

- GEH[®] – High-capacity adsorbents for water treatment 源于德国GEH公司的高性能水处理吸附材料

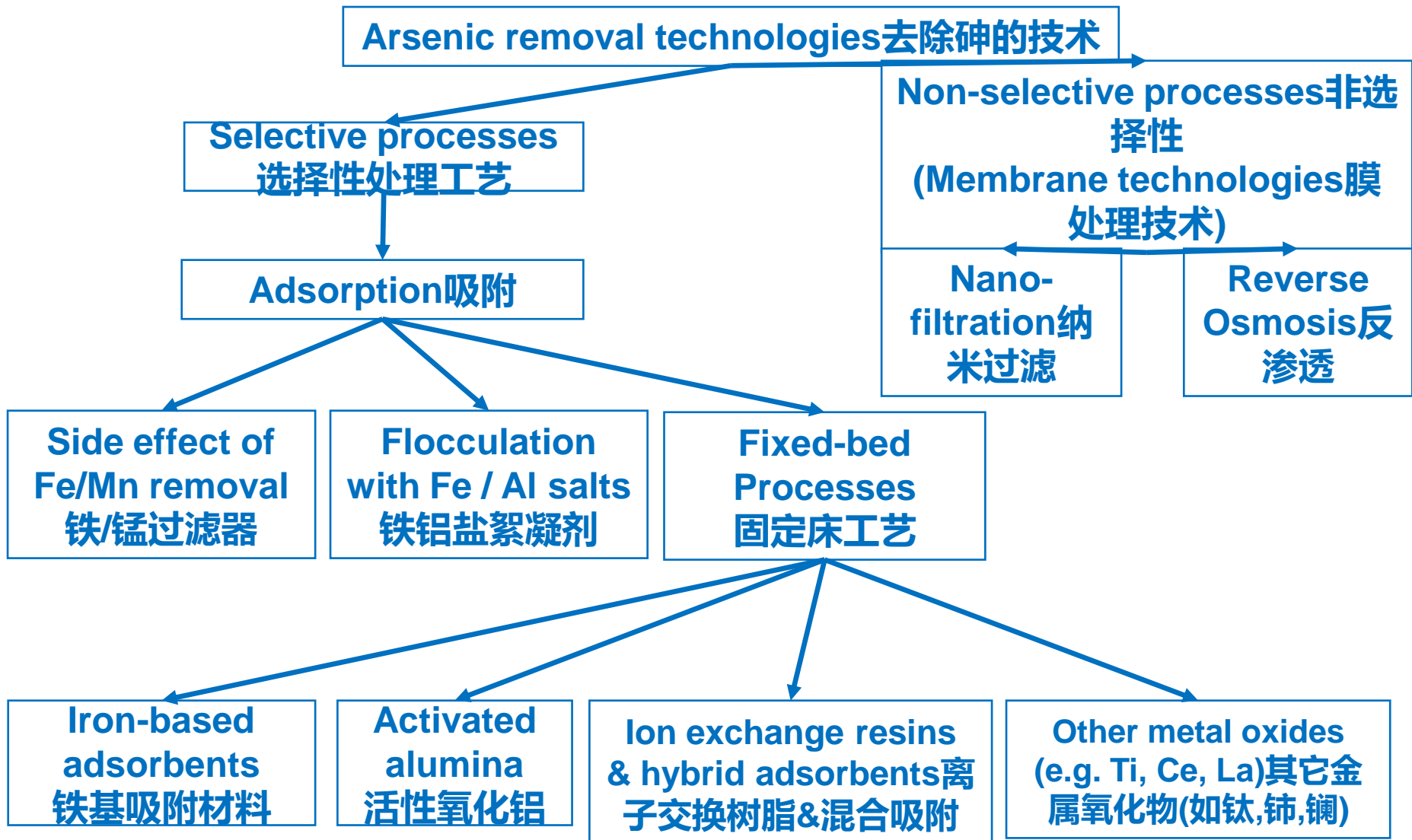


Comparison of Technologies and Competitive Products

技术差异化及竞争性产品分析

Arsenic Removal from Drinking Water: Overview

饮用水中除砷-概述



Membrane technologies (NF/RO) 膜处理(纳米及反渗透技术)

