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GLOBAL ECO-INDUSTRIAL PARKS PROGRAMME

Industrial Symbiosis - Overview

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Contents

Definitions

IS Benefits

Implementation mechanism

Requirements for success, drivers and challenges

International experience (examples)

Hierarchy of Environmental Opportunities

- **Intra-company**
  - Within the same company, such as heat recovery & reuse
- **Inter-company**
  - Based on one to one exchange among different companies
- **Collective undertaking**
  - Can only be done in larger groups, e.g. recycling centrally treated WW to be reused within the park
- **Urban synergies**
  - Users or Suppliers outside the park, whether industries or surrounding community.

- Internal (cleaner production) and external (synergies) are complementary approaches with the same aim
- Focus today is on external opportunities

Industrial Synergies

"***Industrial synergies***" have a broader focus than "***industrial symbiosis***" as these cover different types of industrial collaboration

1. **Supply and Market synergies** : Co-location and clustering of companies in the supply and value chains.
2. **Utility synergies**: Shared use of utility infrastructure, mainly revolving around water and energy but also storage facilities
3. **Service synergies**: Sharing of services and activities between companies (e.g., joint training of staff and sharing of maintenance contractors).
4. **By-product synergies <u>(industrial symbiosis):</u>** The use of a previously disposed waste (as solid, liquid, gas) from one facility by another facility to provide valuable by-products

Industrial Symbiosis

- According to the EU, it is "***the process by which wastes or by-products of an industry or industrial process become the raw material for another***"
- A particular kind of synergy, which "engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products".
- A circular business model
  - Which mimics the functioning of ecological systems in which energy, material cycle continually with no remaining waste products
  - Improving financial performance through increasing operational efficiency, creating value
  - Encouraging long-term culture changes which could foster more innovation, create new businesses and job opportunities

Benefits of IS

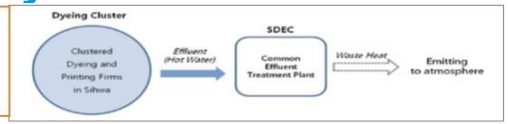
https://csmathsg.com/course-content/week-8/section-8-5-industrial-symbiosis/

Not a New Approach (National examples)

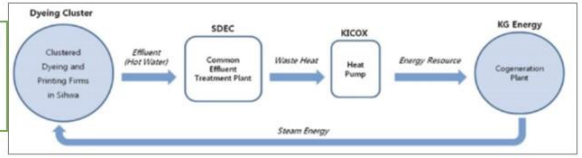
- **Examples form other Industries**
  - RDF as alternative fuel to cement industry
  - Fiberboard companies
  - Composting of domestic bio-waste
  - Recycling of plastic and paper
  - Secondary smelters (iron & steel, lead, etc.)
  - Animal fodder from food and grain milling wastes
  - Landfill biogas is to electricity
- **Examples form the sugar industry**
  - Paper form Bagasse
  - Ethanol from Molasses
  - Soil Conditioner from Vinasse

Internationally Commercialized: South Korean Cluster

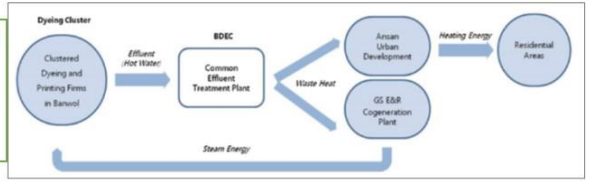
Before the application of IE/IS principles



After the application of IE/IS principles – Heat exchange in the cluster



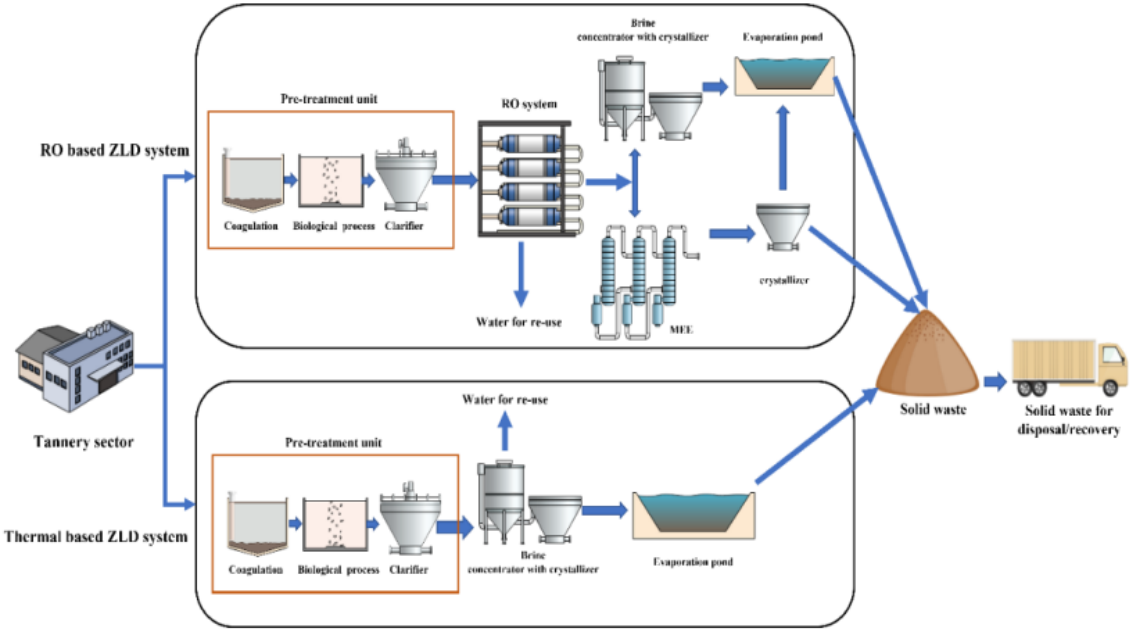
After the application of IE/IS principles – Heat exchange in the cluster and residential area



After the application of IE/IS principles – Effluent sludge recycling

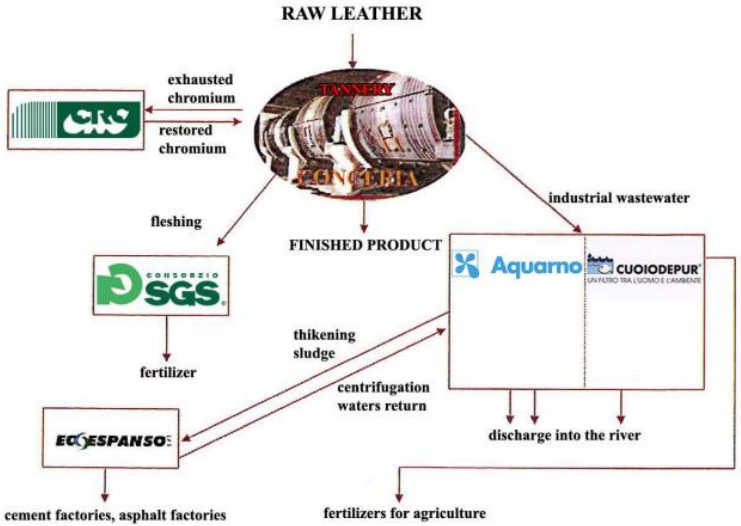
Sukjin Yoon, Khalid Nadvi, "Industrial clusters and industrial ecology: Building 'eco-collective efficiency' in a South Korean cluster" Geoforum 90 (2018) 159–173
https://doi.org/10.1016/j.geoforum.2018.01.013

Internationally Commercialized: ZLD in India, US and China

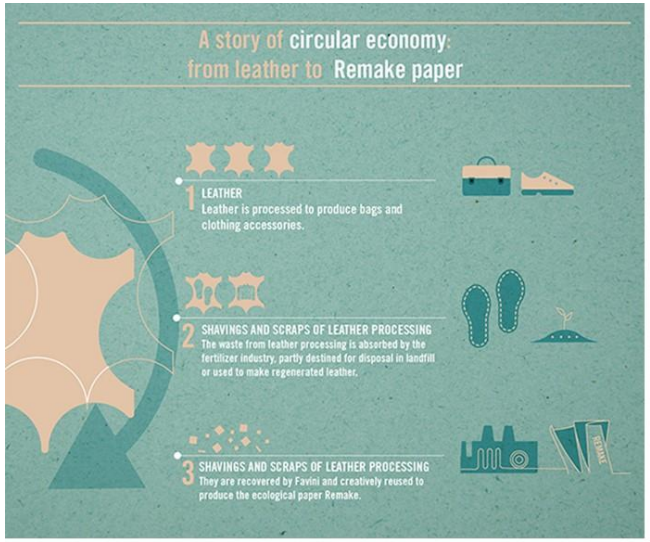


Internationally Commercialized: Santa Croce sull' Arno cluster

Santa Croce sull'Arno - By-product summary scheme

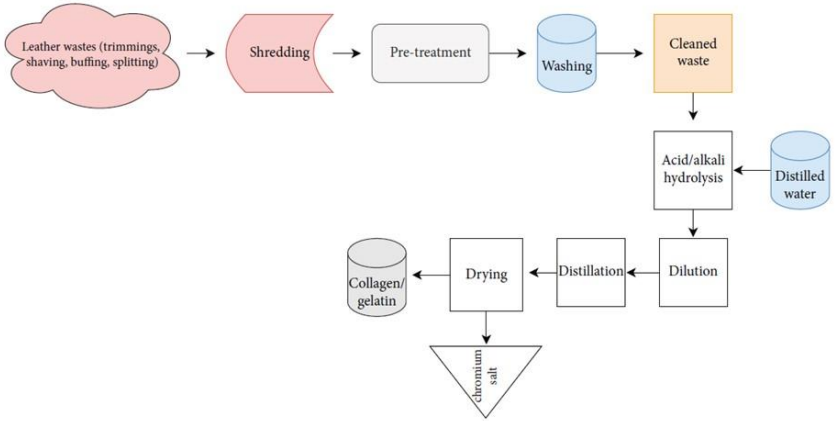


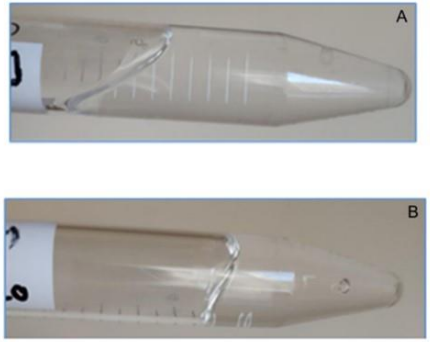
Internationally Commercialized: Processing eco-sustainable paper



https://www.favini.com/en/news/from-the-manufacturing-of-leather-into-remake/

Internationally Commercialized: Gelatin Production





https://timesofindia.indiatimes.com/home/science/scientists-make-gelatine-from-tannery-waste/articleshow/45407352.cms

Maistrenko, L.; Iungin, O.; Pikus, P.; Pokholenko, I.; Gorbatiuk, O.; Moshynets, O.; Okhmat, O.; Kolesnyk, T.; Potters, G.; Mokrousova, O. Collagen Obtained from Leather Production Waste Provides Suitable Gels for Biomedical Applications. Polymers 2022, 14, 4749. https://doi.org/10.3390/polym14214749

Internationally Commercialized: Preparation of compost from animal hair waste

Technology	Salient Features	Techno - Economics
• A suitable bacterial species have been identified for the degradation of hair waste followed by the manufacturing of compost using keratin hydrolysate (product of hair degradation) • The whole process could be completed within a time span of 9-10 days	• The compost is organic in nature • The supplementation of compost enhances the yield of paddy crop • The preparation of compost provides a technological solution to the disposal of solid waste, hair	• This technology has been already commercialized • Mineral salts that are locally available in the market will be utilized for the degradation of hair • Capacity: Upto 500 kg

Internationally Commercialized: Chromium Recovery

Location	Chrome recovery plants	Waste utilization
• Bursa Leather Industrial Park, Turkey	• This industrial park has integrated Chrome recovery plant within the CETP	• Currently only a small part of solid waste from the tanning process (fleshing, shaving and buffing) are re-used in the production of gelatin.
• Santa Croce Sull'arno Leather Industrial Park, Italy	• Consorzio Recupero Cromo Spa • This private company is composed of 240 member tanning companies from all over the district. These companies send the exhaust chrome liquor to the consortium for chrome extraction.	• The recovered chrome is returned to the original companies which use it directly in tanning processes. This plant can produce over 21.000 kilos of basic chrome sulphate per day.
• Al-robeky Leather Industrial Park, Egypt	• Proposed Chrome recovery unit	• Residual chrome recovery from the tanning bath, justified from both an economic and environmental point of view.

Various Implementation Mechanisms

Individual arrangements

- One-to-one contracts
  - Simplest form of Exchange
- Middle men
  - When small supply quantity and a few customers, need for collection and storage

Collective Arrangements

- Management of Industrial Park
  - When material exchanged needs special processing or treatment as well as an insurance of quality
- Mutualization

Mutualization

- Whereby participants share their collective resources, based on their specific needs coordinating how they are managed
- These mutualized resources can be handled by a participating member, who can also be the user of these resources, an association of members or an independent third-party
- Examples:
  - Organizing public transit for employees
  - Pooled purchasing of goods and services (equipment for personal or communal protection, pallets, uniform cleaning, landscaping, etc.).
  - Shared storage space.
  - Shared PV Rooftops
  - Shared precipitation tanks
  - Communal management of certain residual materials may lead to the development of new services or industries nearby.

Depending on the case, collaboration between

Source Company	• Sustain generation of the waste • Ensure quality meets the standards of receiving company
Receiving Company	• Commitment to the contract requirements (payment schedule, facilitation, etc.)
Transporters/ Collectors	• Commitment to delivery to the agreed parties • Efficient scheduling of collection • Preserve the waste characteristics and value
Park management	• Supervision and documentation (databased) of IS implementation • Promotion of the network • Facilitate the waste exchange process, as needed (e.g. collection and segregation)
Authorities/ Governmental Entities	Facilitating Symbiosis through: • Adequate planning of industrial parks • Proper policies providing incentives/disincentives

Minimum Requirements for Success

- **In general, IS requires the following:**
  - Flow of knowledge,
  - Diverse organizations,
  - Value-added destinations of non-product outputs,
  - A collective approach to the system as a whole, based on the assimilation of its benefits especially those for each stakeholder
- **How does this apply to our case?**
  - Knowledge of types and quantities are available
  - Mostly similar organizations,
  - Destinations are identified
  - Benefits to stakeholders are to be further investigated

Waste Valorization

- **Does it have a potential market ?**
  - Identify the potential destinations
  - Value indicates whether it should be exchanged with nearby company, or further transportation is still profitable
- **Identifying the waste value added requires**
  - Does it require further treatment ?
  - Identify cost savings (e.g. disposal costs)
- **Market value compared to cost (CAPEX and OPEX)**

Drivers

Individual Level

- Increased prices of resources (electricity, fuel, water, material)
- Profit of source and receiving companies
- Strict environmental legislations: increased penalties

National Level

- Social benefits (creating job opportunities)
- Growth of wastes market
- Presence of governmental encouraging policies/ strategies (Sustainable Development Strategy- Egypt Vision 2030), and waste law 2020
- **Requirements of the Global Market**

Egypt National Climate Change Strategy 2050,, climatelaws.org/geographies/egypt/policies/egypt-national-climate-change-strategy-nccs-2050

Challenges

As per a European Commission document of 2016

- Stability of waste amount and quality:
  - As it is a waste from production, it could be therefore minimized at anytime or when RECP is increased.
  - The changes in production volume will change the amount of waste/by-product.
  - In certain industries, it has no stable standard composition
- Lack of standards and benchmarks
- Lack of cleaner production regulations
- Long transportation distance affects the economic feasibility
- Lack of knowledge and insight in potential valorization routes for residuals and by-products
- In some cases, difficulty in finding sufficient and relevant information on how and where suitable potential partners/clients can be found

Barriers

- **Economic:** Risk of business discontinuity spreading to IS participants
- **Technological** : industries know how
- **Information:** Data sharing vs information confidentiality
- **Resistance to Change**: Those benefiting from current condition, e.g. waste collectors or virgin material suppliers, obstructing direct waste exchange
- **Quality :**Waste contamination and mixing

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