Avaliação da Suinocultura Brasileira pelo Conceito de Economia Circular: da Alimentação dos Suínos à Digestão Anaeróbia

22/03/2023

Dr. Airton Kunz

Pesquisador da Embrapa Suínos e Aves

Embrapa

Exportações de ovos crescem 81,5% em 2021

10/01/2022

EXPORTAÇÕES DE CARNE DE FRANGO CRESCEM 19,7% EM JANEIRO

07/02/2022

Exportações de carne suína aumentam 18,2% em janeiro

08/02/2022

ABPA PROJETA DESEMPENHO POSITIVO PARA AVICULTURA E SUINOCULTURA EM 2021 E 2022

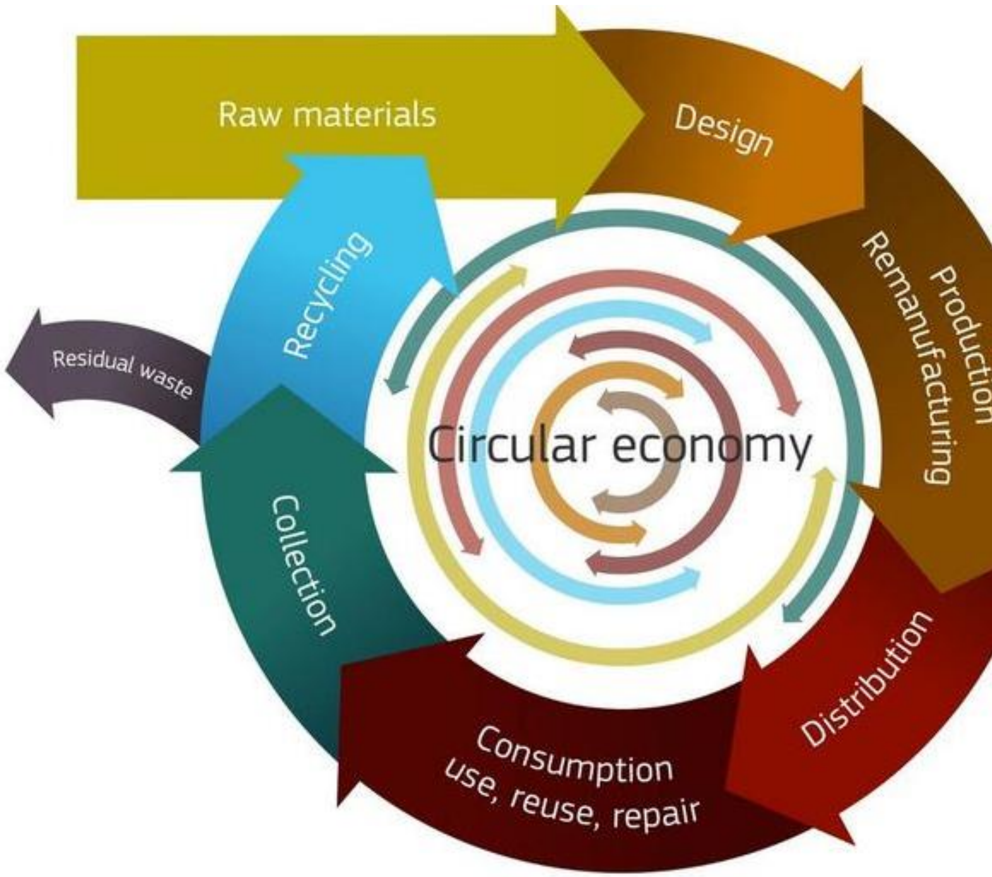
16/12/2021

Fonte: abpa-br.org/mercados

O que é economia circular?

O conceito de economia circular (EC) propõe a manutenção do valor dos recursos extraídos e produzidos em circulação por meio de cadeias produtivas integradas.

Fonte:Oliveira et al 2019



Processos Produtivos Produzem Resíduos!!!

Como podemos gerenciar?

