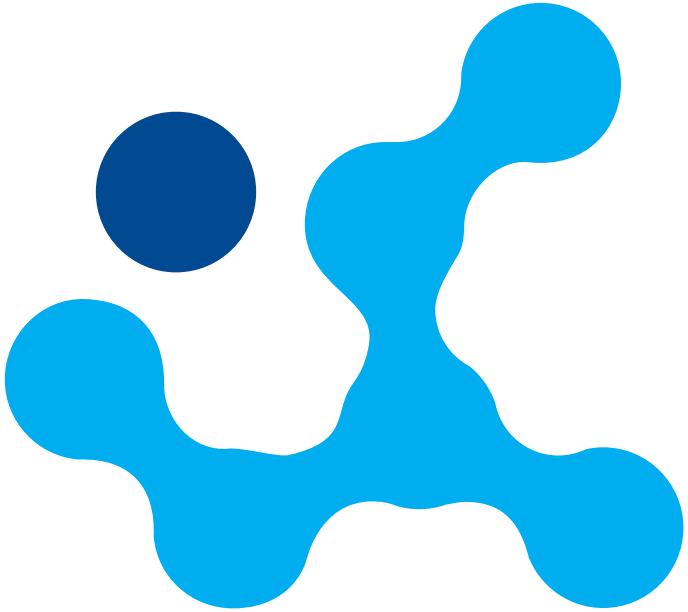


Microbial Control in Oil and Gas Operations

Biocides for the oilfield and fuel treatment

VINK CHEMICALS

A Team with Our Customers

Vink Chemicals product portfolio includes the complete range of well-known biocides for several segments of the oil and gas operations: drilling, completion, stimulation, fracking, production, EOR, transportation, pipelines and facilities, terminals, refineries, water treatment and aftermarket. Whether treating crude, gas, diesel, gasoline, biodiesel, marine fuel, Vink Chemicals is your partner.

Vink Chemicals keep on the cutting edge of innovation to offer new and novel chemical products that meet today's strict environmental, technical and quality requirements.

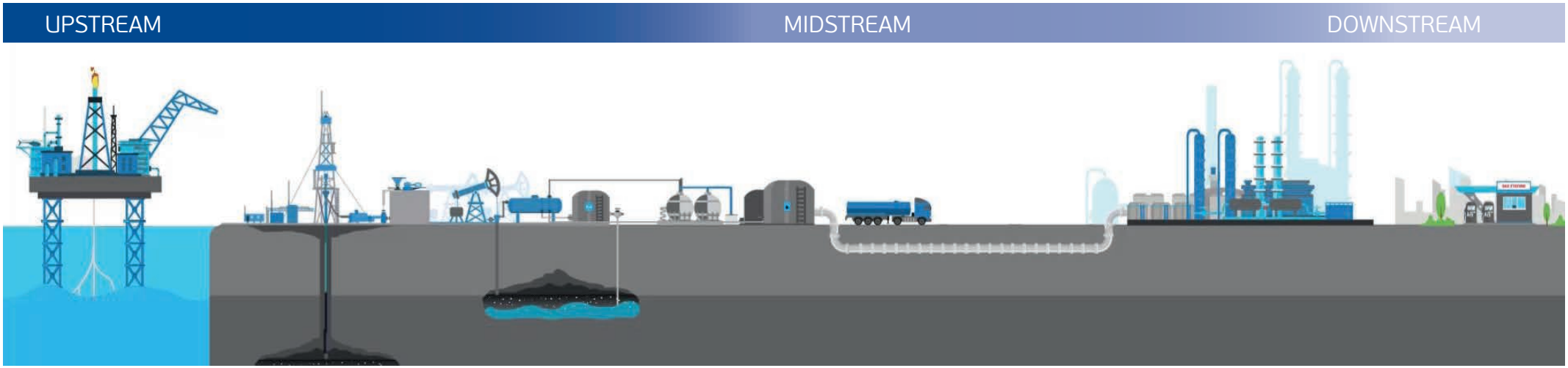
Under the brand names grotan, grotamar, Stabicide , Vinkocide and parmetol, Vink Chemicals offers leading biocidal products with numerous application profiles in upstream, midstream, and downstream applications in oil and gas sector safeguarding our customers' products and assets.

