ANAEROBIC DIGESTION
FOR
SUSTAINABLE EFFLUENT MANAGEMENT

A brief summary of the opportunities to create a sustainable effluent management system to reduce the environmental impact of waste materiel, add value by converting it to energy for local consumption or export to the grid and return residual plant nutrients and fibrous materials for agriculture use.

Permastore Limited
Eye
Suffolk
IP23 7HS
England

Tel: ++ 44 (0) 1379 870723
Fax: ++ 44 (0) 1379 870530

E-mail: sales@permastore.co.uk
Web Site: www.permastore.co.uk

ANAEROBIC DIGESTION

Anaerobic Digestion (AD) uses wet wastes to produce energy in the form of a methane-rich biogas. The process involves the bacterial fermentation of effluent materials at a temperature of around 30-35ºC (mesophilic fermentation) or 55ºC (thermophilic fermentation), during which 60% or more of the organic material may be converted into biogas. AD takes place in large, heated, insulated tanks and the rate of fermentation will depend on the nature of the feedstock and the operating temperature. The methane evolved may be consumed locally, partly for the digestion process or used in a generator to produce electricity for export into a grid. The 'digested' sludge may then be separated into liquid and solid components with the liquid element being used as a fertiliser and the solids being used as a soil conditioner or, with further processing, as a higher value organic compost.

Biogas production is becoming the preferred method of dealing with large quantities of organic wastes to provide a sustainable management system. It has been extensively adopted in the UK, mainland Europe and Scandinavia with the construction of many large scale anaerobic digestion plants in the past 10 years. The mainly European technology is now being exported to the Far East and North America where it is increasingly seen as the most environmentally friendly and cost effective method of processing high volume effluents, offering substantial benefits to owners, local communities and to society as a whole.

Benefits of AD to Owners, Communities and Society

- Reduction of CO_2 emissions
- Reduction of methane and nitrous oxide emissions
- Control of odours
- Prevention of nitrate leaching to groundwater
- Return of organic matter to the land
- Reduction of pathogens in raw effluents
- Saving on landfill capacity
- Conservation of limited fossil fuel resources
- Saving on limited resources for production of commercial fertilizers
- Contribution to national and international measures for the control of 'greenhouse gases'

Permastore has been designing, manufacturing and building both aerobic and anaerobic digester tanks for the agricultural, municipal and industrial sectors for some 20 years.

With hundreds of tanks supplied to treatment plants over this period, it has a substantial knowledge of digester tank design considerations.

In the UK, anaerobic digestion is now the predominant method for treatment of effluents in the municipal sector. In mainland Europe and Scandinavia Permastore® Tanks are also used in anaerobic digester processes dealing with effluents from several sources including livestock slurry, domestic sewage, and industrial waste materials from meat packing and other food processing plants. Typical sizes for such digester tanks range from 600m^3 to over 5000m^3 capacity.

A typical digester package from Permastore comprises:-

- A Glass-Fused-to-Steel digestion tank with a suitable height to diameter aspect ratio, selected glass coatings appropriate for the contents and process and engineered for the specified loadings and pressures.
- An external beam roof with continuous Glass-Fused-to-Steel sheeting for the critical gaseous zone.
- Access steelwork for the tank and roof.
- Insulation.
- Assorted ancillary equipment and connections.
- Installation by Permastore Contracts Department

ASPECT RATIO

This is generally between 1 and 1.2 to 1. A lower profile tank has recently been supplied to Thames Water for an acidification digester as part of a development site, but this incorporates the facility to be easily extended should they wish to revert back to a normal anaerobic system.

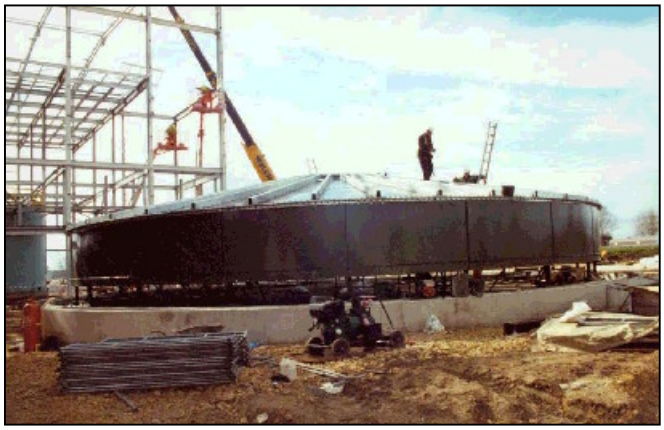
This photo shows a digester complete with cladding and Stair tower

PERMASTORE® EXTERNAL BEAM ROOF

With its external beams leaving an uncluttered corrosion resistant interior, the Permastore® External Beam Roof has been developed with digestion tanks in mind.