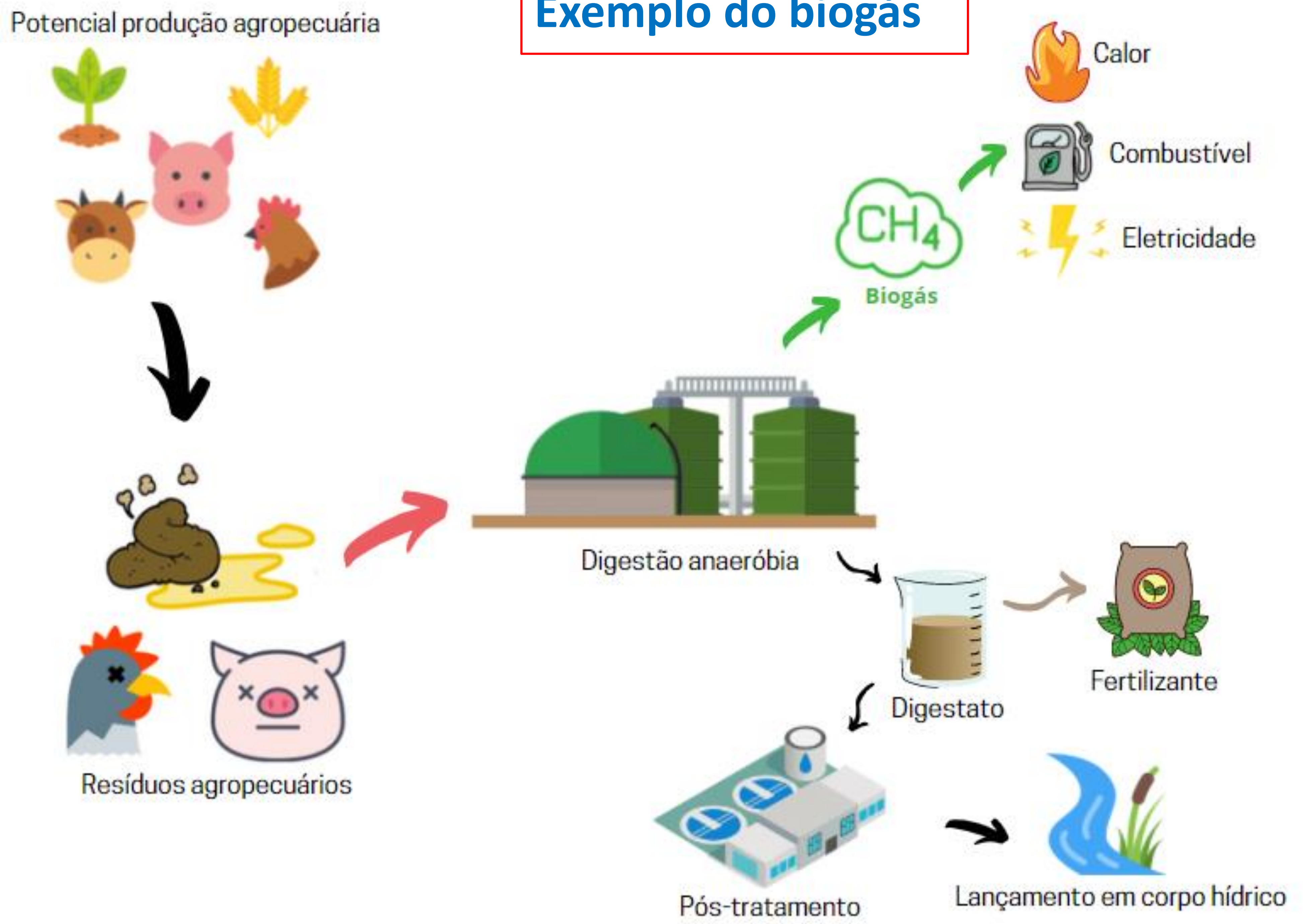
- ✓ Conheça o resíduo.
- ✓ Quais os desafios?
- ✓ Como reduzir o impacto ambiental e agregar valor ao passivo gerado?

Antes de tratar...

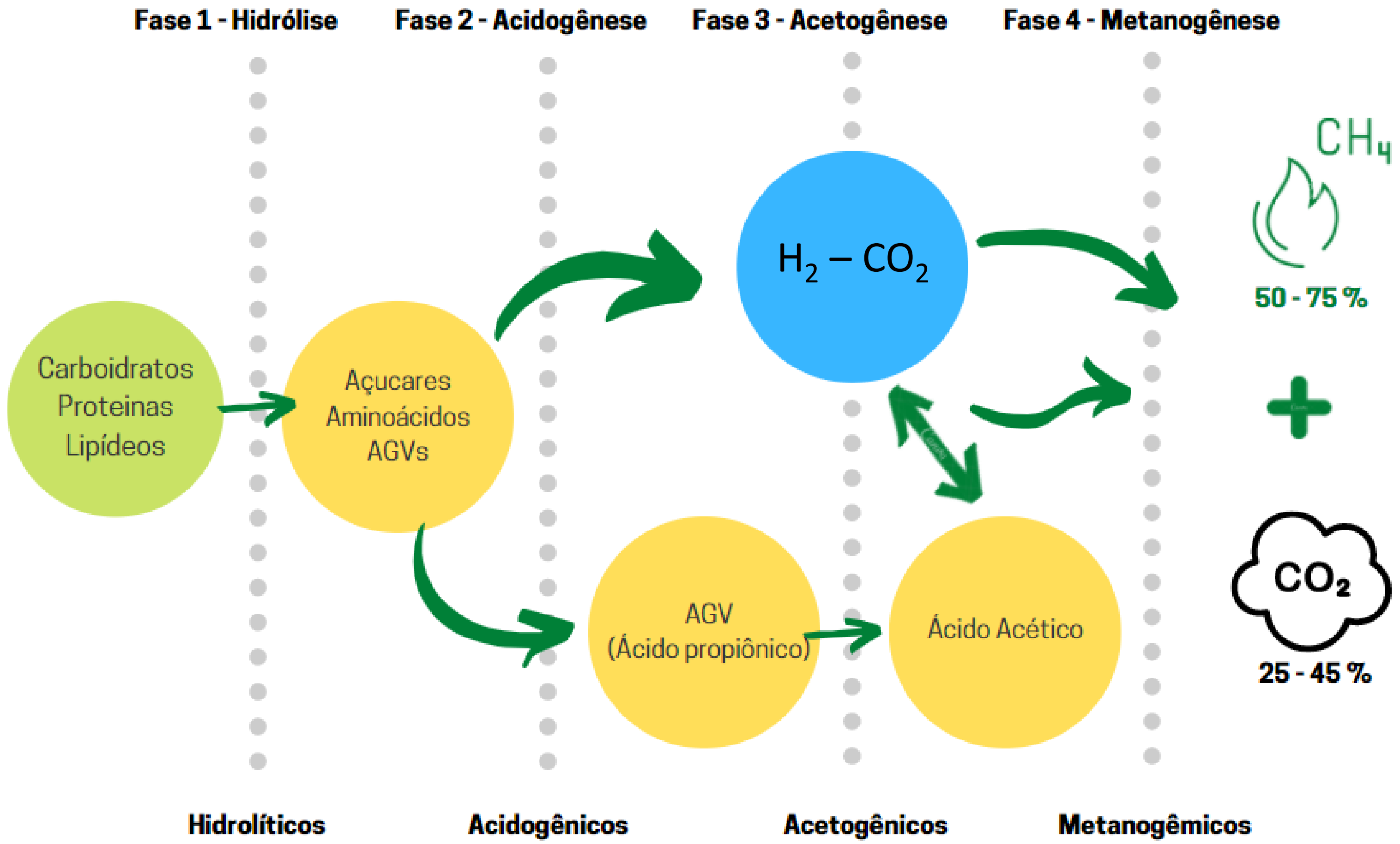
- ✓Como os resíduos estão sendo produzidos??
- ✓Reduzir o desperdício de água.
- ✓Otimizar o uso de insumos.
- ✓Processo produtivo e gestão dos resíduos devem estar integrados.

