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WASTE MANAGEMENT TECHNOLOGY*

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Abstract

As the population grows there is an increase in wastage from our economic activities. Causing pollution on land, water, air, and on all other living things. India, being the second largest populous country in the world produces enormous organic and inorganic waste. While the household and agriculture waste may be used immediately after simple treatment, the waste generated from industries cannot be used as it is. If the industrial leftovers are effectively recycled or retreated by adopting suitable management techniques, then there will be no unwanted element in the environment. Rather, all nutrient elements if recycled, may enrich soil and other natural resources. Scientists and economists have found new technology to treat all waste as a source through recycling, conversion, source of energy, and land reclamation. Now, they have come to the conclusion that waste is a waste if untreated, but if it is modified in some other form, it is a potential resource and a wealth for our future. However, the only requirement is that it should be treated properly or taken care of. This paper examines some of the technology adopted by scientists, economists to use the waste as one of the potential resource either through knowledge or any other means for increasing productivity, maximising returns, and reducing pile up of unused waste. Successful case studies have been reviewed and analysed critically.

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1. Introduction

Management is a technique by which resources are used in a rational manner in order to achieve maximum benefit to the organisation or the system. Environmental waste management on the other hand, is solving pollution arising out of waste and to control the waste in a meaningful manner without harming the environment. The point is that a waste is a waste until we find other forms of usage for it. But once the unwanted is treated or modified to some other form, it is a potential resource ready for reuse.

A little waste will not create any immediate problem to the environment, but even a little hazardous waste poses a substantial danger to living things. USA, UK and France generate large quantities of hazardous wastes, names (i) *Waste recovery* through a change in production process; (ii) *Chemical treatment* by means of neutralisation of hazardous debris; (iii) *Biological treatment* through fungi to degrade toxic organic compounds; (iv) *Solidification and encapsulation* to render the toxic component in a stable or insoluble form as far as possible; and (v) *Incineration* to remove noxious acidic gases from refuse.

To meet the challenges of waste management three principles are seen vital:

i) Legitimacy of action based on the principles that whatever we do that should be useful to the society and should not hard the environment.

ii) Sharing of technology with poor so as to reduce wastages.

iii) Justice to all, the benefits of new innovation should go to the poor as well. The technology or the innovation should be effective.

This paper aims to present the technologies available for waste management. The successful management of scrap recycling and integration of unused into production process is illustrated with suitable examples.