Upstream, Midstream & Downstream

Wherever there is a water presence there is a high risk that microorganisms will grow. Most of the processes and fluids applied in oil and gas (O&G) production offer ideal conditions for microbiological growth.
Microorganisms take many forms, and their uncontrolled growth can cause enormous health, safety and environmental issues, in addition to economic damage to assets, equipment or hydrocarbon products. Microbiological influenced corrosion (MIC) causes billions of euros worth of damage each year.
Biocides have economical and social benefits: their use extends the product life, protects the staff and the equipment. Biocides are indispensable in O&G as they reduce the consumption of energy and natural resources as well as the volume of waste.

Microorganisms can take many forms as bacteria, fungi and algae and can develop in the presence of oxygen (aerobic) and without oxygen (anaerobic). They feed from various sources of nitrogen, phosphorus, sulfur and carbon. Bacteria can colonize the pores within the oil reservoir as 'native inhabitants' and therefore be introduced to the system through the injected or produced water.
In offshore production facilities, all water sources (recycled, seawater) are potential sources of microbial contamination. Bacteria attack metal of process equipment in an indirect mode, resulting in microbiologically influenced corrosion (MIC) and subsequent loss of structural integrity. Further, microorganism may be present as biofilms causing flow restrictions (loss of fluid velocity) and loss of heat transfer capacity in heat exchangers.

Sulfate reducing bacteria (SRB) – the most common type of bacteria in the oilfield, especially where seawater or brines are used as a fluid. SRB metabolize sulfate sources by forming biogenic hydrogen sulfide (H_2S) leading to the complex phenomenon of 'reservoir souring', which may result in severe fouling due to sulfide deposits.
Acid producing bacteria (APB) generate organic and inorganic acids through their metabolic activities and have been recognized as a potential cause of severe corrosion in structural assets.
Iron & manganese oxidizing bacteria are major causes of MIC in the oilfields. This type of bacteria is oxidizing Fe^{2+} to Fe^{3+}, Mn^{2+} to Mn^{3+} to obtain energy for growth, thus creating $FeCl_3$ and $MnCl_3$ that are very corrosive. They also scavenge oxygen creating hospitable environment for anaerobic bacteria.



UPSTREAM

Right through upstream supply chain: drilling, completions & workover, stimulation, fracking, production, EOR operations, and well shut-in, bacterial growth can pose a serious issue for operators.

Areas of potential challenges:

Drilling

Getting the correct environment for drilling operation is critical. In water-based drilling fluids, excessive growth of bacteria can prevent additives working successfully and impact the overall cost and performance reservoir. Areas affected

- Drilling Fluids/muds, drill strings, drill heads, drill pipes
- Water downhole, on topside in separator tanks, reserve pits, impoundments, and ponds
- Pumps & valves

Completions & Workovers

Completion fluids help prepare, repair, cleanout and complete the well bore during the completion phase. Recycling of flowback and produced water from wells is commonly adopted strategy to control surface water and environmental impact. However, bacteria thrive in this types of water affecting:

- Packer and hydrotesting fluids
- Polymers used in balancing, permeation, pressurization of the well
- The wellbore (sensitive to aerobic bacteria)
- Casing – acid producing bacteria leads to H_2S (APB) causing corrosion
- General well integrity and formation

Stimulation & Fracking operations

Seen as the most highly-water intensive segment of the operation, bacteria can be introduced into the well from outside through the injected groundwater/or seawater and from produced water that re-used and pumped back but is not properly treated. This leads to issues in:

- Well fractures and pores – bacteria can colonise in pores within the oil reservoir causing blockages reducing well productivity
- Frack fluids – polymer and additives can be degraded by microbes leading to loss of performance of operation
- Hydraulic fracturing operations particularly in shale plays are susceptible to sulfate-reducing bacteria (SRB) and acid-producing bacteria (APB) which may lead to sour gas production, microbially induced corrosion and bioclogging

