ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Economical Benefit Through Industrial Symbiosis: Trash To Treasure: A Case Study In An Indian Industrial Area.

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ABSTRACT

Industrial ecology and industrial symbiosis although being understudied in India. Green twinning is already being in practice as firms collaborating to pursue more economical ways to dispose their unwanted products. This direct inter firm exchange of unwanted products is the main cornerstone for industrial symbiosis. Value potential trends of different firms vary according to the various factors. In Vizag cluster we have studied some industries where green-twinning happening over different value potential trends. And we will discuss the different factors which will affect this value potential. With little modifications, how firms can get maximum embedded energy of a material in order to obtain economical benefits apart from environmental benefits were discussed.

Keywords: Industrial ecology, Industrial symbiosis, waste exchange, industrial waste.

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ISSN: 0975-8585

INTRODUCTION

As we all know industrial ecology been the new age study and been the concern. Since the conservation of natural resources has been our main concern than waste disposal which is also included in IE. Now a day economic constraints of environmental regulation on firms has increased [1]. Industrial Symbiosis (IS) have been the new age tool and boom to get potential solutions for reaping economic and environmental benefits [2]. In countries like India large populations and limited resources leads to scarcity, provokes conservation of natural resources. IS & IE has been the right answer to this situation. IS enables the industries to approach doing made with less. The present environmental degradation prompts the governments to elevate the standards of regulation over time. IS – Inter firm collaboration enables the exchanges of wastes and unwanted products to other industries as inputs. Disposal as waste is not the only way now as IS introduced.

A potentially valued waste can make money through it. Since there are firm waste disposal costs (incinerators and land fillings) which are relatively sometimes high, the industries are finding new ways to dispose their waste (In other words, giving away to other useful industries) in practice, firms willingly forgo economical profit from exchanges, particularly with those materials that are difficult or expensive to dispose of [3]. Some industrial symbiosis networks, called as industrial eco- systems are thought to exist in some industrial clusters, but are not yet may be recognized [4]. And common bilateral exchanges between firms called green twinning and kernels of symbiosis are much more in practice. In this paper, we will discuss about different value trends in which industrial waste is being exchanged. And the factors that affect the value potential trends are being discussed.

Many nations have put serious concerns over resource conservation by waste management strategies etc,. The waste management staircase which are seven strategies are: waste disposal, pollution control, recycling, waste minimization, pollution prevention, cleaner production, and Industrial ecology and finally will reach sustainable development (W. B.Hamner, 1996). In this stair case every lower strategy is covered under higher strategy. For example, recycling is covered under waste minimization, thus finally every strategy can be covered under industrial ecology. Hence forth industrial ecology is the latest strategy for waste management. And waste hierarchy by [5] also has been incorporated many national waste policy and legislation in several countries like the European Union,1989; Dept of Environment U.K 1994, 1995.

Industrial ecology is being considered as a simple guideline for extracting maximum embedded value or energy from waste material. And Industrial symbiosis is the main application of Industrial ecology. Till date, a pool of literature has discussed and highlighted the success of spontaneously developed an industrial symbiosis networks [6,7,8]. In contrast, it has also been realized that 'evolution toward industrial symbiosis is not an immediate process; rather it requires deliberate and intentional action' [9].

Industrial symbiosis involve the physical exchange of materials, energy, water and by-products among several firms. [10]. IS exemplifies the popular saying "one man's trash is another man's treasure."IS seems to be the most successful and durable functional systems evolved from the pursuit of economic benefits [11,12]. Three kinds of symbiosis can happen by-product or waste product exchange, utility sharing, cooperating on common issues [13]. And this discussion concentrates mainly on bilateral exchange with economic benefit. Eco- industrial parks are a new concept,especially in India, where recreating Kaulandburg like Eco-industrial park is almost a long-term plan. So, industrial symbiosis have been the most promising tool to be implemented to conserve the virgin raw and minimize the energy consumption. Even though the IS network has been slowly implemented, green twinning (i.e waste exchange) was existing in many parts of the country. IS provides an analytical framework for perceiving how industries cooperate in the pursuit of competitive advantage. The main driving forces for the firms to take up IS or green twining are regulations and economical advantages.

DATA ANALYSIS

In eastern south India, Andhra Pradesh state from place named Vizag, some industries were taken to collect data. Industries like National Thermal Power Plant Simhadri(coal based power plant), DIVIS laboratories Ltd, Andhra Cements are surveyed and analytical results are shown here. And also entities like Andhra Pradesh Pollution Control Board and Coastal Waste Management Project by Ramki were also visited for the data collection.The results of collected data were analyzed and tabled below.