O melhor resíduo é aquele que não é gerado!!!

Exemplo do biogás



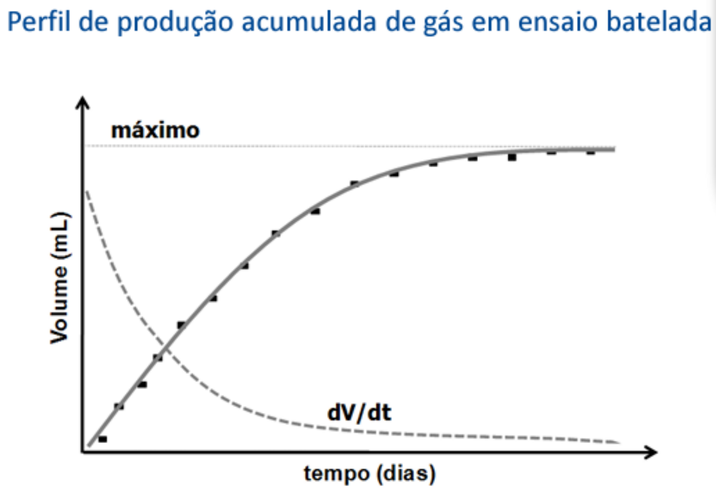
Como acontece a digestão anaeróbia?



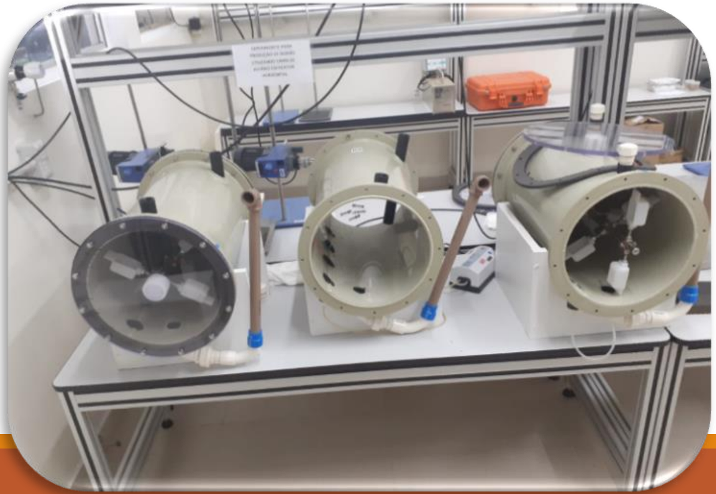
Biodigestor de Lagoa Coberta

CSTR (do inglês *Continuous Stirred Tank Reactor*)

Laboratório de estudos em biogás - LEB



Laboratório de reatores anaeróbios



1 / 8

Bioresource Technology Reports 15 (2021) 100716

Contents lists available at ScienceDirect

Bioresource Technology Reports

journal homepage: www.sciencedirect.com/journal/bioresource-technology-reports

Swine manure biogas production improvement using pre-treatment strategies: Lab-scale studies and full-scale application

Deisi Cristina Tápparo [a], Daniela Cândido [b], Ricardo Luis Radis Steinmetz [c], Christian Etzkorn [d], André Cestonaro do Amaral [a], Fabiane Goldschmidt Antes [c], Airton Kunz [a,c,*]

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A R T I C L E I N F O

Keywords:
Solid-liquid separation
Biogas improvement
Swine production system
Biogas plant

