Introduction to AcornVac
Vacuum Plumbing Systems

What is a Vacuum Plumbing System?

Vacuum Plumbing Systems are simply a viable alternative to underground piping that use the combined energies of vacuum pressure and gravity for the collection and disposal of waste through a piping network that can be routed above grade. Hundreds of vacuum plumbing systems are in operation around the world and are accepted by most code authorities. In addition, vacuum plumbing systems and have been included as a viable drainage solution in the latest editions of the International Plumbing Code and Uniform Plumbing Code.

What are the advantages of vacuum drainage?

Vacuum drainage systems offer a number of benefits to a variety of construction projects:

All types of construction:

- Vacuum toilets use only ½ gallon of water per flush to efficiently and effectively rinse down and refill the toilet bowl. This can provide a significant savings in water supply and sewage disposal costs.

- Vacuum plumbing systems use smaller diameter piping (PVC, copper or stainless) and smaller diameter fittings, and are self venting thereby eliminating vent stacks and reducing material and labor costs.

- The drainage piping network servicing a vacuum plumbing system can be installed vertically or horizontally, providing flexibility in layout and building design, as well as provide an economic alternative for renovation project piping.

- Vacuum plumbing systems accommodate an open architectural environment by eliminating the need to provide vent and waste stacks.

- Vacuum drainage systems allow existing buildings with limited drainage to be developed when traditional underground piping upgrades are cost prohibitive because of structural limitations (post tension slab foundations), restrictive site issues (bedrock, inappropriate inverts, historical building categorization), or embedded contaminants in the floor (asbestos).

- The operational dynamics of a vacuum plumbing system result in fewer in line blockages, reducing maintenance cost and disruption. When toilet blockages do occur, they are easily located and can be readily remedied.

- Vacuum plumbing systems can accommodate a range of waste types and flow rates – from facilities with multiple toilets, to high temperature waste streams. Vacuum plumbing also provides an effective alternative to below grade grease waste drainage.

Commercial Retail and Supermarket Construction:

- Vacuum drainage systems eliminate the need for costly underground drainage piping in the sales area on renovation projects.

Introduction to AcornVac
Vacuum Plumbing Systems

Advantages of Vacuum Plumbing for Commercial Retail and Supermarket Construction - continued:

- Vacuum drainage systems work in concert with the new "open" architectural store environment where electrical and refrigeration services are brought to display cases from overhead. Drainage can now follow these services, allowing for unprecedented flexibility in store layout.

- Vacuum drainage systems are completely adaptable to last minute merchandising changes.

- New construction projects can be completed faster, saving construction costs and allowing a facility to be brought online in a more timely fashion. Often, projects can be completed during inclimate weather because the facility can be closed before the weather conditions prohibit construction.

- Vacuum drainage systems create a cleaner environment and reduce health hazards associated with the possibility of gravity drain back up on the sales floor.

- Vacuum drainage systems allow existing buildings with limited drainage to be developed for supermarket use when traditional trenching and underground piping upgrades are cost prohibitive because of site conditions – post tension slab, bedrock, asbestos, high water tables, etc.

- Because trenching is eliminated, store remodel activities are less expensive, safer, more sanitary, and take less time.

- Vacuum drainage equipment can be capitalized and taken with the owner if the facility is abandoned.

How does it Work?

A Vacuum Drainage System consists of three or four basic components, 1) a vacuum generating station; 2) a piping network that allows for transport of waste from its' point of origin – ex. toilet, wash basin, mop sink, shower, refrigerated food case, air condenser, etc. to the vacuum generating station; 3) vacuum interface components that isolate the vacuum piping network from atmospheric pressure at the point of origin and allow waste to be transported from the fixture to the piping network; 4) purpose made toilets, designed to rinse and re-fill on ½ gallon of water.

Vacuum Generating Station

Referred to as the "Vac Center", the vacuum generating station includes vacuum pump(s) which operate as needed to create and maintain constant vacuum pressure within the waste piping network, and storage tank(s) that collect and discharge the waste into the facilities' sewer main.

Operation of the pump(s), collection tank(s), historical data recording, and alarm reporting is fully automated by controls provided with the Vac Center. The vacuum pump(s) run only on demand, and the system is sized to provide ample operating capacities.

Introduction to AcornVac
Vacuum Plumbing Systems

Piping Network

The piping network for a vacuum waste system is maintained under continuous vacuum pressure and is generally fabricated out of PVC, copper, or other smooth bore, non-porous material. The network consists of “risers” which transport the collected waste vertically from the point of origin to horizontal mains and branches leading to the Vac Center. The mains and branches are sloped at a rate of 1/4" per foot toward the Vac Center and thus, for the most part, waste travels by gravity to the Vac Center, just as is it does in traditional underground drainage piping.

Unlike gravity drainage systems, a major benefit of vacuum plumbing technology is the ability of the vacuum piping to be routed around obstacles, and to allow slope recovery if grade from the point of collection to the Vac Center cannot be maintained at 1/4" per foot. This is done by creating “steps” in the running branches and mains which are cleared by differential pressures that exist between the point of origin and the Vac Center during a waste extraction cycle.

Vacuum Interface Components

At the heart of a vacuum drainage system are the vacuum interface components that allow waste to be efficiently transported from the fixture to the Vac Center.

Toilets-

In the case of toilets, the components include a normally closed vacuum interface valve or Extraction Valve which acts as a point of separation between constant vacuum pressures in the waste piping network and atmospheric pressure at the toilet bowl; a control device or Controller, which assists in opening the Extraction Valve in the presence of a pneumatic signal generated by the flush valve push button.

Operation

When the Extraction Valve is opened, atmospheric pressure at the toilet bowl is in direct interface with vacuum pressure in the waste piping network. The pressure differential causes air to enter the toilet bowl and pull the waste through the fixture outlet and transport the resultant emulsion into the waste piping network routing to the vacuum center.

Sinks, Lavatories and other plumbing fixtures -

In the case of grey water, standard fixtures drain via gravity to a temporary collection vessel, also known as an Accumulator. The Accumulator is typically connected via gravity piping to the p-trap outlet servicing the sink, lavy or plumbing fixture. As the Accumulator fills, a sealed chamber within the Accumulator becomes pressurized to approximately 1-1/2” water column which is sufficient to create the pneumatic signal required at the Controller. The presence of the signal initiates the waste discharge process and air enters the Accumulator and pulls the contents of the Accumulator through the outlet and Extraction Valve and into the vacuum waste piping network. The Extraction Valve is installed between the Accumulator and the vacuum waste piping network, and typically opens for a cycle lasting approximately 3-4 seconds.

Waste routes through the waste piping network directly to the Vac Center waste collection tanks, where it is temporarily held before discharge to the facility sewer main, or in the case of grease waste, into code compliant grease interceptors or grease remediating equipment.