

Part III Solid Waste Engineering

12 Evolution of Solid Waste Management

12.1 Solid Waste—a Consequence of Life

Problems with the disposal of wastes can be traced from the time when humans first began to congregate in tribes, villages, and communities and the accumulation of wastes became a consequence of life.

12.2 Waste Generation In a Technological Society

Materials Flow and Waste Generation

The Effects of Technological Advances

Of particular significance are the increasing use of plastics and the use of frozen foods, which reduce the quantities of food wastes in the home but increase the quantities at agricultural processing plants.

Thus, the engineers responsible for the design of solid waste facilities must be aware of trends, even though they cannot, of course, predict all the changes in technology that will affect the characteristics of solid wastes.

But important questions arise: Which elements of society generate the greatest quantities of solid waste and what is the nature of these wastes? How can the quantities be minimized? What is the role of resource recovery? Can disposal and recovery technology keep up with consumer product technology?

12.3 The Development of Solid Waste Management

Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes.

In its scope, solid waste management includes all administrative, financial, legal, planning, and engineering functions involved in solutions to all problems of solid wastes. The solutions may involve complex interdisciplinary relationships among such fields as political science, city and regional planning, geography, economics, public health, sociology, demography, communications, and conservation, as well as engineering and materials science.

Functional Elements of a Waste Management System

The activities associated with the management of solid wastes, from the point of generation to final disposal have been grouped into the six functional elements: (1) waste generation; (2) waste handling and separation, storage, and processing at the source; (3) collection; (4) separation and processing and transformation of solid wastes; (5) transfer and transport; and (6) disposal.

Waste Generation

**Waste Handling and Separation, Storage,
and Processing at the Source**

Collection

**Separation, Processing, and
Transformation of Solid Waste.**

Transfer and Transport

Disposal

12.4 Integrated Solid Water Management

Hierarchy of Integrated Solid Waste management

Source Reduction

Recycling

Waste Transformation

Landfilling

Planning for Integrated Waste Management

Proper Mix of Alternatives and Technologies

Flexibility in Meeting Future Changes

Monitoring and Evaluation

12.5 Operation of Solid Waste Management Systems

Management Issues

Setting Workable but Protective Regulatory Standards.

Improving Scientific Methods for Interpretation of Data

Identification of Hazardous and Toxic Consumer Products Requiring Special Waste Management Units

Paying for Improved Waste Management Units.

Designating Land Disposal Units at or near Large Urban Centers

**Establishing and Maintaining More
Qualified Managers to Develop and
Operate Waste Management Units
Future Challenges and Opportunities
Changing Consumption Habits in Society
Reducing the Volume of Waste at the
Source
Making Landfills Safer
Development of New Technologies**

13 Sources, Types, and Composition of Municipal Solid Wastes

13-1 Sources of Solid Wastes

- (1) residential,
- (2) commercial,
- (3) institutional,
- (4) construction and demolition,
- (5) municipal services,
- (6) treatment plant sites,
- (7) industrial,
- (8) agricultural.

13-2 Types of Solid Wastes

Residential and Commercial

Special Wastes

Hazardous Wastes

Construction and Demolition

Municipal Services

Treatment Plant Wastes and Other Residues

Industrial Solid Waste

Agricultural Wastes

13.3 Composition of Solid Wastes

Composition of MSW

Distribution of Individual Waste Components

Effect of Waste Diversions on Distribution of Components in Residential MSW

13-4 Determination of the Composition of MSW in the Field

Residential MSW

Commercial and Industrial MSW

The field procedure for component identification for commercial and non-process industrial solid wastes involves the analysis of representative waste samples taken directly from the source, not from a mixed waste load in a collection vehicle.

13-5 Types of Materials Recovered from MSW

Materials Commonly Separated from MSW

Specifications for Recovered Materials

13-6 Future Changes in Waste Composition

Impacts of Waste Diversion Programs

Future Changes in Waste Components

14 Physical, Chemical, and Biological Properties of Municipal Solid Waste

14- 1 Physical Properties of MSW

Specific Weight

Moisture Content

Particle Size and Size Distribution

Field Capacity

14- 2 Chemical properties of MSW

Proximate Analysis

Fusing Point of Ash

**Ultimate Analysis of Solid Waste
Components**

**Typical proximate analysis and data for
materials found in residential,
commercial, and industrial solid**

Essential Nutrients and Other Elements

14- 3 Biological Properties of MSW

**Biodegradability of Organic Waste
Components**

Production of Odors

Breeding of Flies

14- 4 Physical, Chemical, and Biological

Transformations of Solid Waste

Physical Transformations

Biological Transformations

15 Disposal of Solid Wastes and Residual Matter

15-1 The Landfill Method of Solid Waste Disposal

The Landfilling Process

Preparation of the site for landfilling.

Reactions Occurring in Landfills.

Concerns with the Landfilling of Solid Wastes

15-2 Composition and Characteristics, Generation and Control of Landfill Gases

**Composition and Characteristics of
Landfill Gas**

Generation of Landfill Gases

Management of Landfill Gas

15-3 Composition, formation and control of leachate in landfills

Composition of Leachate

**Water Balance and Leachate Generation
In Landfills**

**Fate of Constituents in Leachate in
Subsurface Migration**

Control of Leachate in Landfills

Leachate Collection Systems

Leachate Management Options

15-4 Environmental Quality Monitoring at Landfills

Vadose Zone Monitoring

Groundwater Monitoring

Landfill Air Quality Monitoring