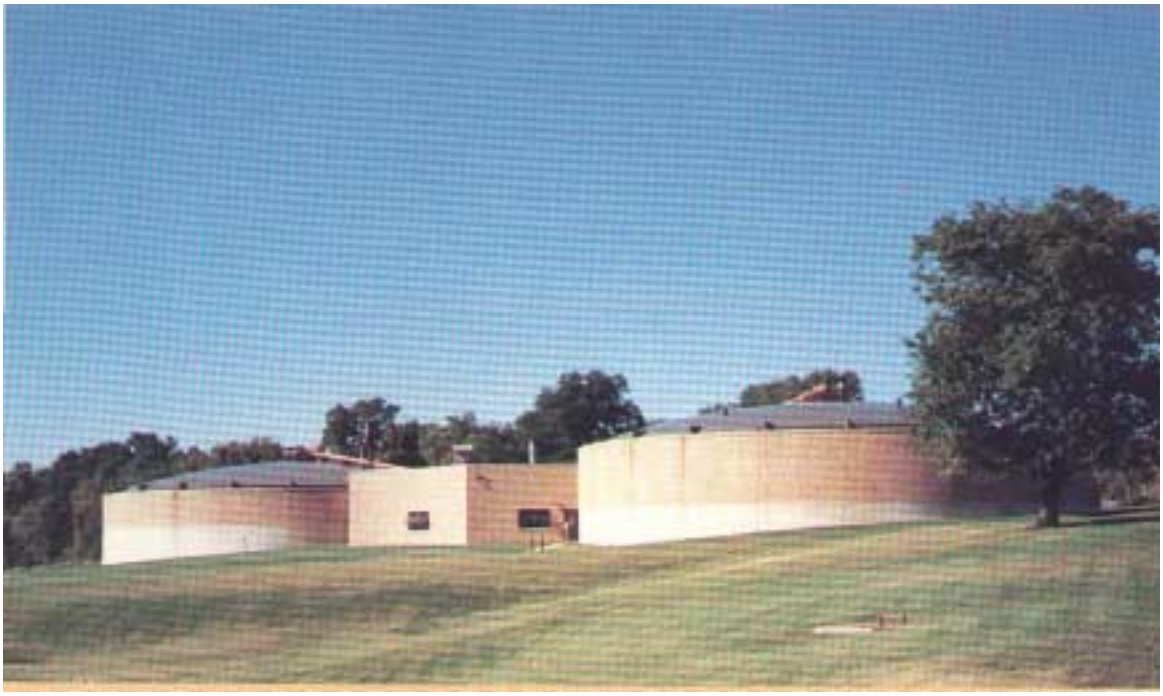
WALKER PROCESS EQUIPMENT

Division of McNish Corporation

Equipment for the Water and Wastewater Industry



ANAEROBIC DIGESTION

ON THE COVER
Aurora, Illinois utilizes these two fixed Covers and three other 100 foot diameter Fixed Covers all provided with GasLifter mixing and HeatX heating equipment.

At DeKalb, Illinois a Fixed Cover and Floating Cover with GasLifter mixing in each, The secondary cover in the background is a Walker Gasholder.

INTRODUCTION

Anaerobic digestion of sewage sludge long has proven to b e a very effective method of preparing sludge for ultimate disposal. In anaerobic digesters, the quantity of solids that must ultimately be disposed of is reduced by destroying part of the volatile solids, releasing water and methane gas, and resulting in a sludge stable enough for disposal without nuisance. Utilization of methane gas to heat the digester and for other in-plant uses further extends the cost effectiveness and energy efficiency of the process. Today's high rate digester systems operate at much higher digester loadings and perform far beyond that possible with the early single stage, low rate systems. Good performance hinges on proper control of the digester environment.

Controlling scum and maintaining reliable homogenous sludge composition with thorough mixing maximize digester efficiency. Heating is required to maintain optimum digester temperature.