Description介绍

- Like other ions, arsenic is rejected by reverse osmosis membranes and partly by nanofiltration membranes.同其它离子一样, 砷对于反渗透不敏感, 因此这种工艺对于砷无法去除, 纳米膜过滤技术仅去除部分砷
- Removed arsenic is accumulated in the concentrated waste stream被去除的砷聚集在浓缩的水流当中



Copyright: <https://commons.wikimedia.org/wiki/File:Northcapecoral-RO.jpg>

✓ Pros优点

- ✓ Non-selective technology非选择性工艺
→ Removes also other contaminants也可去除其它污染物
- ✓ Proven technology技术成熟
- ✓ Modular in design模块化设计
(→ easily scalable) 可轻松量化

✗ Cons缺点

- ✗ Non-selective technology
→ will remove all constituents (deionized water)非选择性处理技术同时去除了所有成分(去离子水)
- ✗ Pre-treatment usually required通常需预先处理
- ✗ Concentrated waste stream导致沉淀浓缩水流
- ✗ High energy requirements高耗能
- ✗ High-tech process with high investment costs投资大
- ✗ Maintenance works require skilled personnel需配置熟练技术工维护

Side effect of Fe/Mn removal 铁锰过滤的副作用

Description介绍

- Reduced ground waters contain usually dissolved iron/manganese 日益减少的地下水通常含有铁/锰溶解物
- Fe/Mn is removed by oxidation and filtration 氧化及过滤去除了铁/锰
- Arsenic adsorbs on the Fe/Mn hydroxide floccs 砷被铁/锰氢氧化物絮凝物吸附
- Rule of thumb: 1 mg/L Fe is required for removal of 100 µg/L As 经验值: 去除100微克/升的砷需要1毫克/升的铁

✓ Pros优点

- ✓ Arsenic is simultaneously removed → No additional treatment is required 砷被同时去除 – 无须额外处理
- ✓ Removal of Fe/Mn is standard technology 此工艺基于标准技术

✗ Cons缺点

- ✗ Arsenic removal efficiency depends strongly on Fe/As ratio and on Fe removal efficiency 砷去除效率高度取决于铁/砷含量比例及铁的吸附效果
- ✗ It is not ensured that arsenic will be removed below the limit value 无法保证砷含量低于标准值
- ✗ Usually an additional polishing step is required 通常需要额外增加“研磨”步骤以达最佳效果



Copyright: Iron/ Manganese removal plant, Wikipedia, Petr Novák

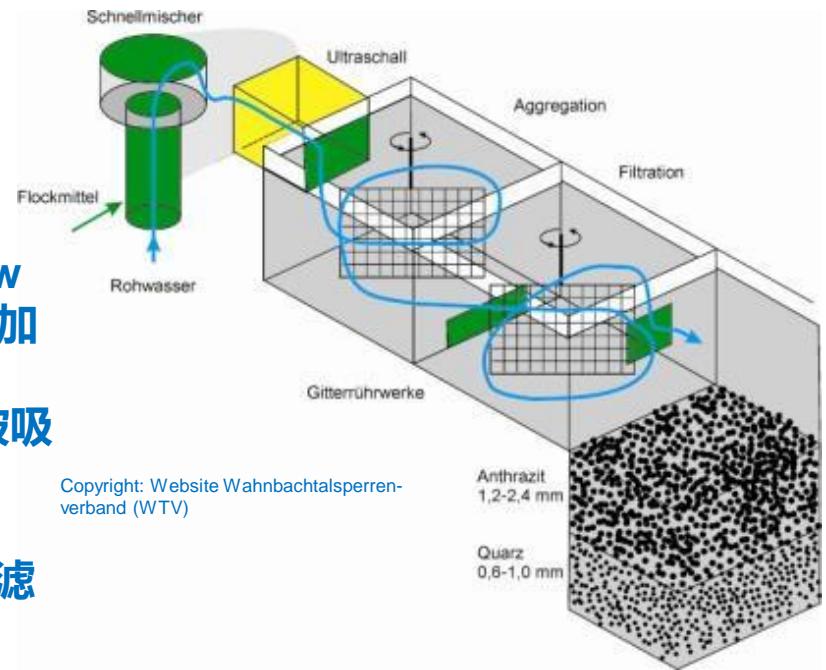
Flocculation with Fe / Al 铁铝盐絮凝剂

Description介绍

- Iron or aluminium salts are added into the raw water for flocculation/precipitation 铁或铝盐添加到原水用于絮凝/沉淀
- Arsenic adsorbs on the precipitated flocs 砷被吸附于沉淀絮凝物表面
- The flocs are removed from the water by sedimentation or filtration 絮凝物经由沉淀或过滤从水中去除