ISSN: 0975-8585

Table:1. Economical benefits from industrial symbiosis to firms

MATERIAL	FROM (Name of the Industry)	TO	QUANTITY	ECONOMIC BENEFIT	TREND
Fly ash	NTPC	Brick industries, cement manufacturing industries, road constructions	2,800 to 4000 T/day approx.	35-40cr/annum approx.	Cost saving*
Bottom ash	NTPC	Ground improvement techniques	1300kg/day approx.	4 to 5cr approx. per annum	Cost saving*
Slag	RINL	Andhra cements	500 to 550 T/day approx.	2 to 2.2 lakhs/day (profit)	Profit
Gypsum	Coromandal	Andhra cements	20 to 30 T/day	14 to 21K/day (profit)	Profit
Spent carbon	DIVIS	Anjani cements	200 to 300 kg/month	10000/- per month	Cost saving
Process residue(solid)	DIVIS	Anjani cements	30T/month	8 to 10 lakhs /month	Cost saving
Process residue(liquid)	DIVIS	Via waste firm to (paints, tar etc)	20T/month	6 to 7 lakhs/ month	Cost saving
Mixed spent solvent(liquid)	DIVIS	Via waste firm to (paints, coal tar etc)	130KL/month	9,10,000Rs/month	Profit
Fly ash	DIVIS	Brick industries	25to40T/day	5000 to 5400/- per day	Cost saving*
Lube oil	DIVIS	Waste firm processing	150L/month	300 to 500/- per month	Cost saving*

Note: * indicates cost saving with neither loss nor profit.

From the table.1, following trends is depicted. They are Disposal with extra cost, disposal with neither lose nor profit, and disposal with economic benefit. Moreover first two trends come under cost savings. And the third trend falls under eco-sales.There are many environmental benefits, but as in this discussion we're focusing only on economical benefits to the firms.

Disposal with extra costs

Even though it is very beneficial for firms disposing them to other firms, there is a more scope of earning. As listed in the table._Pharma industries like DIVIS have been giving their waste to other firms & paying money to the firms to take their waste. Without paying other receiver firms may not take their waste. Either it is for transportation of waste or waste is considered hazardous & receiver firm have to pay for regulations or for re-processing before they use. This symbiosis may not seem beneficial but when we look at the previous disposal methods of these wastes like incineration or handling to waste management firms which are more costly affairs or not at all economical. By this symbiosis the firms are almost saving a lot when compared to previously employed methods. By Input-modifications, process modifications or re-processing this extra cost can be avoided and firms can get benefits even from waste & that's how it is called "Trash to Treasure".

Disposal with neither lose nor profit

In this second trend, for instance, we take fly ash from power plant (NTPC), which is free of cost but receiver just has to pay for transportation. So there is no profit or no lose to firm. And it is useful to the receiver-firm. If it is not given away, then the handling cost of fly ash to store it & dispose it costs very heavily (annually NTPC vizag is spending around 40-50 crores for storing remaining fly ash from the plant. So if fly ash is completely taken away by the receiver-firms, then cost saving for NTPC would be very humongous). By giving away the part of waste, NTPC is approximately saving 20-30 crores of storage costs (because not all waste has been taken away since fly-ash production is very high). Another example is the lube oil from pharmaceutical industry DIVIS. Because of lube oil got its own value waste firms are ready to take it even

though it is used. But since it was used oil with dirt and all and is not processed, Divis is giving it for free. As discussed in the previous trend even though it is not processed, because of its value, lube oil has been given away to a symbiotic-receiver (i.e here third-party) at free of cost where 3rd party authorized dealer process it and make profit out of it. So this is neither profit nor loss exchange.

Even lube can also be processed inside the firm but only if there's a significant amount of lube oil to process. Because economics obviously act as a major criteria. Hence fourth sometimes giving to waste firms is the best way of disposal to save money. Even though sometimes if there's no profit or no lose, giving away waste helps in cost savings.

Disposal with economic benefits

When we discover waste is not really a waste, it's very beneficial. That is how the phrase "Trash to Treasure" coined. Yes, as listed in the above table like slag, chemical, gypsum, MSS, the giver firms are actually earning profits, even through waste, by selling them to receiver-symbiotic firm. Either it's because of scarcity or demand some wastes will get profits to firms. When every firm progress to this trend, then the symbiosis can be perfectly put into practice, then the maximum value polluted can be extracted from product even economically.

Literally the receiver firms are buying waste from firms. Slag is the by-product of iron-ore, which is a serious waste so lots of slag has been utilized in these blended cements. This symbiotic exchange involves in increased sales, and cost savings too, so do business development.