Walker Process has a wealth of experience in anaerobic digestion developed since the company's founding in 1946. We have the capability to provide a complete and compatible digester system from the covers used for process containment to the mixing, heating and gas control equipment necessary for a full operating system. Our experience assures you of an effective digester facility. The following pages describe Walker Process equipment components and systems for anaerobic digestion.

DIGESTER COVERS

Four 90 Foot diameter Walker Process Fixed Covers each with three 48 inch Gas Lifters at Dallas, Texas, South Side WWTP, also shown, is one 60 foot diameter spiral-guided Gasholder.

Fixed Covers by Walker Process are typically furnished for 20 to 120 foot diameter tanks in five-foot increments. Walker Process fixed covers are entirely self-supporting and require no interior columns. Their welded steel construction insures a gas tight structure, which also avoids the temperature and shrinkage cracking common in concrete covers. Fixed covers consist of radial steel supports converging on a central compression ring. At the tank wall, a skirt plate is provided for a gas seal, and a thrust ring carries all radial loads and prevents radial load transmittal to the tank wall. Design operating pressures, live load allowances and roof plate thickness can be provided to customer specifications.

Fixed covers are most commonly applied to digesters where little variation in liquid level or sludge volume is expected. For this reason, fixed covers are often applied on primary digesters in a two-stage system.

Fixed Cover under erection prior to roof placement.

Floating Covers by Walker Process are typically furnished for 20 to 120 foot diameter tanks. This type of cover floats directly on the digesting sludge by utilizing radial trusses with steel ceiling plates welded to the underside o the trusses. The roof can be steel plate, precast or poured concrete or built-up roofing. The attic space formed provides and insulation space to reduce digester heat loss. A skirt plate, approximately three feet deep, encloses the trusses and extends into the tank liquid. Covers are provided with concrete ballast located on the ceiling plate periphery to produce the specified operating gas pressure. Floating covers are also often applied on primary digesters in a two-stage system. Since floating covers float directly on the sludge, there is little gas storage volume available but large variations in sludge volume are easily accommodated and any scum is submerged in the tank liquid. Cover mounted rollers and vertical guides provide for smooth cover travel with varying sludge level.

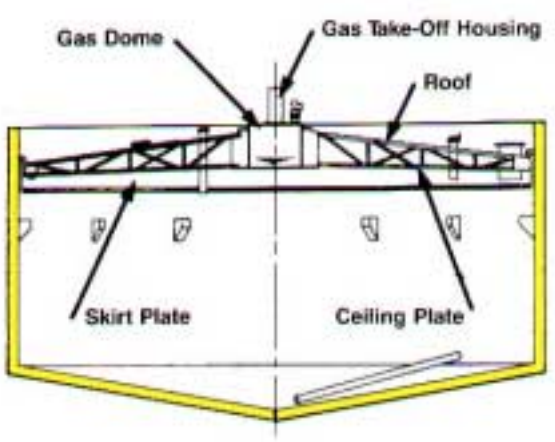
GasHolder Covers by Walker Process are typically furnished for 20 to 95 foot diameter tanks. This cover traps gas, at constant pressure, under the roof, enabling it to float above the sludge on the variable volume gas bubble. Radial truss construction is utilized with steel roof plates and a skirt plate, which is typically five to seven feet deep to provide gas storage and a liquid seal. Peripheral concrete ballast is located at the bottom of the skirt plated to produce the required operating pressure. Heavy, vertical wide flange guide columns are extended well below the skirt plated to effect maximum roller separation, insuring stability.

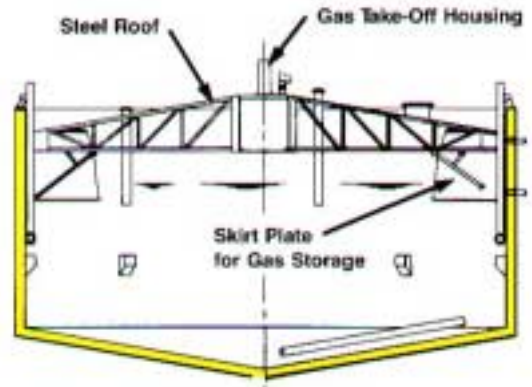
GasHolders may be applied on secondary digesters to provide gas storage for digester heater or other gas consuming equipment in the plant. GasHolders are also often used on single stage digesters in small plants. Normally, a relatively constant sludge level is used, but varying levels can readily be accommodated to facilitate supernatant separation.

