



PAUL – Introduction, function & feedback

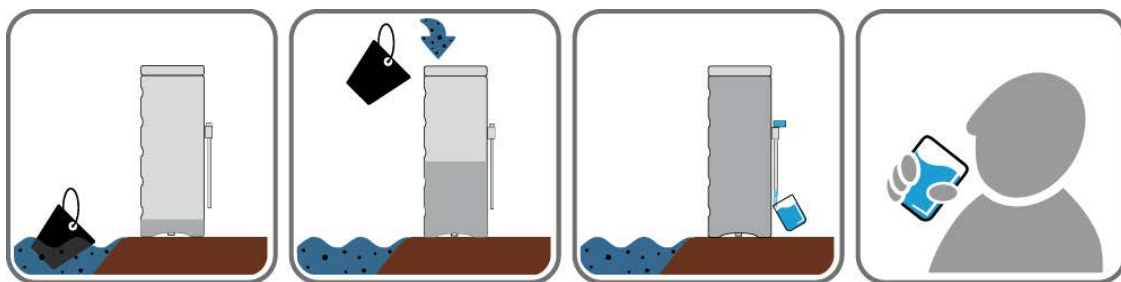
as of 01.05.2015

PAUL – a short introduction

The WaterBackpack „PAUL“, developed by the Department of Sanitary and Environmental Engineering of the University of Kassel, provides safe water from unsafe raw water sources by removing bacteria, pathogens, viruses etc. PAUL is used for **decentralised water supply** in rural areas, small **villages, schools, hospitals** etc. as well as in emergencies and disasters. PAUL is a unique new tool in decentralised water supply with the following main features:

- ✓ PAUL delivers **1,200 Liter water per day** (up to **6,000 L/d** depending on circumstances)
- ✓ excellent water quality: **bacteria** and **viruses** are removed by **99.99%** (avg.) up to **99.99999%**; certified by UBA, Federal Environmental agency, Germany
- ✓ no **energy**
- ✓ no **chemicals**
- ✓ no skilled **personnel** needed
- ✓ operation manual comprises of four pictograms, thus PAUL can be used even by **illiterates**,
- ✓ absolutely **robust**, no moving parts, **lifetime 10+ years**
- ✓ no **maintenance** in emergencies & disasters, **minimum maintenance** in permanent use over many year
- ✓ **portable** by one person on the back

The complete “operation manual” is seen here:



PAUL serves 2 tasks:

- PAUL is a **new & perfect tool** in **emergencies and disasters** (that's what he originally was developed for), see the WHO guidelines on drinking water quality (2011), chapter 6.7 and the Sphere-Standards (2011), chapter 3, standard 1
- PAUL, due to its **long 10-year-lifetime**, is a quick, cheap and easy solution for **decentralised water supply** in rural areas, small **villages, schools, hospitals** etc. on a **permanent use basis**.



PAUL consist of a pre-sieve and an **Ultra Low Pressure UltraFiltration (ULPUF)** with an organic PES membrane, weighs 23 kg and measures 38 by 38 by 106 cm, thus six or twelve units fit on one Euro-Palette. Although lightweight, PAUL delivers more than 1,200 Litre of potable water (1.2 tons) per day which is sufficient for 400 people to survive in an emergency situation, and with more than 1,450 units in use worldwide, more than **500,000 people** benefit from more than **1.75 million Litre of water filtered per day**.

Make sure to see the last page for distribution of PAUL and links to videos etc.

PAUL as well as the overfilling prevention valve (OPV), allowing fully automated operation, which is described below, are wholly manufactured in the Kassel **handicapped workshop** employing 300+ handicapped people.

So far, more than **1,450 PAUL** are in use in more than **50 countries** from Afghanistan to Zimbabwe – water for **half a million people in disaster conditions**, see last page...

Most recent, April/May 2015 some 60 PAUL are on their way to **NEPAL** – water for **20,000+ people!**

The logos of some organisations that brought PAUL into use are shown below.



