disas- Kanda (IAS, rtd.) and IGCS Area Coordinator Landuse. ter management and early warning systems, as a Experts from Indian and German academic and nonwitness to the tragic losses in Chennai, the German academic institutions like IIT Madras, Greater Chen-Consul General H.E. Achim Fabig supported a nai Municipal Corporation, TU Dortmund University meeting with key German and Indian stakeholders (Germany), Anna University, Germany's developfrom government, business, community and aca- ment cooperation agency GIZ, TU Munich, Barefoot demia, with a vision to identify practical action steps Academy, All India Disaster Mitigation Institute, to prevent such disasters, and develop sustainable Madras Chamber of Commerce and Industries, Indistrategies for future scenarios. Organized by the In- an Institute for Human Settlements, Institute for do-German Centre for Sustainability (IGCS) at IIT- Transport and Development Policies, Bonn Universi-Madras, the meeting was held on 7 and 8 April in ty, Environment Foundation India, and the Chennai Savera Hotel. A field trip was organized on 9 April to Rain Centre shared their views and experience over areas which were affected by the floods such as four panels. Chembarambakkam Lake.

our goal for the panel discussions was to help main- resilience. Panelists highlighted the need for a post-

The first panel focused on disaster risk management "Since Chennai is recovering from the recent floods, and climate adaptation, early warning systems and



Photo: Speaker: H.E. Mr. Achim Fabig, Consul General of the Federal Republic of Germany in Chennai. Seated from Left to Right: Prof. Sudhir Chella Rajan, Professor, IIT Madras and Coordinator, IGCS; Prof. R. Nagarajan, Dean, International & Alumni Relations, IIT Madras; Dr. Mohan Kanda, I.A.S. (retd.); and Prof. A. Kolar, Emeritus, IIT Madras, former IGCS Area Coordinator

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cities for temporary storm water storage. They also sewage were the focus areas of the fourth panel. Inrecommended the use of community radio to share depth discussions on water supply and sewage cyinformation during floods, and to develop a concrete cles; water sources for urban areas; and flood and communication system during disasters. Panelists drought mitigation in light of land use changes ocsuggested that disaster risk reduction be main- curred. Panelists stressed that planning actions be streamed into housing schemes, and the creation of made in view of long-term purposes, rather than as a a forum of risk management consultants, academi- fire-fighting approach, and ecosystem services solucians and NGO experts to meet in frequent intervals tions for water and waste water management be to discuss risk management and remedy measures.

The second panel highlighted governance and the role of media, and the critical role of participatory democracy to identify problems. Panelists warned about Chennai becoming a desert city if we did not break our pattern of silence. They showcased the importance of adopting traditional knowledge that our ancestors have gifted us, for example planting drought resistant paddy, which are tolerant to climatic changes and are capable of adapting to extreme weather patterns.

Regarding the role of the private sector, it was pointed out that while the private sector is usually blamed for unsustainable urban development; many industries are still recovering from the losses they incurred in December. The third panel focused on development and urbanization issues, with discussions occurring on land developers and wealth; sustainable versus parasitic urbanization models; and land use changes. To advance a holistic approach to urbanization, panelists advocated for an interdisciplinary and integrated urban planning approach, involving engineers, administrators and the society.

flood audit and to create green and open spaces in Water resources management in urban areas and understood.



The event ended with an innovative open space session where all participants identified and developed ideas to continue their work in collaborative projects to ensure sustained momentum on an issue of such significance. The open space session resulted in a number of themes that were identified by all the participants, including research, studies and toolboxes; policies; disaster awareness; technical solutions; role of corporates and private sector; local participation and governance; and public forum/platform. A report about suggestions and recommendations that arose from the conference will be published shortly.

Winter School on "URBAN AIR POLLUTION AND HEALTH **RISK** "

and

First Indian International Conference on Air Quality Management (IICAQM 2016)

11th to 16th February 2016

These two events were jointly organized by the De- pants. partment of Civil Engineering, IIT Madras and UFZ Helmholtz Centre for Environmental Research, Leipzig, Germany.

