WaterBackpack "PAUL®" for disasters and for permanent water supply

Examples of PAUL® and PAUL® stations

sponsored by

www.dbu.de



Deutsche Bundesstiftung Umwelt Franz-Bernd Frechen, IWA Fellow

Chair, IWA Specialist Group "Membrane Technology" 2014-2017

Chair, DWA Committee on "Membrane Bioreactors"



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







timeline of PAUL development

- **Ü** 2001: started tests
- **Ü** 2002: first appearance in a <u>television broadcast in Germany</u>
- **Ü** 2005:
 - Frechen & Waldhoff:

Water supply from surface waters with a small gravity flow membrane filtration unit for use in cases of disasters

IWA Specialty Conference "Wastewater Reclamation & Reuse for Sustainability (WRRS 2005)", Nov. 8-11.2005, Jeju, Korea

- **Ü** 2006: sample **PAUL** unit presented
- **Ü** ... many presentations (but unfortunately not enough publications)
- **Ü** 2010: <u>NGOs start distribution</u> of PAUL for emergencies
- **Ü** 2013: creating the acronym "**ULP-UF**" for <u>**Ultra Low Pressure Ultrafiltration**</u>
- **Ü** 2013: explaining cake layer control at the 7th IWA-MTC in Toronto
- **Ü** 2014: beginning of usage for **permanent supply**: "**PAUL station**"
- **Ü** 2020: **3,176** units in **85** countries, **578 for permanent supply**



Deutschland Land der Ideen Ausgewählter Ort 2011







overview

- **Ü** PAUL[®] standard units in emergencies and for "simple" permanent water supply
- **Ü** How does a **PAUL® station** look like?
- **Ü** examples of **PAUL®** station for permanent supply
- **Ü** rainwater ponds as a raw water source



Deutschland Land der Ideen







PAUL® standard units in emergencies and for "simple" permanent water supply

In many locations, **PAUL**[®] standard units that originally were distributed due to a disaster or emergency situation are still in use for "simple" permanent water supply after the disaster or emergency situation is over.

In several other situations not related to disasters, **PAUL®** standard units are introduced for "simple" permanent water supply.

In both cases, however, **PAUL®** standard units are filled with <u>buckets</u>, in contrary to the **PAUL®** station arrangement that is shown later.



Deutschland Land der Ideen Ausgewähler Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



Slide 7

The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen <u>www.waterbackpack.org</u> Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewähler Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen <u>www.waterbackpack.org</u> Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020









German Water Partnership





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



 Market and Control
 Market and Control

 Market and Control
 Market and Control



The WaterBackpack Company Gmb Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020







installed in Tanzania March 2012
 since then, no more cases of diarrhea, cholera or other waterborne diseases according to locals



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020













The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org Deutschland Land der Ideen

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org Deutschland Land der Ideen







How does a **PAUL® station** look like?



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011





German Water



PAUL® station for permanent water supply

Slide 23



examples of PAUL® station for permanent supply



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen ***** Ausgewählter Ort 2011





German Water



WaterBackpack PAUL 2nd November 2020



Slide 25

The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen









WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



Ausgewählter Ort 2011

WaterBackpack PAUL 2nd November 2020

Total cost of local installation (no stands, no pump necessary): <u>380 Euro</u> (2016) (this & next slide)





Slide 28

The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen





German Water Partnership

Indien © FG SWW 18.03.2016 13:29:28



WaterBackpack PAUL 2nd November 2020



Slide 29

Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Ausgewählter Ort 2011







PAUL® station step by step (1): Enayam Puthenthurai

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







PAUL® station step by step (2): Enayam Puthenthurai

WaterBackpack PAUL 2nd November 2020

ndia 2016 © CARE-T / terre des hommes The WaterBackpack Company GmbH Deutschland Land der Ideen German Water



Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Ausgewählter Ort 2011







PAUL® station step by step (3): Enayam Puthenthurai

WaterBackpack PAUL 2nd November 2020





Deutschland Land der Ideen Ausgewählter Ort 2011







PAUL® station step by step (4): Enayam Puthenthurai

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



Slide 35

The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020



Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

...... Ausgewählter Ort 2011





Partnership



Slide 40

WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewähler Ort 2011







WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen





dex

PAUL® can be used with rainwater, groundwater from wells or river water and maybe even other sources. However, the best source for raw water is **rainwater**, most likely from a pond, see examples hereafter, as rainwater usually is free from

- geologic load (e.g. arsenic, other heavy metals)
- industrial pollution
- ø pollution from farming (e.g. nitrate)

The solids that usually cause the brown color of most ponds (see examples) will be removed perfectly by PAUL®

<u>If water is scarce</u>, the only solution seems to be drilling wells. <u>However</u>, this is costly, success is not guaranteed, sometimes the well operation is not sustainable, or drilling may fail in general.

Thus, always also consider the possibility for <u>rainwater harvesting</u>. Storage in a cistern, tank or simply a reservoir/lagoon/pond. This usually is cheaper and the quality of the water might be better as outlined above. See a sample on the next slides.



Deutschland Land der Ideen Ausgewählter Ort 2011











The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org







dex Menter Parenter Revenues and Revenues of

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020



WaterBackpack PAUL 2nd November 2020



Slide 50

The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



Ghana (Tamale/Kulaa) © 2015 Eugen Müller/Zürich



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020

This pond was created for rainwater harvesting for a PAUL® station at a cost of 2 500 €. This picture shows the pond immediately after filling ... The water is very murky But see pictures later





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen <u>www.waterbackpack.org</u>

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen <u>www.waterbackpack.org</u> Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020



Transportation (150 km from Kampala) and work of the excavator was < 2,200 €

Uganda 03/2019 © Steger



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewähler Ort 2011











The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen <u>www.waterbackpack.org</u>

Deutschland Land der Ideen







This picture shows the pond in use today. Rainwater is to be used as raw water for PAUL® station (background), and cattle directly drink from the pond Uganda 03/2019 © Steger Deutschland



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011





dex

WaterBackpack PAUL 2nd November 2020





The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen







Credits and awards

WaterBackpack PAUL 2nd November 2020

Selected awards

won by **PAUL**®

Ausgewählter Ort 2011

Winner 2011 in the

category "society"

GreenTec Awards

WINNER

2016 Water & Sewage

AQUA AWARD 2017

AQUANET

BERLIN BRANDENBURG

2019 Melvin Jones Fellow

Lions Clubs International

FOUNDATION

Deutschland Land der Ideen

PAUL® was developed at the

Research was sponsored by

All pictures presented in this document were collected by The WaterBackpack Company

KASSFI N F S 'Δ' R



Deutsche Bundesstiftung Umwelt

www.dbu.de



The WaterBackpack Company GmbH www.waterbackpack.org

All pictures presented in this document are copyright as mentioned in the respective picture.



The WaterBackpack Company GmbH Prof. Dr.-Ing. F.-B. Frechen www.waterbackpack.org

Deutschland Land der Ideen Ausgewählter Ort 2011