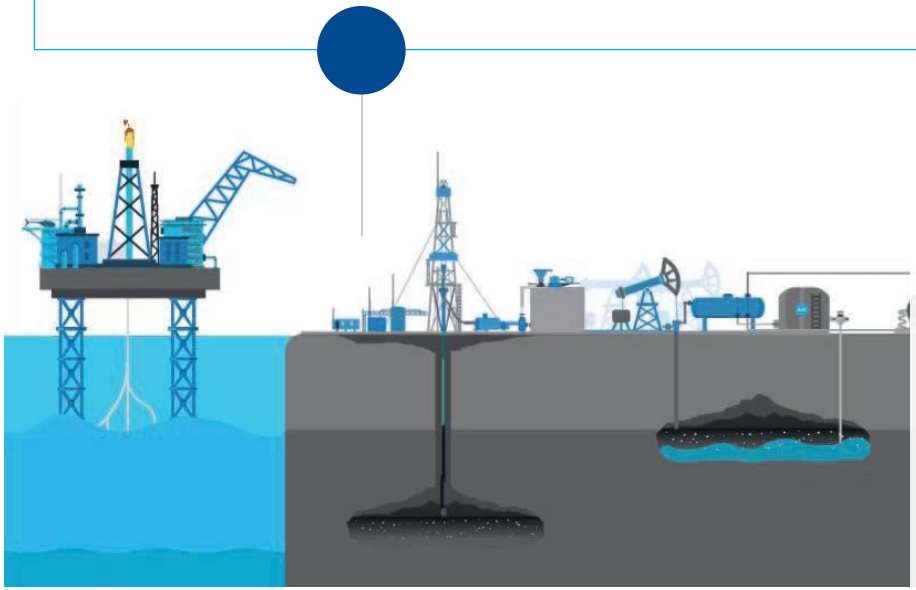
Production

In the 3 phases of recovery - primary, secondary and tertiary - water in the well and formation or injected into the well to recover oil can come under attack from bacteria. This may impact:

- Separators for crude and water
- Water flooding process (secondary stage) – protection of the water injected is critical
- Water storage tanks and re-injection lines and wells

Decommissioning

Oil and natural gas wells when they have reached the end of their economic life are abandoned and decommissioned – sometimes they are idled or shut in for a period of time awaiting reopening at a future date. With idled /shut-in well or improper decommissioning, microbes can proliferate inside the wells causing severe problems ranging from corrosion, fouling, H_2S generation.



Vink Chemicals biocides for upstream

- grotan OX
- Vinkocide DBNPA 20
- Vinkocide GA 50
- Vinkocide THPS
- Vinkocide BND 20
- Vinkocide BAC 50
- grotan TK 5
- grotan WS
- stabicor OX

MIDSTREAM

Midstream activities include the processing, storing, transporting, and marketing of crude, fuels and natural gas, and natural gas liquids.

Areas of potential challenges:

Terminal

- For emergency treatment of fuel and/or crude cargos that have built up water zones inside the hold
- Treatment of wastewater streams from ships

Storage

- Sludge build up in storage tanks gives anaerobic bacteria an environment where it can thrive
- Haze in fuel could be an indications of microbiological contamination
- Water accumulation in dead zones is ideal for microbiological growth

Pipelines

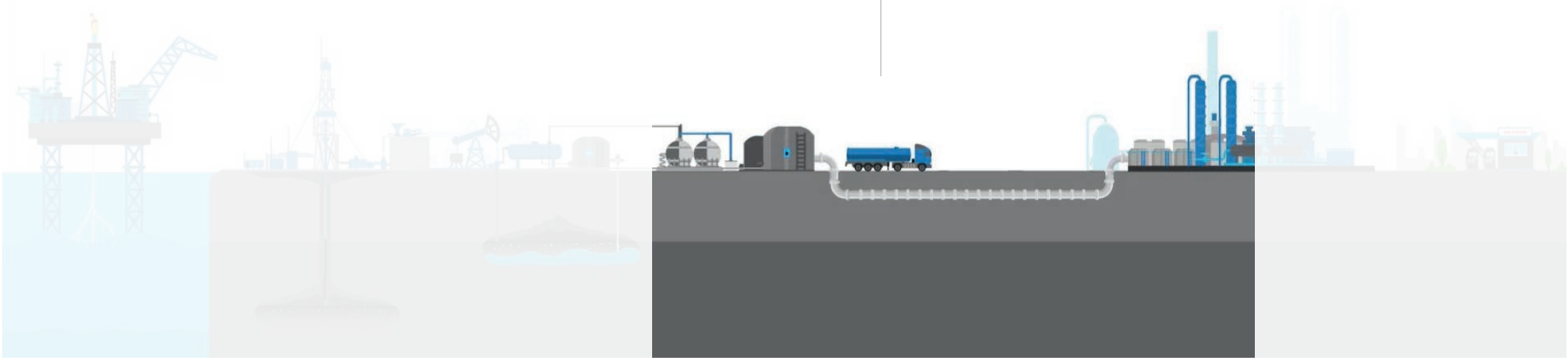
- Severely affected by a range of microorganisms
- Mothballing of pipelines – that lay inoperable and gather water
- Hydrotesting pipelines – contaminated water introduced into the system