DISCUSSIONS

Factors affecting value potential of wastes are Waste quality, Geographical vicinity of industries, Availability of symbiotic industries & Demand for waste and Policies & regulations

Waste Quality

The Quality of by-product or waste product must be taken into consideration from the symbiotic receiver firm point of view. For instance a by-product from firm A has a waste for symbiotic exchange (simple waste exchange) to firm B. B is already having an alternative of that by-product with good quality (considering policies& regulations). If B got to take it from A the third party refining is needed(because not all wastes are ready to use as input). So firm A has to bear those refining charges too. Even though the symbiotic exchange is beneficial, but it is not so economical (because if it is not a symbiotic exchange, then waste disposal costs will be higher). Industrial third party unauthorized firms are a much more threat to the environment. Especially in India only authorized third party firms have to be considered. To maintain the quality of waste from the firm, either post processing is needed or input/process modification may help to maintain some waste quality.

Availability of symbiotic industries

Diversity of firms was the most favorable part of IS exchanges. Since similar wastes from all the firms at particular geographical area cannot used by same industries and that's how eco-industrial parks came into existence with different industries. If receiver-firms are not available, then there is no scope for exchange of waste because it is not economical. To exchange waste from firms far away transportation costs may exceed the actual disposal costs. At the same time, the firms that are very near geographically to the receiver-firm have all the chances to take that waste. Then the value potential of that waste may be increased due to demand. Even though the value of waste is hiked, the receiver still gets it less than the virgin raw material costs and that's how it is works.

Policies and regulations

Policies and regulations are the main driving forces for the industrial symbiosis. There's a perspective, that increasing regulation may provoke industries to reconsider these existing business practices and drive industries to become more competitive through increased innovation [14]. Policies force firms to take up IS exchanges other than to dispose their waste. In the other way round, IS offers useful insight for

ISSN: 0975-8585

policy makers to make policies waste disposal in an environmentally responsible manner. If there are regulations on certain wastes for their disposal, the firms obviously force themselves to let go off the waste in the cheapest way possible under regulation. So firms' trend to use IS for disposal and this affects the value of waste.

Geographical vicinity

Close geographical prominence is extensively known as the pre- requisite for IS. 'The keys to IS are the synergistic possibilities offered by geographic proximity'[15]. However, close proximity is not the only criteria, even though firms are discussed. IS exchange happens, but the value potential differs because of transportation facilities and costs for the waste. Synergies having two choices for the same wastes will choose the least possible distant firm, even though it may sell its waste at high cost because overall cost will be less.