2. Technology of Waste Management

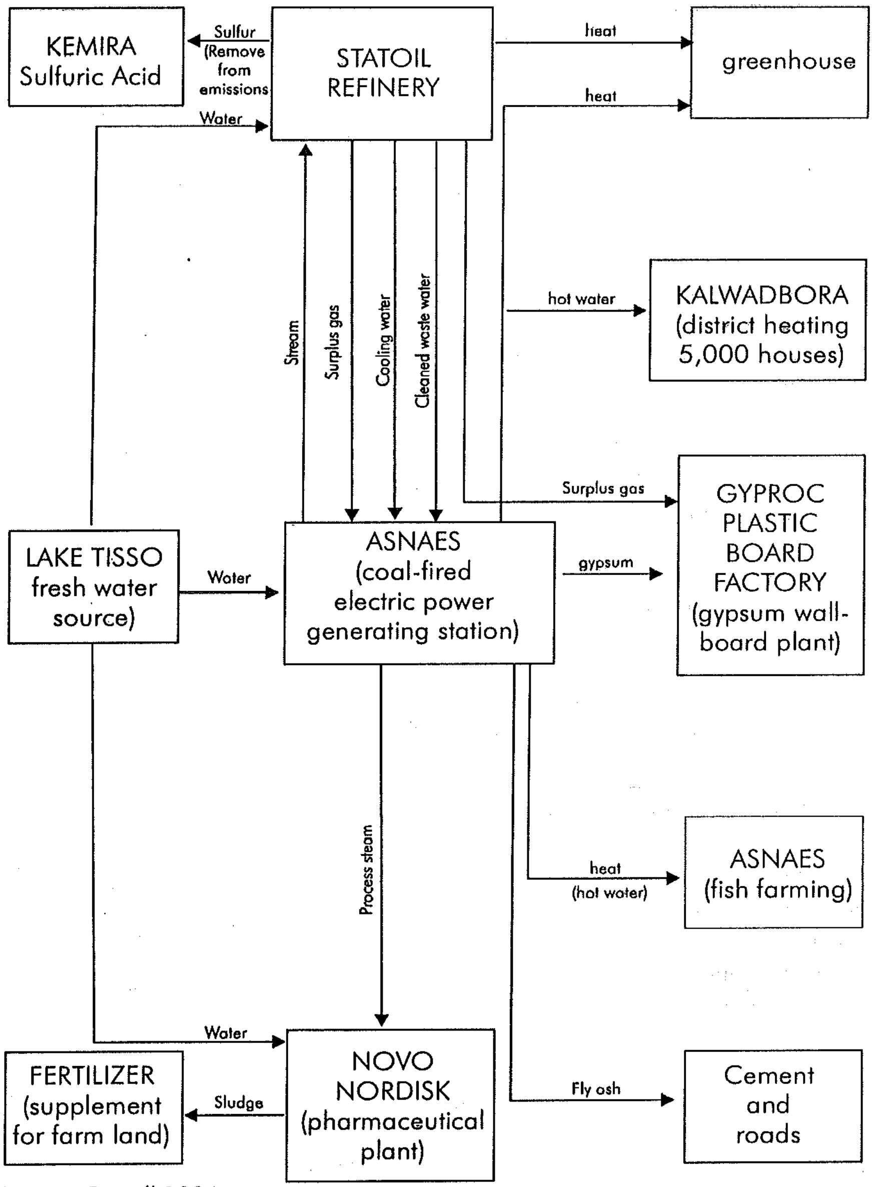
2.1 The Background

Large scale industries such as sugar cane factories, thermal power stations use large amount of energy for various operations. Components like cooling towers, boilers, condensers, heaters, and sludge tank collections, (which deals with hot or warm water) deal with the extraction or transmission of energy from or to a fluid and some of the energy is released to the environment. In these cases the wasted energy could be recovered to enhance the efficiency of the system. This not only allows savings in terms of energy consumption but will also help in maintaining CO_2 emission at the present level. It may not be economical to recover and use all waste energy in the same factory. But it may be feasible to recover the energy and sell it to other companies to allow them to manufacture or process their products. Small and medium industries may be so designed and located so that they can buy the excess energy from the big companies and use it for their own production purpose. This kind of arranged location of inter dependent companies may invariably benefit the large scale industries and small scale industries and the country as a whole by reducing fossil fuel imports. The limitation is that the amount of energy available for sale and its conditions must be known before setting up of the such units (Venkannah *et al.* 2002).

2.2. Waste Management Technology through Industrial Integration

A coal fired power plant, namely Asnaes power station in Denmark, supplies electricity to Denmark, and exports a part of it's power to Sweden via under-sea cable. The power station is also at the centre of co-operation between the industries in Kalundborg, designed to improve their competitive position while reducing their impact on the environment. The power station's hot water, heated by condensing stream, is pumped to 5,000 houses in the town. Some of the cooling water before being returned to sea is diverted to fish farms owned by the power station, where it is used to raise the temperature of the water in fish tanks by a few critical degrees. The fish produced in the farm is exported to France and Japan. Through this process the company earns good foreign revenue.

The power station also produced two other valuable wastes that is fly ash and gypsum. The ash is caught before it goes up the chimney and shipped from station to a cement maker in Jutland. The scrubbing system is built to reduce the sulphur content of the emissions, one of the main contributors to acid rain. The scrubber produces gypsum and the Gyproc factory which currently gets some of its supplies from a sister station near Copenhagen, buys this. Gypsum is sandwiched between the Card board. This factory runs its dryers, and essential and expensive part of the process of making plasterboard on a light fuel-gas piped directly from Norwegian refinery.



