

Data augmentation approaches for improving animal audio classification

In this paper we present ensembles of classifiers for automated animal audio classification, exploiting different data augmentation techniques for training Convolutional Neural Networks (CNNs). The specific animal audio classification problems are i) birds and ii) cat sounds, whose datasets are freely available. We train five different CNNs on the original datasets and on their versions augmented by four augmentation protocols, working on the raw audio signals or their representations as spectrograms. We compared our best approaches with the state of the art, showing that we obtain the best recognition rate on the same datasets, without ad hoc parameter optimization. Our study shows that different CNNs can be trained for the purpose of animal audio classification and that their fusion works better than the stand-alone classifiers. To the best of our knowledge this is the largest study on data augmentation for CNNs in animal audio classification audio datasets using the same set of classifiers and parameters. Our MATLAB code is available at <https://github.com/LorisNanni>.

General information

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MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Computational Biophysics and Imaging Group, Università degli Studi di Padova, Italy

Contributors: Nanni, L., Maguolo, G., Paci, M.

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Original language: English

ASJC Scopus subject areas: Ecology, Evolution, Behavior and Systematics, Ecology, Modelling and Simulation, Ecological Modelling, Computer Science Applications, Computational Theory and Mathematics, Applied Mathematics
Keywords: Acoustic features, Animal audio, Audio classification, Data augmentation, Ensemble of classifiers, Pattern recognition

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Source ID: 85082116223

Research output: Contribution to journal > Article > Scientific > peer-review

Classifying soil stoniness based on the excavator boom vibration data in mounding operations

The stoniness index of forest soil describes the stone content in the upper soil layer at depths of 20–30 centimeters. This index is not available in any existing map databases, and traditional measurements for the stoniness of the soil have always necessitated laborious soil-penetration methods. Knowledge of the stone content of a forest site could be of use in a variety of forestry operations. This paper presents a novel approach to obtaining automatic measurements of soil stoniness during an excavator-based mounding operation. The excavator was equipped with only a low-cost inertial measurement unit and a satellite navigation receiver. Using the data from these sensors and manually conducted soil stoniness measurements, supervised machine learning methods were utilized to build a model that is capable of predicting the stoniness class of a given mounding location. This study compares different classifiers and feature selection methods to find the most promising solution for this learning problem. The discussion includes a proposition for a meaningful measurement resolution of the soil's stoniness, and a practical method for evaluating the variability of the stone content of the soil. The results indicate that it is possible to predict the soil stoniness class with 70% accuracy using only the inertial and location measurements.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation Technology and Mechanical Engineering, Metsäteho Oy

Contributors: Melander, L., Ritala, R., Strandström, M.

Publication date: 2019

Peer-reviewed: Yes

Publication information

Journal: Silva Fennica

Volume: 53

Issue number: 2
Article number: 10068
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Ratings:

Scopus rating (2019): CiteScore 3.1 SJR 0.589 SNIP 1.007

Original language: English

ASJC Scopus subject areas: Forestry, Ecological Modelling

Keywords: Activity recognition, Spot mounding, Stoniness classification, Supervised machine learning

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<http://urn.fi/URN:NBN:fi:tty-201907011929>

Source: Scopus

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Research output: Contribution to journal › Article › Scientific › peer-review

Remediation of sedimented fiber originating from pulp and paper industry: Laboratory scale anaerobic reactor studies and ideas of scaling up

Anaerobic treatment of sedimented fibers collected from bottom of a bay that had been receiving pulp and paper mill wastewater for about 70 years were studied for the first time in semi-continuously fed continuously stirred tank reactors (CSTR). Anaerobic treatment of the fiber sediment was shown to be feasible, without dilution and with nitrogen and buffer supplement, at organic loading rates (OLR) up to 2.5 kg VS/m³d and hydraulic retention times (HRT) of 60 d resulting in methane yields of 201 ± 18 L CH₄/kg VS. Co-digestion of sedimented fiber with sewage sludge at an OLR of 1.5 kg VS/m³d and HRT of 20 d resulted in a methane production of 246 ± 10 L CH₄/kg VS. The techno-economic feasibility of mono and co-digestion process together with several case dependent factors such as maximum operable OLR, digestate utilization needs to be evaluated before making further conclusions for larger scale remediation applications.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Finnish Consulting Group (FCG Suunnittelu ja tekniikka Oy)

Contributors: Chatterjee, P., Lahtinen, L., Kokko, M., Rintala, J.

