Put refuse in a pipe; let air do the work

Vacuum refuse collection won't work everywhere but its capabilities merit attention for use in selected situations.

By B. T. KOWN and E. A. KASS, Gibbs & Hill, Inc., New York, N.Y. Suppose your community could collect 150 cu yd of refuse an hour using only a few people and no collection vehicles? It's possible, if you are willing to invest in a pneumatic (vacuum) collection system.

A system like the one just described is based on a community-wide layout involving 2000 feet of 20-inch pipe. It could collect an average daily refuse load of 76 tons (30,000 people at 5 lbs/cap) in communities where 60% of the refuse is deposited during the peak periods from 5 p.m. to 9 p.m.

Sweden, where vacuum refuse collection was developed, has operated similar systems for years. Other European operations include the Westminster Housing Project in England, a new housing project at Grenoble, France, and the Olympic Village at Munich, West Germany. Walt Disney World, outside Orlando, Fla., operates a vacuum refuse collection system with 15 inlet facilities.

A vacuum system for community-wide refuse collection would operate under the same principle as those already used by many hospitals to collect soiled linen and refuse. However, the source distribution, rate and characteristics of community residential refuse are much different.

Let's examine some of the parameters affecting the feasibility of a community-wide system and look at the types of communities where the system would be most effective.

Modern refuse management for an urban community generally involves four major sequential steps:

- Assembling of refuse at source buildings.
- Door-to-door collection and hauling to a central transfer station by route vehicles.
- Transport to disposal site from the transfer station.
- Final disposal.

The vacuum system replaces door-to-door collection using route vehicles. This comprises the most costly step of the four-step process and contributes the major portion of total management costs.

A vacuum system (as shown in the accompanying sketch) has the following major components: refuse inlet facility, transport pipe, the central receiving station housing the
refuse silo, exhausters and filters.

The exhausters create a fast-moving airflow through the main transport pipe and branch lines. A charge of refuse accumulated above a branch line drops into the moving air to be whisked to the central station and separated by gravity into the silo. The main transport pipe may have many branch lines, but only one operates at a time.

The system requires no special preparation of refuse at the source. Bulky material that cannot be put into the system is handled separately.

In high-rise buildings, refuse deposited into the gravity chute accumulates above the pipe until an inlet valve opens and drops the charge. Signals from the central station control the inlet valves.

**Capacity and application**

The size and length of the transport pipe and timing of valve operation primarily determine the capacity of a vacuum refuse collection system. Presently operating systems use carbon steel pipe having diameters of 20 inches and 24 inches.

A system with a maximum traveling length of 10,000 feet has been reported. Air velocity through the pipe ranges between 70 ft per sec to 90 ft per sec, at about 7.5 inches Hg (mercury) vacuum. Although detail design and operational data are not available, these numbers are believed to be the optimum condition for existing systems.

The high velocity air and vacuum create a driving force transporting about three charges of approximately one cu yd per charge through several thousand feet of pipe at the same time. Charges move through the pipe at a speed of 30 ft per sec to 50 ft per sec.

The layout and timing of all sequential events must be analyzed to accurately determine system capacity. To determine the approximate capacity, calculations should be based on:

- Average values of charge speed (30 ft/sec).
- Pipe length (midpoint of the longest line).
- Delay time (the valve opening and charge injection based on 30% of average traveling time).

As these numbers indicate, a vacuum system has its maximum effectiveness when applied to areas having a high refuse source density. For example, the system referred to earlier would accommodate a daily average load of only 28 tons (11,000 residents) using 5000 feet of 20-inch pipe.

This does not eliminate the possibility that a vacuum system can be operated at far below maximum capacity and still be more economical than other collection methods. The lower the source density, the more the collection cost per ton for a vacuum system. This, of course, would make conventional collection by routing vehicles more attractive.

There is also an upper limit of source density beyond which other modern refuse management systems would be more economical than a vacuum system.

A large commercial building, such as the World Trade Center in New York City, or a multifunctional complex, such as Marina Towers in Chicago, provide good examples. Here refuse compaction at the source and direct hauling are more economical than sending refuse through a vacuum system to a central receiving station, and then transporting the refuse from the station to the disposal site.

**Ideal operation**

A new high-rise urban development within or close to large cities offers the ideal situation for a vacuum system.

Therefore, the vacuum system for community-wide refuse collection is not a breakthrough with universal application. In many cases, its economical advantage will be marginal.

When properly applied, the system has merits that deserve the close attention of those in the field. Although the initial investment is high, vacuum system requires very little manpower. For conventional methods the opposite is true. Vacuum systems would then be advantageous as long as the increase in labor cost is greater than capital outlay charges.

Envirogenics Co., a division of Aerojet-General Corp., is a licensee of the Swedish Centralsug vacuum system in this country. Several other firms provide hospital-type, light-duty systems. We expect that some of these firms will soon participate actively in community-wide applications.