Source: Cornell 1994

Figure 1 : Kalundborg Prototype Industrial Ecosystem

A few hundred meters east of the power station lies the Norwegian State owned oil-refinery, which supplies most of surplus gas to this power station. The power station adopts its furnaces for the purpose and produces a saving of upto 30,000 tonnes of coal a year. In turn, the refinery buys steam from the power station. This process has helped the refinery to reduce output of carbon dioxide. The refinery is also removing most of the sulfur from its emissions and selling it as pure sulfur to the manufacturer of sulfuric acid. Besides this the refinery cleans its own cooling water and waste water and pumps it to the power station, making possible another reduction in fresh water consumption in a place (Kalundborg) where the fresh water is considered as scarce.

Novo Nordisk plant located a few kilometers away from the power plant employs 1,000 people, produces insulin, enzymes, and penicillin (mainly by fermentation). The plant produces large amount of potentially valuable wastes in the form of sludge. Novo treats its sludge and makes it safe to be spread on farm as a fertiliser supplement. In fact, Novo sprays it on the fields for free, saving farmers about $100 per hectare on their fertiliser bills.

These instances teach us many important lessons, namely co-operation, trust and mutual understanding. Each swap or trade deal is negotiated independently with the emphasis on mutual commercial benefits. Although all these inter-linkages or inter-dependencies were purely economic, the participating plants help the environment in one way or the other. The success of Kalundborg power plant also teaches us the importance of quality, safety, and environmental sympathy (Knight 1999:43).

2.3 Hazardous Waste Management Technology

As stated in the in the introduction, certain wastage is considered as hazardous debris, which always pose danger to the environment. But, if there is a will, there is a way. As such, the hazardous litters can also be reused or recycled for some productive purpose. In this section an attempt has been made to examine how used cameras, soft drink bottles, plastic waste, motor vehicles spare parts and used types were recycled in a meaningful manner.

Single use cameras of Kodak are designed in such a way that 85 per cent of each camera can be reused or recycled. The main core of the camera and flash unit of the models with a flash are typically reused for a maximum of six times. Parts that do not pass inspection are grouped up and fed into the raw martial stream for modeling into new cameras. The lens is sent for toy manufacturing. The card board case is incinerated in a waste energy incinerator at the Kodak plant. Through a separate non-reimbursed programme, the photofinisher may also recycle the polyethylene film spool and steel film magazine (France *et al.* 1994: 340).

Soft drink bottle (Polyethylene Terephthalate-PET) is being recycled since 1992 in USA. During that year the nation wise recycling rate was more than 40 percent. About 24 per cent of all PET products are recycled. It is being used for carpets, for insulation of sleeping bags, pillows and ski-jackets. As of 1991, about 35 per cent of all synthetic carpeting sold in the USA were made partly from old soft drink bottles. Alternatively, PET can be chemically treated and used to make polyurethane foam insulation or polyester resin bath tubes or it can be repolymerised into PET (ibid; 343)

In another incidence a scientist has demonstrated how plastic waste can be converted into diesel, gasoline, and lubricant oil. The scientist has claimed that fuels quality is at par with those obtained from crude oil. It is profitable and does not generate dioxins. The process involves two stages. The first stage involves depolymerisation of plastic waste under controlled reactions. A mixture of plastic waste can be used. For instance, one kilogramme of waste can consist of 500 grammes of plastic bags, 200 grammes of plastic sandals, 200 grammes of discarded raincoats and 100 grammes of computer scrap. In the first stage, the mixture is processed along with coal and patented additives, and them heated at a temperature of about 350°C in the absence of oxygen. About 1100 Millie of liquid distillate is formed, which accounts for 80 per cent of the waste by weight. The rest of the junk is converted into gases, which is equivalent to liquefied petroleum gas. In the second stage, the distillate undergoes fractional distillation, which requires a maximum temperature of 360°C. Between room temperature and 200°C, petrol is formed. From 240-360°C, diesel is produced. Above 360°C, lubricant oil is generated. The fuel ratio is 60 per cent gasoline, 30 per cent diesel and 8-10 percent lubricant oil (Jamwal 2003).