✓ Pros优点

- ✓ Proven standard technology for water treatment 技术相对成熟的水处理工艺
- ✓ Simultaneous removal of turbidity and some other constituents 同时去除混浊物及其它物质
- ✓ Relatively low costs for chemicals (FeCl₃) 成本相对低廉(氯化铁)



✗ Cons缺点

- ✗ Arsenic removal efficiency depends on Fe dosage 砷的去除效率效果取决于铁的添加量
- ✗ Post-treatment of arsenic-loaded sludge 含砷的污泥需要后处理
- ✗ High investment costs / footprint 投资大/占地面积大
- ✗ Relative complex technology requiring maintenance and skilled personnel 工艺相对复杂，因此需要专业技术工维护保养
- ✗ Not suitable for small plants 小公司不太适用

Adsorption with Granular Ferric Hydroxide

氢氧化铁颗粒吸附(即德国GEH产品)

Description介绍

- Arsenic is removed with a fixed-bed adsorber filled with ferric hydroxide in granular form 在固定床中添加氢氧化铁颗粒物过滤吸附，有效去除砷
- The adsorbent has to be replaced when it is exhausted 吸附产品耗尽后添加补充即可
- Product quality has to be in accordance with DIN EN 15029 产品质量符合DIN EN 15029标准



✓ Pros优点

- ✓ Very simple plant design and easy operation 设计人性化，操作简便
- ✓ High selectivity for arsenic, resulting in highest capacity 高度针对砷处理，可最大程度保证吸附量
- ✓ Low maintenance effort and high reliability 低维护成本，高可靠性
- ✓ Proven technology used in 2000+ plants worldwide 全球超过2000家工厂已在使用，技术成熟
- ✓ Solid waste can be easily disposed (→ e.g. no sludge dewatering) 固态废弃物很容易处理(污泥无须脱水浓缩)

✗ Cons缺点

- ✗ Media lifetime depends on the raw water composition (competitive adsorption) 氢氧化铁媒介物的寿命取决于原水的含量(改善性的吸附)
- ✗ Adsorbent needs regular replacement 吸附颗粒须定时更换

Adsorption with Activated Alumina 活性氧化铝吸附

Description介绍

- Arsenic is removed with a fixed-bed adsorber filled with aluminium oxide in granular form 在固定床中添加活性氧化铝颗粒进行砷的吸附
- The adsorbent has to be replaced or regenerated when it is exhausted 吸附剂须在失效时予以更换或者再生



Copyright: AXENS IFF Group Technologies

✓ Pros优点

- ✓ Simple plant design and easy operation 设计人性化，操作简便
- ✓ Relatively low price 成本相对较低廉

✗ Cons缺点

- ✗ Media lifetime depends on the raw water composition (competitive adsorption) 媒介物的寿命取决于原水的含量(改善性的吸附)
- ✗ Adsorbent needs regular replacement 吸附剂须定期更换
- ✗ Less adsorption capacity compared to iron-based adsorbents 与铁基吸附材料比性能较差
- ✗ Not recognized in practice anymore 适用认可度不再
- ✗ Capacity is very pH dependent 吸附量非常取决于水的酸碱度PH值
- ✗ Problem of Al-leaching at higher pH 在水PH值偏高时会发生铝浸出

Anion Exchange Resins (IEX) 离子交换树脂



Copyright: https://commons.wikimedia.org/wiki/File:Ion_exchange_resin_beads.jpg

Description 介绍

- Synthetic resins remove arsenate and other ions from water by ion exchange process 合成树脂通过离子交换工艺去除水中的砷及其它离子
- IEX resin has to be regenerated when it is exhausted 树脂失效后须重新再生
- Hybrid IEX resins (coated with Fe-hydroxides) 混合离子交换树脂(表面涂层为氢氧化铁)

