Recycling of waste material

Recycling is one of the fundamental parts of the waste management plan. Although it alone cannot solve a community's municipal SWM problem, it can divert a significant portion of waste stream from disposal in landfill and combustion facilities. Recycling has a lot of direct and indirect significance for the society, and this can be grouped under the following three broad areas (UNCHS, 1994):

1. **Economic significance**

Economic assessment of waste recycling is a difficult task as many of the beneficial environmental and social impacts of recycling are long-term and are intangible, and, therefore, are difficult to quantify. Some of the short- and long-term economic benefits are:

a) Cost reduction

Resource recovery through recycling of solid waste could be of interest to waste management authorities as a means of reducing the waste disposal cost. Any saving in waste management cost could be a significant incentive to the authorities to increase the coverage of service areas and improve the service level. They can save cost from fuel for transportation, operation and maintenance, and generate revenue by sale of recyclables, etc.

b) Employment

Recycling of waste is a labour intensive activity, and its potential to ease the unemployment problem is high. Enhanced recycling activities, for example, can create an additional job market for skilled and unskilled workforce, and they can adapt to any of the occupations such as a labourer in recycling business or industry or a dealership.

c) Energy saving

Use of recyclables in some industrial processes is known to consume less energy than the use of any other raw material. The reduction in energy consumption in one industry could mean its availability for some other industry in need.

d) Reduced health care costs

Improved health and sanitary conditions in urban areas resulting from indirect benefits of waste recycling can reduce the investment in public health programme.

e) Saving costs for other public utilities

Enhanced solid waste recycling practices can reduce the frequency of sewer clogging, blocking of natural watercourse and pollution of water bodies. This will benefit the concerned public utilities through reduced cost in cleaning sewers and improved public safety due to blocked sewers and narrowing of natural watercourse.

2. **Environmental and health significance**

The volume of waste is increasing rapidly because of population growth and economic development. The composition of waste is also changing, leading to waste production with more recyclables. At the same time, polluted waste fractions are increasing because of increasing complex processes being used in industries, and these contribute increasingly to environmental degradation. This notwithstanding, recycling helps, among others, in the following ways, to facilitate effective waste management:

a) **Improved environment**

The environmental pollution may be due to inadequate SWM as well as due to its effect on other urban infrastructure. Recycling reduces the volume of waste that has to be finally dumped, and thereby causing reduction in pollution at the waste disposal sites. When there is reduction in volume of waste because of its increased reuse, different types of pollution (e.g., water, air and land) will get abated.

b) **Natural resource conservation**

Industries with natural products as their raw material for production are depleting natural resources. Use of more and more recyclable solid wastes in industrial production will relieve the tremendous pressure on these precious resources. For example, recycling of waste paper means a lower demand for wood, which means less cutting of trees and an enhanced possibility for sustainable use of the forest. Using recyclable items in the production process would reduce the demand for energy as well.

3. **Social significance**

People engaged in waste collection activities are normally of low social and economic standing. This is especially true with scavengers, which is evident from persisting poor quality of their living and working conditions. Different groups of people engaged in waste recycling have a hierarchical social and economic status, in which, processors are at the top of the hierarchy followed by waste dealers and wholesalers, waste buyers and waste collectors in that very order, while scavengers are at the bottom. Although there is this social and economic hierarchy within the waste recycling business, the overall social esteem of waste recycling operators is low.

A formal recycling arrangement will help promote the social esteem of waste workers and facilitate their upward social mobility due to increased earning. In addition, the improved recycling activity will increase the economic value of the waste and will reduce waste scavenging activity providing opportunity for scavengers to switch to a more socially acceptable occupation. In short, institutionalised recycling programmes will help remove the stigma associated with waste scavenging and transform it to an economic enterprise.

COMPONANTS OF RECYCLING PROGRAMME

Recycling programmes are designed according to the needs and priorities of the communities. This may include a mix of strategies, ranging from simple, single material drop-off centres to large scale, centralised processing facilities.