As process designers seek alternatives to gas mixing of contents, central mixers are increasingly being used and the structural integrity of the entire roof and tank becomes more critical.

The design of the external beam roof allows for various mixer loads (together with wind and snow loads) to be readily accommodated.



ACCESS STEELWORK

With full design and manufacturing facilities Permastore can supply an integrated access system.

Such systems include full stair systems, walkways, peripheral handrails, and roof platform to integrate with existing access.

INSULATION

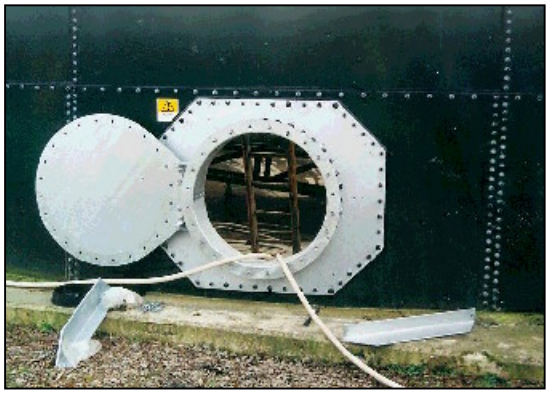
There are two main types of insulation typically fitted to digesters:

The GRP sectional panel system (photo left) and the “wrap & clad” system (photo right)

The sectional panel provides easier access, but the “wrap & clad” system is more economical and colour matching to adjacent buildings is usually easier with the range of plastic coated steel cladding available.

ANCILLARY EQUIPMENT

Typical equipment includes viewports, weirboxes, manways, hatches, pipe connections and mixer mounts, illustrated below:



ALTERNATIVE MATERIALS FOR DIGESTER CONSTRUCTION?

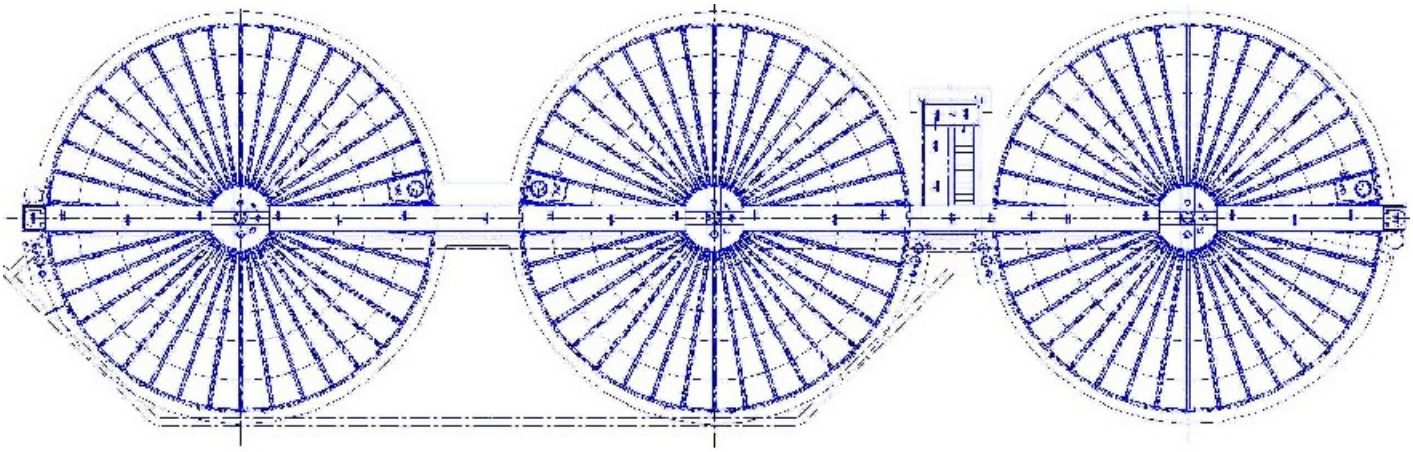
The development of Glass-Fused-to-Steel as a leading material for modern anaerobic digestion plants is a result of considerable experience with alternative materials and technologies. The structural integrity of the tank, and especially the interface with the roof, is essential to maintain constant operating pressures and temperatures. Ingress of oxygen into the gaseous zone of the anaerobic digester will change the nature of the process and may result in the excessive production of severely corrosive materials such as hydrogen sulphide and sulphuric acid.

