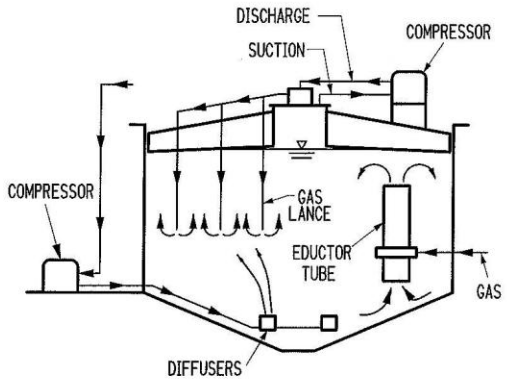
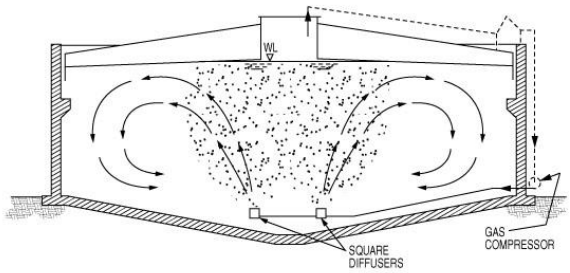
WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Anaerobic Digester Mixing Systems

This paper presents various types of Digester mixing systems and how they function.
Digester mixing equipment falls into three (3) distinct categories: gas injection with either confined injection or unconfined injection systems, and mechanical systems that use pumps or mixers with impellers.

1) GAS INJECTION
    a. Unconfined Gas Injection
    b. Confined Gas Injection
2) MECHANICAL PUMPING
3) MECHANICAL STIRRING

GAS INJECTION SYSTEMS	
 **Gas Injection Systems**	**Gas Injection Lance Type** – This is an example of an unconfined gas injection system that marketed initially as the Perth System and later copied by a number of competitors. **Shear Box Diffusers** – This is an example of an old technology gas injection system. **Eductor Tube Systems** – This is an example of a confined gas injection system that creates a pumping action to produce mixing through continuous or intermittent gas injection.
 **Gas Injection Diffusers**	The shearbox diffusers are old technology that used multiple depressions in the digester floor with gas fed through the side of the digester. The gas feed system required high pressure (high energy consuming) compressors due to the depth of the injection point below the liquid surface. This system has proven to be prone to plugging, ineffective, inefficient in every way and considered obsolete.

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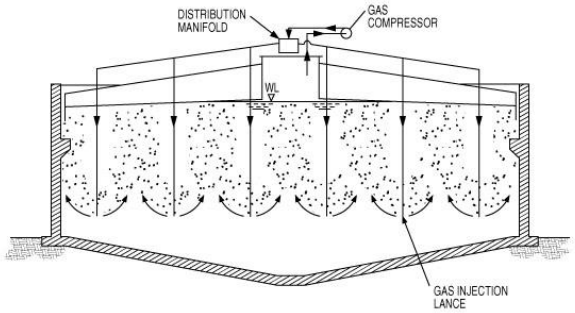
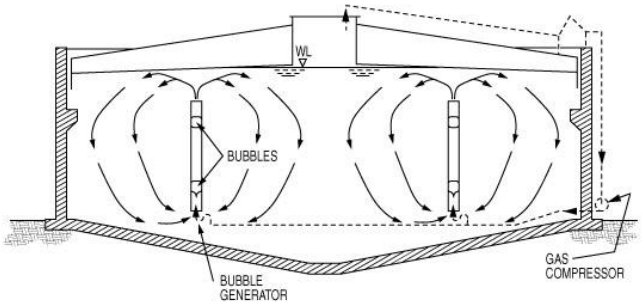


Gas Injection Lances

The multiple gas lance system was initially offered as a low-submergence, multiple-point lance arrangement exclusively for scum breakup. This system uses a rotary valve, which causes alternating lance emission, only one lance at a time being in operation.

The theory was that a power saving can be realized through the use of alternating gas injection. This system is flawed in that only a partial gas injection to a partial volume for a partial time period cannot possibly produce full mixing effectiveness to the entire digester, with less power input.

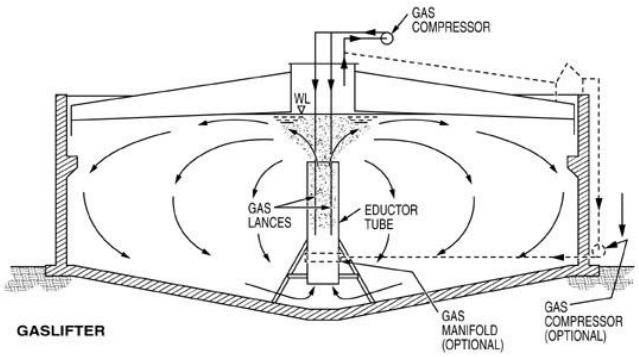
An additional consideration of the ineffectiveness of such an unconfined gas injection system is that the lances, when mounted on covers that rise and lower due to liquid level variations and/or gas storage volume, actually rise to such an elevation at the highest level that the floor of the digester is virtually unaffected by the gas emission; it is doubtful that there is much effect even at the lowest level.



Gas Injection – Eductor Tubes

The gas piston type system sometimes referred to as the "Cannon" mixer or "Bubble Gun" system uses multiple eductor tubes that are fed from the bottom, through the sidewalls of the digester, into a "bubble chamber" which, it was claimed, injects a whole bubble into the eductor tube, completely filling the cross section of the tube. The bubble is intended to remain in this form, without breaking apart, and when emitted from the top, "bursts with fury," breaking surface scum.