Source separation

Source separation refers to the segregation of the recyclable and reusable materials at the point of generation. This requires that several designated materials be separated into their own specific containers, while other programmes use only two containers – one for the storage of mixed recyclables and the other for regular wastes. Source separation may be voluntary or mandated and is done in conjunction with several recycling programmes.

Drop-off / Buy-back

A drop-off programme requires residents to separate the recyclable materials and bring them to a specified drop-off or collection centre. However, we must take into account local conditions when

designing a collection programme. For a community that does not provide a curbside pickup, for example, educating and encouraging citizens to deliver materials to a drop-off site may be all that is needed. A recycling centre can be established at the same location where residents deliver waste. Mobile recycling drop-off trailers can also be used. Drop-off recycling, however, is less convenient than curbside pickup. If a thorough educational and promotional effort is not made, drop-off programme tends to have lower participation rates than curbside collection. Buy-back refers to a drop-off programme that provides monetary incentives to participate. In this type of programme, the residents are paid back for their recyclable material directly or indirectly through the reduction in collection and disposal fees. Establishing a buy-back centre (i.e., a place where recyclables are purchased) may help induce citizens to recycle. Some buy-back centres purchase some materials and accept others, depending on current market conditions. Private or public mobile buy-back operations can serve some areas, purchasing recyclables from small communities or from neighbourhoods of large metropolitan areas on a regular schedule.

Curbside programme

In a curbside system, source separated recyclables are collected separately from regular refuse from the curbside, alley, or commercial facility. Curbside programmes vary greatly from community to community. Some programmes require residents to separate different materials that are stored in their own containers and collected separately. Other programmes use only one container to store recyclables or two containers, one for paper and the other for heavy recyclables (e.g., glass aluminium, etc.).

Storage and collection of recyclables

Collection of source-separated materials is a necessary component of recycling programme. Establishing a collection system for source-separated materials will require more careful planning than regular trash collection. Some principles of sound recyclables storage and collection should be understood, while developing a programme, and these include:

a) **Resident convenience**
   The easier it is for residents to separate materials, the higher the participation and recovery rates will be.

b) **Collection crew convenience**
   The system should be convenient for collection crews. For example, loading and sorting activities should be as simple as possible.

c) **Cost effectiveness**
   Equipment and procedures must be designed to maximise collection crew and vehicle productivity.

d) **Integrity of materials**
   The storage and collection system should keep recyclables in the best shape possible. It should be properly handled, dry and contaminant free.

How residents store recyclables in a household and curb has a direct impact on the success of a recycling programme. The storage container should provide a handy way to store materials until collected, and it must be easy for the collector to distinguish recyclables from garbage.

Collection vehicles for recycling

Collection vehicles that are designed specifically for collecting recyclables have several storage bins, which can be easily loaded and often equipped with automatic container-tipping devices. Although these

modified vehicles may still be considered as options, a dedicated, closed-body collection vehicle for recycling with sufficient capacity offers such significant advantages as easy loading and unloading, flexible compartments and protection from weather. Of course, this warrants a substantial initial investment.

Processing equipment for recycling

Recycling involves a number of processing techniques and these processes require different equipments. However, some of the special equipments used in recycling are:

a) **Balers**

Balers can be used to densify many types of materials including paper, cardboard, plastics and cans. Balers can improve space utilisation and reduce material transportation costs.

b) **Can densifiers**

Can crushers are used to densify aluminium and steel cans prior to transport.

c) **Glass crushers**

These are used to process glass fraction separated by colour and break it into small pieces. This crushed material is then called cullet, and can be reprocessed into new glass products.

d) **Magnetic separators**

These are used to remove ferrous material from a mixture of materials.

e) **Wood grinders**

These are chippers and are used to shred large pieces of wood into chips that can be used as mulch or as fuel.

f) **Scales**

These are used to measure the quantity of materials recovered or sold.

