

Waste

“Waste refers to material that is not prime product and has no further use for their own purpose of production, transformation or consumption and needed to be discarded”.

Waste may be generated during preparation of raw material, during processing and during the consumption of final product.

Industrial waste management generally refers to a set of strategies and approaches that aim to eliminate, reduce, reprocess or dispose off waste, produced in an industrial setting.

Legislation

A community strategy for waste management was published in 1989 to address the problem of increasing amounts of waste being disposed. It provides the following principles:

- **The prevention principle:** waste generation should be minimized as much as possible.
 - **The polluter pays principle:** whoever produced the waste should pay for handling it.
 - **The precautionary principle:** one should anticipate problems related to waste.
 - **The proximity principle:** waste should be handled as close as possible to where it is generated.
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- Generally speaking, raw and auxiliary materials as well as processing aids enter the production process and exit as one of the following:
 - as a desired product
 - non-product specific waste
 - as a product specific waste
 - The amount and quantity of the product didn't influence the type and quality of non-product specific waste.
 - A typical example of non-product specific waste includes containers for chemicals involved in cleaning and disinfection.
 - Product specific waste quantity can be altered through technical means which can lead to change in product quality.
 - Typical examples of product specific waste are slaughter house waste from meat production, leaves, orange and potato peels etc.
 - Product specific waste produces during processing of raw material at various steps of production, in which the desired components are extracted from the raw material.
 - After extraction, there are still often other potentially useful components present in the remaining material.
 - The utilization and disposal of product specific waste is difficult, due to its inadequate biological stability, its potentially pathogenic nature, its high water content, its potential for rapid autoxidation, as well as its high level of enzymatic activity.

Biological stability and the potential growth of pathogens:

- Many types of waste material either already contain large numbers of microbes and/or will be altered quickly through microbial activity.
- It regulations concerning infectious disease are not properly observed, and then hygienically unacceptable conditions can arise e.g. through maggots or mold.
- The breakdown of protein is always characterized by the generation of strong odors.

High water content:

- The water content of meat and vegetable waste lies between 70 and 95% by mass.
- High water content increases transport costs of the waste.
- Mechanically removing the water through use of a press can lead to further problems with waste water disposal, due to the high level of organic material in the water.

Rapid autoxidation:

- Waste with a high fat content is susceptible to oxidation, which leads to the release of foul-smelling fatty acids.

Changes due to enzymatic activity:

- In many types of waste arising from vegetables and fruits, enzymes are still active, which accelerate or intensify the reactions involved in spoilage.
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- Waste disposal and by-product management in the food processing industry pose problems within the areas of environmental protection and sustainability.
 - The two general methods of traditional waste utilization have been to use the waste as either animal feed or fertilizer.

Important Types of Product-Specific Food Waste

Fruits and vegetables

- The main processing steps include general cleaning, removal of leaves, skin and seeds, blanching, processing and packaging.
- Waste includes peel, stem, seeds, shell etc. and damaged, expired and returned foods.
- This type of waste can be reused as animal feed or converted to compost, mulch or soil conditioner.

Bakery

- The waste is caused by overproduction, product deterioration, damaged goods or operator errors.
- Improving process control will reduce this waste.
- Bakery waste can be reused by feeding to animals or composting.

Meat and poultry

- The basic steps in processing livestock include slaughtering and bleeding, scalding and skin removal, evisceration, washing, chilling and packaging.
- Wastes include hides, hoof, head, feathers, viscera, bones, fat, blood and meat trimmings etc.
- Waste reuse and recycling options include animal and pet food, composting, fertilizer, cosmetics, blood meal, gelatin etc.

Dairy products

- The principal processing steps are clarification or filtration, blending and mixing, pasteurization and homogenization, process manufacturing and packaging.
- Waste consists of expired product, curd, whey, milk sludge from the separation process.
- Reuse include animal feed, utilization of whey in different products, extraction of proteins and carbohydrate, produce methane by anaerobic digestion, production of alcohol by fermentation.