Combination Covers, which are gasholders with ceiling plates, are also available and provide the advantages of floating covers in addition to providing gas storage.

Gasholders are available In both vertical and spiral guide design. Spirally guided covers are furnished with block assemblies that have no rotating parts. This block assembly provides non-metallic surfaces for contact on all three faces of the cover guide, reducing maintenance and providing a superior guide system.

Floating Cover





Floating Gasholder

Non-rotating block assembly for a spirally guided Gasholder.

DIGESTER MIXING

GasLifter systems provide superior digester mixing combined with simplicity in operation and maintenance. In the GasLifter system, compressed digester gas is released through multiple gas lines and diffusers, at about 12-foot submergence, into a central eductor tube or multiple peripheral eductor tube. This creates a pumping effect taking sludge from the bottom of the tube(s) and releasing it at the top of the tube(s) just below the surface. This highly efficient reticulation method produces intense mixing in the vertical and horizontal directions, wall to wall in the digester. Efficient mixing assures maximum gas production and volatile solids destruction, reduces grit and scum accumulation, and produces a homogenous digester preventing stratification and short-circuiting. GasLifter systems provide several advantages:

Low pressure, seven psi, gas compressors produce efficient high rate re-circulation while operating at a shallow submergence due to the confined release of gas within the eductor tube(s).

Accessibility of all in-tank components through the gas dome permits easy maintenance if required.

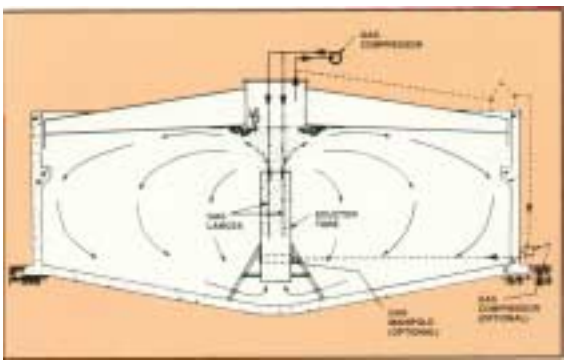
Safety chambers allow for periodic removal of individual gas lines and diffusers for inspection without loss of gas or the need to dewater.

Intermittent operation can be utilized to reduce power costs and compressor wear due to high rate re-circulation capacity provided.

Grit accumulations are more readily controlled since the eductor tubes take their suction near the bottom of the digester.

Heating jackets can be constructed integral with the eductor tube(s) to provide effective internal sludge heating with the DirecTube GasLifter.

Flexibility in system design can provide effective mixing for and specific digester design by either suspending the eductor tube(s) from the cover or supporting them from the digester bottom. The eductor tube can also be furnished with an externally fed gas manifold injection in lieu of individual gas lines.



Digester mixing systems that produce a measurable pumped flow often are sized sassed on “turnover,” which is the amount of time required to re-circulate the digester contents once. By calculating digester volume, mixing system capacity can be selected based on a given turnover rate. Digesters are typically designed for a turnover time of 20 to 30 minutes.

Preliminary selection of a GasLifter system can be made fro the capacity table below based on turnover rate.

Eductor Tube Diameter (inches)	**Expected Re-circulation Rate** (GPM)
18	3,750
24	6,750
30	10,500
36	15,000
42	21,000
48	26,500
54	34,000
60	42,000
72	60,000
84	82,500

The expected re-circulation rates listed are based on a nominal 12-foot submergence and are valid for either suspended or bottom supported tubes.
Studies have shown that the degree of digester mixing is closely related to the total power delivered to the digester contents.
Velocity gradient or “G” value identifies power delivered and can be used to more definitively design digester mixing systems. Horsepower, sludge viscosity and digester volume all factor into design by this method and the designer should consult his Sales Representative or Walker Process for specific applications.