Material recovery facilities (MRF)

MRF (pronounced 'murf') is a centralised facility that receives, separates, processes and markets recyclable material. It can be operated with both drop off and curbside programmes. The primary advantage of MRF is that it allows materials directly from the municipalities and processes them uniformly. It is generally designed to handle all type of recyclables. Implementation of MRF in a municipality depends upon a number of factors as follows:

a) **Market demand**

When additional processing is required, MRF is more useful as buyers may have certain material specifications.

b) **Separate collection**

In systems that require residents to separate their recyclables, intermediate separation and processing is required.

c) **Number of different recyclables**

In general, a MRF will be more beneficial when a large number of different recyclables are collected.

d) Quantities of materials

Because MRF involves substantial capital and operating costs (e.g., buildings, equipment and labour), it is expected to handle a significant amount of materials to justify its operation.

Full stream processing

This is a high technology separation technique, which processes all components of municipal waste. The materials recovered by this process tend to be of lower quality than those recovered or source separated in MRF because the former is a mix of various types of wastes. To achieve a better quality, the materials obtained through the full stream processing must be cleaned, which is a costly process. However, this technique remains attractive because it does not require source separation, and it is used in the following applications:

a) Refuse derived fuel (RDF) preparation

In this application, it is used to extract the combustible portion of municipal waste.

b) Municipal waste composting

In this application, it is used to concentrate the compostable portion of municipal solid waste. Note that this is sometimes performed as part of RDF preparation.

c) Material recovery

In this application, it is used to recover and resell certain materials, and thereby making material recovery a recycling technology as well.

In full stream processing, depending on the facility design, the materials are separated either mechanically or by hand, and size and weight are the main characteristics used to separate the materials. For example:

- When the material is dumped, oversized materials such as furniture, etc., are removed;
- Rotating screens are used to separate materials of different sizes (small and large);
- Ferrous material is extracted using a magnet system;
- Air classifier is used to separate the lighter material;
- Light materials including plastic and paper are further processed into rdf;
- Heavy fraction is mechanically or manually sorted to recover saleable materials such as cardboard, etc.

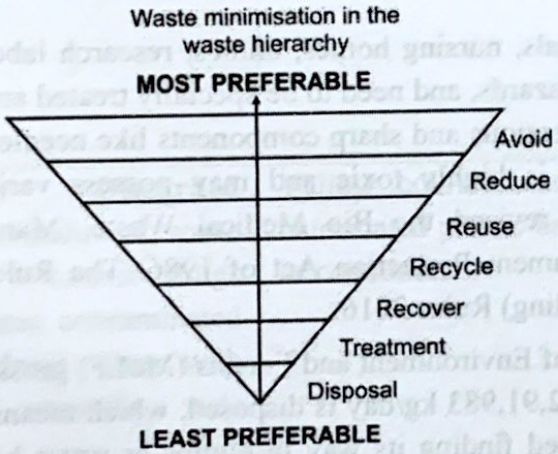
Waste minimization technologies

Waste minimization refers to strategies that are aiming to prevent waste at source through upstream interventions.

1. On the production side, these strategies are focusing on optimizing resource and energy use and lowering toxicity levels during manufacture.
2. On the consumption side, waste minimization strategies aim to strengthen awareness and prompt environmentally conscious consumption patterns and consumer responsibility to reduce the overall levels of waste generation.

What is waste minimisation? Waste minimisation can be defined as "systematically reducing waste at source". It means:

- Prevention and/or reduction of waste generated
- Efficient use of raw materials and packaging
- Efficient use of fuel, electricity and water
- Improving the quality of waste generated to facilitate recycling and/or reduce hazard
- Encouraging re-use, recycling and recovery



Waste minimization is also known by other terms such as waste reduction, pollution prevention, source reduction and cleaner technology. It makes use of managerial and/or technical interventions to make industrial operations inherently pollution free. It should be also clearly understood that waste minimization, however attractive, is not a panacea for all environmental problems and may have to be supported by conventional treatment/disposal solutions. Waste minimization is best practiced by reducing the generation of waste at the source itself. After exhausting the source reduction opportunities, attempts should be made to recycle the waste within the unit. Finally, modification or reformulation of products so as to manufacture it with least waste generation should be considered.