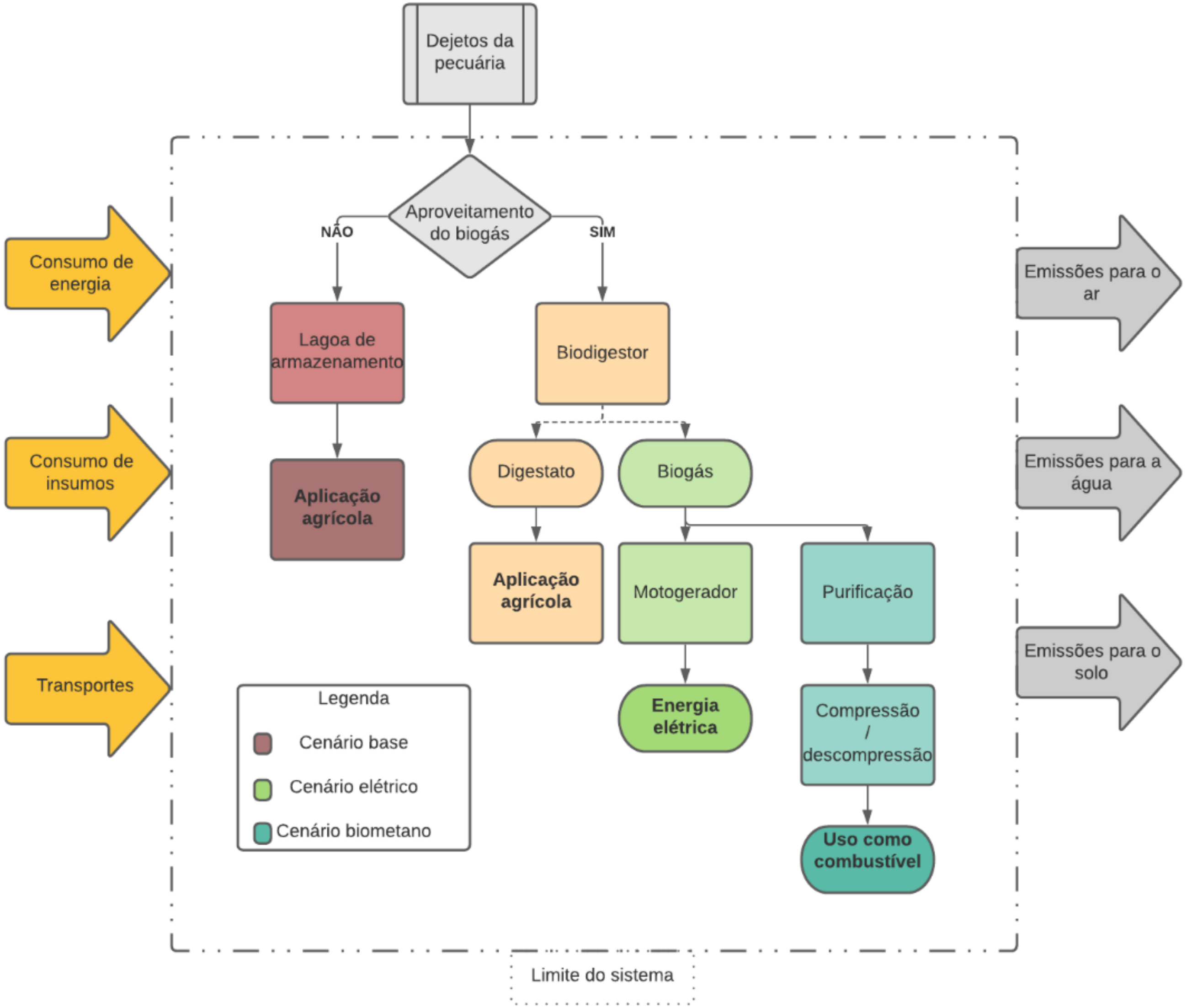
A B S T R A C T

The paper deals a case study of solid-liquid separation (SLS) approaches for swine manure biogas recovery in a system configured to treat solid fraction on Continuous Stirred Tank Reactor (CSTR) and liquid fraction on Covered lagoon biodigester (CLB) in a large scale. At the same time, scale down reactors on laboratory scale were operated under same conditions. Biogas productivity of full-scale CSTR showed an average of 0.65 ± 0.23 $NL_{biogas}\ L^{-1}_{reactor}\ d^{-1}$, while CLB was around 0.18 ± 0.05 $NL_{biogas}\ L^{-1}_{reactor}\ d^{-1}$. The results of lab-scale can

https://www.embrapa.br/suinos-e-aves/biogasfert/calculadora

ACV como uma ferramenta – Descarbonização da Pecuária!

