Technical solutions /platforms for local drinking water processing

Transportable device, solar-cell powered or with car battery

Technical solutions /platforms for local drinking water processing

Small stationary solution with integrated drinking water storage tank and solar-cells for drinking water production for a village of about 300 inhabitants for instance (ca. 1200 l/d)

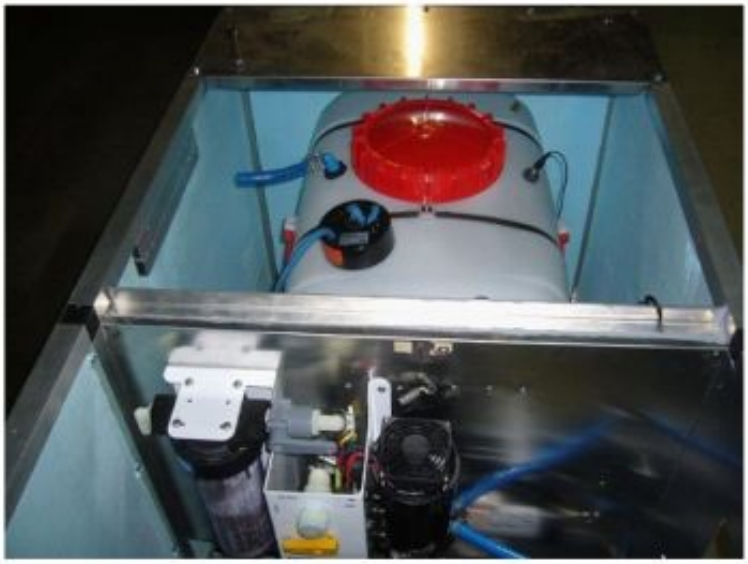
Technical solutions /platforms for local drinking water processing

Stationary container solution for production of 40 m³ drinking water a day. Storage tank, solar-cells or wind energy are optional.

Technical solutions /platforms for local drinking water processing

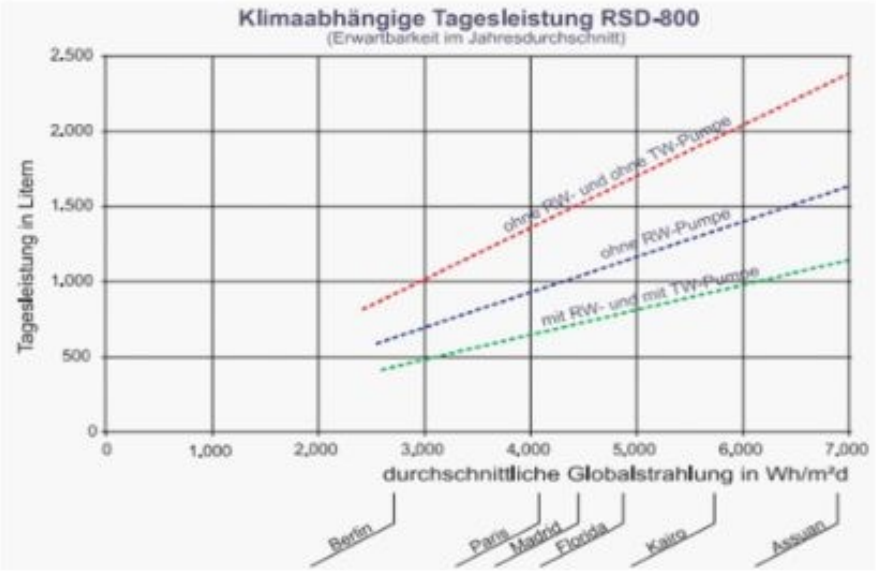
Solar thermal water distillation, suitable for desalination of 4.8....22.5 litres a day per square meter panel

Technical solutions /platforms for local drinking water processing



Reverse osmosis, suitable for desalination and disinfection of 500 l a day

Energy yield and drinking water production



Daily drinking water production with a solar-cell powered small local drinking water device

