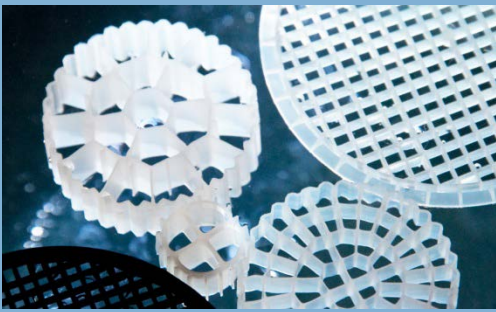


AnoxKaldnes™ Moving Bed Biofilm Reactor

Oil & Gas | Technology Data Sheet

AnoxKaldnes invented the Moving Bed Biofilm Reactor (MBBR) technology in 1985, based on the biofilm principle for treating organic matter, nitrification and denitrification. Supported by more than 20 years of continuous research and development as well as application expertise, AnoxKaldnes MBBR technology is unparalleled in the industry, with more than 700 references worldwide.



Our plastic carrier elements, which are the key to this technology, are designed based on the results of decades of research and development. The configurations of these elements have been designed to provide not only high surface area for bacterial growth, but protected spaces within the media that enable the biofilm to thrive.

In addition to media design, AnoxKaldnes is unparalleled in its research of the aeration grids that provide complete mixing for a nourishing environment for biological activity.

The flexible design of our systems enables Veolia to apply this technology in a variety of ways to meet your needs for biological treatment.

A Proven Solution in the Oil & Gas Industry

The AnoxKaldnes™ MBBR is ideal for refinery applications where biological treatment is required. This technology provides effective removal of high concentrations of BOD, COD and VOC. Our robust systems are stable and are not upset by high variations in loading.

Where biological treatment systems are already in place, our MBBR offers an easy upgrade option to expand capacity without adding tanks.

Our vast experience and pilot testing capabilities enable us to offer performance guarantees in a variety of applications.

AnoxKaldnes™ MBBR technology has been providing reliable biological treatment at this Texas refinery for more than a decade.



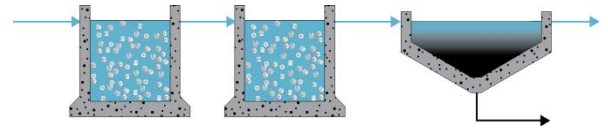
Benefits of the AnoxKaldnes™ MBBR Process

- **Compact Systems** – The high surface area provided by our carrier elements enable system designs with small footprints.
- **Robust, Reliable Process** – The system can handle high loadings of BOD, COD, and VOC, and is not upset by fluctuations in flow or loading.
- **Flexible Reactor Designs** – The process can be applied as a stand-alone MBBR solution, a Hybas™ combination process, or a BAS™ combination process. (See reverse side for details.)
- **Easy to Operate and Control** – Replacement of media is not required.
- **Easy to Retrofit Existing Systems** – Increases capacity, often without additional tanks.
- **No Clogging of Biofilm Carriers** – Excess biological growth sloughs off naturally, maintaining healthy bacteria and consistent treatment results.

Flexible System Designs with Proven Performance

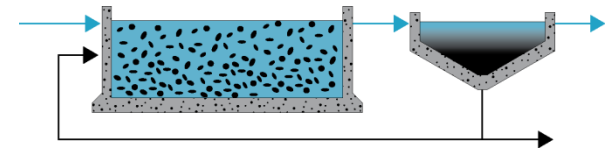
AnoxKaldnes stand-alone MBBR solutions

AnoxKaldnes pure MBBR systems are compact, simple to operate, and very efficient for removal of BOD, Ammonia and nitrogen.



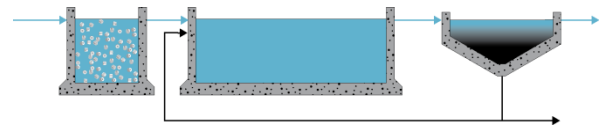
Hybas™ combination process

The Hybas™ combination process utilizes both suspended and attached growth within the same reactor. Nitrification takes place mainly in the biofilm. Hybas biological process is a superior integrated fixed-film activated sludge (IFAS) process and can be used as a very efficient upgrade of activated sludge plants for enhanced nitrification or nitrogen removal within existing volumes. Enhanced biocaggl phosphorus removal (EBPR) can also be included.



BAS™ combination process

The BAS™ combination process consists of one or more AnoxKaldnes MBBRs, followed by an activated sludge (AS) system. The high-rate biofilm stage is designed to pretreat the wastewater to remove the readily bio-degradable organic matter prior to the activated sludge system.



Recent Projects Selected from 700 References Worldwide

Client and Location	Year Completed	Load	Objectives	Design
Formosa PB4, Vietnam	2014	6380 kg COD/d	COD removal	MBBR
Formosa PM5, Vietnam	2014	295 kg N/d	Nitrification	Hybas™
Nynas Refinery, Sweden	2012	450 kg COD/d 27 kg TKN/d	Pre DN + COD + nit	MBBR
Shell Qatar, Qatar	2012	26,000 kg COD/d	COD removal	BAS™
Confidential Asphalt Refinery, USA	2012	444 kg BOD5/d 115 kg NH4/d	>95% BOD removal <50 mg/l NH4	MBBR
Preem Raff, Sweden	2011	Mean 257 kg COD/d Design 380 kg COD/d	COD removal	MBBR
Suncor Montreal Refinery, Canada	2010	1470 kg BOD/d	BOD removal	MBBR
Valero St. Charles, USA	2010	3387 kg BOD/d 860 kg TKN/d	>95% BOD removal and <5 mg/l NHr	Hybas™
Dhangdong Shanxian Chemicals, China	2007	6,456 kg COD/d 486 kg NH4-N/d	COD removal and nitrification	MBBR
Qilu Petro Corp., China	2007	400 kg NH4/d	Ammonia removal	MBBR

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