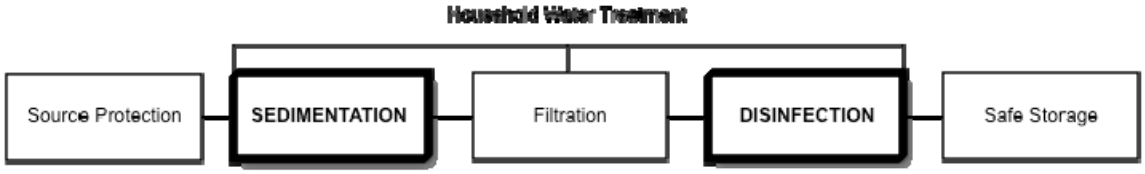
Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: PUR

The Treatment Process



Potential Treatment Capacity

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Viruses • Some protozoa • Helminths • Turbidity	• Some heavy metals (e.g. arsenic, chromium, lead) • Taste, odour, colour	• *Cryptosporidium parvum* • Toxoplasma oocysts • Dissolved chemicals

What is PUR?

PUR is a combined flocculant-disinfectant. The PUR packet was developed by Procter & Gamble (P&G) in collaboration with the U.S. Centers for Disease Control and Prevention (CDC) to replicate the community water treatment process at the household level.

PUR is a powder which contains both coagulants and a timed release form of chlorine. PUR is sold in single packets designed to treat 10 L of water.

The product uses coagulation and disinfection to remove turbidity and pathogens from water at the same time. When added to water, the coagulant first helps the suspended particles join together and form larger clumps, making it easier for them to settle to the bottom of the container. Then chlorine is released over time to kill the remaining pathogens. The treated water contains residual free chlorine to protect against recontamination.

How Does it Remove Contamination?

Particles that cause turbidity (e.g. silt, clay) are generally negatively charged, making it difficult for them to clump together because of electrostatic repulsion. But coagulant particles are positively charged, and they chemically attracted to the negative turbidity particles, neutralizing the latter's negative charge. With mixing the neutralized particles then accumulate (flocculation) to form larger particles (flocs) which settle faster. The flocs can then be settled out or removed by filtration.

Some bacteria and viruses can also attach themselves to the suspended particles in water that cause turbidity. Therefore, reducing turbidity levels through coagulation may also improve the microbiological quality of water.

As well, chlorine forms hydrochloric acid when added to water which reacts through oxidization with microorganisms and kills them.

PUR Packet (Credit: P&G)

Household Water Treatment and Safe Storage Fact Sheet: PUR

Operation

The contents of a PUR packet is added to 10 L of water and stirred vigorously for five minutes. The water is then left for several minutes to settle. If the water does not become clear it is stirred again for a few minute before being left once again.

Once the water becomes clear and the flocs have all settled to the bottom, the water is decanted and filtered through a cloth. The water should then be left for 20 minutes before it is consumed. This gives time for the chlorine to disinfect any remaining pathogens.

Contaminated source water

Formation of flocculant after introduction of PUR

Formation of flocculent after 5 minutes of stirring

Decanting the water through a clean cotton cloth

Clean water ready for storage and use

How to Use PUR (Credit: Population Services International)

Household Water Treatment and Safe Storage
Fact Sheet: PUR Key Data

Inlet Water Criteria

- pH between 5.5 and 7.5; disinfection is unreliable above a pH of 9

Treatment Efficiency

	Bacteria	Viruses	Protozoa	Helminths	Turbidity	Arsenic
Lab	> 100%[1,2]	> 99%[1,2]	> 99%[1,2]	> 99%[1]	> 100%[1]	> 99%[1,2]
Field	> 100% [2]	Not available	Not available	Not available	87%[4]	85-99%[2,3]

[1] Allgood (2004)
[2] Souter et al (2003)
[3] Norton et al (2003)
[4] Norton et al (2003)

- Can remove some organics and some pesticides (Allgood, 2004)
- Can remove significant quantities of heavy metals including arsenic, lead and chromium (Allgood, 2004)
- *Toxoplasma* oocysts and *cryptosporidium parvum* oocysts are highly resistant to chlorine disinfection (CDC, 2007). Chlorine alone should not be expected to inactivate these pathogens.

Operating Criteria

Flow Rate	Batch Volume	Daily Water Supply
Not applicable	10 L per packet	Unlimited

- Need to follow manufacturer's instructions

Robustness

- Free residual chlorine protects against recontamination
- Dosing is predetermined according to a typical water source; proper use requires following instructions from the manufacturer
- Requires supply chain, market availability and regular purchase of the product

Estimated Lifespan

- Packet needs to be used within 3 years of manufacture

Manufacturing Requirements

Worldwide Producers:
- Procter & Gamble

Local Production:
- Cannot be made locally; must be shipped, distributed and sold locally

Maintenance

- Products should be protected from exposure to temperature extremes or high humidity

Household Water Treatment and Safe Storage
Fact Sheet: PUR Key Data

Direct Cost

Capital Cost(s)	Operating Cost(s)	Replacement Cost
US$0	US$0.10/10 litres[1] US$73/year[2]	US$0

Note: Program, transportation and education costs are not included. Costs may vary depending on location.
[1] Clasen (2007)
[2]Assumed 20 litres/household/day

Other

- Some users complain about the taste and odour that chlorine may cause in water
- Chlorine reacts with organic matter naturally present in water to form by-products such as trihalomethanes (THMs), which are potentially cancer-causing
- Lantagne et al. (2008) indicate that THM levels produced during household chlorination may fall below World Health Organization (WHO) guideline values

References

Allgood, G. (2004). Evidence from the Field for the Effectiveness of Integrated Coagulation-Flocculation-Disinfection. IWA World Water Congress 2004. Marrakech, Morocco. Workshop 33.

Clasen, T. (2007). Presentation. London School of Hygiene and Tropical Medicine.

Souter et al. (2003). Evaluation of a New Water Treatment for Point-of-Use Household Applications to Remove Microorganisms and Arsenic from Drinking Water. Journal of Water and Health, 01.2, 73-84.

Norton, D.M et al. (2003). A Combined Flocculent-Disinfectant Point-of-Use Water Treatment Strategy for Reducing Arsenic Exposure in Rural Bangladesh. 10th Asian Conference on Diarrhoeal Diseases and Nurtition , Dhaka, Bangladesh.

Norton, D. M. et al. (2003). Field Trial of a Flocculent-Disinfectant Point-of-Use Water Treatment for Improving the Quality and Microbial Safety of Surface Pond Water in Bangladesh. 10th Asian Conference on Diarrhoeal Diseases and Nutrition Dhaka, Bangladesh.

Further Information

Centers for Disease Control and Prevention: www.cdc.gov/safewater

Proctor & Gamble: www.csdw.org/csdw/pur_packet.shtml

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