The winter school on "URBAN AIR POLLUTION AND technical presentations by leading manufactures HEALTH RISK" had five modules. First three modules namely M/s TSI Bangalore, M/s Thermo, Chennai and covered fundamentals of air pollution, monitoring, M/s Fluidyn Bangalore on recent developments in assessment and modelling of air pollution through 13 indoor and outdoor air quality monitoring equiplectures by experts working in related areas and ments and software were also arranged to all winter demonstration of various instruments used for meas- school and conference participants. In addition, a pre urement of ambient air quality and stack emissions. -conference tour to showcase on-going IGCS project The remaining two modules were part of the First on air quality monitoring activities at waste manage-Indian International Conference on Air Quality Man- ment sites and places of historical importance in agement (IICAQM 2016), that provided 24 case stud- Chennai (Mahabalipuram and Dakshina Chitra) was ies and 15 invited talks. Apart from the expert lectures, cutting edge research activities carried out in the Department of Civil Engineering, IIT Madras and UFZ Helmholtz Centre for Environmental Research, Leipzig, Germany were also showcased to the partici-

As part of the winter school and the air quality management conference, a Springer author workshop by Ms. Swati Meherishi, Senior Editor of Springer and arranged for the participants.

The first Indian International Conference on Air Quality Management (IICAQM 2016) aimed at bringing together leading academicians, scientists, engi-



Winter School and IICAQM 2016 participants

neers and research scholars to exchange and share their experiences and research results related to all aspects of air quality management including ongoing IGCS research project. This year's conference was focused on the theme: '*Healthy Air Quality, Healthy Environment and Healthy City'*.

During the conference 24 papers and five posters were presented in four technical sessions of the conference, mainly focused on (i) Air Quality Monitoring; (ii) Air Quality Assessment and Control; (iii) Air Quality Modelling; Indoor Air Quality and (iv) Health Risk Assessment. Along with this 15 invited talks took place by experts from academia, regulatory agencies and research organizations. Demonstration of air quality monitoring instruments and software by the industries and one panel discussion on "low cost sensors in urban air quality management and exposure analysis" were also included in the conference. The conference proceedings will be published as a special issue in Springer. Both events were attended by more than 66 students and 40 faculty members representing IITs, NITs, reputed universities and AICTE reorganized engineering colleges, 10 participants from government research organizations, 5 industry professionals and officials from Tamil Nadu Pollution Control Board (TNPCB), Chennai, Karnataka State Pollution Control Board (KSPCB), Bangalore, and experts from Germany, USA, Italy and India.

Winter School Inauguration function



IICAQM 2016 Inauguration function



IICAQM 2016 Panel discussion



IICAQM 2016 Valedictory



IGCS Research Scholars

Roos Gerritsen is working as a short term lecturer and researcher at IGCS from February until July 2016. Roos is an anthropologist, working at the University of Heidelberg where she teaches urban popular

and articulation of 'everyday utopias'. Her research investigates new food practices that revolve around organic food, neo-traditional recipes as well as vernacular food such as street and village food. For this research she does participant observation in and around Chennai by attending food walks, cooking sessions as well as consumption practices in shops, restaurants and so on. These various urban foodscapes have in common their call for localism, environmentalism, health and nostalgic consumption. What are the imaginaries and motivations that move these actors to seek these new forms of production and consumption? How are they related to other lifestyle politics and practices? And what are the implications of this new food consumption for the urban environment? What do they say about the everyday utopias of cities? Roos investigates these questions by seeing these new foodscapes as manifestations of sustainable urban living in everyday life worlds.



Jonas Cordova Gomez is a civil engineer from UTFSM Valparaiso, Chile. He currently studies the MSc "Sustainability, Society and the Environment" at University of Kiel, Germany with focus in water re-

and media anthropology. sources and society and governance. His background Her research focuses on and work experience in developing countries like visual culture, Zambia and Haiti has been a motivation to keep media and urban aes- working in the area of sustainable development in an thetics and cultural politics international context. He is currently working on his in south India. At the IGCS, master thesis on the topic of Sustainable Urban in collaboration with Chris- Drainage Systems (SUDS) in the area of Velachery, toph Woiwode, she is Chennai under the supervision of Prof. F. Steinbruch working on sustainable (IGCS), Prof. K.P. Sudheer (IIT Madras) and Prof. Niand ethical food consump- cola Fohrer (CAU Kiel) He will be part of the IGCS as tion and the imagination research scholar between March and June 2016.