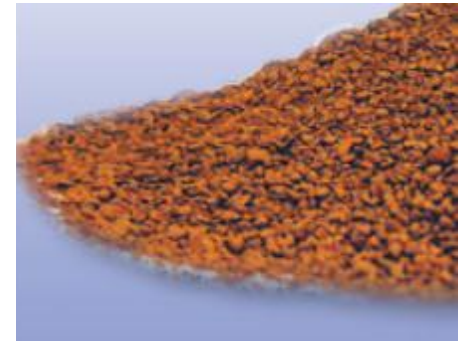
✓ Pros 优点

- ✓ IEX removes also other ions from the water 树脂也会去除水里其它离子
- ✓ Resins can be regenerated 树脂可以再生利用
- ✓ Good hydraulic properties (→ uniform bead size) 水力性能好 – 树脂颗粒规格统一
- ✓ High reaction kinetics 高反应动力

✗ Cons 缺点

- ✗ Low selectivity for arsenic; 对于砷处理针对性较低 capacity is affected by sulfate etc. 吸附量受硫酸盐等影响
- ✗ No removal of As(III) 无法去除三价砷
- ✗ Due to short lifetime, IEX must be regenerated regularly 由于树脂使用寿命偏短, 须频繁再生
- ✗ Regeneration requires chemicals and post treatment of arsenic-rich brines 树脂再生需要添加化学药剂及含砷盐水的后处理
- ✗ Not recognized in practice 现实使用接受度低
- ✗ High material costs 材料成本高

Other Adsorbents 其它吸附材料



Copyright: EP Minerals

Description 介绍

- Various metal oxides or other synthetic chemicals are used as arsenic adsorbents (e.g. titanium dioxide, lanthanum oxide, zirconium oxides,...)
- The adsorbent has to be replaced when it is exhausted

✓ Pros 优点

- ✓ New materials show in laboratory test sometimes good removal capacities 实验室显示新材料可能有时具备很好吸附能力

✗ Cons 缺点

- ✗ Media lifetime depends on the raw water composition (competitive adsorption) 媒介物的寿命取决于原水的含量(改善性的吸附)
- ✗ Laboratory results usually could not be confirmed in practice 实验室结果通常在实际使用中无法获得确认证实
- ✗ Limited practical experience with the new materials (limited references) 实战经验有限
- ✗ Very high prices for high-tech products or low price for low quality products (e.g. recycled material) showing weak capacity 高科技产品成本非常高昂, 低质量产品价格非常低廉, 如再生材料利用, 效果参差不齐
- ✗ Applied metal might be problematic for drinking water purposes (→ Leaching) 应用材料可能对于饮用水的潜在问题及影响如离子浸出

Competitive products 竞争产品分析

■ **High-quality products 高质产品**
for drinking water
Treatment 饮用水应用

VS.