Motor vehicle spare parts is again one of the most highly recycled consumer products. In USA about 75 per cent of the vehicle scrap processed is recycled or reused. For example body panels, doors, wheel covers, tyres, radiators, radios, and fenders are sold in second-hand shops. The remaining 25 percent of the motor vehicle called as 'fluff', consist of plastics, fluids and lubricants, rubber glass and other materials. Now engineers have developed a new technique to use these fluff materials for producing oils, gas and fillers for thermoplastics. Whatever remaining fluff disposed to landfills represents less than two percent of the total volume of waste material sent to municipal landfills each year. Besides, 80 per cent of lead acid batteries are recycled; tyres and bumpers are also recycled (Ibid: 343)

Illinois Environmental Protection Agency in USA redirects 100 tyre dumpsites and removes and recycles about one million tyres. Through its type clean-up contractors, the agency processes and delivers the tyres to power plants that blend the tyres with coal to produce electricity. They currently market 12.5 million waste tyres annually either for beneficial use or for recycling. They act as a regulatory or enforcement agency and operate a clean-up programme to redirect type dumpsites. The company sponsors 20 to 30 countrywise type collections annually in which thousands of citizens bring their waste tyres to a central location for proper disposal (Anon 199: 6)

Used tyres and tubes can be made as sofas, high stools, centre tables, office chairs, coffee bars, clocks, mirrors, painting frames etc. Furniture and other useful materials made from these wastes are cost-effective, durable, strong and can last a lifetime. Hence, we are getting imperative environment friendly furniture. Ms. Rama Anand, New Delhi, introduced this innovative technique. It is environment friendly as it is getting rid of millions old tyres, the world over is a big problem. Normally, the used tyres do not biodegrade quickly, occupy too many landfills, and release thick black toxic fumes and chemicals into the air when burnt. (Anon 2003 a).

2.4 Bio-Waste Management Technology

Although bio-waste may easily degrade in the environment, but if it is properly treated, can become a potential resource for our future. A few case studies related to solid state bio-gas, wed as natural dyes and salt, and water from sugarcane are explained as an innovative step in bio-waste management.

The Natural Sugar and Allied Industries (NSAI) in Latur, Maharashtra did not buy a single drop of water for its operation during the year 2002-03. In fact, the company has consumed 500 cubic meters of water per day, costing Rs. 8750/- is saved due to their effort to produce water from sugarcane. Normally, the cane comprises 70 to 75 per cent of water. To start the crushing, water of a natural reservoir was used. Thereafter water extracted from sugar cane was utilised. First and foremost the company also prevented leakages from all pipelines. The exhaust and steam of the boilers are trapped and the condensed water is collected and then reused to cool bearings of the mills, clean the juice heater, wash the floor and remove the ash of the boilers. The water used in the turbine and air compressors was also collected in the spray pond and recycled. Treated effluent of the factory and excess water of the spray pond was collected in pits from where it percolas into a well. With the result, the company is saving Rs. 1.5 million. Based on the success story of NSAI, about 50 sugar industry managers have visited the industry and learnt the new technology for their adaptation in their sugar industries (Deulgaonkar 2003).

Water is adversely affected by aquatic weeds and other waste materials resulting in critical problems in agriculture, navigation, irrigation, public health and fish culture. Now scientists have found a new way to turn aquatic weeds into useful one through recycling. The aquatic weed contains 13 elements such as N, P, K, Z, Mg, Na, S, Mn, Cu, Fe, Ca, and B. Needs contain more K, Fe : Cathan terrestrial plants. Besides nutrient providing they improve soil texture and increase water holding capacity of soil, which is very important in sandy laterite and heavy clay soil. Excessive use of chemical fertiliser causes ecological imbalance in the long run. To overcome this problem long run recycling of weed will help to a great extent. The slow rate of release of nutrients over a longer period of time is another benefit (Verma 2003).