> Chennai has been intensively affected in recent times by natural disasters like droughts and floods, the last one in December 2015. Part of Velachery, one of the residential neighborhood of Chennai affected by the floods, was only included some few years ago to the urban area and had an unplanned and fast development. With a dense urbanization, high proportion of sealed areas and the lack of green areas, the surface runoff turns in a major source of urban flooding and water pollution. Therefore it is necessary to find sustainable solutions adapted to different projected scenarios. The research at IGCS intends to find some of them, which will be proposed to the city but also to the household level. Understanding the actual conditions on the field, infrastructure and human behavior will be very important. Therefore a survey of infrastructure, collecting data and mapping will be done in these 3 months. Afterwards a model will be created and the collected information will be analyzed to see which solutions would be the best for the city and the community.

FEATURE

Co-composting of Septage in Aerated Static Pile Anu Rachel Thomas*, Prof. Ligy Philip*, Prof.Dr.-Ing. Martin Kranert**

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Introduction

Sludge is a type of waste, produced from the treatment of wastewater in on-site (e.g. septic tank) and off-site (e.g. activated sludge) systems. Septic tank waste (septage) management is a major problem in developing countries as they mainly depend on onsite waste management systems for sanitation.

Disposal of untreated septage into land and water bodies can lead to serious health threats and environmental pollution (NUSP, 2011) as it is a host for many pathogens like viruses, bacteria, and parasites (Yen-Phi et al., 2010; Hédi et al., 2009). It is also a cocktail of many of the emerging contaminants (ECs) like pharmaceutically active compounds (PhACs) (Verstraeten et al., 2005) and personal care products (USEPA, 2009), which are mostly xenobiotic in nature. The septage thrown into fields or water bodies in partially treated state will undergo further decomposition and emit undesirable greenhouse gases (GHGs) like methane, carbon dioxide and nitrous oxide (Diaz-Valbuena et al., 2011)

Sludge can be treated by different methods like stabilisation, thickening, dewatering, drying and incineration. The stabilisation process can be carried out under aerobic or anaerobic conditions. Composting is an aerobic mode of sludge stabilization process and it is a sustainable method for managing the septage biosolids (Haug, 1980).

Composting is the biological decomposition of organic material into a humus-like substance. Fig 1 shows a typical composting process. The process occurs naturally, but can be accelerated and improved by controlling environmental factors such as carbon: nitrogen ratio, moisture content, pH, temperature and oxygen supply. Septage solids are mixed with a bulking agent (e.g., wood chips, dry leaves) and aerated mechanically or by turning. Biological activity generates temperatures that are sufficiently high to destroy pathogens. The composting process converts septage into a stable, humus material that can be used for soil amendment.





practices that balance the carbon: nitrogen ratio and for the following parameters: water content (105°C provide adequate aeration and moisture can mini- for 24h), pH and electrical conductivity (EC) (1:10 w/ mize GHG emissions. Since the C:N ratio of septage is v compost: water extract) and ash content (550°C for low, it has to be co-composted with organic waste 2 h, previously oven-dried at 105°C). The filtrate was and bulking material in order to increase the C:N used for total organic carbon (TOC), Chemical oxygen ratio and moisture removal for efficient and fast deg- demand (COD), Ammonia (NH4⁺-N) and Nitrate (NO3⁻radation.

Problem Statement

Even though composting can be considered as a sustainable treatment technology for septage management, only very few research studies have been carried out to understand the efficiency of co-

composting of septage. In this study, efforts were made to find out the suitable bulking material using self-heating test. A lab scale aerated static pile composting system was made to understand composting mechanism and to monitor the potential greenhouse gases emissions from the system during the treatment.