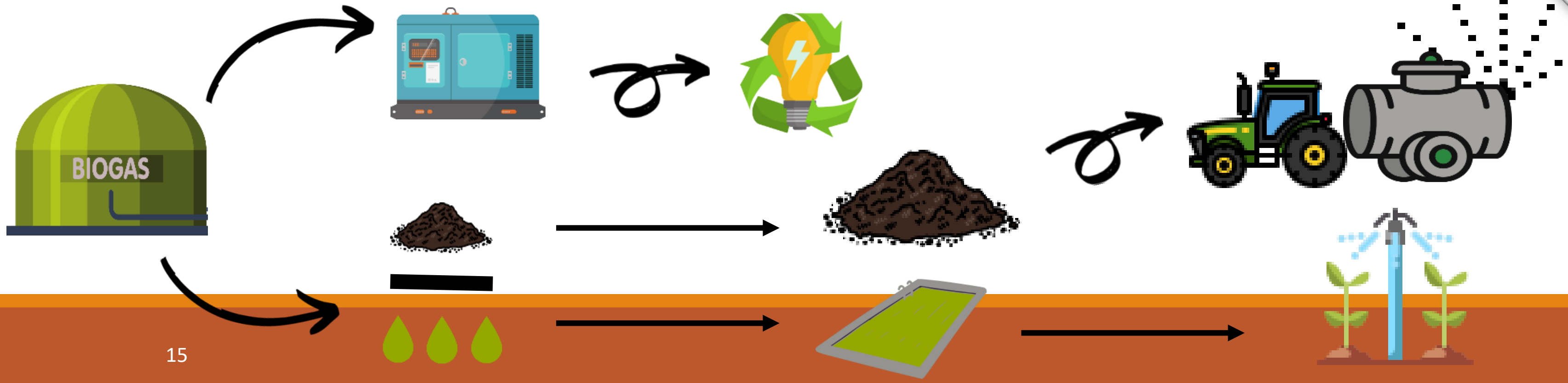
Limite do Sistema



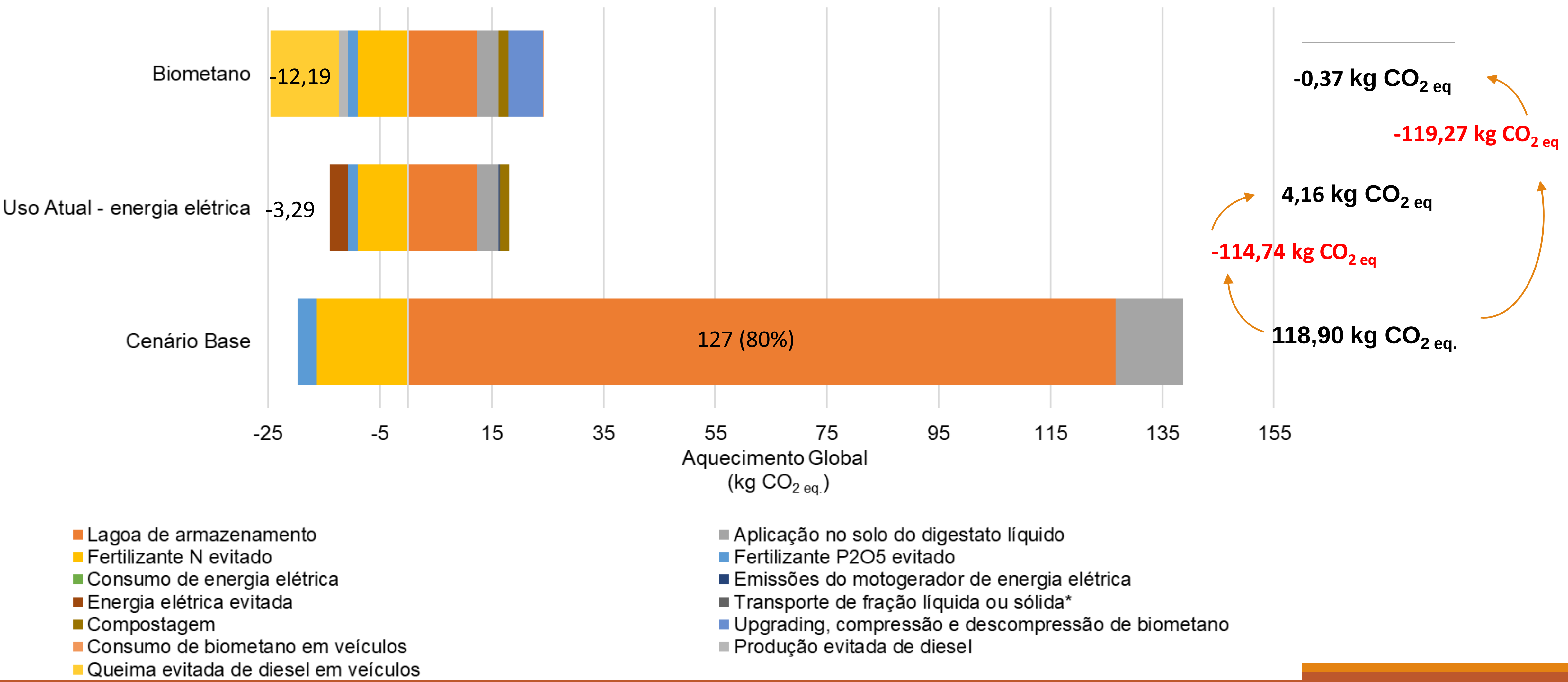
Suinocultura - Fazenda Recanto 1

Informações sobre uso atual do biogás

Localização	Escala da atividade produtiva	Volume de dejetos tratados	Produção de biogás	Geração de energia elétrica	Uso do digestato
Patos de Minas – Minas Gerais	12.000 suínos em terminação e 7.000 em creche e pré-creche	109.500 (t/ano)	2.100 m³/dia	4.500 kWh/dia	Fertirrigação e compostagem



Suinocultura - Fazenda Recanto 1



Journal of Cleaner Production 354 (2022) 131654

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Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Life cycle assessment of waste management from the Brazilian pig chain residues in two perspectives: Electricity and biomethane production

Camila Ester Hollas [a], Karina Guedes Cubas do Amaral [b,**], Marcela Valles Lange [b], Martha Mayumi Higarashi [c], Ricardo Luís Radis Steinmetz [c], Evandro Carlos Barros [c], Leidiane Ferronato Mariani [b], Vanice Nakano [b], Airton Kunz [a,c,*], Alessandro Sanches-Pereira [b,e], Gilberto de Martino Jannuzzi [d]

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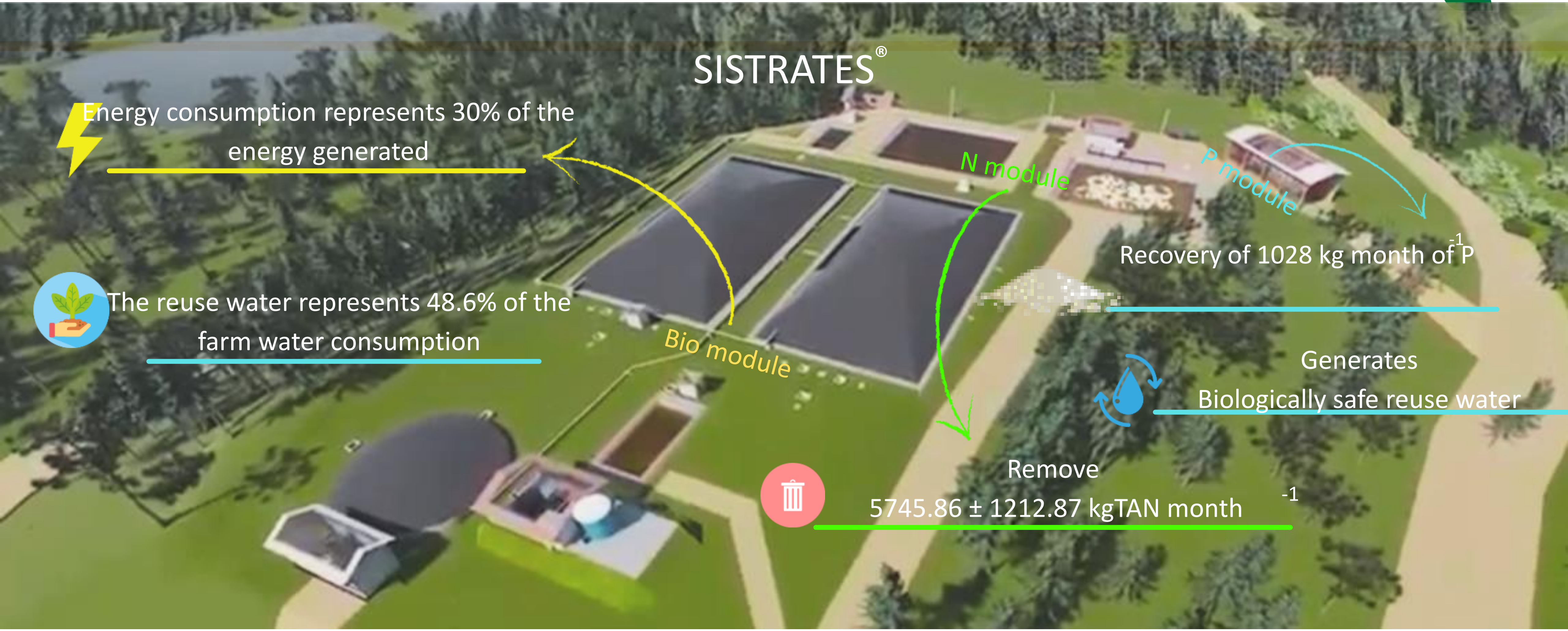
ARTICLE INFO

