Life Cycle Environmental Assessment Progard® Cartridge

Self-Declared Environmental Claim, According to ISO 14021: 1999

Purpose of the Study

EMD 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, EMD Millipore Lab Water has set up the ech$_2$o™ Collection & Recycling Program for water purification cartridges, in order to reduce the environmental impacts related to the disposal of the cartridges and to reclaim the material for future uses.

The program, which was developed in partnership with Heritage Environmental Services, offers EMD Millipore customers a truly traceable and certified collection and recycling solution. A web-based process makes it easy for customers to return cartridges, and the program has been adapted for small- and large-volume users.

To substantiate this program, the environtal impact of two end-of-life scenarios was evaluated. The results of the comparative cradle-to-grave study conducted on the Progard® water purification cartridge are presented here. The Progard cartridge is a pretreatment cartridge that is a major selling reference for EMD Millipore Lab Water. It is distributed worldwide, similarly to other types of cartridges, and is considered to be representative of the pretreatment cartridges in the EMD Millipore product portfolio.

EMD Millipore is a division of Merck KGaA, Darmstadt, Germany

Life Cycle Environmental Assessment

The goal of this study is to assess the environmental benefits of a collection and recycling program applied to water purification cartridges in the U.S.

The environmental assessment performed is a multi-stage, multi-component and multi-criteria LCA, conducted in accordance with the ISO® 14040 and ISO 14044 standards.

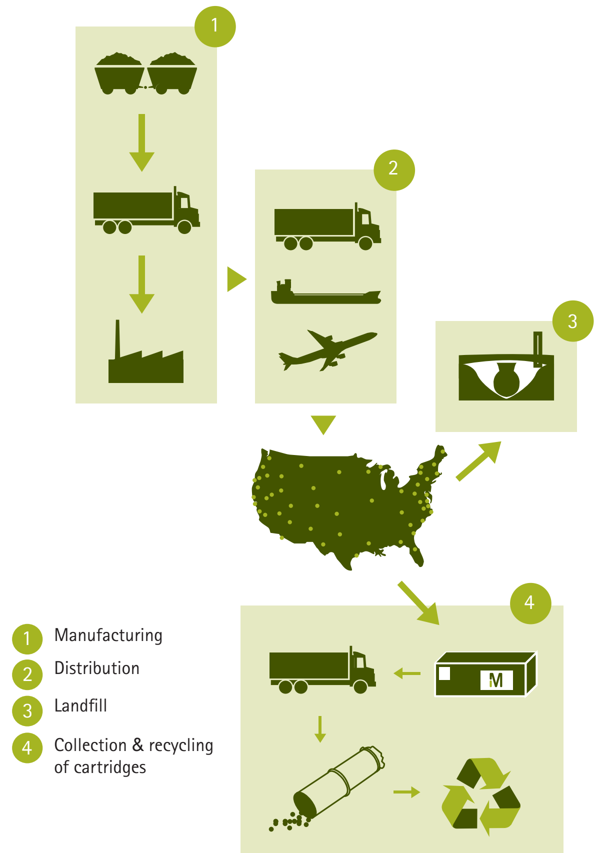
The functional unit was defined as one cartridge:
The purpose of the Progard cartridge is to contribute to the water purification when it is used in an EMD Millipore water purification system. It is typically used over a 5-month period and allows delivery of Type II grade water (resistivity > 5 MΩ.cm, total organic carbon < 30 µg/L) when it is utilized in an Elix® water purification unit.

All the methods selected were CML 2001 and IPCC 2007. Data on transportation, materials and processes were collected directly at the suppliers or sourced from the EcoInvent database.

The steps of the product life cycle were considered (cradle-to-grave), except for the step of usage. The cartridge indeed is always used as a consumable in a water purification system and the water and energy consumptions are associated with the purification unit, and not with the consumable itself.

The transportation from the manufacturing site to the point of use in the United States was established according to the known paths and splits between air, sea, and road transportation.

Cartridge Life Cycle



End-of-Life Scenarios

The following end-of-life scenarios have been considered for the environmental assessment.