Experimental Investigation

Self-Heating test was carried out by mixing different bulking materials with sludge. Mixing was based on moisture content. Biowaste, which is rich in organic content, was used as a co-composting material with sludge. The sludge that resembles septage was obtained by mixing anaerobic digestate and raw wastewater in the ratio of 1:1 (by volume). The bulking materials like wood

barks, dry leaves and straw were obtained from the periphery of ISWA lab, University of Stuttgart, Germany. Biowaste was obtained from Fermentation plant in Leonberg, Stuttgart. In order to understand the detailed mechanism of composting, an aerated Results and Discussion static pile composting setup was made at ISWA, University of Stuttgart. The setup consisted of a composting drum with provisions made for compost sampling, temperature monitoring, gas sampling and leachate collection. The experimental set up is

Also, USCC (2008) reported that good composting shown in Fig. 2. The compost samples were analyzed N) analyses. Gas samples were collected from the headspace of drum and analysed using online FTIR. Temperature data were stored using a temperature data logger. Aeration was provided from the bottom of the pile using an air pump having a capacity of 4.5Nm³/h



Fig. 2 Experimental set-up of aerated static pile composting

Self-heating test was conducted for different feedstock composition like (1) bulking material and sludge (2) bulking material, sludge and biowaste and (3) biowaste and sludge. Fig 3 shows the Dewar flask, in which self-heating test were carried out. A feedstock composition which shows a rapid increase in

temperature and retains above 55°C can be consid- The temperature profile during composting is shown ered as the best composition. in Fig 4. A typical composting profile will have three



Fig. 3 Self-heating test in Dewar flasks

Temperature is considered as a silver goal in composting process. As microorganisms consume organic matter for their growth, heat will be released as a byproduct. This is the reason for temperature development. The results revealed that the mix of dry leaves, biowaste and sludge is suitable for composting when compared with other six compositions.

A feed stock composition of 22 kg sludge, 2 kg dry leaves and 46 kg biowaste was used for the lab scale aerated static pile composting system.

The mixing was performed in such a manner that the initial moisture content attained 66% and a C:N ratio of 28, which is the recommended composting criteria (Rynk, 1992)



Fig. 4 Temperature profile during composting

phases: mesophilic phase (20-45°C), thermophilic phase (45-70°C) and cooling phase.

The temperature profile passes through all the three phases. The retention at higher temperature (>55°C for more than 3 days) met the regulatory requirement for pathogen inactivation.

The compost samples were analysed initially, and finally. Initially, the compost had a pH 5.07, EC 2.72 mS/cm, TOC 1890 mg/L, COD 4650 mg/L, NH4+-N 63.8 mg/L, NO3-N 7.5 mg/L, wet bulk density 365 mg/m³ and an ash content of 28%. The final compost resulted in a pH 7.48, EC 1.52 mS/cm, TOC 398 mg/L, COD 1750 mg/L, NH4⁺-N 24.8 mg/L, NO3⁻-N 3.5 mg/L, wet bulk density 1100 mg/m³ and an ash content of 36%. The moisture content reduced from 66% to 56%. The reduction in organic fraction and nutrients indicates a significant microbial activity for organic matter transformation. An increase in pH might have been caused by the volatilization of ammonia gas. EC is an indicator of salinity. Higher salinity can cause phytotoxic effects. Since the EC was decreasing during composting, the final compost can be used for fertilizer application. As composting progresses, the mass and volume get reduced. This may be the reason for increase in wet bulk density.

Methane, carbon dioxide and nitrous oxide were monitored throughout the composting period. The concentrations of all the gases were fluctuating continuously. This may be due to the occurrence of different biological processes inside the composting pile. The methane gas concentration varied from 100-1000 mg/m³ and nitrous oxide was measured in the concentration range of 0.5-10 mg/m³. The ratio of carbon dioxide to methane was always found to be above one. This ensures that the aerobic condition was prevailing inside the composting drum (Nguyen, 2012). Gas emission studies were also carried out during thermophilic phase. The results showed that GHG emissions were less in composting when compared to that from landfills (USCC, 2007).