ABSTRACT

SISTRATES

Sistema de Tratamento e Efluentes da Suinocultura

www.youtube.com/watch?v=xn5p1CMnH3s
(maquete virtual – Sistrates)


SISTRATES®
Energy consumption represents 30% of the energy generated
The reuse water represents 48.6% of the farm water consumption
N module
P module
Bio module
Recovery of 1028 kg month^{-1} of P
Generates Biologically safe reuse water
Remove 5745.86 ± 1212.87 kgTAN month^{-1}

Para saber mais....

Journal of Environmental Management 301 (2022) 113825

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

ELSEVIER

Integration of swine manure anaerobic digestion and digestate nutrients removal/recovery under a circular economy concept

Daniela Cândido [a], Alice Chiapetti Bolsan [b], Camila Ester Hollas [c], Bruno Venturin [c], Deisi Cristina Tápparo [c], Gabriela Bonassa [c], Fabiane Goldschmidt Antes [d], Ricardo Luís Radis Steinmetz [d], Marcelo Bortoli [e], Airton Kunz [a,c,d,*]

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ARTICLE INFO

Keywords:
Nitrogen removal
Phosphorus recovery
Water reuse
Swine wastewater
Biogas
Energy recovery

ABSTRACT

The application of the circular economy concept should utilize the cycles of nature to preserve materials, energy and nutrients for economic use. A full-scale pig farm plant was developed and validated, showing how it is possible to integrate a circular economy concept into a wastewater treatment system capable of recovering energy, nutrients and enabling water reuse. A low-cost swine wastewater treatment system consisting of several treatment modules such as solid-liquid separation, anaerobic digestion, biological nitrogen removal by nitrification/denitrification and physicochemical phosphorus removal and recovery was able to generate 1880.6 ± 1858.5 kWh d^{-1} of energy, remove 98.6% of nitrogen and 89.7% of phosphorus present in the swine manure. In addition, it was possible to produce enough fertilizer to fertilize 350 ha per year, considering phosphorus and potassium. In addition, the effluent after the chemical phosphorus removal can be safely used in farm cleaning processes or disposed of in water bodies. Thus, the proposed process has proven to be an environmentally superior swine waste management technology, with a positive impact on water quality and ensuring environmental

sustainability

MDPI

Review

Second-Generation Phosphorus: Recovery from Wastes towards the Sustainability of Production Chains

Camila Ester Hollas [1], Alice Chiapetti Bolsan [2], Bruno Venturin [1], Gabriela Bonassa [1], Deisi Cristina Tápparo [1], Daniela Cândido [3], Fabiane Goldschmidt Antes [4], Matias B. Vanotti [5], Ariel A. Szögi [5] and Airton Kunz [1,3,4,*]

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Abstract: Phosphorus (P) is essential for life and has a fundamental role in industry and the world food production system. The present work describes different technologies adopted for what is called the second-generation P recovery framework, that encompass the P obtained from residues and wastes. The second-generation P has a high potential to substitute the first-generation P comprising that originally mined from rock phosphates for agricultural production. Several physical, chemical, and biological processes are available for use in second-generation P recovery. They include both concentrating and recovery technologies: (1) chemical extraction using magnesium and calcium precipitating compounds yielding struvite, newberyite and calcium phosphates; (2) thermal treatments like combustion, hydrothermal carbonization, and pyrolysis; (3) nanofiltration and ion exchange methods; (4) electrochemical processes; and (5) biological processes such as composting, algae uptake, and phosphate accumulating microorganisms (PAOs). However, the best technology to use depends on the characteristic of the waste, the purpose of the process, the cost, and the availability of land. The exhaustion of deposits (economic problem) and the accumulation of P (environmental problem) are the main drivers to incentivize the P's recovery from various wastes. Besides promoting the resource's safety, the recovery of P introduces the residues as raw materials, closing the productive systems loop and reducing their environmental damage.

Keywords: waste treatment; struvite; chemical precipitation; biological recovery; nutrient recovery; phosphate

Citation: Hollas, C.E.; Bolsan, A.C.; Venturin, B.; Bonassa, G.; Tápparo, D.C.; Cândido, D.; Antes, F.G.; Vanotti, M.B.; Szögi, A.A.; Kunz, A. Second-Generation Phosphorus: Recovery from Wastes towards the Sustainability of Production Chains. *Sustainability* **2021**, *13*, 5919. https://doi.org/10.3390/su13115919

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1. Introduction

Phosphorus (P) has gained increasing attention in the world scenario in the last few years. The concern with the limitation of natural sources, associated with the constant demand beyond the environmental impacts, has attracted attention to this element [1,2]. Besides essential for life, the P has a fundamental role in the industry and the world food production system, directly influencing the economic sector [3].