The gas distribution system outside the digester wall is complex, to assure equal gas distribution to the multiple eductor tubes. The gas compressor must be higher pressure and higher horsepower due to the bottom feed. This system uses less-efficient, more maintenance intensive and costly liquid ring seal compressors. The eductor tube and its bubble generator are inaccessible, and if plugged, the digester must be dewatered to gain access.



Gas Injection - Eductor Tube

The basic GasLifter System consists of a single, centrally located, floor-mounted eductor tube with individual gas lances. The gas release point, regardless of the depth of the digester, is 12 feet, permitting the use of a 7 psi gas compressor. In spite of the relatively shallow submergence, mixing is effected to the bottom of the digester because the recommended bottom-supported eductor tube extends to within 2’ to 4' of the bottom center of the digester, from which point the sludge is pumped.

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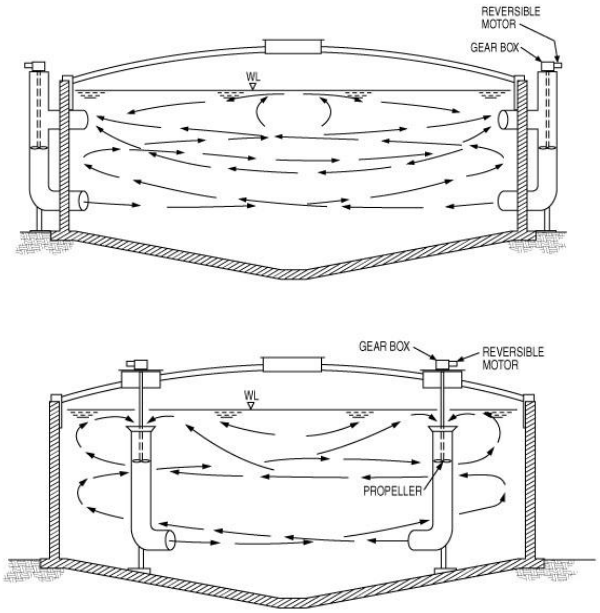
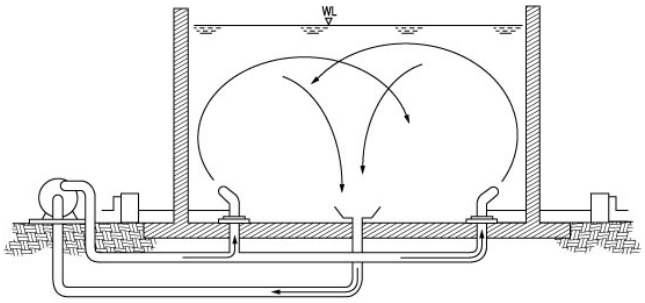
MECHANICAL MIXING SYSTEMS



Mechanical Mixer – Eductor Tubes

There are two (2) types of mechanical impeller systems that use draft tubes. One type is mounted inside the digester, and the other is mounted outside the digester tank.
The early systems with impellers contained in a draft tube in digesters had problems with fouling or "ragging". Later so-called "rag-less" impellers were developed that also feature reverse-rotation motors to discharge the rags free of the impeller blades.

As with all digester mixers, the power input must be considered at the impeller blade, i.e. the actual water HP exhibited by the impeller blade, specifically not the motor HP.



Pumped Hydraulic Mixing

The external pump system was originally offered for mixing sludge holding tanks. Later they were promoted for use in anaerobic digesters.
The external pump is a chopper pump, the internal nozzles being floor-mounted, multiple, and rotatable to achieve differing angles of attack. The adjustment linkage to operate the nozzle angle is typically imbedded in the basin floor.

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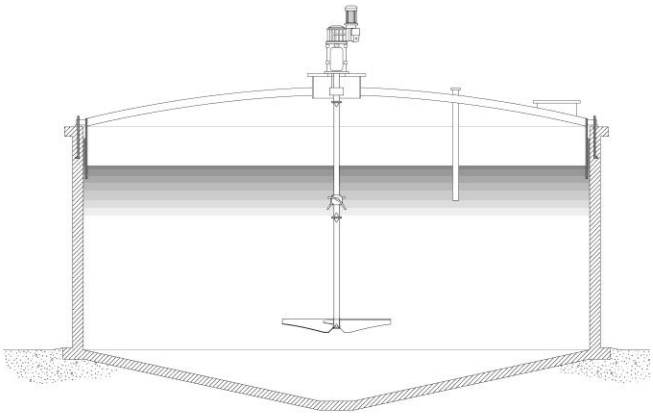

Mechanical Agitator/Mixer

VERTICAL SHAFT AGITATOR
The mixing system consists of a dual set of downward pumping impellers that are relatively large diameter and rotated at a relatively slow speed. Each agitator and its impeller blade geometry are custom designed for the specific mixing application and geometry of the tank.
The impellers are custom designed to optimize the most effective glide ratio, lowest power usage with the highest pumping capacity.

The agitator is driven through a hollow shaft reducer and the shaft is supported by a secure base that supports a thrust bearing.

The main shaft is sealed with a labyrinth water seal that positively prevents leakage of gas from the digester. A monitoring device provides remote indication of low water level in the seal.

The carbon steel shafting is clad in stainless steel to provide both maximum strength of carbon steel and the corrosion protection of stainless steel. All impellers are 100% stainless steel.
Controls include automatic periodic reversal of shaft rotation to keep debris from accumulating on the impellers.

- Low Power Consumption
- High Turnover without agitation that may cause foaming
- Controlled Downward Pumping and blending
- Thorough Whole Volume Mixing/Blending
- Produces Uniform Solids Concentration and Temperature throughout the volume
- Minimal Maintenance

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