Summary and Conclusions

Self -heating test helped to find a better feed stock composition. Sustained higher temperature ensured pathogen inactivation. Final compost quality indicated that it can be used as a fertilizer since it has enough organic and nutrient content for plants to grow. In general, co-composting can be a suitable and sustainable option for septage treatment.

References

Diaz-Valbuena, L. R., Leverenz, H. L., Cappa, C. D., Tchobanoglous, G., Horwath, W. R. and Darby, J. L., 2011. "Methane, Carbon Dioxide, and Nitrous Oxide Emissions from Septic Tank Systems." *Environmental science & technology* 45(7): 2741–47.

Haug, R. T., 1980 "The Practical Handbook of Composting"

Hédi, R. M., Didier Lecomte, D., Ladevie, B. and Sablayrolles, C., 2009. "Monitoring of Pathogenic Microorganisms Contamination during Heat Drying Process of Sewage Sludge." 2009, *Process Safety and Environmental Protection* 87(6): 377–86.

Nguyen, T. P., 2012 "Greenhouse Gas Emissions from Composting and Anaerobic Digestion Plants", Doctoral thesis, Universitat zu Bonn, Germany.

NUSP, 2011. "Septage Management in Urban India."

Rynk, R., 1992. "On-farm Composting Handbook." NRSA-54, North East Regional Agricultural Engineering Service, Ithica, Ny 14853-5701.

USCC. 2007. "Composting , Global Climate Change and Carbon Trading." : 2006–8. "Greenhouse Gases and the Role of Composting : A Primer for Compost." : 5–7.

USEPA. 1994. "Guide to Septage Treatment and Disposal Guide to Septage Treatment Disposal." (September)

Verstraeten, I. M., Fetterman, G. S., Meyer, M. T., Bullen, T. and Sebree, S. K., 2005. "Use of Tracers and Isotopes to Evaluate Vulnerability of Water in Domestic Wells to Septic Waste." *Groundwater Monitoring & Remediation* 25(2):107–117.

Yen-Phi, V. T., Rechenburg, A., Vinneras, B. and Kistemann, T., 2010. "Pathogens in Septage in Vietnam." *Science of the total environment* 408(9): 2050–53.

Upcoming Event

IGCS Summer School 2016

Biomass and Coal

– Two Carbon Fuels of Different Ages: German and Indian Perspectives 09 July to 18 July 2016

Technical University Berlin

The nine-day program addresses a variety of aspects related to the sustainable and clean use of biomass and coal. Lectures by German and Indian representatives from academia, industry, and politics will introduce technical, environmental, economic, and political aspects of the supply and use of these two solid fuels. These lectures will be designed to foster a lively discussion between the participants. Furthermore, the participants will carry out projects related to the topics of the lectures. Here, the participants are expected to team up with their fellow students with different academic backgrounds to achieve fruitful results based on interdisciplinary teamwork. The program is complemented by topic-related excursions.

For further information visit http://www.igcs-chennai.org/?page_id=3590

Book Release "Disaster Management in India: Evolution of Institutional Arrangements and Operational Strategies"

On 3rd March 2016 a book release function was held at MS Swaminathan Research Foundation, Chennai. The book "Disaster Management in India: Evolution of Institutional Arrangements and Operational Strategies" is authored by Dr. Mohan Kanda. Dr. Kanda is adjunct faculty at the IGCS as Area Coordinator in landuse, Department of Humanities and Social Sciences, IIT Madras. Foremost, however, he is a retired Indian Administrative Service officer of Andhra Pradesh who has spent over four decades in public service and has served the state and the central governments in several capacities in various important departments, including as Secretary to the Government of India and Chief Secretary to the Government of Andhra Pradesh. After retirement from the Service, Dr. Kanda served as a Member of the National Disaster Management Authority (NDMA), Government of India, and as a member of the Steering Committee of the Planning Commission for the formulation of the 12th Five Year Plan for "Agriculture and Allied Sectors".





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Website www.igcs-chennai.org