Waste Storage And Collection

Generation

Storage/Separation

Waste
- Collection
  - Transport

Recyclables
- Collection
  - Transport

Yard Waste
- Collection
  - Transport

?
Waste Storage: Concerns

- Original concerns
  - public health and aesthetics
  - container type and location
  - collection method
Waste Storage 2

• Current issues
  – Container size/automation
  – Multiple constituents may have to be stored: commingled or separately
    • paper (one or more types)
    • glass (3 colors)
    • aluminum
    • plastics
      – milk containers
      – soda containers
  • Additional containers increase the cost of waste collection
    – ~ 50-70% of total disposal cost
Storage - Collection Containers

• Commercial vs. Residential
• Commercial
  – hauled containers - those which are hauled away full using mechanical lifting (6 - 40 yd3)
  – stationary containers - those which are emptied and returned immediately
What is wrong with this picture?

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Storage - Collection Containers

Residential
• Stationary container emptied into truck
  – manually
    • high injury rates
    • heavy containers
    • broken glass/sharp objects
    • temporary containers which fall apart when wet
• automatic
Manual collection

Manual collection vehicles are operated by one driver who is responsible for driving and loading debris into the truck. The design of the low entry cab allows the operator to safely step in and out of the truck in order to efficiently perform their task.
Semi-Automated collection
The driver operates a mechanical arm on the vehicle, which is made to load a specially designed refuse cart into the body of the truck. Semi-automated helps reduce injuries and other possible hazards from injuring staff.
Fully-Automated Collection

The operator uses a set of hand controls to mechanically lift and return a roll out cart from the homeowner’s curbside.
Waste Collection

A. Collection service
   – point of collection
   – public vs. private
   – level of service
      • frequency
      • special items
      • crew size
B. Collection vehicles
C. Modeling waste collection
D. Recyclables Collection
A. Collection Service: Point of collection

Point of collection
a. Backyard
b. Setout/setback
c. Setout
d. Curbside / alley
e. Central drop-off (rural)
   - place refuse at mail box
   - centrally located dumpsters
   - direct haul to disposal site
A. Collection Service

2. Frequency
   – minimum generally once a week
   – more required in densely populated areas due to minimal storage space
   – Commercial may be daily or when full
   – impacts vehicle size, collection rates

3. Management of bulky items
   – Collect with other refuse
   – Collect on special request
   – Seasonal pickup / special days
   – Pickup on report by collection crew
   – Do nothing
A. Collection Service: Public Versus Private Collection

- Public system
  - city owns and operates all equipment
  - manages personnel
  - funded from property tax, user fees or a utility bill
A. Collection Service: Public Versus Private Collection

Potential Advantages
- non-profit
- centralized operation
- city maintains complete control over refuse

Potential Disadvantages
- capital expenditures can be difficult
- may require passage of a bond
- tendency to minimize short term spending, regardless of long term implications
- less innovation
A. Collection Service: Public Versus Private Collection

Private Collection

• Contract - city gives a contract to one firm at a set fee based on a bidding process (privatization)
• Private subscription - allows for competition amongst waste haulers
• Advantage
  – no need for capital expenditures
  – no sudden cost increases
Collection Crew Size

- labor is an expensive part of refuse collection so efficient use of work day is important
- optimal number will be determined by
  - collection point / level of service
  - Current equipment
  - population density
  - contract restrictions
  - what is being collected
Collection Crew Size

• Typically, for a curbside pickup scenario, a one person crew can maximize

• Optimal truck for a one person crew is:
  – side loading - automation
  – right side drive or 2 steering wheels
  – low entry
Modeling Refuse Collection:

- **Objective:**
  - how many trucks are needed?
  - labor requirements?
  - scheduling
Modeling Refuse Collection

Model Parameters for a stationary container system:
1. time to reach first collection stop
2. time per house
3. time spent driving between stops
4. Haul time - time spent driving to disposal/processing site with full truck and returning for continued collection
5. Site time - time spent waiting and unloading
Modeling Refuse Collection

6. Other times
   - check in and check out
   - traffic
   - breaks
   may be avoided if drivers are on a fixed route versus an 8 hour day

7. time spent returning to garage at end of day

8. contingency for truck repair
Modeling Refuse Collection

9. Contingency for sick leave, vacation, etc.
10. Compaction factor - in truck density
    typical value is 800 lb/yd³
    % utilization
    generation rate?
Modeling Refuse Collection

Use these data to calculate:

– number of vehicles required
– labor requirements
– costs
– Energy consumption and emissions

Variables:

– crew size
– vehicle size
– collection frequency/collection rate
Vehicle Utilization

Collectors would like to collect 24 hrs/day
- necessary in large cities
- traffic, alley collection
More efficient use of vehicle
- better gas mileage with less traffic
Some landfills receive 24 hrs/day
- trend for regional sites receiving long haul waste
Collection With Recycling

1. Collection of mixed MSW and sorting at a MRF (materials recovery facility)
2. Collection of commingled recyclables, ONP or fiber separate, followed by:
   - sorting of mixed recyclables at MRF or at point of collection
   - set out in carts (32-96 gal) which require automation and sorting at MRF
   - Requires a separate vehicle
Collection With Recycling

- Chosen alternative will influence MRF design and capacity requirements
- Yard waste is also collected separately in many communities
Trucks with Multiple Compartments

- Many different types of vehicles are available
- Costs for a vehicle which carries about 30 yd$^3$ of compacted refuse ~$150,000
- Options:
  - Side vs. Rear loading
  - Automated lifting
  - Multiple compartment vehicles
    - With some compaction
    - Some adjustable
Potential Designs

• Designs with split buckets where recyclables and refuse are segregated prior to dumping
  – Configurations can be customized
  – Caution!
    • automation means more technical problems
    • watch out for new designs with no road experience
Co-collection of Refuse and Recyclables

San Francisco
- three carts (32 gal)
  - yard and food waste, soiled paper
    - provided a small bin for kitchen
  - recyclables
  - refuse
- Compostables - semiautomatic vehicle
- Refuse and recyclables - dual compartment, semiautomatic
Safety

• Third most dangerous job after fishing and timber cutting
  – fall off trucks
  – hit by cars
  – inappropriate disposal of wastes
  – lifting injuries
• Training and daily vehicle inspections
Source segregation / separation

The more fractions collected separately
- the more optimal handling of each fraction
- potentially the more interest for the citizen

versus
- the more costly the collection, e.g. transport of separated secondary materials
- the more inconvenience for the citizen (space, alertness, etc.)
- the greater the risk for wrong separation (item in wrong collection unit)
Participation rate vs no. of fractions