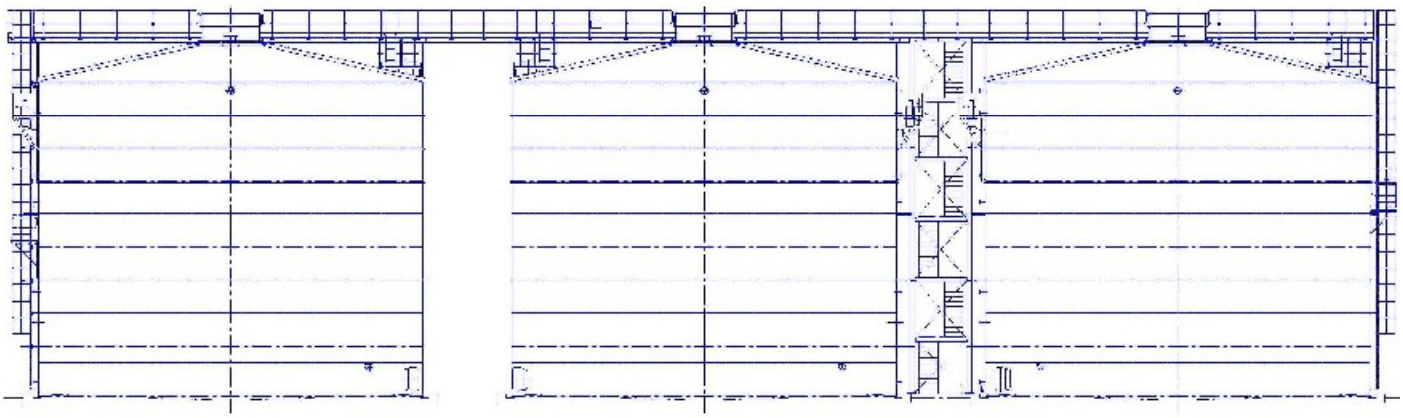
GRP roofs used in the past have proved unsuitable for the temperatures and loads imposed. Coupled with poor design and UV degradation, a number of failures have resulted.

The photo below shows a sectional GRP roof where the joints have been repaired. The repair itself is then de-laminating.

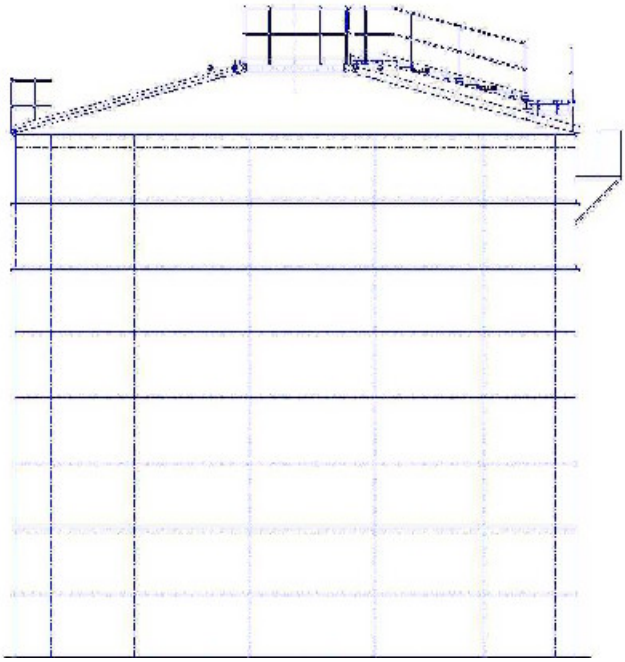
Concrete walled tanks for liquids are now increasingly being questioned following a number of failures resulting from H_2S attack of the steel reinforcing bar. Prevention of such an attack is difficult and costly; repair of a failed tank is almost impossible and demolition is the usual result.