DIGESTER HEATING

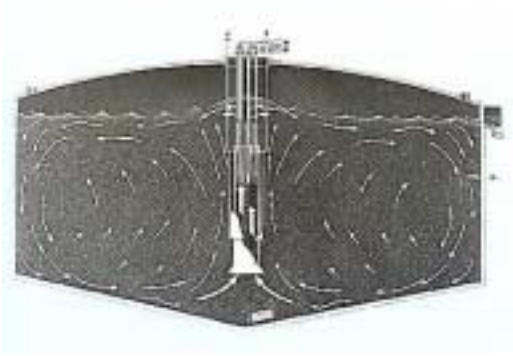
DirecTube GasLifters combine all the features and advantages of GasLifter mixing systems with a convenient, economical and simple method of digester heating. The DirecTube consists of an eductor tube construc5ted with a hot water, heat exchanger, jacket surrounding the tube. The annular jacket is fitted with multiple internal baffles to provide turbulent water circulation and is shop pressure tested to insure integrity. Hot water gives up heat to the sludge circulated through the eductor tube to easily maintain digester temperature. The high efficiency of the jacket exchanger permits use of a low heating water temperature of 140° to 150°F. A Walker Process boiler that burns digester gas and auxiliary fuel produces the hot water for the DirecTube. Efficient, convenient internal heating is thus provided while also eliminating external heat exchangers, sludge re-circulation piping, valves and pumps with associated controls.

DirecTubes are Conservatively designed to provide ample heat transfer capacity. Actual field tests of the DirecTube have proven its effective neat transfer capacity and heat transfer coefficients ("K") as high as 300 BTU/hr/ft^2/°F have been measured. Although heat transfer is greatest across the inside area of the eductor tube, due to higher internal sludge velocities, significant heat transfer also occurs at the exterior surface of the eductor tube due to the induced flow over that surface. Nevertheless, design is based on a "K" value on only 100 and only the inside surface area of the eductor tube is used. The relatively low hot water temperature of 140° to 150°F can be increase to hot water re-circulation can also be increased to further extend capacity.

This conservative design provides very high heating capacity and allows intermittent operation of the GasLifter to allow supernatant decanting and normal mixer shutdown while also conserving power. DirecTubes are normally constructed with a minimum heating capacity of 250,000BTU/hr. with maximum capacity limited only by the tube length.

Nominal heating capacities per linear foot of eductor tube length are listed below:

Eductor Tube Diameter (inches)	Heating Capacity/Foot (BTU/hr.)
18	21,200
24	28,300
30	35,300
36	42,400
42	49,500
48	56,500
54	63,600
60	70,600
72	84,800
84	98,900



DIGESTER HEATING

HeatX sludge heaters by Walker Process are for plant designs utilizing external sludge heating equipment. Type EB units are combination exchanger-boiler units: Type E units are separate exchanger units used in conjunction with another hot water source; Type B units are separate boiler units which are used with DirecTube internal heat exchangers.

All Walker Process HeatX units are designed, tested, inspected and stamped in compliance with ASME requirements. Boilers and exchangers are shop pressure tested and burners are shop fired to insure integrity and proper settings for efficient operating. All units are completely factory assembled and ready for operation after jobsite piping and electrical connection are made.

HeatX units are available in the sizes shown in the table below. The sizes are based on specific design parameters such as heat transfer coefficient, areas, sludge and water flow rates and temperatures. Capacities are based on heating water temperatures of 150°F and sludge temperatures of 95°F.

Tabulated sexing can be affected if specified parameters vary. Larger or special size units are available for specific digesters heating applications. The designer should contact his Sales Representative or Walker Process for specific information.