Transportation (marine, ships, cars)

- Excessive pitting corrosion in cargo oil tanks caused by microbial influenced corrosion (MIC) originates from sulfate-reducing bacteria (SRB) that resides in settled water at the bottom of the tanks
- Contaminated water within transmission systems (ballast water, etc.)

Vink Chemicals biocides for midstream

- grotan OX
- Vinkocide DBNPA 20
- Vinkocide GA 50
- Vinkocide THPS



DOWNSTREAM

In the downstream market – refineries, marine and automotive sectors – water entering the systems from airborne sources are a potential hazard for crude oil and high value processed fuels such as diesel, biofuels, marine fuel oil and other paraffinic fuels (like HVO).

Areas of potential challenges:

Refineries: Crude & Processed Fuel Storage Tanks: microorganisms in water bottoms in crude oil storage tanks, cause corrosion, degrade products, and damage inventories and infrastructure. Moreover, processed fuel tanks are routinely a target for bacteria and fungi (i.e. mold and yeast), commonly found in these fluids and some classes of microorganisms can exist in a fuel even under relatively water free conditions. They form slime, heavy bio-sludge deposits on tank bottoms and walls or may stabilize emulsions in processed fuels. In fuel lines, they cause rapid and severe corrosion of tanks (MIC) and can lead to deviations of the fuel specifications

Biofuels can be particularly problematic. By nature, they are readily biodegradable and provide a good source of nutrients for the microbes. The waste products from the metabolism of these microorganisms (like APBs) can create sludge and corrosive acids (acetic and formic acid). In automotive fuel systems, microorganisms cause damage to components, engine failure and injector blockages. The costs for decontaminating heavily infected facilities and the consequential losses due to system and equipment failures are high.

Marine Fuels: microbes in terminal storage tanks can be passed on down to the fuel distribution chain to contaminate facilities. If left unchecked, it can cause pitting in ship fuel tanks, compromise the fuel quality and reduce the engine performance.

Some of the known problems caused by microbial contamination are:

1. Metal Corrosion (Tanks & Pipelines)
2. Gelatinous slime & solids in fuel tank storage
3. Plugged filters, meters, gauges & nozzles
4. Fuel quality problems (Hazing, Discoloration & Residue)
5. Elastomer breakdown (Seals, gaskets, etc.)
6. Emulsion Problems (Interface build-up & hazy fuel)

Vink Chemicals biocides for downstream

- grotamar 71
- grotamar 82
- Vinkocide PG 1.5
- Vinkocide GA 50
- Vinkocide BAC 50

Utility Systems within O&G Industry

Crude oil and gas production is always connected to the challenge of handling water co-extracted from the reservoir during enhanced production or separated during the numerous steps of processing the hydrocarbon fluids. Within the entire value chain of the upstream, midstream and downstream sector, process water is used in various utilities like

- Cooling towers
- Steam generation

Process and wastewater handling require the implementation of a professional water management program to suppress the possible bacterial development on O&G water utilities like

- Heat exchangers
- Water wells
- Injection wells
- Wastewater pits
- Dehydration plants
- Condensers
- Filtration units
- Storage tanks
- Pipelines etc.