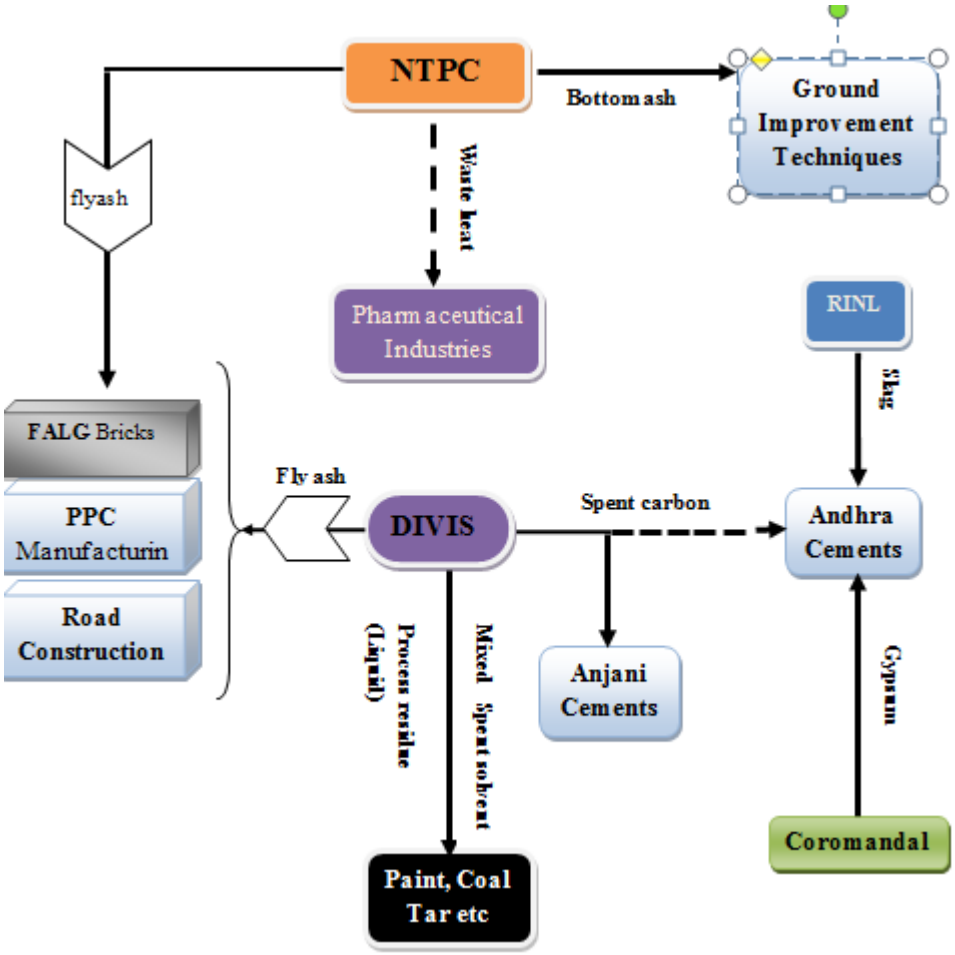

Figure:1. Symbiosis network.

→Dotted line indicates proposed symbiosis.

CONCLUSIONS

In this study we want to show the firms, that there is a very humongous scope to extract the maximum embedded energy from the raw material. And there is a scope to make money from waste with little modifications or changes. By detailing and discussing how industries can create value potential to waste products and factors affecting them to contribute to research to the discovery of economic benefits to the firms through inter-firm actions. The trends that are discussed will also contribute to research. Under regulatory constraints and economical constraints as driving force how firms can collaborate to create economic and environmental outcome. Even from waste IS as a tool firms getting economically benefitted. We

contribute to the environmental strategy by showcasing IS as an innovative approach to satisfy economic and environmental concerns. And furthering research work by empirically detailing how industries may use IS as a tool to create environmental and economic value beyond their own organizational territories.

ACKNOWLEDGEMENT

The technical support extended by GMR Institute of Technology, Rajam (Autonomous) is highly appreciated. We appreciate the cooperation of the industries like DIVIS laboratories Ltd, National Thermal Power Corpoartion Simhadri, Andhra cements Ltd from Visakhapatnam.

REFERENCES

[1] Darnall N. Regulatory stringency, green production offsets, and organizations'financial performance. Public Administration Review 2009; 69 (3): 418–434.
[2] Porter M.E, van der Linde C. Toward a new conception of the environment- competitiveness relationship. Journal of Economic Perspectives 1995; 9 (4) : 97–118.
[3] Paquin RL, Howard-Grenville J. The evolution of facilitated industrial symbiosis. Journal of Industrial Ecology 2012; 16 (1) : 83–93.
[4] Chertow MR."Uncovering" industrial symbiosis. Journal of Industrial Ecology2007; 11 (1): 11–30.
[5] Price JL, Joseph JB. Demand management—a basis for waste policy: a critical review of the applicability of the waste hierarchy in terms of achieving sustainable waste management.Sustainable Development 2000; 8: 96–105.
[6] Heers RR, Vermeulen WJV, de Walle FB. Eco-industrial park initiatives in the USA and the Netherlands: first lessons. J. Clean. Prod 2004;12 : 985 – 995.
[7] Chertow MR."Uncovering" industrial symbiosis. Journal of Industrial Ecology 2007;11:11– 30.
[8] Gibbs D, Deutz P. Reflections on implementing industrial ecology through eco- industrial park development. J. Clean. Prod 200 ; 715:1683 - 1695.
[9] Boons F, Baas L. Types of industrial ecology: the problem of coordination. J. Clean. Prod 1997; 5 : 79-86.
[10] Chertow MR. Industrial symbiosis: literature and taxonomy. Annual Review of Energy and Environment 2000; 25: 313–37.
[11] Desrochers P. Industrial symbiosis: the case for market coordination. Journal of Cleaner Production 2004;12:1099–110.
[12] Chertow MR. Uncovering industrial symbiosis. J. Ind. Ecol 2007 ;11 (1) : 11- 30
[13] Chertow MR, Ashton WS, Espinosa JC. Industrial symbiosis in Puerto Rico: environmentally-related agglomeration economies. Regional Studies 2008; 42: 1299 312.
[14] Porter ME, van der Linde C. Toward a new conception of the environment- competitiveness relationship. Journal of Economic Perspectives 1995; 9 (4) : 97–118.
[15] van Berkel R, FujitaT, Hashimoto S, Fuji M. Industrial symbiosis in Japan.Environ. Sci. Technol 2009; 43 (5) :1271- 1281.