Capacity (BTU/hr.)	Sludge Recirc. Rate*	Water Recirc. Rate**	Sludge Tubes	Sludge Tube Area ($ft.^2$)
Type EB Units				
250,000	150	80	4'-4"	27
400,000	150	80	6'-4"	41
500,000	150	80	8'-4"	55
700,000	150	80	12'-4"	83
1,000,000	200	150	12'-6"	125
Type E Units				
1,500,000	360	200	12'-6"	205
2,000,000	360	150	12'-6"	255
2,500,000	360	150	16'-6"	340
3,000,000	360	150	16'-6	445

*Note that sludge and water re-circulation rates may affect HeatX capacity that would require variation to the information above.
**Flow rate is based on flow per pass.

HEATX FEATURES

Separate boiler and exchanger design allows an operating boiler temperature range of 180° To 190°F. This provides a high enough boiler temperature to avoid condensation and corrosion that can occur at boiler temperatures of 160°F or lower.

Scotch Marine boiler is designed in accordance with ASME standards and utilizes a refractory lined back plate to provide a durable thermal barrier and eliminate corrosion and leakage problems. The tightly constructed Scotch Marine design also permits use of a forced draft burner with safety.

The HeatX burner is designed to burn sewage gas and auxiliary fuels; such as natural gas, LPG or fuel oil. Upon sewage gas depletion. Manual or automatic burner control is possible in blending or switchover modes. The burner is the same proven forced draft design utilized by commercial boiler manufacturers and has been successfully applied on Walker boilers for decades. Since forced draft fans handle only cold, uniformly dense combustion air, they provide grater efficiency and a more easily controlled air-fuel ratio for simpler operating and reduced maintenance.

The exchanger unit is an efficient concentric tube type utilizing countercurrent forced circulation of hot water and sludge. Hot water, circulated through the tube annulus, and sludge are circulated at high velocities to take advantage of increased heat transfer at the high velocities. This permits efficient operation with less surface area than in other designs. Heat transfer coefficients ("K") of as high as 380 have been measured in actual field tests, but exchangers are conservatively designed based on a "K" value of only 220 to provide ample heating capacity.

End castings are designed for easy removal to permit inspection of tubes and to prevent any leakage of sludge into the heating water. Rifling in the castings causes turbulence to reduce fouling at the bends.

Operating temperature of the exchanger ranges from 140° to 150°F to prevent sludge baking on the tube surfaces. For this reason, Walker HeatX units have operated at full efficiency for 25 to 30 years. This is accomplished by blending hot water from the boiler prior to the exchanger.

Above, two 750,000BTU/hr. EB HeatX units at Hinsdale, IL. Picture taken from the burner side.

Below, the picture shows the boiler viewing port at the opposite end from the burner.

OTHER WALKER PROCESS EQUIPMENT PRODUCTS

GRIT REMOVAL
HydroSeperator
Rolling Grit
Grit Washer

BIOLOGICAL PROCESS
EnviroDisc® RBC - Rotating Biological Contactor
Rotary Distributors

SKIMMING
HeliSkim
RotoDip Skimmer
Grease Prep - Skimmings & Grease Preparation Systems

SEDIMENTATION & THICKENING
Circular Collectors & Thickeners
Bridge Supported
Pier Supported
Plow Type, Spiral Flights, MultiDraw, SightWell
UniMix Flocculating Clarifiers
Spur Gear Drives
Rectangular Collector Mechanisms
HeliThickener

SOLIDS CONTACT CLARIFIERS
MC ClariFlow
RollFlow™ Clarifier

SLUDGE DIGESTION
Covers – Fixed, Floating, GasHolder, Combination Cover
GasLifter Circulator-Mixer
HeatX – Heat Exchanger, Boiler, Combination Units

RollAer - For Aerobic Digestion

WATER TREATMENT
Paddle Floculators
UniMix Flocculator
InstoMix Flash Mixer
Cascade Tray Aerators

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