1- Landfill for all components (Step 3)
Disposal of cartridge in local municipal landfill.
Corrugated packaging is recycled at the national average rate of 77%.

2- Collection and recycling (Step 4)
- Collection
Assumed average shipping distance of 1400 km by truck and 100 km by delivery van.
Transportation of reclaimed materials to the recycler or end-user is excluded.

Product Description

The following components of the cartridge have been retained for the study. The cumulative weight (1.94 kg) accounts for more than 95% of the cartridge and its packaging. The components include the:

- Cardboard box used to ship the cartridge from the manufacturing site to the point of use and to ship back the cartridge to the dismantling center
- Label
- PVC caps
- Extruded polypropylene housing
- Polyethylene separators
- EPDM O-ring
- Coconut shell-derived activated carbon
- Polypropylene filter
- Polyphosphate crystals
- PE plastic bag used for the collection to the recycling center

Boundaries and Assumptions

Material Production

- Production of coconuts (for activated carbon) was modeled using the production of palm nuts as a surrogate.
- Burdens associated with coconut production were allocated to the coconut shell on the basis of economic value. The shell was assumed to account for 2.5% of the economic value of the coconut based on analysis by Smith et al. (2009).
- Methane released during the carbonization of coconut shells was assumed to be flared and was therefore modeled as biogenic carbon dioxide.

Manufacturing

- Cutting of the extruded tubes for Progard cartridges results in 2% scrap that is recycled (open loop).
- One third of the manufacturing facility's annual energy and water use was allocated to the assembly of the cartridges. The assembly energy and water use was allocated based on the annual production volume of cartridges.
- Transportation from suppliers has been taken into account for all components whose weight is > 10% of the overall weight of the cartridge and its package. Therefore transportation of caps, labels and O-rings was not considered. Packaging used for the transportation of the raw material to the manufacturing site was not taken into account. Employees were not considered.

End-of-Life

Product components that are not recycled are assumed to be incinerated with energy recovery.
Waste generated during recycling process is assumed to be landfilled.

Recycling

Corrugated packaging is recycled at the national average rate of 77%.
Recycling channels are in place for the polypropylene components of the cartridge.
It was decided to split equally the benefits of the recycling between the producer of the cartridge and the user of further potential material generated from the cartridge. Therefore the benefits of the recycling were accounted for at a 50% level.

Results

Global warming potential	-3%
Non-renewable resources	-7%
Air acidification	0%
Eutrophication	-11%
Non-renewable energy	-8%
Product and packaging solid waste	-42%

Environmental impact benefits of the collection and recycling scenario versus landfill for the overall life cycle of a Progard cartridge.

Results based on several indicators of flux and environmental impact highlight the specific benefits of the recycling program: reduction of product and packaging solid waste (> 40%) and eutrophication (> 10%). To a lesser extent, non-renewable energy and abiotic depletion (7-8%) are also reduced.

Results of life cycle assessment for six impact categories

Impact category	Unit	PROGARD Recycling Scenario	PROGARD Landfill Scenario
Global warming potential	kg CO_2 eq.	12.9	13.1
Non-renewable resources depletion (Abiotic depletion)	10^{-2} kg Sb eq.	10.0	10.8
Air acidification	10^{-2} kg SO_2 eq.	7.0	7.0
Eutrophication	10^{-2} kg PO_4^{-3} eq.	2.9	3.3
Product and packaging solid waste	kg	1.0	1.7
Non-renewable energy	MJ eq.	219.5	238.1

Conclusion

- This recycling program is overall beneficial in terms of environmental impacts. The reduction of landfill space and the avoidance of material production offset the mailback transportation to a central location for dismantling.

- The benefits will improve with recycling of additional component material.

- EMD Millipore is committed to the ech$_2$o program and the development of other product stewardship initiatives but ultimately success will depend on the participation of the customers.

The Life Cycle Assessment was conducted by Pure Strategies, Inc., MA, USA.

For more information, please visit www.millipore.com/ech2o

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