Analysing types of collection system engineering essay

Based on their mode of operation, collection systems are classified into two categories: hauled-container systems and stationary-container systems.

Hauled-Container Systems (HCS):

Collection systems in which the containers used for the storage of wastes are hauled to the processing, transfer, or disposal site, emptied, and returned to either their original location or some other location are defined as hauled-container systems. There are two main types of hauled-container systems: (1) tilt-frame container and (2) trash-trailer. The collector is responsible for driving the vehicle, loading full containers and unloading empty containers, and emptying the contents of the container at the disposal site. In some cases, for safety reasons, both a driver and helper are used.

Systems that use tilt-frame-loaded vehicles and large containers, often called drop boxes, are ideally suited for the collection of all types of solid waste and rubbish from locations where the generation rate warrants the use of large containers. Open-top containers are used routinely at warehouses and construction sites. Large containers used in conjunction with stationary compactors are common at commercial and industrial services and at transfer stations. Because of the large volume that can be hauled, the use of tilt-frame hauled container systems has become widespread, especially among private collectors servicing industrial accounts.

The application of trash-trailers is similar to that of tilt-frame container systems. Trash-trailers are better for the collection of especially heavy rubbish, such as sand, timber, and metal scrap, and often are used for the collection of demolition wastes at construction sites.

Stationary-Container Systems (SCS):

Collection systems in which the containers used for the storage of wastes remain at the point of waste generation, except when moved for collection are defined as stationary-container systems. Labor requirements for mechanically loaded stationary-container systems are essentially the same as for hauled-container systems.

There are two main types of stationary-container systems: (1) those in which self-loading compactors are used and (2) those in which manually loaded vehicles are used.

Because a variety of container sizes and types are available, these systems may be used for the collection of all types of wastes.

The major application of manual transfer and loading methods is in the collection of residential wastes and litter. Manual methods are used for the collection of industrial wastes where pickup points are inaccessible to the collection vehicle.

Collection Routes:

Once the equipment & labor requirements have been determined, collection routes must be laid out so both the work force & equipment are used effectively. In general, the layout of collection routes is a trial-and-error process. There are no fixed rules that can be applied to all situations.

Some of the factors that should be taken into consideration when laying out routes are as follows:(1) existing company policies and regulations related to such items as the point of collection and frequency of collection must be identified, (2) existing system conditions such as crew size and vehicle types must be coordinated, (3) wastes generated at traffic-congested locations should be collected as early in the day as possible, (4) sources at which extremely large quantities of wastes are generated should be serviced during the first part of the day, and (5) scattered pickup points where small quantities of solid wastes are generated should, if possible, be serviced during one trip or on the same day, if they receive the same collection frequency.

Layout of Routes:

The layout of collection routes is a four-step process. First, prepare location maps. On a relatively large-scale map of the area to be serviced, the following data should be plotted for each solid-waste pickup point: location, number of containers, collection frequency, and, if a stationary-container system with self-loading compactors is used, the estimated quantity of wastes to be collected at each pickup location. Second, prepare data summaries. Estimate the quantity of wastes to be collected from pickup location serviced each day that the collection operation is to be conducted. Where a stationary-container system is used, the number of locations that will be serviced during each pickup cycle must also be determined. Third, lay out preliminary collection routes starting from the dispatch station or where the collection vehicles are parked. A route should be laid out that connects all the pickup locations to be serviced during each collection day. The route should be laid out so that the last location is nearest the disposal site. Fourth, develop balanced routes. After the preliminary collection routes have been laid out, the haul distance for each route should be determined. Next, determine the labor requirements per day and check against the available work times per day. In some cases it may be necessary to readjust the collection routes to balance the work load and the distance traveled. After the balanced routes have been established, they should be drawn on the master map.

Schedules:

A master schedule for each collection route should be prepared for use by the engineering department and the transportation dispatcher. A schedule for each route, on which can be found the location and order of each pickup point to he serviced, should he prepared for the driver. In addition, a route book should be maintained by each truck driver.

Transfer and transport:

The functional element of transfer and transport refers to the means, facilities, and appurtenances used to effect the transfer of wastes from relatively small collection vehicles to larger vehicles and to transport them over extended distances to either processing centers or disposal sites. Transfer and transport operations become a necessity when haul distances to available disposal sites or processing centers increase to the point that direct hauling is no longer economically feasible.

Transfer Station:

Important factors that must be considered in the design of transfer stations include:

type of transfer operation to be used, (2) capacity requirements, (3) equipment and accessory requirements, and (4) environmental requirements.

Type of Transfer Station:

Depending on the method used to load the transport vehicles, transfer stations may be classified into three types: direct discharge, storage discharge, and combined direct and storage discharge.

Direct Discharge:

In a direct-discharge transfer station, wastes from the collection vehicles usually are emptied directly into the vehicle to be used to transport them to a place of final disposition. To accomplish this, these transfer stations usually are constructed in a two-level arrangement. The unloading dock or platform from which wastes from collection vehicles are discharged into the transport trailers is elevated, or the transport trailers are located in a depressed ramp. Direct-discharge transfer stations employing stationary compactors are also popular.