Seafood

- Waste include rubbish from fishing operations, skin, bones, cuttings, viscera, brine, sauces, spoiled products, expired good.
- To reduce waste, improve the quality of fish delivered to the plant and optimize the process.
- Waste can be reused or recycled into per food, protein hydrolysate, fish meal, oil or compost.

Typical ways of food waste disposal

1. General methods

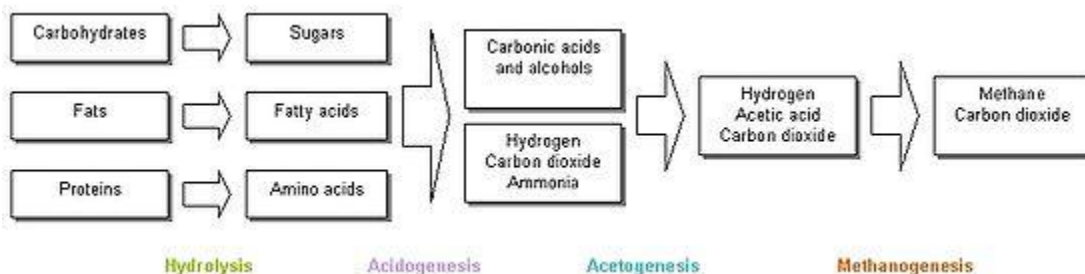
- These general methods of waste disposal are:
 - Incineration
 - Anaerobic fermentation
 - Composting
- If the water content of the waste is relatively low (< 50% by mass), from technical standpoint incineration is only a viable option.
- For the food waste with a higher water content (> 50% by mass) anaerobic fermentation to methane and CO₂ (biogas) is most applicable.
- Composting as a mean of disposal has been developed to the point that cellulose and hemicellulose can be broken down without a problem.

Incineration

- Incineration is the oxidation of combustible material in the waste to produce heat, water vapor, nitrogen, carbon dioxide and oxygen.
- Incineration can usually be carried out near the point of waste collection.
- The waste is reduced to a biologically sterile ash product, which is approximately 10% of its pre-burnt volume and 33% of its pre-burnt weight.
- The bottom ash residues can be used for material recovery or secondary aggregates in construction.

Anaerobic fermentation

- Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen.
- The process is used for industrial or domestic purposes to manage waste and/or to produce fuels.
- The digestion process begins with bacterial hydrolysis of the input materials (carbohydrates, fats and proteins).
- Acidogenic bacteria convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia and organic acids.
- These acidogenic bacteria then convert these organic acids into acetic acid, along with additional ammonia, hydrogen and carbon dioxide.
- Finally, methanogens convert these products to methane and carbon dioxide (biogas).
- The methane in biogas can be burned to produce both heat and electricity.



Composting

- Composting is the aerobic biological degradation of biodegradable organic waste.
- In composting, worms and fungi break up the material.
- Aerobic bacteria manage the chemical process by converting the inputs into heat, CO₂ and ammonium.
- The ammonium is further converted by bacteria into plant nourishing nitrites and nitrates through the process of nitrification.
- Compost is used as soil conditioner, as fertilizer and as a natural pesticide for soil.

2. Agricultural methods

- Ruminant can be fed with waste having cellulose and hemicellulose content as they have enzymes necessary to break these substances down.
- Food waste with a high mineral content can be used as fertilizer.

3. New methods

- New methods focus on certain contents of the food waste.
- The fibrous material (soluble and insoluble) from apple, tomato, and carrot waste as well as peels from citrus fruits can be extracted.
- In food production industry, these fibers serve to bind water in food due to their absorptive properties and ability to form gels.
- Pectin, a soluble fiber, can be extracted from apples, citrus fruit and beet waste.
- Fat is partially removed from slaughterhouse waste, and is then used as a basis for many products in the chemical and cosmetic industries.
- Processing milk generates a large amount of whey. It is possible to use whey in foods.