■ **Low-quality products 低质产品**
for other applications: 其它用途

- (Industrial) waste water treatment 工业废水
- Groundwater remediation 地下水

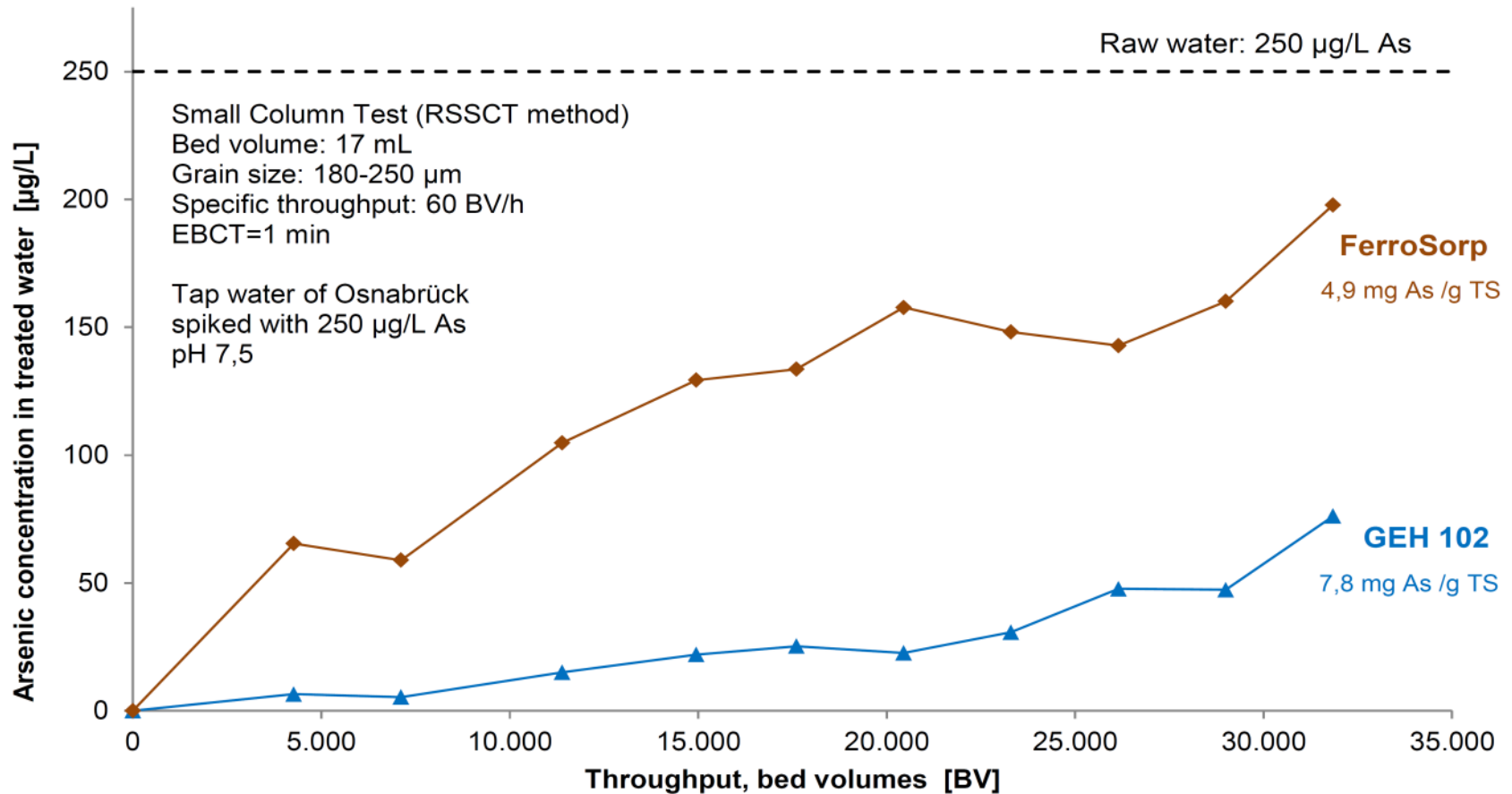
Parameter	Units	EN DIN 15029 specs, Tab A.1, MAX	GEH Wasserchemie	Hego Biotec
			GEH 102	FerroSorp Plus
Dry solids	%	-	57,3	84,3
Iron, Fe	g/kg	-	605	291
Arsenic, As	mg/kg	20	< 1	69
Lead, Pb	mg/kg	40	< 1	<1
Cadmium, Cd	mg/kg	5	< 0,05	0,35
Chromium, Cr	mg/kg	250	36	3
Copper, Cu	mg/kg	100	10	1
Manganese, Mn	mg/kg	3.000	1.224	13.300
Nickel, Ni	mg/kg	250	43	54
Zinc, Zn	mg/kg	250	21	55
Phosphate, PO4	mg/kg	-	<60	7.982