All water contacted pieces of equipment may act as bioreactors resulting in biofilm formation and potentially MIC. Water management programs almost always require some means of biological control based on biocide treatment

Vink Chemicals biocides for Utilities

- grotan OX
- Vinkocide BND 20
- Vinkocide DBNPA 20
- Vinkocide GA 50
- Vinkocide THPS
- Vinkocide BAC 50

Technical Service and Applications Team

Vink Chemicals Oil & Gas group is a vastly experienced team, who has advanced understanding of microbiological issues in the O&G industry. Our technical department can advise on biocide selection: assessment requests, species identification, work out solutions and make product recommendations. This includes industrial hygiene, toxicology, ecotoxicology, regulatory issues, and all aspects regarding the correct, efficient, and economical use of biocides. Furthermore, we have dedicated microbiological laboratories in Germany and the technical service group is set up to visit customer sites.

- Testing and analysis capabilities that are tailor-made.
- Carry out extensive assessment/audit of your facilities.
- Laboratory testing of hydrocarbon streams to optimize and customize additive treatment rates & customized chemical treatment programs.
- Identification of potential process improvements based on “best industry practices” and recommend adjustments according to “good housekeeping practices” to enhance any potential biocide treatment. If applicable, we will focus on well-established methods and guidelines like ASTM or NACE
- Can determination of the optimal microbiological chemistry and incompatibilities with other chemical programs (e.g. Reduced effects on polymers for EOR, gel fracturing and slick water operations)
- Mobile Testing/onsite testing

Research and Development

Vink Chemicals has a state-of-the-art R&D lab that includes microbiological as well as research and product development capabilities. We identify and assess potential synergies of new and established active ingredients and determine the optimal concentration and stability of products as a function of time and application conditions. In a team with our customers we are constantly looking for new trends in your specific market (i.e. booster technology, souring control, bio-based raw materials and biocidal actives). We develop specific field monitoring tools for residual biocides and online technologies to feed data into your “digital twin” for optimized dosage control and added value of our biocide treatment packages.

Regulatory advice

You are not alone navigating the waters of the Biocidal Products Regulation (BPR), REACH, UFI or the CLP Regulation. We would be pleased to advise you on regulatory issues and support you in implementing the applicable laws, directives and regulations as well as the required applications, registrations and authorizations of all biocidal products

Biocide Application in O&G Industry

A biocide treatment can be preventative and/or curative and the **purpose of biocide is to**

Prepare

- Preparing the water or system for injection is most critical stage of oil production

Decontaminate/Cure

- After long periods, whether its downhole, pipelines or tanks the effects of microbiological growth can be severe. Many different types of microorganisms will be active and highly fouled systems need to be sanitized/decontaminated by an effective biocide

Preserve and prevent

- The biocide should be able to preserve the fluids through the whole process and thereby
- Must prevent the re-introduction of potentially harmful organisms into the oil and gas bearing formation

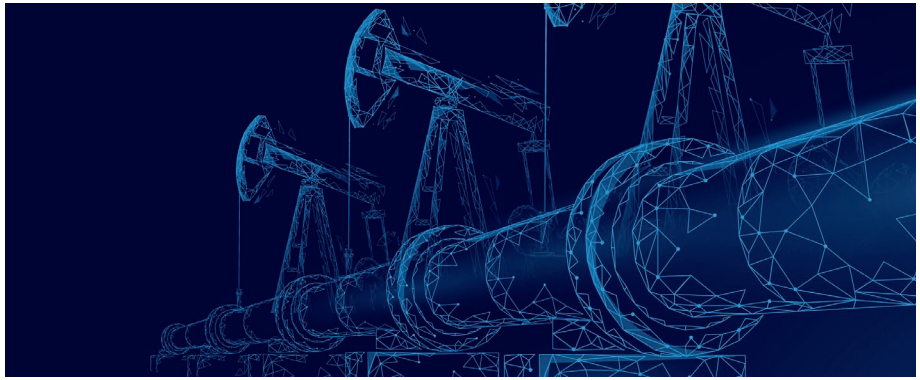
Biofouling Control

controlling the growth or proliferation of microbes that can potentially be harmful to the operation of the oilfield, or to the value of the hydrocarbon product that is produced

- water injection system: to enhance oil production (Waterflooding)
- Production after treatment

Souring Control

Souring due to the infiltration of bacteria is a common problem in the O&G industry. Biocides are used to avoid or eliminate souring. However, once SRB's gain a foothold in the system, they are very difficult to control. Besides regular injection of the biocides, service and oil companies often employ other techniques to control souring. Most involve the cleaning of surfaces, tanks, etc to remove and eliminate the biofilms that harbor the problematic bacteria.