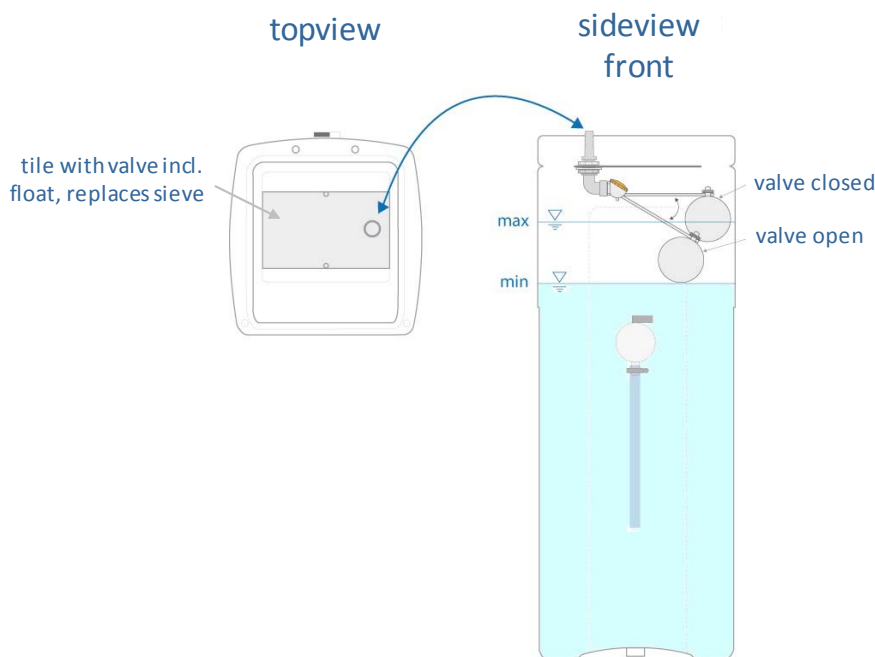
To our best knowledge, all units that were distributed so far by aid organizations remained in place. This means that PAULs that were brought into an emergency situation, still serve as a **permanent water supply system**.

Today, even more units are brought into service intentionally for **permanent use** rather than in actual disaster situations.

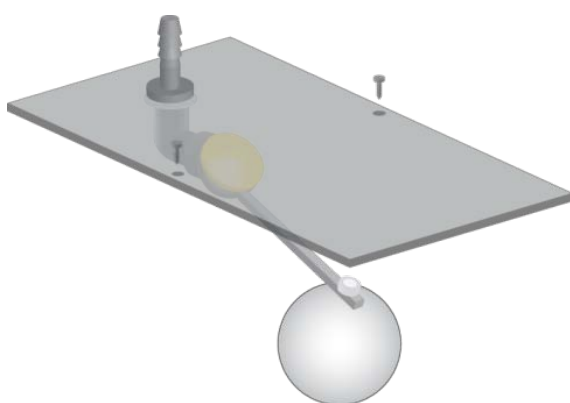


PAUL – automated operation with the overfilling prevention valve (OPV)

Usually, PAUL is filled with a bucket. In many locations, however, raw water comes from a reservoir or raw water tank and can be fed into PAUL by gravity. In order to prevent PAUL from overflowing, a simple valve unit is available that avoids overflowing, as can be seen from the figure.



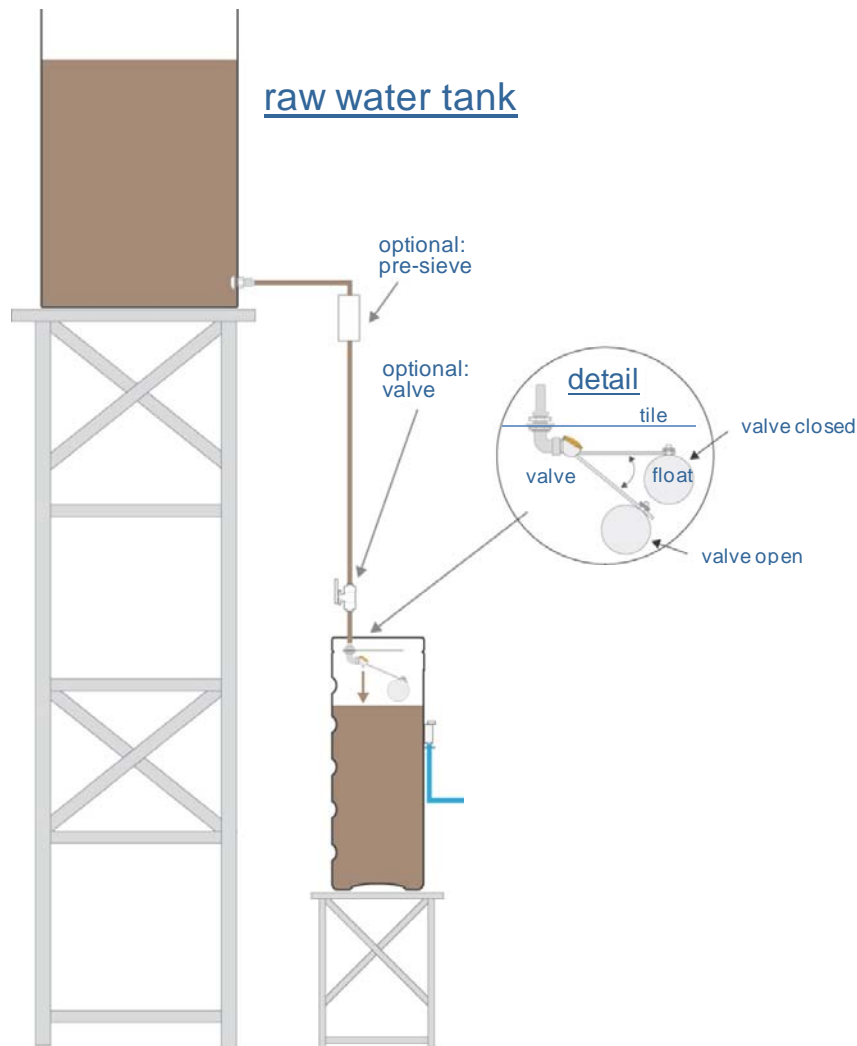
The sieve that is usually found on top of PAUL is replaced by a tile of identical size, which holds a valve with a float. On top, there is a connector where a hose of ½" diameter can be connected. Once PAUL is filled up, the valve closes automatically, preventing PAUL from being overfilled. During filtration, the valve opens again, so continuous unattended filtration is possible.