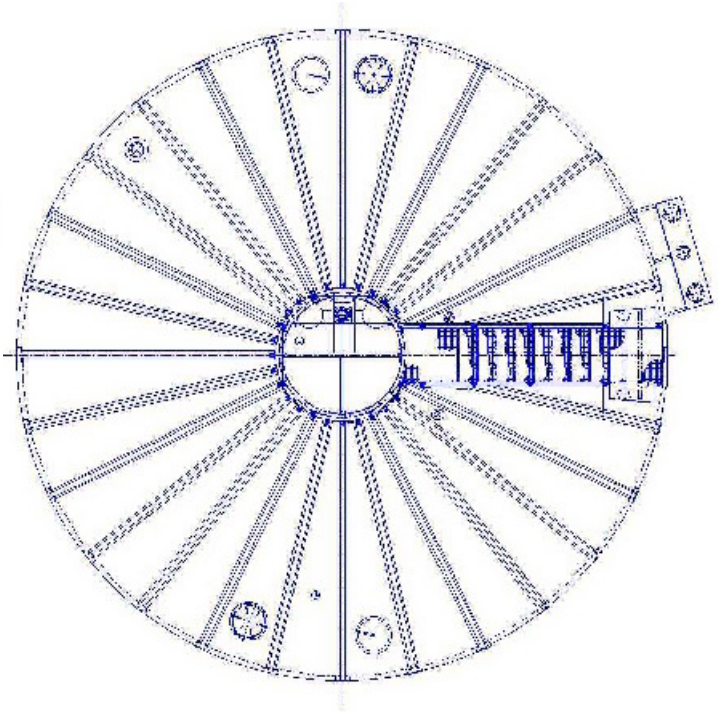
The photo below shows a newly built concrete walled tank already weeping externally as the liquid contents seep through. The re-bar will already be under constant attack from corrosive salts embedded in the structure.



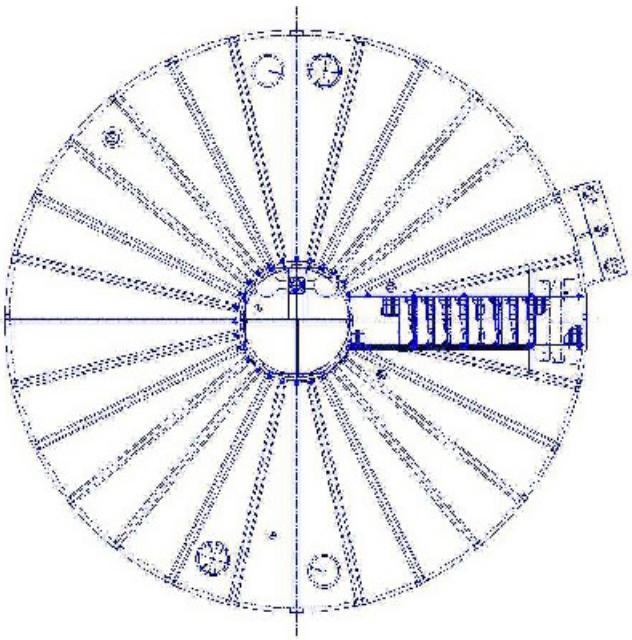


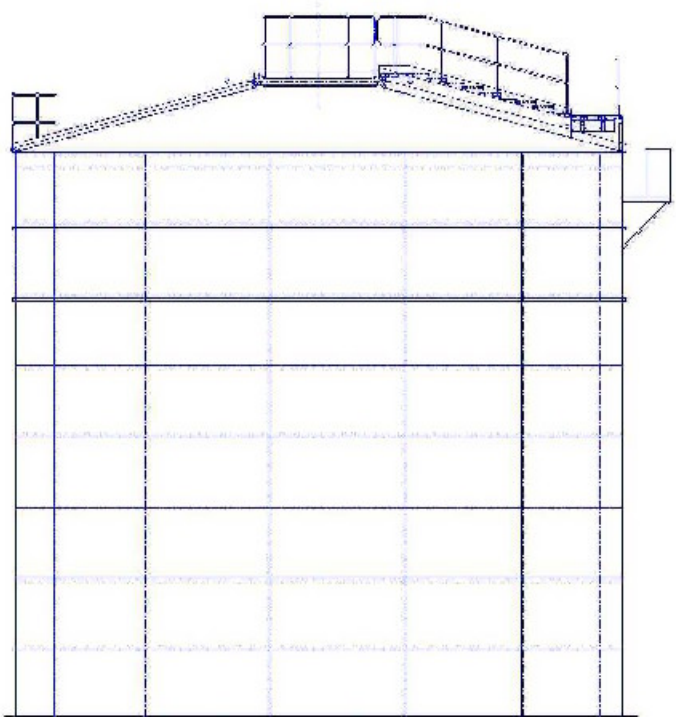
CUSTOMER: OTV Birwelco Ltd	END USER: Southern Water
SITE: Bexhill & Hastings STW	DUTY: Anaerobic Digester
MODEL: 5347.5 x 3	OPERATING VOLUME: 2,600m^{3}ea
ROOF: Permastore® External Beam	FINISH: Isofusion® & Trifusion®





