

# Comparison of the environmental impact of an Elix® 3 water purification system with a distillation apparatus



## Purpose of the study

Merck Millipore's commitment is that its operations will become environmentally sustainable in the long-term by dramatically reducing the consumption of non-renewable resources, reducing waste and adopting company wide behavioral changes that support sustainability. In-line with this commitment, Merck Millipore Lab Water has developed and adopted water purification technologies that reduce energy and water consumption in comparison with methods such as distillation.

The study presented here compares the environmental effects of an Elix® 3 (Merck Millipore) water purification system and a distillation system, operated in the Europe. A brief financial analysis also highlights the saving resulting from the reduced water and energy consumption of the Elix®.

## Background information

### Elix® 3 water purification system

The Elix® 3 water purification system combines reverse osmosis, electrodeionization and UV 254 nm to deliver 3 L per hour of purified water (resistivity > 10 Mohm.cm, Total organic carbon < 30 ppb) from tap feed water.

A pretreatment cartridge (Progard® S2) is used upstream the system to remove chlorine and chloramines present in the feed water, as well as to remove large particles and reduce the hardness of the water.



## Water purification systems information

	Elix® 3	Still
Capacity	3 L/hr	3 L/hr
Volume of feed water needed to produce 3 L of purified water per hour	15 L	26.6 L
Energy consumption to produce 1 L of purified water	0.160 kWh	1.65 kWh
Energy consumption in stand-by mode	0.045 kWh	Not applicable
Consumables	2 x Progard S2 packs	Not applicable

\* A Barnstead Mega-Pure® MP-3A 3 was selected for the study.

## Environmental impact of one consumable Progard S2 (production and distribution phases)

	Production	Distribution	Total
Global warming potential (GWP)	5.9 kg CO <sub>2</sub> eq	10.6 kg CO <sub>2</sub> eq	16.5 kg CO <sub>2</sub> eq
Energy necessary	39.6 kWh	46.3 kWh	85.8 kWh
Water required	107.8 L	28 L	135.8 L

Values obtained through life cycle assessment using SimaPro 7.0 (Source of data: EcolInvent, Method Impact 2002+).

## Calculation

### Scope of the study

A production of 20 L of purified water per day was considered for both purification systems. Therefore, the duration of production for both systems is 6.7 hours per day. The Elix® purification unit remains in stand-by mode for 17.3 hr per day. Utilization of the systems was considered for 20 days per month and 12 months per year.

Over this one year period, two consumables (Progard S2) are necessary for the Elix® 3. The energy, water consumption and GWP of the manufacturing and the distribution of the Progard were accounted for in the calculations.

The phase of product usage only was considered in the study.



### Summary calculations

Energy	Unit	Elix®	Still
Energy consumption to produce 3 L of purified water	kWh	0.16	1.65
Energy consumption per day to produce 20 L water	kWh	1.07	10.89
Energy consumption during stand-by mode per day	kWh	0.78	Not applicable
Energy consumption per day	kWh	1.85	10.89
Energy consumption of the purification unit per year	kWh	444	2614
Energy consumption per year, including consumables	kWh	617	2614

Water	Unit	Elix®	Still
Water consumed to produce 3 L of purified water	L	15	26.6
Water consumed per day ( 20 L purified water produced)	L	100	178
Water consumed per year	L	24000	44880
Total water consumption, including consumables	L	24270	44880

Global Warming Potential *	Unit	Elix®	Still
GWP per day	Kg CO <sub>2</sub> eq	0.69	3.93
GWP per year due to system operation	Kg CO <sub>2</sub> eq	100	944
GWP per year, including consumables	Kg CO <sub>2</sub> eq	199	944

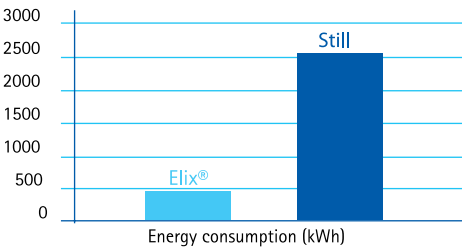
\* GWP calculated using the following conversion factors: 0.356 kg CO<sub>2</sub> eq per kWh energy produced in the Europe (Ecolinvent 2, data March 2010), and 0.317 kg CO<sub>2</sub> eq per m<sup>3</sup> water used.



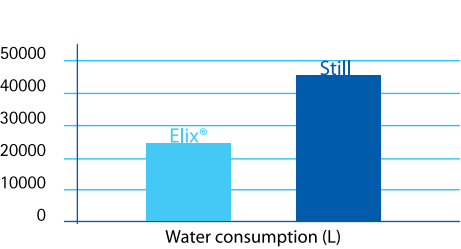
Results of the energy consumption, water consumption and GWP over one year of product usage

Over one year of usage, the Elix® purification unit is significantly more sustainable than a still. All three parameters of energy, water consumption and global warming effect are much decreased for the Elix®.

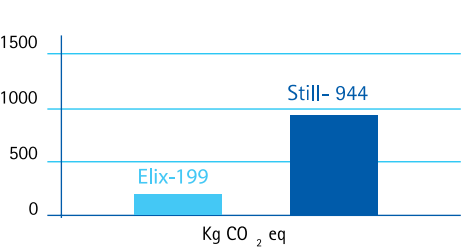
Energy consumption over a one year period of utilization



Water consumption over a one year period of utilization



Global Warming Potential over a one year period of utilization



Financial assessment

In order to assess the benefits of reduced water and energy consumptions, the costs of energy and water per year of operation were calculated for both purification solutions.

	Elix®	Still	Saving
Cost of water per year – 3.25€ per m³ water, average Europe	130€	231€	101€
Cost of energy per year – 0.178€ per kWh	79€	465€	386€

