Book of Abstracts

Industrial Symbiosis from a technical perspective: challenges and opportunities

WG1 worskhop & conference
Bruxelles, September 10, 2024

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Content

Artificial intelligence supporting industrial symbiosis

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ABSTRACT

This paper explores the opportunities, challenges, and barriers associated with implementing Industrial Symbiosis (IS), specifically focusing on utilizing Artificial Intelligence (AI) technologies. IS, which involves exchanging materials, energy, and resources between different industries to promote sustainability and efficiency, presents significant potential for enhancing resource utilization and reducing environmental impact. However, the successful implementation of IS faces various challenges and barriers, including technological, organizational, regulatory, and cultural factors. This paper investigates how AI technologies can address some of these challenges and facilitate the adoption of IS practices. By leveraging AI for data analytics, optimization, decision-making support, and predictive modeling, industries can enhance the identification of symbiotic opportunities, optimize resource exchanges, and improve overall efficiency. Furthermore, AI can help overcome barriers such as information asymmetry, complex network dynamics, and uncertainty associated with IS implementation. Despite the promising potential of AI in advancing Industrial Symbiosis, several challenges remain, including data availability, interoperability, privacy concerns, and ethical considerations. This paper provides insights into the role of AI in enabling and accelerating the implementation of IS while also highlighting the need for interdisciplinary collaboration, policy support, and ethical guidelines to maximize its benefits and address potential risks.

Keywords: Artificial Intelligence; Circular Business Model; Circular Business Model Innovation; Circular Economy; Industrial Symbiosis; Circular Manufacturing; Manufacturing; Sustainability; Literature Review

KEYWORDS

Artificial Intelligence; Circular Business Model; Circular Business Model Innovation; Circular Economy; Industrial Symbiosis; Circular Manufacturing; Manufacturing; Sustainability; Literature Review

Bridging the gap: Overcoming barriers to industrial symbiosis implementation insights from the inset project

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ABSTRACT

Industrial Symbiosis (IS) holds promise for revolutionizing resource management, environmental stewardship, and economic vitality. However, successful implementation is hindered by multifaceted challenges, as revealed by stakeholder engagements in the INSET project.

The INSET project (Industrial Symbiosis Capacity Building for Enterprises and related sectors through a disruptive, digital and pragmatic training and awareness approach), catalyzed by funding from the Erasmus + program's 2023 call, embodies a visionary initiative aimed at bolstering Industrial Symbiosis through an innovative blend of disruptive, digital, and pragmatic training and awareness methodologies tailored to enterprises and their affiliated sectors.

Central to our investigation are the formidable barriers hindering IS realization. The acute shortage of dedicated personnel proficient in IS methodologies is among these challenges, exacerbated by a glaring deficiency in understanding the intricate web of technologies underpinning Industrial Symbiosis frameworks. Moreover, economic hurdles loom large, impeding the widespread adoption of IS practices, while administrative inadequacies pose formidable roadblocks to fostering IS initiatives effectively.

Our inquiry unveils a nuanced landscape wherein stakeholders spanning diverse sectors - from administration and academia to business support ecosystems - grapple with distinct challenges compared to businesses and their associated networks. Consequently, bespoke strategies tailored to the unique needs of each stakeholder cohort emerge as imperative for navigating the complex terrain of IS implementation.

In charting a path forward, our study underscores the imperative of nurturing two foundational capacities pivotal to IS advancement: the art of designing IS, fostering collaboration and resource exchange among disparate actors, and the science of managing IS implementation, encompassing robust coordination, regulatory frameworks, and vigilant monitoring mechanisms.

In conclusion, while the barriers to IS are significant, they are not insurmountable. The findings from the INSET project illuminate the critical areas requiring targeted intervention. By addressing the personnel and technological gaps, alleviating economic constraints, and streamlining administrative processes, stakeholders can pave the way for robust IS implementation. Ultimately, fostering a collaborative environment and equipping stakeholders with the necessary skills and knowledge through innovative training and awareness initiatives will be vital to unlocking the full potential of IS, leading to a more sustainable and economically vibrant industrial ecosystem.

KEYWORDS
Industrial Symbiosis; Challenges; Stakeholder Engagement; INSET Project; Implementation Strategy; Resource Management

Deepening human security and industrial symbiosis in the context of the EU enlargement

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ABSTRACT

The socio-political, economic, cultural, religious, ethical, mental or technological-communicative differences, with a significant impact on the standard of living and the quality of life in the human communities that populate the planet Earth, contribute to strengthening the potential of humanity to face the most violent and destructive effects and results of the multidimensional global crisis, through the diversity of chances and identities it generates. The multifaceted global crisis is primarily generated by normative, axiological and moral disorientation and relativization, and the loss and devaluation of society's most fundamental values such as science, knowledge, the meaning of development and progress.

The process of reorganization and renewal of contemporary society must begin with concern for man and his primary interests and needs, such as safety and security. The central concern in the process of building national security as a state policy must converge to the strengthening of human security in the context of deepening Industrial Symbiosis with its new aspects at the regional level, in the context of the EU enlargement approach, to build a knowledge-based society in this area, a morally renovated community, rebuilt based on no spheric and bioethical principles, starting with the states of Eastern Europe targeted by the prospects of EU enlargements, such as Ukraine and the Republic of Moldova, as well as several states from the Western Balkans.

The bioethical and human security problematics are defending social equity and human rights and pleading for eliminating human risks in the context of global changes.

The social, economic, political, military, cultural or environmental processes, phenomena and events are interdependent and inter-influencing. The contemporary global crisis is characterized by complexity and multi-dimensioning, determining the appearance of new types of risks and menaces to national, regional or even international security. The imperative necessity of contracting contemporary global threats at the level of protection of the human person can be fulfilled through re-conceptualization at local, regional and global scales, in methodological and bioethical ways, of the perspectives of strengthening human security (Sprincean, 2017).

The necessity to focus on the states of Eastern Europe for the creation of the Industrial Symbiosis and a knowledge-based society is justified by the need to resolve first the biggest discrepancies and the most severe deviations from ensuring human security, especially appeared because of the continuation of the war launched by Russia against Ukraine in February 2022. More significantly, this concern for the strengthening of personal safety and human security will become actual for the entire EU but especially in Eastern Europe in the context of the effort of the community of Western states to restore all spheres of social life in Ukraine and its neighboring countries in the post-war period. The renewed society needs to be grounded in objectives such as improving environmental sustainability while achieving economic benefits.

Inclusiveness of the research methodology in the investigation becomes a fundamental theoretical requirement since only a holistic and generalized approach can provide a sufficient conceptual framework to

understand and analyze the totality and depth of the issues at hand. The investigation results include practical recommendations for all involved stakeholders and different actors at national and EU levels responsible for efficiently functioning a knowledge-based society as an inclusive system of producing and implementing knowledge and innovations.

KEYWORDS
Human Security; EU enlargement; Eastern Europe; Industrial Symbiosis; Knowledge-based Society; Multidimensional Crisis

Implementing/facilitating water-related industrial symbiosis as solution for circular water resources management

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ABSTRACT

There is a growing concern about the water shortage, which will deepen in the context of climate changes and population growth in the urban environment. The 5Rs (Reduce, Reuse, Recycle, Restore and Recover)-based circular water management is proposed based on closing loops to minimize water abstraction and pollution within the water usage cycle. Considering the main role of water authorities, including water supply and sewage operator, in integrated water resources management, Industrial Symbiosis (IS) as self-organized/planned and facilitated is considered a solution to achieve more sustainable water management. Several water innovation practices of water/wastewater treatment and reuse, including utility sharing for alternative water supply and wastewater treatment, water recovery, energy recovery from water, material/nutrients recovery from wastewater, and material/waste exchange for advanced water/wastewater treatment, are analyzed. The water-energy-material nexus is considered for establishing a local network of specific companies as physical exchangers to achieve environmental and competitive benefits in a collective approach.

Also, regional water supply and sewage operators are analyzed for IS facilitating as a business and intelligence development opportunity. In particular, the role of the municipal wastewater treatment plants, through their involvement in public-private partnerships for implementing or facilitating IS, is assessed. Several case studies, e.g., eco-industrial parks and European research projects, are considered to examine the role of water innovation in Industrial Symbiosis. Challenges, solutions, and future priority in water related IS implementation considering water reduction/reusing/recycling/restoring and recovery are systematically presented to enhance potential developments on symbiotic water innovation and the potential of Industrial Symbiosis for achieving water sustainability goals. For example, reusing water in industry, especially within a Circular Economy, should address the increasing water efficiency challenge. However, there is no universal solution for water reusing, which requires finding individual solutions customized based on industry type and location, existing infrastructure and boundary conditions.

KEYWORDS

Circular Water Management; Industrial Symbiosis; Water/wastewater Treatment; Water Reuse; Water Innovation Practices; Resource Recovery

Industrial symbiosis awareness: economic kpis perspective with eu circular economy policies

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ABSTRACT

Industrial Symbiosis fosters resource efficiency among industries, which promises to strengthen economic prosperity with the principles of a Circular Economy. This study reveals the critical drivers between Industrial Symbiosis awareness, economic Key Performance Indicators (KPIs), and European Union (EU) Circular Economy policies. EU countries' Circular Economy initiatives and statistical analyses of economic indicators such as real Gross Domestic Product (GDP) per capita, municipal waste generation, renewable energy sources, research and experimental development, and material footprint explain the impact of symbiosis practices on economic performance. The findings provide significant positive correlations between GDPs per capita, waste generation, material footprint, and resource productivity, emphasizing the relevance of symbiosis in fostering economic resilience and sustainability within EU member states. Based on these results, strategies for enhancing symbiosis awareness are needed to optimize economic KPIs such as cost reduction, revenue generation, resource efficiency, and competitiveness. The study contributes to a deeper understanding of how Industrial Symbiosis awareness can progress economic growth while advancing the Circular Economy in EU countries and beyond. Fostering Industrial Symbiosis and sustainable resource management requires implementing demonstration projects that can effectively provide the practical benefits of symbiotic relationships within targeted sectors or geographical areas. Furthermore, establishing robust monitoring and evaluation mechanisms is crucial for assessing the impact of awareness strategies and symbiosis initiatives, allowing for continuous advancement and improvement based on feedback, ensuring long-term success and sustainability.

KEYWORDS

Circular Economy; Industrial Symbiosis; Economic KPIs; Symbiosis Awareness; Resource Efficiency; Resource Productivity

Industrial symbiosis on the production sectors of cyprus: lessons learned

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ABSTRACT

The economic activity in Cyprus is spread between the services, industry, and agriculture sectors. In 2022, the industry and agriculture sectors contributed 13.47% and 1.65% to Gross Domestic Product (GDP), respectively. However, the industry sector increased its contribution to the GDP by around 35% between 2014 to 2022. This industrial production growth resulted in an increasing stream of wastes and by-products, thus creating a significant challenge for sustainable development. Industries mainly belonging to the construction sector face challenges concerning efficient and environmentally friendly waste management. The lack of holistic waste management schemes resulted in most cases in the deposition of inert materials to open landfills. The lack of mapping and detailed information about those waste streams' characteristics, quality, and quantities introduces difficulties in developing Industrial Symbiosis schemes within the local production ecosystem. This study aims to present a recently developed Industrial Symbiosis scheme between organizations of the construction sector, the overall methodological approach, the identified barriers, and the lessons learned. This scheme includes a cement industry, a quarry company, a manufacturing company, and an academic and research organization that undertakes the development and facilitation of the collaboration. The consortium aims to valorize industrial wastes/ by-products into valuable raw materials and then incorporate them into production processes of innovative and environmentally friendly products. It was identified that an efficient Industrial Symbiosis scheme should be beneficial to all partners. To ensure that, time must be spent establishing trust and developing efficient communication and logistics pathways among the collaborative parties. Moreover, a robust collaboration with experts from academia or outside academia could secure a successful knowledge transfer, a fundamental requirement in those cases. Furthermore, funding schemes or legislative requirements could spark and accelerate the development of more Industrial Symbiosis solutions and partnerships.

KEYWORDS
Industrial Symbiosis; Waste Management; Construction; Innovative products; Barriers; Lessons Learned

Methodology to promote, identify, and evaluate industrial symbiosis actions

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ABSTRACT

Industrial Symbiosis (IS) fosters synergies between industries to improve resource efficiency and create new, more sustainable business opportunities. However, there remain challenges in promoting IS due to the lack of adequate management tools to enhance industrial collaborations and communicate its benefits.

The strategy developed has been tested and applied within the iWAYS project, focusing on compiling relevant and critical information from companies, including the demands and needs of resources and the IS initiatives implemented. Additionally, a tool has been proposed to facilitate the self-assessment of the technical and socio-economic viability of implementing each synergy.

The methodology applied has been developed as a step-by-step approach as follows:

STEP 1: Collect information on "Offer and/or Demand Resources" through an ad hoc template by analyzing resource flows and streamlining the exchange process. Understanding the characteristics, limitations, quality, and quantity of a company's resources is essential in IS. This way, companies can share comprehensive data with other interested parties.

STEP 2: Gather information on current "IS practices" implemented. A template that compiles information regarding the economic, environmental, or social benefits of this current IS practice has been developed. This template is adaptable for future synergies that may be implemented. This document aims to disseminate best practices, provide data for sustainability reports, improve the company's image, and promote IS in its environment.

STEP 3: Implement a methodology for the self-assessment of the sustainability of identified synergies. A self-assessment tool has been defined and designed to cover the assessment of various dimensions associated with sustainability criteria, including technical, environmental, social, and economic aspects. Each dimension contains multiple established indicators with formulated evaluation questions in an Excel datasheet. With some algorithms applicable to the answers (dropdown menu), it assigns a score that determines the relevance of each indicator. The tool's results allow users to identify the benefits of IS practices and highlight critical aspects to review their feasibility. The results may be presented in various ways with the help of visual graphics.

During the presentation, practical cases will be provided to improve the understanding of the entire methodology and the results that may be obtained.

KEYWORDS
Industrial Symbiosis; Resources Catalogue; Industrial Symbiosis Practices; Self-assess

NISP® and SYNERGIE® supporting industrial symbiosis worldwide

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ABSTRACT

Industrial Symbiosis is crucial in advancing the Circular Economy by promoting efficient industry resource-sharing. This research explores the potential for implementing Industrial Symbiosis across 12 industrial zones in Alicante, Spain, over six months using the SYNERGie® resource matching platform by International Synergies Limited (ISL) and facilitated support activities. With over 20 years of experience, ISL has facilitated significant environmental and economic impacts, including avoiding 42 million tons of CO2 emissions and generating over £2B in economic benefits through their NISP® network in England.

This project aims to evaluate the applicability of ISL's NISP® methodologies and the SYNERGie® platform in Alicante to enhance resource efficiency, reduce waste, and improve economic productivity. The research employs a mixed-methods approach encompassing:

1. We will identify principal manufacturing companies and stakeholders for resource-matching workshops where we will locate each companies have and wants and generate initial ideas for matching companies based on these resources.
2. Use the SYNERGie® platform for resource mapping and synergy identification among local industries with the workshop results and direct company interactions. The platform's history of aiding industries in utilizing undervalued resources is crucial for decarbonization, especially in tackling Scope 3 emissions. The Advisor function within SYNERGie® uses advanced algorithms and global successes to find solutions.
3. Interviews with industrial participants to gather quantitative and qualitative data to gauge their readiness for symbiotic relationships and overcome potential barriers.
4. Development of viable synergies that participants are committed to implementing with the support of our solution-provider network.

While results are pending, the project aims to identify over 100 potential synergies from workshops, advance at least 10% of these synergies to the under-development stage, where companies actively seek solutions, and resolve at least one synergy as a case study. The study will also assess the carbon footprint and tonnage impact and update literature on technical and non-technical barriers to Industrial Symbiosis.

In summary, this project tests the feasibility of replicating ISL's successful model in Alicante, adapting proven practices to local industrial contexts to replicate similar sustainable and economic benefits. This initiative aims to promote global adoption of these practices, contributing to broader sustainability and net-zero objectives.

KEYWORDS

Industrial Symbiosis; Resource Matching Platform; Facilitation; Circular Economy; Efficient Resource Sharing; Decarbonization; Implementation

Opportunities, challenges and barriers found in industrial symbiosis implementation in the Basque Country

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ABSTRACT

Industrial Symbiosis can be a powerful tool to facilitate the transition towards the Circular Economy for industries of all types and sectors. The Basque Country, located in the north of Spain, has industrial solid roots and density, primarily SMEs, and a significant metal sector presence. In this industrial ecosystem, the technical consultancy Onurak ecosolutions, together with jurist partners and researchers from the University of the Basque Country, has so far carried out three Industrial Symbiosis projects in the region: two of them within the framework of a business association, and a third one in an industrial estate.

The three projects have been carried out using a similar method: 1) mapping stage by presenting the project to the companies and issuing a questionnaire for data collection (primary raw materials consumed, main waste streams generated and main interests in sharing services/infrastructures), 2) stage of identification of synergy opportunities and 3) stage of technical-legal and economic feasibility study.

The results show great opportunities arising from Industrial Symbiosis and challenges and barriers to its implementation. The main opportunities identified early in the Industrial Symbiosis between companies in an industrial ecosystem focus on mutuality or sharing synergies. In all three projects, companies are highly interested in primarily sharing the management and transport of their waste streams and generating renewable energy self-consumption communities. The challenges and barriers identified are related to the need to overcome the operational inertia of the companies, especially in smaller SMEs.

Based on this experience, it is concluded that Industrial Symbiosis requires awareness raising and should be implemented gradually, starting with small, simple and effective synergies. This will generate a climate of trust in companies towards this tool and thus lead progressively to behavioral changes towards greater openness and acceptance of Industrial Symbiosis.

KEYWORDS
Industrial Symbiosis; Implementation; Basque Country; Opportunities; Challenges; Mutuality

Opportunities for industrial symbiosis between the agroindustrial and furniture sectors: R&D projects

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ABSTRACT

The agricultural sector is the most critical industry in the Region of Murcia (Spain), dedicating 50% of its entire surface to crops. This high production is associated with huge waste derived from vegetal transformation and processing. In this context, research and development have played a crucial role in exploring the feasibility of converting these underutilized resources into high-value compounds for synthesizing materials applicable to the furniture sector. This integrated approach seeks to reduce waste, minimize environmental impact, diversify raw material sources in the furniture sector and promote circularity in the supply chain. In recent years, CETEM has worked on three main lines related to the identification, extraction and application of compounds derived from vegetal by-products in the production of innovative and sustainable materials, replacing conventional ones, which can commonly be toxic: 1. Lignin extraction from lignocellulosic waste materials using physical, chemicals and biologicals methods for application in the synthesis of adhesives; 2. The production of bio pigments from the citrus waste fermentation to develop dyes and colorants for coatings; and 3. The processing and functionalization of vegetal fibers for the manufacture of agglomerated composites. This research found a lignin-based adhesive used as a binder in fiber composites, an orange dye used to color wood coatings and particle boards made from 100% vegetable by-products fiber (artichoke, rice husk and vine stem).

KEYWORDS
Sustainable Materials; Valorization; Furniture; Adhesives; Bio-pigments; Composites

Portuguese footwear cluster - industrial symbiosis, innovative green materials, processes and products

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ABSTRACT

Fashion businesses, including footwear, need to decarbonize and help minimize the depletion of the planet's resources and greenhouse gas emissions. Realizing this transition is fundamental and will not happen spontaneously. It requires planning and collaborative efforts involving private and public sectors across value chains. While some businesses have immediate opportunities, namely e-commerce platforms, others will benefit from research and innovation, such as Industrial Symbiosis, biological and biobased materials, man-made material-to-material recycling, and circular processes.

Firm steps are being accomplished within BioShoes4All, a Portugal PRR, Next Generation EU cofounded project aiming to support the transition of the footwear and allied trade sectors to a circular and sustainable bioeconomy. It is promoted by 50 companies covering the whole footwear value chain. It includes leather, soles, chemicals, software, production equipment, leather goods and footwear, representation and leadership, plus 20 R&D bodies with complementary capabilities coordinated by CTCP.

The project promotes industrial symmetry between footwear value chain companies and agri-food, agro-industrial, forest biomass, and pre- and post-consumer waste businesses.

The global approach pursued in the project will be shared, along with examples of the new and "next generation" of materials and processes resulting from Industrial Symbiosis, including:

- Leathers valorizing hides from the meat industry and tanned with pine tree bark.
- Coated textiles embed bio polyurethanes and chestnut shells or olive stones with over 70% biogenic carbon globally.
- Soling materials incorporating up to 80% bio content, namely bio rubber, rise, and mussel shell.
- Polymeric materials for soles or whole shoes incorporate over 50% pre- and post-consumer waste.
- New concepts of functional, durable, or circular footwear.

A critical step towards sustainability in footwear is doing a materials and product life cycle assessment (LCA). Results and strategies to reduce the carbon footprint by applying LCA and Industrial Symbiosis approaches will be presented.

KEYWORDS
Bioeconomy; Footwear; Industrial Symbiosis; Leather; Polymers

Textile and wood industries symbiosis

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ABSTRACT

One of the biggest challenges for textiles is the increasing amount of waste from textile production and second-hand textiles, much of which ends up in landfills or is incinerated, polluting soil and water and emitting greenhouse gases. Recently, attempts have been made to find appropriate technical measures for environmental protection and sustainable recycling. The study focuses on new ways of using textile waste in the wood industry, specifically incorporating textile waste into particleboard. Manufacturing is the industrial sector with the most significant potential for symbiotic relationships. Directly reusing waste as raw materials between companies is an Industrial Symbiosis. Reusing one company's waste as a raw material by another company supports sustainable development and provides social and economic benefits. As a result of this Industrial Symbiosis, the paper proposes an idea and a technological pathway for converting textile waste into raw material in the particle board industry. This could be an innovative idea for applying the Circular Economy principles.

KEYWORDS
Wood Industry; Textile Waste; Circular Economy

The significance of livestock wastes in the context of industrial symbiosis and the reuse of these wastes

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ABSTRACT

Industrial Symbiosis is a concept that enables the integration of waste and by-products between different industries. This approach ensures more efficient use of resources by utilizing or reusing waste generated in one sector in another sector. The Industrial Symbiosis of livestock waste enables cooperation between various industries, promoting the utilization and reuse of these wastes.

Nowadays, issues such as environmental sustainability and resource efficiency, inter-industry cooperation and reuse of resources are becoming increasingly important. In this context, ensuring Industrial Symbiosis of livestock waste and reusing it in animal nutrition has become a significant environmental and economic issue.

Livestock waste generally consists of various sources such as animal manure, animal residues and animal by-products, which are rich in organic matter and nutrients. Correctly managing these wastes is critical for reducing environmental pollution, efficiently using resources, and providing economic benefits. Among these wastes, especially blood and bone meal, are rich sources of protein and minerals essential for animal nutrition. A blood meal is a waste of animal origin rich in protein. In meat processing plants, the blood obtained after slaughtering animals is processed, dried and ground into powder. The blood meal obtained in this way is an important protein source for animal feed. It contains amino acids necessary for young animals' growth and development, as well as some components supporting their immune system and improving digestive health. Bone meal is obtained from the bones of animals in meat processing plants. It supports animals' skeletal health and can enhance eggshell quality. First, using these wastes meets animals' nutritional needs by increasing animal feed's protein and mineral content.

As a result, Industrial Symbiosis of animal waste is an essential strategy for environmental sustainability and resource efficiency. This approach lays the foundation for a more sustainable future by increasing cooperation between industries and encouraging the evaluation and reuse of waste. In this way, a comprehensive win-win situation can be created that benefits both the environment and the economy.

KEYWORDS
Livestock Wastes; Industrial Symbiosis; Waste Reuse; Sustainable Agriculture; Waste Management; Environmental Sustainability

Understanding the industrial symbiosis through a waste-to-energy approach

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ABSTRACT

Valorization of waste via repurposing it into resilient raw feedstock for consumer goods, energy, or materials is an urgent need today. In addition, promoting the Circular Economy accelerates the transition to these processes and develops opportunities for establishing and flourishing new businesses. This necessitates a better understanding among the research community, stakeholders, and policymakers, a multidisciplinary approach, and a constructive dialogue at a theoretical and practical level. The latter discusses technological, financial and legislative limitations of repurposing wastes for further use and how to overcome existing constraints. We must not waste our waste anymore and enhance the wider public awareness of opportunities for raw material innovation, knowledge transfer, and entrepreneurship. Results indicate the advantages of waste minimization and their improved management, the efficiency of resources, avoidance of dependence on fossil fuels during times of uncertainty, fewer logistics implications, integration of more Renewable Energy Sources (RES) and increase of performance in the industrial sector. In that way, our waste sources can be transformed into the most valuable feedstock for industries for cheap and environmentally friendly energy, fuels or materials. In conclusion, all may be the critical link to the chain of several industries, small and medium size to considerable, to be advantaged by a realistic Industrial Symbiosis future.

KEYWORDS

Wastes; Energy; Materials; Fuels; Chemicals; Innovative Processes

Utilization of processed chicken manure in fish feed production: a sustainable approach

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ABSTRACT

This study examines the potential of using processed chicken manure in fish feed production. Chicken manure can be a valuable resource for fish feed production due to its high protein and mineral content. However, direct use poses pathogenic risks, necessitating appropriate processing methods.

The research investigated the processing of chicken manure through fermentation and heat treatment. The processed manure was incorporated into tilapia feeds at 10%, 20%, and 30% inclusion rates. After a 12-week feeding trial, tilapia with 20% processed chicken manure showed growth performance and feed conversion ratios comparable to the control group.

Results indicate that properly processed chicken manure can be a partial protein source in fish feed formulations. This approach presents significant potential for waste management and sustainable aquaculture practices.

KEYWORDS

Chicken Manure; Fish Feed; Sustainable Aquaculture; Waste Management; Sustainability.

What is the potential of the total site process integration in promoting industrial symbiosis?

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ABSTRACT

Pinch technology and total site integration have an enormous potential to facilitate Industrial symbiosis. They are primarily invented for minimization of waste heat, but later is developed for mass flows in production systems. The use of Pinch technology, as methodology for analysis of material and energy flows and process optimization, can lead to significant cost savings and maximal use of resource inside the company, but also the possibility to share with others in industrial parks. Pinch technology identifies opportunities in resource sharing and process optimization within the integration between all interested sites. It helps to companies in minimization of waste generation and improve overall efficiency. This approach identifies areas where resources can be shared, and waste can be exchanged. Later, this methodology was extended to reduction of gas emissions, optimization of green hydrogen production, minimization of footprint and optimization of Supply Chain. The principles of Pinch technology are the same or remarkably similar for all these extended uses. Selection of streams (heat, mass, items, etc.) is based on the need for use of utilities for their heating/cooling or component supply. Minimization of the use of utilities increase the efficiency and minimize the cost. Selected streams are divided on rich (sources) and poor (sinks) by their content. The quality of each stream is determined by the driving force of process of exchange heat, mass or items. The analysis can be done with table algorithm or graphical approach. In this paper is used Problem Table Algorithm and graphical determination of composite curves as simplest way to compare all uses. In analogy to heat and mass Pinch technology is shown the generalized approach to the Water Pinch, Footprint Pinch, Hydrogen Pinch, and Supply Chain Pinch. Finaly, economic analysis must be done to all generated alternatives as solutions of integration problems. The solution with minimum total cost and optimal driving force is ranged as the best. This methodology can be applied to the production process inside the company, or there can be created solutions as opportunities in exchange heat, mass, water, wastewater, byproducts and many more types of streams between companies inside industrial parks with aim to create industrial symbiosis. The existence of companies interested in exchange of resources in near neighbourhood increase the efficiency of the whole integration and symbiotic process.

KEYWORDS

Pinch Technology; Industrial Symbiosis; Industrial Park; Waste Exchange; Process Integration; Resource Sharing

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