

## Characteristics of installed MPPE units Produced / Process / Wastewater (1)

Unit	Flow rate m <sup>3</sup> /hr (1)	Composition	Influent concentration mg/l (ppm)	Effluent concentration mg/l (ppm)
<b>The Netherlands</b>				
Vermilion (Total) (Harlingen) (3)	4-6	Al, Ar esp. benzene	2000-3000	< 0.5
Allied Signal, Weert	0.2	CFHC, CHC	5	< 0.010
Akzo Nobel Industrial Fibers, Arnhem	25	Solvesso	400	< 0.050
LBC Rotterdam bv; Groupe Fimalac	15/0.1	CHC, Ar	5/2000	≤ 0.1
Shell/Exxon (NAM B.V.), Offshore Gas Produced water, k15A	3-5	Al, Ar, PAH	800-1000	> 90% removal
Shell/Exxon (NAM B.V.), Offshore Gas Produced water k15B	3-5	Al, Ar, PAH	800-1000	> 90% removal
Total F15A E&P, Offshore Gas Produced water	3	Al, Ar, PAH	600-700	> 90% removal
<b>Germany</b>				
Philips Bildröhrenfabrik, Aachen	5	Ar	500	< 0.05
<b>France</b>				
Gaz de France	3	THT	75	< 0.5
Synthexim Calais (3) (4)	6	Ar, CHC, COD	1400 – 11000	> 99.9% removal
<b>Norway</b>				
StatoilHydro/Shell, Ormen Lange Offshore Gas Produced water	68	Al, Ar, PAH	50 - hundreds	>99% removal
StatoilHydro Kollsnes Offshore Gas PW	20	Al, Ar, PAH	240	>99% removal
Offshore Atlantic StatoilHydro Åsgard Å (2)	3	Ar, PAH	70-80	> 98% removal
Offshore Atlantic StatoilHydro Troll B (oil) (2)	9	Al, Ar, PAH	15-25	95-99% removal
<b>United States of America</b>				
Akzo Nobel Resins, Louisville	3	Ar	150	< 0.05
Akzo Nobel Resins, East St. Louis	3	Ar	150	< 0.05
Northeast Chemical Manufacturer	16	CHC	225	< 0.2
Total Fina Elf, Houston	3	Ar	150	< 0.05
Total Fina Elf, Milwaukee	3	Ar	150	< 0.05
Midwestern Chemical Manufacturer	10	Ar, CHC	300	< 0.03
Albemarle Tyrone	6	Ar, CHC	800	< 1
<b>Rest of World</b>				
Offshore South China Sea (2)	3	Al, Ar	200-500	> 99% removal
Woodside Pluto Australia, LNG Terminal	40	Al, Ar, PAH	Hundreds	> 99% removal

(1) 1m<sup>3</sup>/hr = 4.4 gpm  
(2) Long duration test

(3) Combined groundwater and process water  
(4) Combined with biotreatment  
(5) Surfactant Enhanced Aquifer Remediation of DNAPL (SEAR)  
(6) GROs = Gasoline Range Organics (C7 – C10)  
(7) DROs = Diesel Range Organics (C11 – C27)

Abbreviations:

CHC= Chlorinated Hydrocarbons  
Al = Aliphatics  
CFHC= Chlorinated Fluorated HC's  
THT = Tetrahydrothiophene  
  
Ar = Aromatics (BTEX)  
PAH = Poly Aromatic Hydrocarbons  
DNAPL = Dense Non Aqueous Phase Liquids

*For more information about the MPPE Technology please contact:*  
**VWS MPP Systems B.V.** For North and South America  
 Tel +31 318 66 4010 Whittier Filtration Inc.  
 The Netherlands Tel. +1 714 986 5300  
 USA  
 Email: MPPSystems@Veoliawater.com Email:whittier.filtration@veoliawater.com

[www.VWSMPPSystems.com](http://www.VWSMPPSystems.com)

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## Characteristics of installed MPPE units Groundwater (2)

Unit	Flow rate m <sup>3</sup> /hr (1)	Composition	Influent concentration mg/l (ppm)	Effluent concentration mg/l (ppm)
<b>The Netherlands</b>				
Vermilion (Total) (Harlingen) (3)	4-6	Al, Ar esp. benzene	2000-3000	< 0.5
LBC Rotterdam bv; DBOFM (3)	15/0.1	CHC	5/2000	≤ 0.1
Schering Plough, Oss	40	Al, Ar, CHC	600	<1
Solvay Pharmaceuticals, Amsterdam	25	CHC	100	< 0.01
<b>Germany</b>				
Zürich Insurances, Site Akzo Nobel Chemicals, Mannheim	18	CHC, (vinyl chloride)	5	< 0.006
Stadtwerke Flensburg GmbH, Flensburg	6	Ar (BTEX) PAH	14	< 0.01
Chemical Manufacturer Ruhr area DBOM(3)	120	CHC, Ar	0.6	< 0.01
Chemical Manufacturer Cologne area	50	CHC	13.8	< 0.1
AlSCO, Castrop Rauxel (5)	5-15	DNAPL, CHC	Hundreds	> 99% removal
LMBV HB 21n, Schwarze Pumpe	6	Ar, PAHs	50 –150	> 95% removal
LMBV HB 23n, Schwarze Pumpe	10	Ar, PAHs	50 –150	> 95% removal
LMBV HB 27n, Schwarze Pumpe	20	Ar, PAHs	50 –150	> 95% removal
LMBV HB 72n, Schwarze Pumpe	20	Ar, PAHs	50 –150	> 95% removal
LMBV HB 96n, Schwarze Pumpe	20	Ar, PAHs	50 –150	> 95% removal
LMBV Lauchhammer Kokerei (2)	3	Ar, PAHs	140	> 99,9% removal
LMBV Lauchhammer Tanklager (2)	5	Ar, PAHs	50	> 99,9% removal
Oil & Gas Company Dortmund (2)	5	MTBE, BTEX	15	> 99% removal
<b>Italy</b>				
Agip Livorno (2)	5	BTEX, MTBE, GROs(6), DROs (7)	8-10	> 99% removal
<b>France</b>				
Synthexim Calais (3) (4)	6	Ar, CHC, COD (4)	1400 – 11000	> 99.9% removal
Water Service Company (2)	2	CHC, BTEX	700	< 0.5
<b>United States of America</b>				
Akzo Nobel Chemicals LeMoyne (pilot) Alabama (2)	5 – 10	CS <sub>2</sub> , CHC	30	< 0.2
Akzo Nobel Coating, Lenoir, North Carolina	1	Ar	100	< 0.005
<b>Rest of World</b>				
Libya Brega (3)	20	Gasoline, Diesel	1000	> 99% removal

(1) 1 m<sup>3</sup>/hr = 4.4 gpm

(2) Long duration Field test

(3) Groundwater combined with waste water and/or process water

(4) Combined with biotreatment

(5) Surfactant Enhanced Aquifer Remediation of DNAPL (SEAR)

(6) GROs = Gasoline Range Organics (C7 – C10)

(7) DROs = Diesel Range Organics (C11 – C27)

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PAH = Poly Aromatic Hydrocarbons

DNAPL = Dense Non Aqueous Phase Liquids

DBOFM = Design Build Own Finance Maintain

DBOM = Design Build Operate Maintain

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For more information about the MPPE Technology please contact:

VWS MPP Systems B.V.

Tel +31 318 66 4010

The Netherlands

Email: MPPSystems@Veoliawater.com

For North and South America

Whittier Filtration Inc.

Tel. +1 714 986 5300

USA

Email: whittier.filtration@veoliawater.com

**www.VWSMPPSystems.com**