much lower iron content

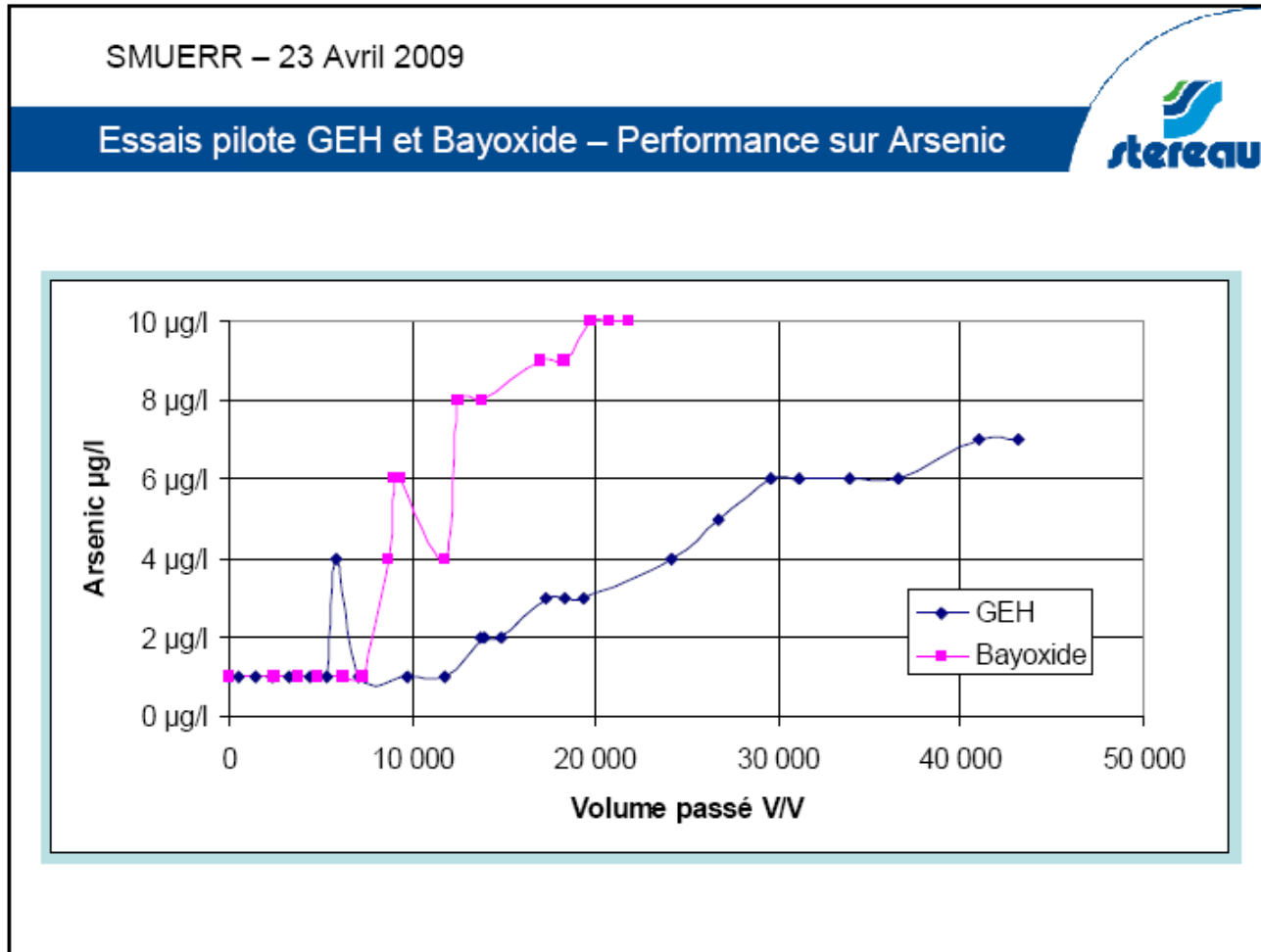
„preloading“

Metal contents expressed relative to dry solids content

Comparison: GEH vs. FerroSorp 效果对比GEH:德国FerroSorp



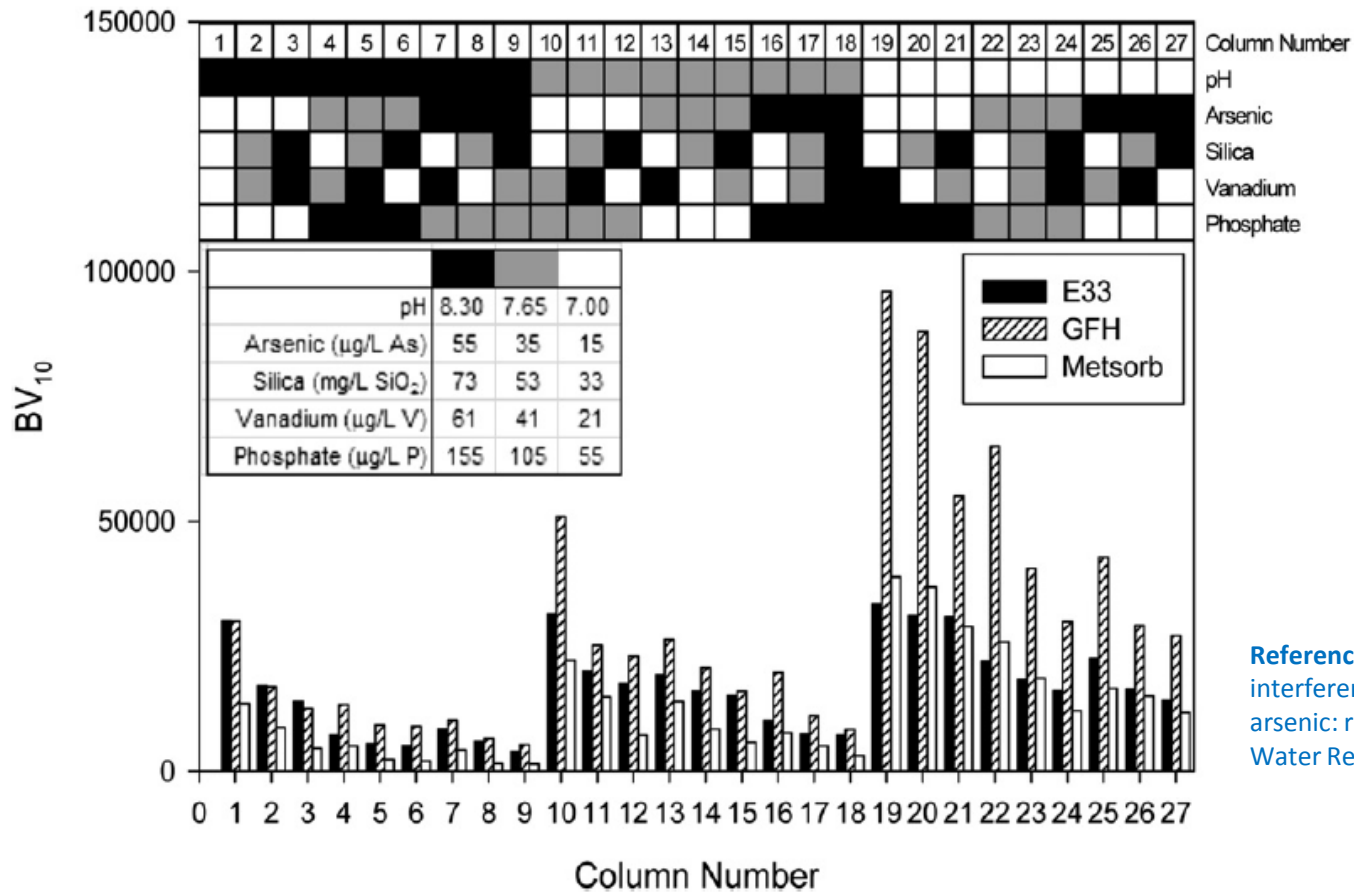
Comparison between GEH and Bayoxide E33 同类产品效果对比GEH:拜耳E33





Competitive products 竞争产品分析

Comparison between GEH and Bayoxide E33 产品效果对比GEH : 拜耳E33

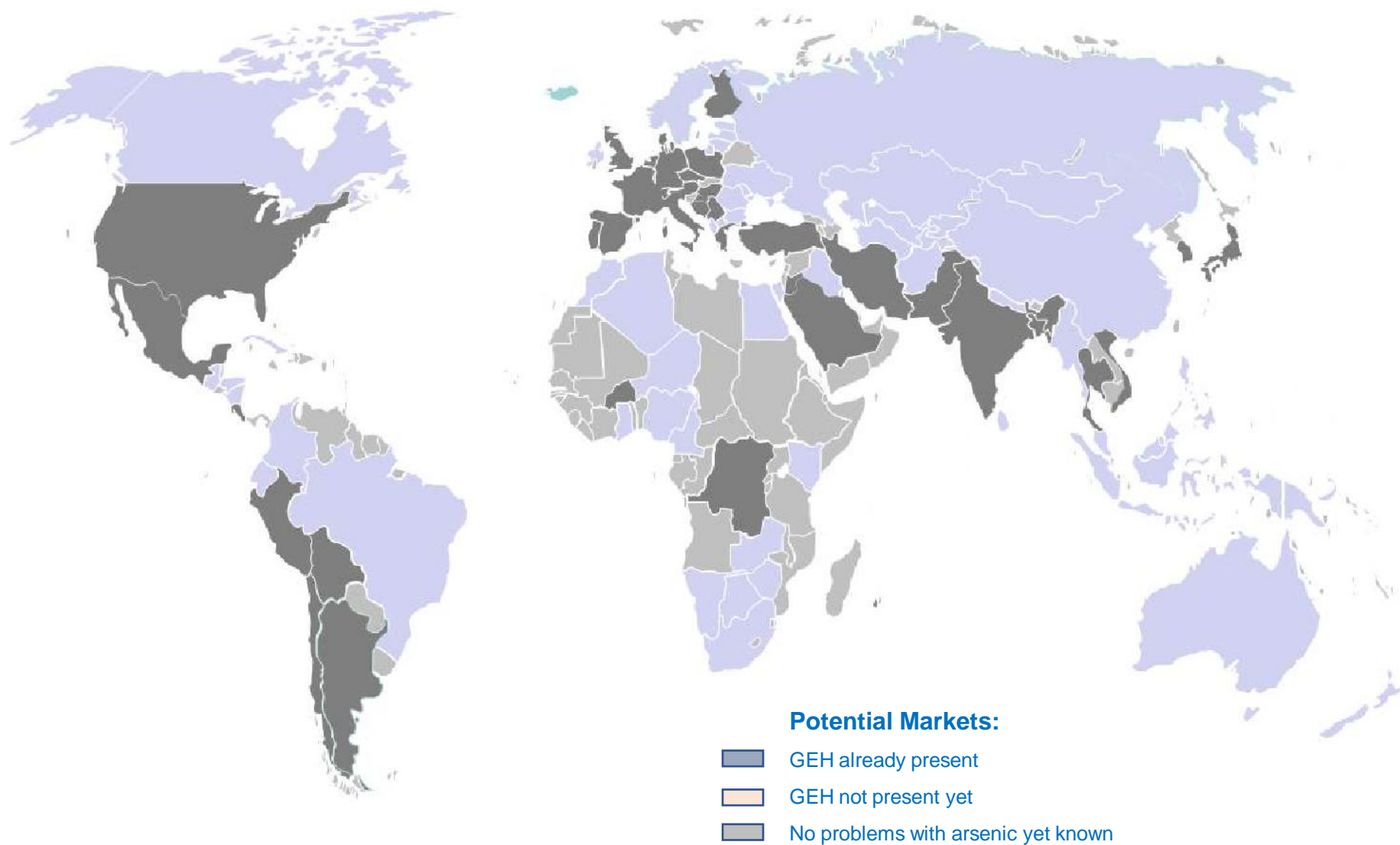


Reference: Nguyen et al (2011). "Effect of interferences on the breakthrough of arsenic: rapid small scale column tests." Water Res 45(14): 4069-4080.

Fig. 3 – BV treated until arsenic breakthrough at 10 µg/L (BV₁₀).

Worldwide in use 世界范围内广泛应用

GEH
wasserchemie



Source of Solutions.



■ Contact us! 现在就联系我们吧

GEH Wasserchemie GmbH & Co. KG

Adolf-Köhne-Straße 4 | 49090 Osnabrück

**Managing Directors
德国管理层**

Dipl.-Ing. Wilhelm Depping

Dr. Heinz Fischer

Dipl.-Ing. Ulrich Mentrup

Contact

Dipl.-Ing. Ulrich Mentrup (Sales Director)
Dr.-Ing. Carsten Bahr (Head of R&D, QMR)
M.Sc. Simon Kellmann (Business Develop. Manager)

Phone

+49 - 541 - 122009

e-Mail

info@geh-wasserchemie.de

中国区销售代表处

吉林省一起环保科技有限公司
负责人：李臻 电话:18239962987 (微信同号)
Email: sqfantasy@sina.com