Typical direct – discharge transfer station

Storage Discharge:

In the storage-discharge transfer station, wastes are emptied either into a storage pit or onto a platform from which they are loaded into transport vehicles by various types of auxiliary equipment. In a storage-discharge transfer station, the storage volume varies from about one-half to two days´ volume of wastes.

Typical storage – discharge transfer station

Combined Direct and Storage Discharge:

In some transfer stations, both direct-discharge and storage-discharge methods are used. Usually, these are multipurpose facilities designed to service a broader range of users than a single-purpose facility. In addition to serving a broader range of users, a multipurpose transfer station can also house a materials-salvage operation.

Capacity Requirements:

The operational capacity of a transfer station must be such that the collection vehicles do not have to wait too long to unload. In most cases, it will not be cost- effective to design the station to handle the ultimate peak number of hourly loads. An economic trade-off analysis should be made between the annual cost for the time spent by the collection vehicles waiting to unload against the incremental annual cost of a larger transfer station and/or the use of more transport equipment. Because of the increased cost of transport equipment, a trade-off analysis must also be made between the capacity of the transfer station and the cost of the transport operation, including both equipment and labor components.

Equipment and Accessory Requirements:

The types and amounts of equipment required vary with the capacity of the station and its function in the waste-management system. Specifically, scales should be provided at all medium and large transfer stations both to monitor the operation and to develop meaningful management and engineering data.

Environmental Requirements:

Most of the large, modern transfer stations are enclosed and are constructed of materials that can be maintained and cleaned easily. For direct-discharge transfer stations with open loading areas, special attention must be given to the problem of blowing papers. Wind screens or other barriers are commonly used. Regardless of the type of station, the design and construction should such that all accessible areas where rubbish or paper can accumulate are eliminated.

Location of Transfer Station:

Whenever possible, transfer stations should be located (1) as near as possible to the weighted center of the individual solid-waste production areas to be served, (2) within easy access of major arterial highway routes as well as near secondary or supplemental means of transportation, (3) where there will be a minimum of public & environmental objection to the transfer operations, and (4) where construction and operation will be most economical. Additionally, if the transfer- station site is to be used for processing operations involving materials recovery and/or energy production, the requirements for those operations must be considered.

Transfer Means & Methods:

Motor vehicles, railroads, and ocean-going vessels are the principal means now used to transport solid wastes. Pneumatic and hydraulic systems have also been used.

Motor Vehicle Transport:

Motor vehicles used to transport solid wastes on highways should satisfy the following requirements: (1) the vehicles must transport wastes at minimum cost, (2) wastes must be

covered during the haul operation, (3) vehicles must be designed for highway traffic,

(4) vehicle capacity must be such that allowable weight limits are not exceeded, and (5) methods used for unloading must be simple and dependable; The maximum volume that can be hauled highway transport vehicles depends on the regulations in force in the state in which they are operated.

Methods used to unload the transport trailers may be classified according to whether they are self-emptying or require the aid of auxiliary equipment. Self-emptying transport trailers are equipped with mechanisms such as hydraulic dump beds, powered diaphragms or moving floors that are part of the vehicle. Moving-floor trailers are an adaptation of equipment used in the construction industry. An advantage of the moving-floor trailer is the rapid turnaround time (typically 6 to 10 mm) achieved at the disposal site without the need for auxiliary equipment. Unloading systems that require auxiliary equipment are usually of the â€Å“ pull-offâ€ type, in which the wastes are pulled out of the truck by either a movable bulkhead or wire-cable slings placed forward of the load. The disadvantage of requiring auxiliary equipment and work force to unload at the disposal site is relatively minor in view of the simplicity and reliability of these methods.

Another auxiliary unloading system that has proved very effective and efficient involves the use of movable, hydraulically operated tipping ramps located at the disposal site.

Operationally, the semitrailer of a tractor-trailer- trailer combination is backed up onto one of the tipping ramps; the tractor-trailer combination is backed up onto a second tipping ramp. The backs of the trailers are opened, and the units are then liked upward until the wastes fall out by gravity. The time required for the entire unloading operation typically is about 5 mm/trip.

Large-capacity containers and container trailers are used in conjunction with stationary compactors at transfer stations. In some cases, the compaction mechanism is an integral part of the container. When containers are equipped with a self-contained compaction mechanism, the movable bulkhead used to compress the wastes is also used to discharge the compacted wastes.

Railroad Transport:

Although railroads were commonly used for the transport of solid wastes in the past, they are now used by only a few communities. However, renewed interest is again developing in the use of railroads for hauling solid wastes, especially to remote areas where highway travel is difficult and railroad lines now exist.

Water Transport:

Barges, scows, and special boats have been used in the past to transport solid wastes to processing locations and to seaside and ocean disposal sites, but ocean disposal is no longer practiced by the United States. Although some self-propelled vessels (such as United States Navy garbage scows and other special boats) were once used, the most common practice was to use vessels towed by tugs or other special boats.

Pneumatic Transport:

Both low-pressure air and vacuum conduit transport systems have been used to transport solid wastes. The most common application is the transport of wastes from high-density apartments or commercial activities to a central location for processing or for loading into transport vehicles. The largest pneumatic system now in use in the United States is at the Walt Disney World amusement park in Orlando, Florida.