CUSTOMER: MJ Gleeson Group Plc	END USER: Thames Water
SITE: Camberley STW	DUTY: Anaerobic Digester
MODEL: 3940	OPERATING VOLUME: 1,200m^3
ROOF: Permastore® External Beam	FINISH: Trifusion®





CUSTOMER: MJ Gleeson Group Plc

END USER: Thames Water

SITE: Swindon STW

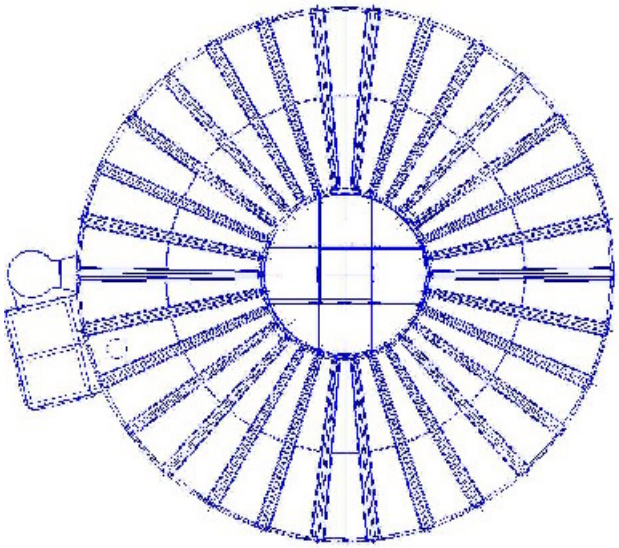
DUTY: Acidification Digester

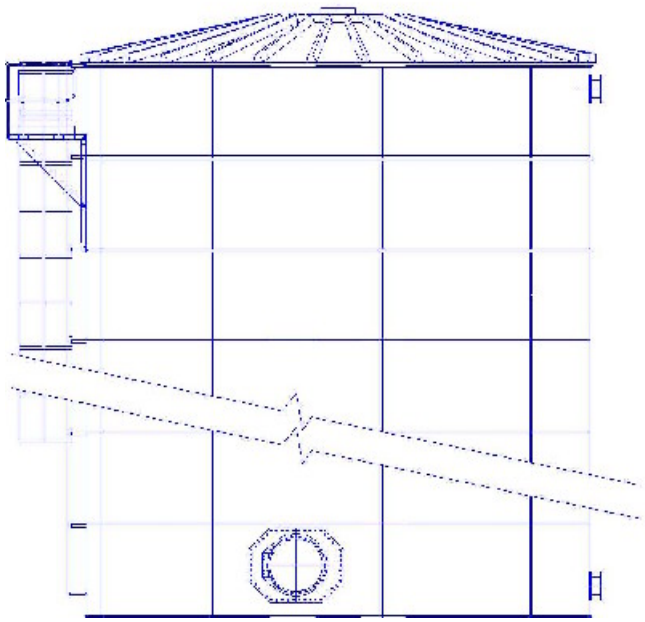
MODEL: 4235SR

OPERATING VOLUME: 1,190m^3

ROOF: Permastore® External Beam

FINISH: Trifusion® & Trifusion® Plus





CUSTOMER: TAE	END USER: Tunnel Refineries
SITE: London Factory	DUTY: Anaerobic Digester
MODEL: 675/28	OPERATING VOLUME: 2,600m^3
ROOF: Permastore® External Beam	FINISH: Trifusion®