Scientists from the Gujarat based Central Salt and Marine Chemical Research Institute (CSMCRI) have figured out a new way to obtain salt from salicornia branchiata-a halophyte. This leafless shrub grows in coastal wastelands having high salinity and moisture levels. Unlike ordinary salt, 'saloni' - the new salt produced from the shrub has important micronutrients such as calcium, manganese, iron, zinc and copper. The shrub is said to yield around three to four tonnes of salt per hectare. The problem is that the commercial cultivation of shrub must be done nearer to the coast so that the top deposition of salt is washed-out with every high tide. Otherwise the land would further deteriorate. Again the new salt extracted from the plant may be costlier than its ordinary counterpart (Singh 2003).

A Bio-gas plant uses cattle dung, human excreta and other organic material as raw material. This material has to be thoroughly mixed with an equal quantity of water. As water becomes a scarce commodity, many are dissuaded from using biogas plants. In order to overcome the water problem, the Central Institute of Agricultural Engineering (CIAE), Bhopal, has developed solid state digestion system. According to this system, the fresh cattle dung is fed into the bio-gas plant with limited dilution by water. Compared to conventional bio-gas plant the new technology requires little quantity of water or no water is required to operate the solid state digester. The other advantage is that the digested slurry can be readily transported to fields for use as compost. The gas yield is also found to be 60 per cent more than that of the conventional plant (Anon 2001).

A research study conducted at Gandhigram revealed that 47 plants, so far considered as weeds or wild plants, become substitutes for chemical dyes. By making use of these plants, about 130 shade cards have been developed so far. Hence, on an average, each plant produces three colours. Further, the study also identified ninety new dye-yielding plants. The study concludes that the natural dying plant has high demand in the international market (Anon 2003 b). There is a high scope for generating foreign currency and employment in the rural areas.

3. Conclusion

Waste management or recycling the waste into further production process is a new technology moving towards rational use of natural resources. It also aimed at sustainable development of human being. Although the classical economists argue that the world is going to face severe crisis for scarce natural resources but the modern economists substantially believe that substitution and technological innovation may solve the problem of scarcity. Scientists all over the world are dedicating themselves to solve the problem converting of wastage including hazardous waste into useful form. The strategy of reduced consumption, increase the rate of recovery and reuse the waste materials may solve the problem of scarcity and bring prosperity to the human being.

References

1. Abbasi, S.A, (1998), Environmental pollution and its Control, Cogent International, Pondicherry: 253-284.

2. Anon (1999), Illinois Environmental Protection Agency : Used Type Programme Activities, Report Prepared for Government, George H. Ryan and the 91st general Assembly in Accordance with Section 55 of the Environmental Protection Act: 1-6.

3. Anon (2001), "Better Biogas Plants", Down to Earth, 9(20): 46-47.

4. Anon (2003 a), "Re-Tyre your Furniture", Gobar Times 12(4): 17

5. Anon (2003 b), "Weeds Add to Shades", Newsletter, Gandhigram Trust, July 2003: 7.

6. Deulgaonkar, Atul (2003), "Water from Sugarcane", Down to Earth, 12(5):25.

7. France, Wayne and Valeria Thomas (1994), "Industrial Ecology in the Manufacturing of Consumer Products", in Socolow R, C. Andrews, F. Berkhout, and V. Thomas (Eds), Industrial Ecology and Global Change, Cambridge University Press, Cambridge : 339-348.

8. Jamwal, Nidhi (2003), "Don't junk it: Waste can power vehicle", Down to Earth, 12 (5) : 23.

9. Knight, Peter (1999), "Closing the Loops", Tomorrow: 40-43.

10. Sankaran S., (1994), Environmental Economics, Margam Publications, Madras; 403-410.

11. Singh, Neelam (2003), "Taste of Waste: How to make plant yield salt", Down to Earth, 12 (13): 24.

12. Venkannah S., and J.G. Lamaletie (2002), "Waste Energy Recovery to Support small and medium Enterprises", Ecology, Environment and Conservation, 8(3): 215-221.

13. Verma J.P. (2003), "Recycling of Aquatic vegetation and Waste Material for Enrichment of Nutrient Status of Pond", in Environmental Challenges of the 21st Century, Arvind Kumar (Edi.), APH Publishing Corporation, New Delhi: 491-496.