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Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Anaerobic digestion, Co-digestion, CSTR, Methane, Pulp and paper industry, Sedimented fiber

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Bibliographical note

INT=keb, "Lahtinen, Leija"

Source: Scopus

Source ID: 85053165247

Research output: Contribution to journal › Article › Scientific › peer-review

Removal and recovery of uranium(VI) by waste digested activated sludge in fed-batch stirred tank reactor

This study demonstrated the removal and recovery of uranium(VI) in a fed-batch stirred tank reactor (STR) using waste digested activated sludge (WDAS). The batch adsorption experiments showed that WDAS can adsorb 200 (±9.0) mg of uranium(VI) per g of WDAS. The maximum adsorption of uranium(VI) was achieved even at an acidic initial pH of 2.7 which increased to a pH of 4.0 in the equilibrium state. Desorption of uranium(VI) from WDAS was successfully

demonstrated from the release of more than 95% of uranium(VI) using both acidic (0.5 M HCl) and alkaline (1.0 M Na₂CO₃) eluents. Due to the fast kinetics of uranium(VI) adsorption onto WDAS, the fed-batch STR was successfully operated at a mixing time of 15 min. Twelve consecutive uranium(VI) adsorption steps with an average adsorption efficiency of 91.5% required only two desorption steps to elute more than 95% of uranium(VI) from WDAS. Uranium(VI) was shown to interact predominantly with the phosphoryl and carboxyl groups of the WDAS, as revealed by in situ infrared spectroscopy and time-resolved laser-induced fluorescence spectroscopy studies. This study provides a proof-of-concept of the use of fed-batch STR process based on WDAS for the removal and recovery of uranium(VI).

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Helmholtz-Zentrum Dresden-Rossendorf, Ita-Suomen yliopisto

Contributors: Jain, R., Peräniemi, S., Jordan, N., Vogel, M., Weiss, S., Foerstendorf, H., Lakaniemi, A.

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Peer-reviewed: Yes

Publication information

Journal: Water Research

Volume: 142

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Scopus rating (2018): CiteScore 12.6 SJR 2.721 SNIP 2.486

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Adsorption, Desorption, Infrared spectroscopy, Sludge, STR, Uranium

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Research output: Contribution to journal > Article > Scientific > peer-review

Anaerobic digestion of 30–100-year-old boreal lake sedimented fibre from the pulp industry: Extrapolating methane production potential to a practical scale

Since the 1980s, the pulp and paper industry in Finland has resulted in the accumulation of fibres in lake sediments. One such site in Lake Näsijärvi contains approximately 1.5 million m³ sedimented fibres. In this study, the methane production potential of the sedimented fibres (on average 13% total solids (TS)) was determined in batch assays. Furthermore, the methane production from solid (on average 20% TS) and liquid fractions of sedimented fibres after solid-liquid separation was studied. The sedimented fibres resulted in fast methane production and high methane yields of 250 ± 80 L CH₄/kg volatile solids (VS). The main part (ca. 90%) of the methane potential was obtained from the solid fraction of the sedimented fibres. In addition, the VS removal from the total and solid sedimented fibres was high, 61–65% and 63–78%, respectively. The liquid fraction also contained a large amount of organics (on average 8.8 g COD/L), treatment of which also has to be considered. The estimations of the methane production potentials in the case area showed potential up to 40 million m³ of methane from sedimented fibres.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering

Contributors: Kokko, M., Koskue, V., Rintala, J.

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Journal: Water Research

Volume: 133

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2018): CiteScore 12.6 SJR 2.721 SNIP 2.486

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Anaerobic digestion, Methane, Pulp and paper industry, Sedimented fibre

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Research output: Contribution to journal › Article › Scientific › peer-review

Biohydrogen production from xylose by fresh and digested activated sludge at 37, 55 and 70 °C

Two heat-treated inocula, fresh and digested activated sludge from the same municipal wastewater treatment plant, were compared for their H₂ production via dark fermentation at mesophilic (37 °C), thermophilic (55 °C) and hyperthermophilic (70 °C) conditions using xylose as the substrate. At both 37 and 55 °C, the fresh activated sludge yielded more H₂ than the digested sludge, whereas at 70 °C, neither of the inocula produced H₂ effectively. A maximum yield of 1.85 mol H₂ per mol of xylose consumed was obtained at 55 °C. H₂ production was linked to acetate and butyrate production, and there was a linear correlation ($R^2 = 0.96$) between the butyrate and H₂ yield for the fresh activated sludge inoculum at 55 °C. Approximately 2.4 mol H₂ per mol of butyrate produced were obtained against a theoretical maximum of 2.0, suggesting that H₂ was produced via the acetate pathway prior to switching to the butyrate pathway due to the increased H₂ partial pressure. Clostridia sp. were the prevalent species at both 37 and 55 °C, irrespectively of the inoculum type. Although the two inocula originated from the same plant, different thermophilic microorganisms were detected at 55 °C. Thermoanaerobacter sp., detected only in the fresh activated sludge cultures, may have contributed to the high H₂ yield obtained with such an inoculum.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Institute for Water Education, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education

Contributors: Dessi, P., Lakaniemi, A., Lens, P. N. L.

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Peer-reviewed: Yes

Publication information

Journal: Water Research

Volume: 115

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Ratings:

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Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Biohydrogen, Butyrate, Dark fermentation, Inocula, Temperature, Xylose

Electronic versions:

Dessi et al 2017 - Biohydrogen production from xylose. Embargo ended: 28/02/19

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<http://urn.fi/URN:NBN:fi:tty-201902051212>. Embargo ended: 28/02/19

Source: Scopus

Source ID: 85014366720

Research output: Contribution to journal › Article › Scientific › peer-review

Effect of temperature on selenium removal from wastewater by UASB reactors

The effect of temperature on selenium (Se) removal by upflow anaerobic sludge blanket (UASB) reactors treating selenate and nitrate containing wastewater was investigated by comparing the performance of a thermophilic (55 °C) versus a mesophilic (30 °C) UASB reactor. When only selenate (50 µM) was fed to the UASB reactors (pH 7.3; hydraulic retention time 8 h) with excess electron donor (lactate at 1.38 mM corresponding to an organic loading rate of 0.5 g COD L⁻¹ d⁻¹), the thermophilic UASB reactor achieved a higher total Se removal efficiency (94.4 ± 2.4%) than the mesophilic UASB reactor (82.0 ± 3.8%). When 5000 µM nitrate was further added to the influent, total Se removal was again better under thermophilic (70.1 ± 6.6%) when compared to mesophilic (43.6 ± 8.8%) conditions. The higher total effluent Se concentration in the mesophilic UASB reactor was due to the higher concentrations of biogenic elemental Se nanoparticles (BioSeNPs). The shape of the BioSeNPs observed in both UASB reactors was different: nanospheres and nanorods, respectively, in the mesophilic and thermophilic UASB reactors. Microbial community analysis showed the presence of selenate respirers as well as denitrifying microorganisms.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Institute for Water Education, UNESCO-IHE Institute for Water Education, Dept. of Civil-Environmental Engineering and Architecture, DICAAR, Université Paris-Est, UPEM, Department of Biochemical Engineering and Biotechnology, Indian Institute of Technology, Delhi, India, IRD UMR 206

Contributors: Dessi, P., Jain, R., Singh, S., Seder-Colomina, M., van Hullebusch, E. D., Rene, E. R., Ahammad, S. Z., Carucci, A., Lens, P. N. L.

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Pages: 146-154

Publication date: 1 May 2016

Peer-reviewed: Yes

Publication information

Journal: Water Research

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ISSN (Print): 0043-1354

Ratings:

Scopus rating (2016): CiteScore 10.9 SJR 2.663 SNIP 2.583

Original language: English

ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling

Keywords: Nitrate, Selenate, Selenium nanoparticles, Thermophilic, UASB

DOIs:

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Source: Scopus

Source ID: 84959326965

Research output: Contribution to journal > Article > Scientific > peer-review

Data-based stochastic modeling of tree growth and structure formation

We introduce a general procedure to match a stochastic functional-structural tree model (here LIGNUM augmented with stochastic rules) with real tree structures depicted by quantitative structure models (QSMs) based on terrestrial laser scanning. The matching is done by iteratively finding the maximum correspondence between the measured tree structure and the stochastic choices of the algorithm. First, we analyze the match to synthetic data (generated by the model itself), where the target values of the parameters to be estimated are known in advance, and show that the algorithm converges properly. We then carry out the procedure on real data obtaining a realistic model. We thus conclude that the proposed stochastic structure model (SSM) approach is a viable solution for formulating realistic plant models based on data and accounting for the stochastic influences.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mathematics, Research group: MAT Inverse Problems

Contributors: Potapov, I., Järvenpää, M., Åkerblom, M., Raumonon, P., Kaasalainen, M.

Publication date: 2016

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Publication information

Journal: Silva Fennica

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Issue number: 1

Article number: 1413

ISSN (Print): 0037-5330

Ratings:

Scopus rating (2016): CiteScore 2 SJR 0.702 SNIP 1.116

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Forestry

Keywords: Data fitting, Form diversity, Morphological plasticity, Plant model, Quantitative structure models, Stochastic functional-structural, Terrestrial lidar

DOIs:

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Source: Scopus

Source ID: 84983200698

Mesophilic anaerobic digestion of pulp and paper industry biosludge-long-term reactor performance and effects of thermal pretreatment

The pulp and paper industry wastewater treatment processes produce large volumes of biosludge. Limited anaerobic degradation of lignocellulose has hindered the utilization of biosludge, but the processing of biosludge using anaerobic digestion has recently regained interest. In this study, biosludge was used as a sole substrate in long-term (400 d) mesophilic laboratory reactor trials. Nine biosludge batches collected evenly over a period of one year from a pulp and paper industry wastewater treatment plant had different solid and nutrient (nitrogen, phosphorus, trace elements) characteristics. Nutrient characteristics may vary by a factor of 2-11, while biomethane potentials (BMPs) ranged from 89 to 102 NL CH₄ kg⁻¹ VS between batches. The BMPs were enhanced by 39-88% with thermal pretreatments at 105-134 °C. Despite varying biosludge properties, stable operation was achieved in reactor trials with a hydraulic retention time (HRT) of 14 d. Hydrolysis was the process limiting step, ceasing gas production when the HRT was shortened to 10 days. However, digestion with an HRT of 10 days was feasible after thermal pretreatment of the biosludge (20 min at 121 °C) due to enhanced hydrolysis. The methane yield was 78 NL CH₄ kg⁻¹ VS for untreated biosludge and was increased by 77% (138 NL CH₄ kg⁻¹ VS) after pretreatment.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio)

Contributors: Kinnunen, V., Ylä-Outinen, A., Rintala, J.

Number of pages: 7

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Publication date: 15 Dec 2015

Peer-reviewed: Yes

Early online date: 5 Sep 2015

Publication information

Journal: Water Research

Volume: 87

Article number: 11500

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2015): CiteScore 10.5 SJR 2.665 SNIP 2.49

Original language: English

ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling

Keywords: Biogas, Hydrothermal pretreatment, Lignin, Methane production, Secondary sludge, Waste activated sludge

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Bibliographical note

AUX=keb,"Ylä-Outinen, A."

Source: Scopus

Source ID: 84941946419

Research output: Contribution to journal › Article › Scientific › peer-review

Applicability of portable tools in assessing the bearing capacity of forest roads

Forest roads provide access to logging sites and enable transportation of timber from forest to mills. Efficient forest management and forest industry are impossible without a proper forest road network. The bearing capacity of forest roads varies significantly by weather conditions and seasons since they are generally made of poor materials and the constructed layers may be mixed with subgrade. A bearing capacity assessment is valuable information when trafficability is uncertain and rutting is obvious. In this study, bearing capacity measurements were carried out using the light falling weight deflectometer (LFW), the dynamic cone penetrometer (DCP) and the conventional falling weight deflectometer (FWD). The aim was to compare their measurement results in relation to road characteristics and moisture conditions. Data were collected from 35 test road sections in four consecutive springs and during one summer. The test road sections had measurement points both on the wheel path and the centre line. The data show logical correlations between measured quantities, and the study presents reliable regression models between measuring devices. The results indicate that light portable tools, the DCP and the LFW, can in most cases be used instead of the expensive falling weight deflectometer on forest roads.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Earth Constructions, Life Cycle Effectiveness of the Built Environment (LCE@BE), Natural Resources Institute Finland (Luke), Natural Resources Institute Finland

Contributors: Kaakkurivaara, T., Vuorimies, N., Kolisoja, P., Uusitalo, J.

Number of pages: 26

Publication date: 2015

Peer-reviewed: Yes

Publication information

Journal: Silva Fennica

Volume: 49

Issue number: 2

Article number: 1239

ISSN (Print): 0037-5330

Ratings:

Scopus rating (2015): CiteScore 2.2 SJR 0.64 SNIP 1.019

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Forestry

Keywords: Dynamic cone penetrometer, Elastic modulus, Falling weight deflectometer, Light weight deflectometer, Stiffness

DOIs:

10.14214/sf.1239

Source: Scopus

Source ID: 84929222878

Research output: Contribution to journal › Article › Scientific › peer-review

Decision-making in rights exporting: The integrated process

Rights exporting plays an essential role in the battle of fighting for Digital Rights Management (DRM) interoperability. The decision making process determines the results of rights exporting. In order to achieve optimal results in rights exporting, we leverage the process with algorithms for rights adaptation and rights decomposition. We also demonstrate how the proposed process can lead to improved results.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D)

Contributors: Lu, W., Zhang, Z., Nummenmaa, J.

Number of pages: 8

Pages: 219-226

Publication date: 2013

Host publication information

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ISBN (Print): 9781450320047

ASJC Scopus subject areas: Information Systems and Management, Ecological Modelling

Keywords: DRM interoperability, rights exporting

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Source: Scopus

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Thermophilic anaerobic digestion of pulp and paper mill primary sludge and co-digestion of primary and secondary sludge

Anaerobic digestion of pulp and paper mill primary sludge and co-digestion of primary and secondary sludge were studied for the first time in semi-continuously fed continuously stirred tank reactors (CSTR) in thermophilic conditions. Additionally, in batch experiments, methane potentials of 210 and 230 m³CH₄/t volatile solids (VS)_{added} were obtained for primary, and 50 and 100 m³CH₄/tVS_{added} for secondary sludge at 35 °C and 55 °C, respectively. Anaerobic digestion of primary sludge was shown to be feasible with organic loading rates (OLR) of 1-1.4 kgVS/m³d and hydraulic retention times (HRT) of 16-32 d resulting in methane yields of 190-240 m³CH₄/tVS_{fed}. Also the highest tested OLR of 2 kgVS/m³d and the shortest HRT of 14-16 d could be feasible, if pH stability is confirmed. Co-digestion of primary and secondary

sludge with an OLR of $1 \text{ kgVS/m}^3 \text{ d}$ and HRTs of 25-31 d resulted in methane yields of $150\text{-}170 \text{ m}^3 \text{CH}_4/\text{tVS}_{\text{fed}}$. In the digestion processes, cellulose and hemicellulose degraded while lignin did not. pH adjustment and nitrogen deficiency needs to be considered when planning anaerobic digestion of pulp and paper mill wastewater sludges. © 2012 Elsevier Ltd.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Tampere University of Technology, Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä

Contributors: Bayr, S., Rintala, J.

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Publication date: 1 Oct 2012

Peer-reviewed: Yes

Publication information

Journal: Water Research

Volume: 46

Issue number: 15

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2012): CiteScore 8.1 SJR 2.914 SNIP 2.442

Original language: English

ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling

Keywords: ADF, ADL, Anaerobic digestion, CSTR, FM, HRT, Methane, NDF, OLR, Primary sludge, Pulp and paper mill, SCOD, Secondary sludge, Thermophilic, TKN, TS, VFA, VS

DOIs:

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<http://www.scopus.com/inward/record.url?scp=84864052991&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=keb bio,FACT1=1

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Research output: Contribution to journal › Article › Scientific › peer-review