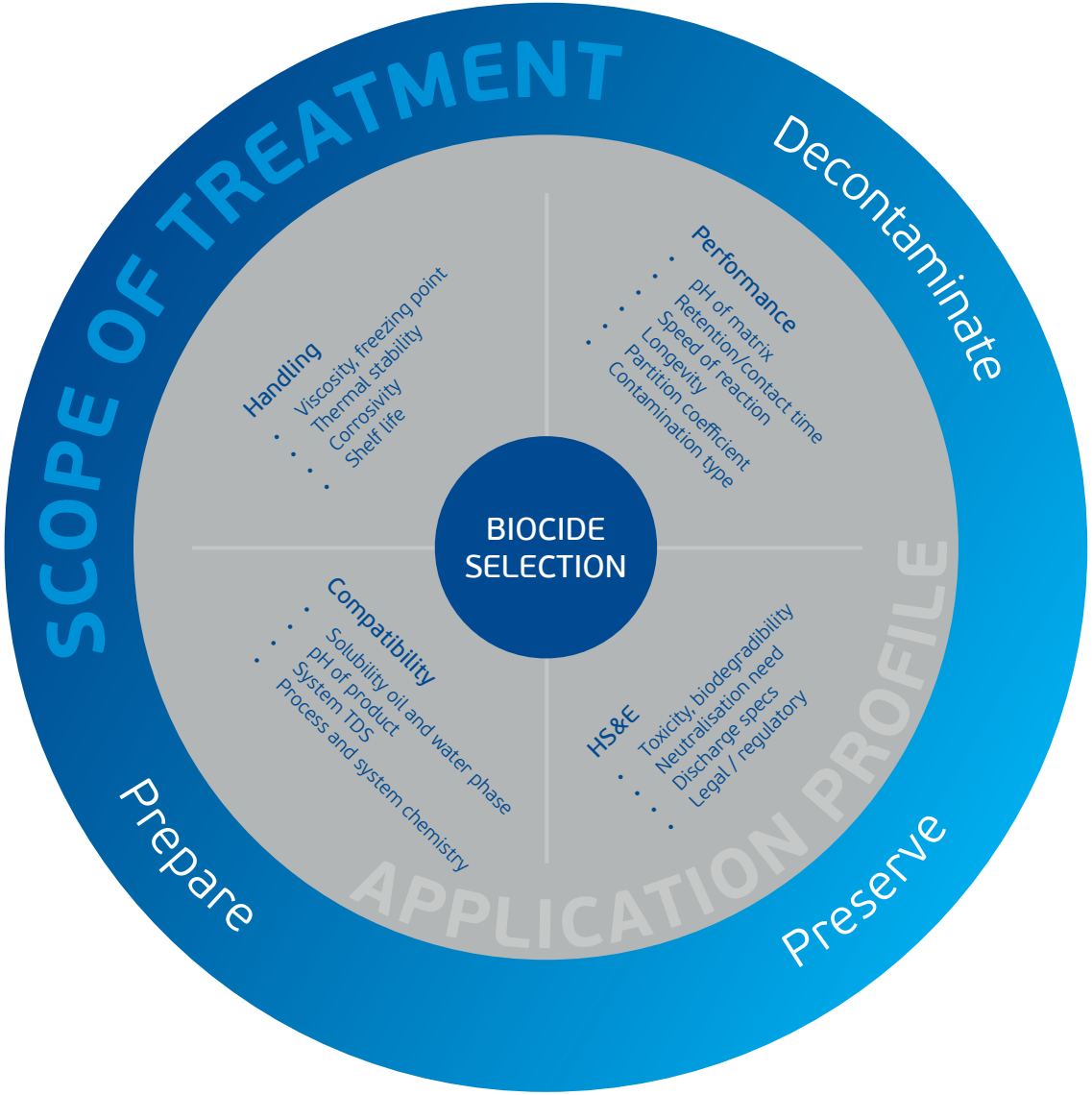
MIC control

If microorganisms attached to surface it allows to form biofilms that contribute to microbiologically corrosion (MIC). This will lead to corrosion failures of pipelines and pumps, with the related problems of equipment downtime, lost production and environmental hazards caused by spills or releases. In the production system, MIC events may be more common that in the injection system, as the separators may contain large quantities of both water and solid deposits.

Water flooding	Production Control
Water reinjection	Separation of production stream (oil, water, gas)
	Make-up water production
	Pigging operation
	Sand jetting operation

Selection of a Biocide

When selecting a biocide program for your application, it is important to consider the scope of treatment and the application profile.
Vink Chemicals can support at every step assessing the data, identifying the issues, and selecting the correct program for your operation



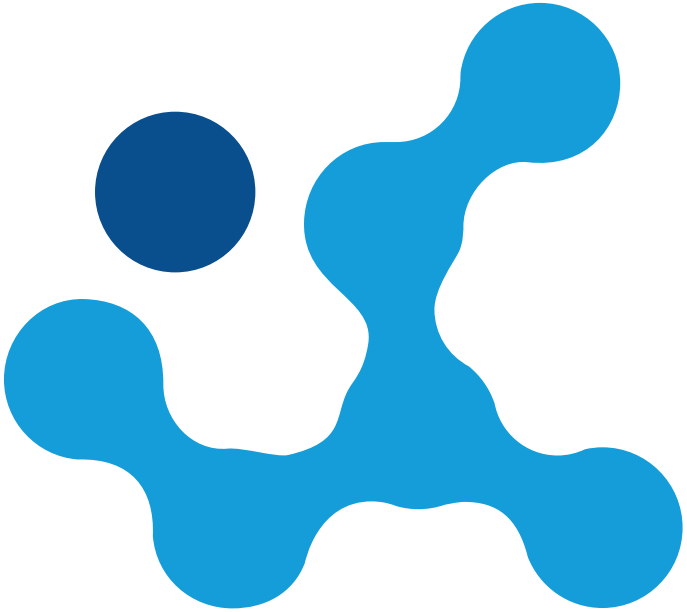
Vink Chemicals Products

Biocides for oilfield and fuel treatment

Product name	Actives	Purpose	Speed of Kill	Duration of Protection	Application Temp/°C	Application pH
Vinkocide DBNPA 20	DBNPA	Prepare	Quick	Short	Low	< 8
Vinkocide GA 20/50	Glutaraldehyde	Decontaminate	Quick	Medium	Medium	7 – 10
Vinkocide THPS	THPS	Decontaminate	Quick	Medium	Medium	< 10
Vinkocide BND 20	Bronopol	Decontaminate	Slow	Long	Low	< 8
Vinkocide BAC 50	Quat/ADBAC	Decontaminate	Medium	Medium	Low	< 10
grotan TK 5	EUF	Decontaminate/Protect	Medium	Long	High	4 – 12
grotan WS	HPT	Decontaminate/Protect	Medium	Long	Medium	5 – 12
Vinkocide PG 1.5	CMIT/MIT	Decontaminate/Protect	Quick	Long	Low	3 – 8.5
Vinkocide F	EDDM	Decontaminate/Protect	Medium	Long	Medium	3 – 9
Vinkocide BIT range	BIT	Decontaminate/Protect	Quick	Long	Medium	3 – 13
grotan OX	MBO	Decontaminate/Protect	Medium	Long	High	5 – 12
grotan TK 6	TMAD	Decontaminate/ Preserve	Slow	Long	Medium	3 - 11
grotamar 71	MBO	Decontaminate/Protect	Quick	Long	High	5-12
grotamar 82	MBO	Decontaminate/Protect	Quick	Long	High	5-12

MANUFACTURING

Vink Chemicals has modern storage facilities for hazardous goods and its own production plants for state-of-the-art manufacturing of biocidal products. At our production sites in Germany, we develop and formulate individual biocides in batch sizes of up to 20 tons per batch. Around 100 specialists worldwide are responsible for our production facilities, distribution, raw material purchasing, R&D and quality control.



A Team with Our Customers

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The products shown in our portfolio do not imply any biocidal product registration in any specifi c country.
Vink Chemicals or sales partners thereof will inform you about the regulatory status of each product upon your request.
Use biocides safely. Always read the label and product information before use.