The mineral extraction of P from phosphate rocks is the primary source of this resource,

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Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Swine manure treatment technologies as drivers for circular economy in agribusiness: A techno-economic and life cycle assessment approach

C.E. Hollas [a], H.C. Rodrigues [b], A.C. Bolsan [b], B. Venturin [a], M. Bortoli [c], F.G. Antes [d], R.L.R. Steinmetz [d], A. Kunz [a,d,*]

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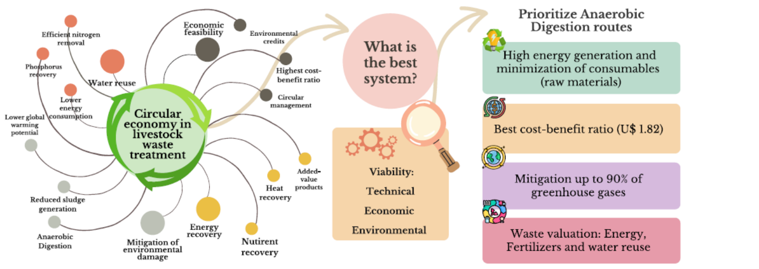
HIGHLIGHTS

- The management of swine manure from the perspective of circular economy is studied.
- Anaerobic digestion is the key to circular economy of the treatment systems.
- Life cycle analysis results indicated mitigations of up to 90 % in CO_2 emissions.
- Effluents treatment results energy, fertilizers, and water reuse, without residues.
- Anaerobic digestion with digestate treatment is the most viable configuration.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editor: Jacopo Bacenetti

Keywords:
Anaerobic digestion
Energy recovery
Livestock
Nutrient recovery
Water reuse
Waste management

ABSTRACT

Anaerobic digestion has been employed as a technology capable of adding value to waste coupled with environmental impact mitigation. However, many issues need to be elucidated to ensure the systems viability based on this technology. In this sense, the present study evaluated technically, environmentally, and economically, four configurations of swine waste treatment systems focused on the promotion of decarbonization and circularity of the swine chain. For this, a reference plant, based on a compact treatment process named SISTRATES® (Portuguese acronym for swine effluent treatment system) was adopted to serve as a model for comparison and validation. The results showed the importance of prioritization of the energy recuperation routes through anaerobic digestion, providing increased economic benefits and minimizing environmental damage. Thus, the SISTRATES® configuration was the one that presented the best designs in a circular context, maximizing the recovery of energy and nutrients, along with the reduction of greenhouse gas emissions, ensuring the sustainability of the pig production chain.

Abbreviations: AD, anaerobic digestion; BOD, biological oxygen demand; CAPEX, capital expenditures; CHP, combined heat and power; CLB, covered lagoon biodigester; COD, chemical oxygen demand; CSTR, continuous stirred-tank reactor; FE, freshwater eutrophication; FS, fixed solids; FU, functional unit; GHG, greenhouse gases; GW, global warming; HRT, hydraulic retention time; IRR, internal rate of return; LCA, life cycle assessment; LCI, life cycle inventory; MLE, Modified Ludzack-Ettinger process; NPV, net present value; OFTE, ozone formation - terrestrial ecosystem; OLR, organic loading rate; OPEX, operating expenditures; P, total phosphorus; S1, scenario 1; S2, scenario 2; S3, scenario 3; S4, scenario 4; SB, baseline scenario; SISTRATES®, Portuguese acronym for swine effluent treatment system; SLS, solid-liquid separation; SM, supplementary material; SOC, soluble organic carbon; SOD, stratospheric ozone depletion; TA, terrestrial acidification; TAN, total ammonia nitrogen; TE, terrestrial ecotoxicity; TN, total nitrogen; TOC, total organic carbon; TS, total solids; UASB, Upflow Anaerobic Sludge Blanket; VS, volatile solids.