The **overfilling prevention valve (OPV)** itself is shown in the left figure.

The tile holds the valve with the float, and on top there is the possibility to connect a hose. The tile has the same dimensions as the sieve that is usually mounted on top of PAUL. Simply remove this sieve by removing the two screws, place the OPV here and fix it with the screws.

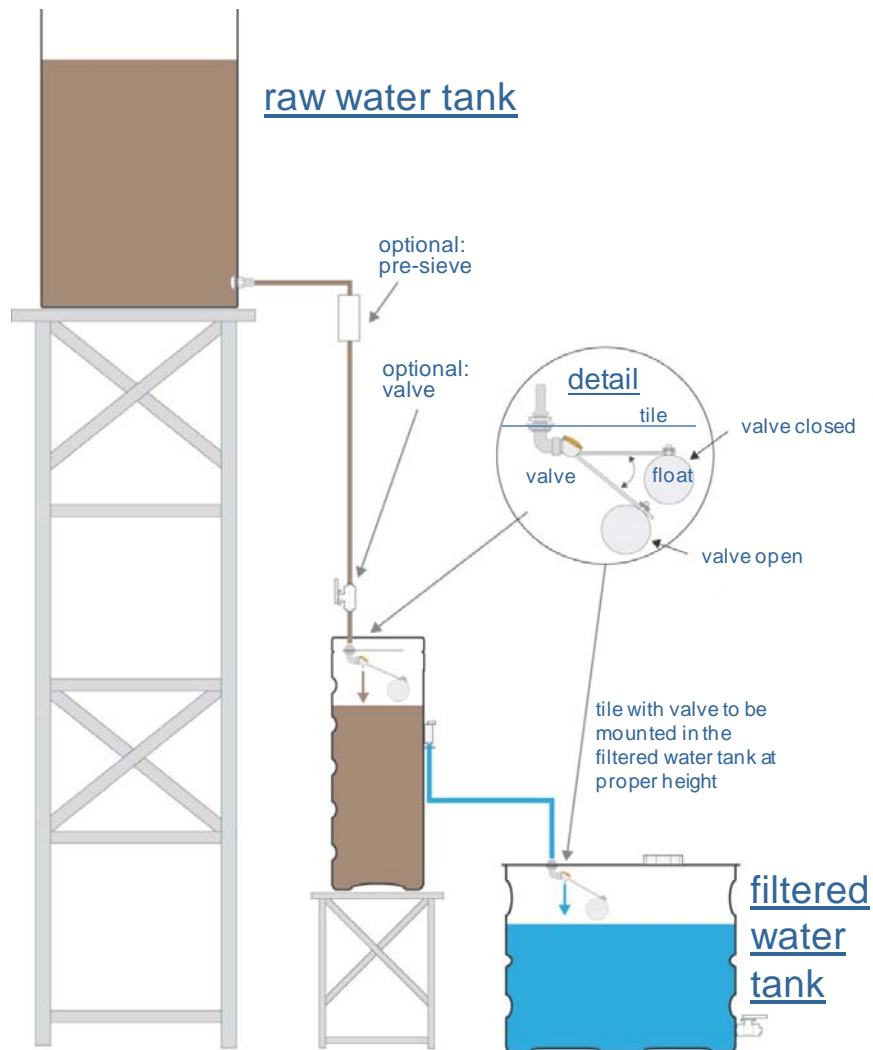
The figure on the next page shows a possible arrangement with a raw water tank and a PAUL unit with OPV. This arrangement allows a fully automated PAUL refilling process: every time water is withdrawn from PAUL, PAUL is refilled automatically (as long as water is in the raw water storage tank) without being overfilled.



The figure on the next page shows a possible arrangement with a raw water tank and a PAUL unit with OPV, and in addition to the OPV installed in PAUL, another OPV is installed in the filtered water storage tank. This arrangement allows a fully automated filtration process: every time water is withdrawn from the filtered water tank, the OPV installed here opens the connection to the outlet of PAUL – and PAUL starts filtering automatically (as long as water is in the raw water storage tank) without being overfilled.

The user who provides the filtered water storage tank can mount the second OPV in a proper height that determines the volume of this tank.

By using 2 OPV's in this manner, a very comfortable & automated operation is possible.



This configuration is in operation already at several locations:

