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Damgaard, Anders; Takou, Vasiliki; Ramin, Elham; Andersen, Maj Munch

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IDENTIFYING INDUSTRIAL ECOLOGY OPTIONS FOR AN INDUSTRIAL PARK - CASE OF RUARAKA, KENYA

Anders Damgaard [1], Vasiliki Takou [1], Elham Ramin [2] and Maj Munch Andersen [3]

[1] *Technical University of Denmark, Department of Environmental Engineering*
[2] *Technical University of Denmark, Department of Chemical and Biochemical Engineering*
[3] *Technical University of Denmark, Department of Management Engineering*

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ABSTRACT

Growth of industries in emerging developing countries like Kenya focus on production of main products often with little focus on the sustainability of their production, especially with regards to the fate of their residues. This has two impacts: 1) that residues may be disposed without a proper focus on associated environmental impacts; and 2) that any inherent value in these residues are not recovered which leads to suboptimal utilization.

Industrial ecology is one of the approaches to ascertain options for improvements in industries, which at the same time takes into account the three pillars of sustainability (environment, economic and social). Chiu and Yong (2004) investigated how industrial ecology was currently used in Asian developing countries (AD). Through a SWOT analysis they identified strengths, weaknesses, opportunities and threats for use of industrial ecology in these countries. They found that ADC needed to adopt industrial ecology as a strategic vision and approach to plan economic, social and ecological development of their economies. Through this approach they could potentially avoid some of the issues developed nations encountered through their industrialization. Lifset and Graedel (2002) has similarly shown how industrial ecology tools can be used for improvements in industrial eco-parks, and how different tools can be used for firm level improvements, between firm levels and regional/global level synergies.

This study is part of the GECKO research project (GrEen and Circular innovation for Kenyan cOmpanies). The main objective of GECKO is to provide scientific support in developing existing industrial parks in Kenya into eco-industrial parks with the case study of a current industrial zone in Ruaraka on the outskirts of Nairobi. The project is carried out as a collaboration between Danish and Kenyan universities as well as governmental entities in Kenya and associated companies in Ruaraka. One of the core sub-objectives is to investigate the opportunities and scope for industrial symbiosis in Ruaraka. In the project, a first step is being done through the development of a matching matrix to

identify potential symbiosis opportunities within waste water, energy and solid waste. In this paper we will elaborate on how such a matching matrix can be developed on solid waste and used to identify symbiotic potentials.

The matching matrix is being developed through a set of steps:

1) Thorough screening using a digital circular screening tool further developed for the project as well as sampling of residues of the 34 companies selected in the Ruaraka industrial zone for residual resources that potentially could be utilized. The best candidates are being selected for further analyses into improvement opportunities, based on a number of parameters including: interest in collaboration, environmental improvement potential, business potentials, technical novelty and scope etc.

2) Grouping of the selected companies by economic activity, and subsequent categorization of their potential waste types (outputs) as indicated by EU regulation (EC No 2150/2002 on waste statistics).

3) Literature review on the potential utilization options of the waste codes identified in step 2.

4) Matching of the companies' inputs and outputs identified in step 2 with the sector(s) in which they could be utilized.

5) Finally, the information from steps 1 to 4 are combined to form the preliminary matching matrix which forms the basis for further technical and business research. A truncated version is illustrated in figure 1. In the first column (waste producers) the companies are grouped according to produced waste types, while in the first row (waste consumers) they are grouped based on their sector. The matching results were further grouped in likelihood of symbiosis set to: high, potential and unlikely, according to their initial implementation potential.

The results of the matching exercise and the screenings so far shows that there from this theoretical approach seem to be relevant opportunities for industrial symbiosis in the Ruaraka case area. This also shows that the review matching exercise combined with the company screening can be used to guide the identification of opportunities for industrial symbiosis efficiently. However, more detailed analysis is needed to investigate the full potential of industrial symbiosis in the specific Kenyan context, which includes, mainly, business aspects related to volumes, residue composition, quality of residue streams, proximity between donor and receiver company and the competitive and regulative situation of the companies. Improvements also need to consider conditions such as limited trust between companies and between companies and environmental authorities, ill-functioning environmental infrastructures, etc. Clearly, industrial symbiosis potentials depend on many factors beyond pure environmental assessments which are often neglected in industrial ecology research and which are particularly important in a developing country context.

Producer of Residual Resources (Donor)	Potential Consumer of Residual Resources (Receiver)						
	Company Name	Company A	Company A, C & D	Company F	Company H	Company B & D
	Company Name	Sector utilization potential (input) / Waste produced (output)	C10-MANUFACTURE OF FOOD PRODUCTS (meat based)	C10-MANUFACTURE OF FOOD PRODUCTS (vegtable based)	C21-MANUFACTURE OF BASIC PHARMACEUTICAL PRODUCTS AND PHARMACEUTICAL PREPARATIONSs	C17-MANUFACTURE OF PAPER AND PAPER PRODUCTS	C22-MANUFACTURE OF RUBBER AND PLASTIC PRODUCTS
	Company A & B	21-ANIMAL AND MIXED FOOD WASTE	Skins for sausages (direct use)	gelatin for jelly or food stabilizer	residual parts: vitamin & hormone synthesis, cosmetics (eg collagen); blood: testing/drug preparation; skins: dressing of burns and skin ulcers/grafting, coating/binding of drug tablets,		
	Company A, B, C & D	22-VEGETABLE WASTES		sauces/juice/culinarry mix that does not require high quality vegetable/fruit	vitamines; nutraceuticals; cosmetics	plant residue to paper	Bioplastics
	Company E	4-CHEMICAL WASTES				SO2/H2S	
	Company F	7-HEALTH CARE AND BIOLOGICAL WASTES			direct use		
	Company B, D &G	14-PLASTICS WASTES					direct use
	Company H	15-WOOD WASTES				direct use	
	Company H + rest of the companies (from packaging)	12-PAPER AND CARDBOARD WASTES			lignin to chemical building blocks	internal use/recycling	
	Company I	11-GLASS WASTES					

LEGEND

High Potential/fairly easy to implement	
Potential based on literature/ to be investigated for this specific case study	
Unlikely due to technology/legislation restrictions	

Figure 1. Truncated initial matching matrix developed for phase 1 on basis of initial screening of first 8 companies in Ruaraka. The matrix includes: 1) very likely symbiosis options, 2: Potential synergies for later phases, and 3: Potential synergies to companies outside Ruaraka

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