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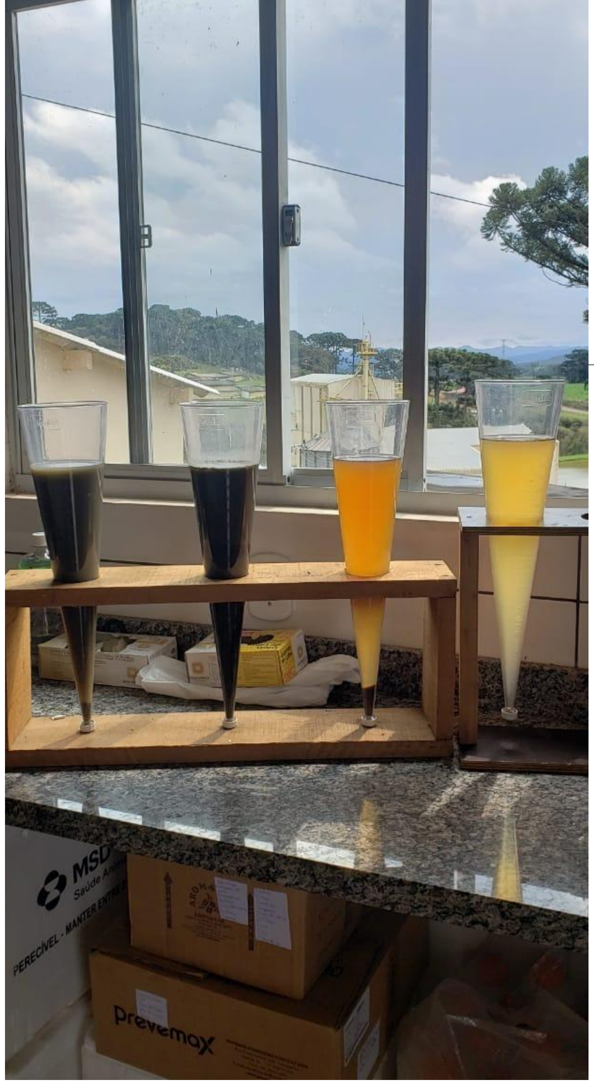
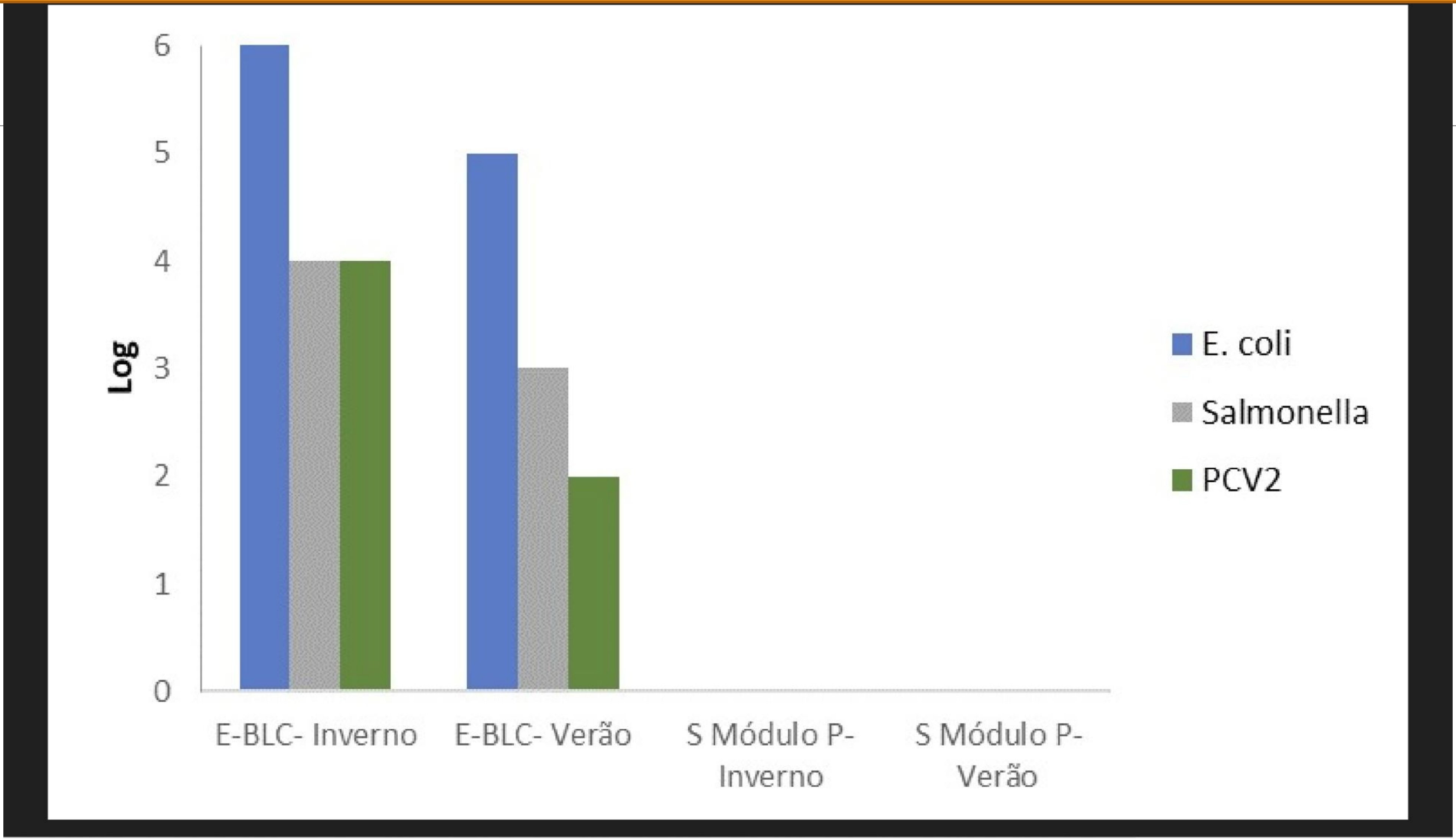
Efluente final

Reúso???


MSD
Prevemax

Qual o Risco Sanitário de Reúso de Água?



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Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Water reuse as a strategy for mitigating atmospheric emissions and protecting water resources for the circularity of the swine production chain

M. Bortoli [a], C.E. Hollas [b], A. Cunha Jr. [c], R.L.R. Steinmetz [c], A. Coldebella [c], M.C. de Prá [d], H. M. Soares [e], A. Kunz [b,c,*]

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ARTICLE INFO

Handling Editor: Cecilia Maria Villas Bôas de Almeida

ABSTRACT

High greenhouse gas emissions, high water demand, and waste with high pollution potential are critical points for waste management generated in animal production. With significant contributions in global emissions of air pollutants, sustainable practices for agriculture are fundamental to mitigate global climate change, besides

Mensagem Final

- ✓ Os problemas (e o mundo) são cada vez mais complexos.

- ✓A resolução dos problemas da produção animal moderna requerem

múltiplas competências.

- ✓ Precisamos pensar e agir de maneira sistêmica.

Não existe "a solução" e sim alternativas aplicáveis a diferentes realidades!!!

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18 A 20 DE ABRIL DE 2023

FOZ DO IGUAÇU-PR

5°FÓRUM SUL BRASILEIRO BIOGÁS E BIOMETANO FOZ DO IGUAÇU - PR

INSCREVA-SE!

PROGRAMAÇÃO

Painéis, Negócios, Visitas Técnicas: agende-se!

Obrigado!

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