Establishing local drinking water production

- water quality overview by random sampling, considering **local geochemical and geographic conditions**, identifying necessary analysis parameters (e.G. pH, conductivity, turbidity, UV absorption at 254 nm, ammonium, nitrate, nitrite, BOD, heavy metals etc.)
- choosing **point of raw water drawing**, considering limnology, stratification, waterbody ecology (considering experience with water reservoirs)
- assessing present **water treatment method**
- **drinking water quality**: odour, taste, colour, CFU (colony forming units), colif. / Ecoli, microbiological stability (TOC, BOD)

Raw water types

- Ground water (typical for middle Europe)
- Surface water: Rivers, streams, lakes
- Rain water, reservoirs
- Hybride types (are typical for local drinking water support in „warm" countries), karst springs, wells, bank filtrate

Ground water is determined by an intensive soil filtration of deposite water and in the best of cases completely free of germ nutrients (organic material) and germs at all. It contains minerals from the soil. It often needs no or few treatment.

Surface water is formerly rain water as well and is directly impacted by the biosphere or part of it respectively. It also contains minerals from the environment. In most cases it needs treatment

Rain water is almost like distilled water and can contain few anorganic acids, very few minerals and does contain CO_2. If it is stored in reservoirs it mostly contains germs, so that treatment is recommended.

Hybride types or mixed water should be deemed to be surface water and, hence, has to be treated.

Water pre-treatment methods and their suitability for local drinkingwater processing

- **Sand filtration.** In connection with aeration a good method to remove turbidity, iron, manganese: **applicable for pre-treatment for all local facilities**
- **Commonly available filter cartridges 1..30 µm -pores.** Removes particles and turbidity: **Common technique for local and end-of-pipe water treatment**
- **Flocculation with sour iron or aluminium salts.** Removes particles, turbidity, coagulated kolloidal and soluted compounds (organic material) and icro organisms. Best method for surface water. Reduces re-formation of germs in the distribution net. Requires pH-controlled dosage of chemicals: **Not suitable for small and local devices because of expensive maintenance.**
- **Membrane filtration.** Removes particles, turbidity, bacteria: Good method for local and end-of-pipe-treatment but expensive and high energy consumption: **Recommended only for special purposes.**
- Reverse osmosis. Removes all ingredients. Suitable for desalination. Expensive and intensive maintenance required: **Recommended only for special purposes.**
- **Distillation:** Desalination, maybe fully solar thermal. Only for some litres a day. **Recommended for special purposes.**
- **Ion exchange.** Removes salts, e.g. nitrates. Not recommended because of small capacity.
- **Charcoal - adsorber:** Removes organic compounds, odour and taste: **Recommended.**
- **Ozone:** Removes organic compounds, odour and taste: **Recommended for special situations.**
- **Special adsorbers (e.g. for Arsenic). Recommended for special raw water siruations.**

Disinfection methods

- All disinfection methods (chlorine, ozone, dispersed silver, UV etc.) only inactivate bacteria (so they can not increase and die off after a while)
- All disinfection methods leave byproducts or residual material of different toxicity, but especially widespread disinfection by dosing chemical substances like chlorine or hypochlorite does
- Residual material from UV-disinfection is too little, to detect it with modern analytical methods; as it comprises of organic material like proteins, fatty acids and glucose it is oxidised to smaller molecules, finally water and CO_2 already during irradiation.
- In opposite to other disinfection methods UV is not a chemical but a physical disinfection method (with some photochemical effects described later). Thus it needs no dosing of hazardous chemicals with complex and costly equipment and with the risk of overdosing
- UV-C (254 nm wavelength) is generated by mercury low pressure lamps which are likewise common fluorescent tubes.

Disinfection methods: some advantages - disadvantages

Chemical disinfection

advantages

- chlorine, ozone, chlorine-dioxide: robust chemical action, firstly destroys most germs even in muddy raw water
- dispersed silver: simple technology, acts sufficiently in tanks
- chlorine: certain depot action in distribution networks

disadvantages

- chlorine (and hypochlorite) leaves some toxic substances, especially with raw water containing much organic material
- ozone: increases microbial re-contamination, especially with organic material
- silver: not effective with short contact time and with charged raw water
- complicated, costly dosage methods

UV disinfection

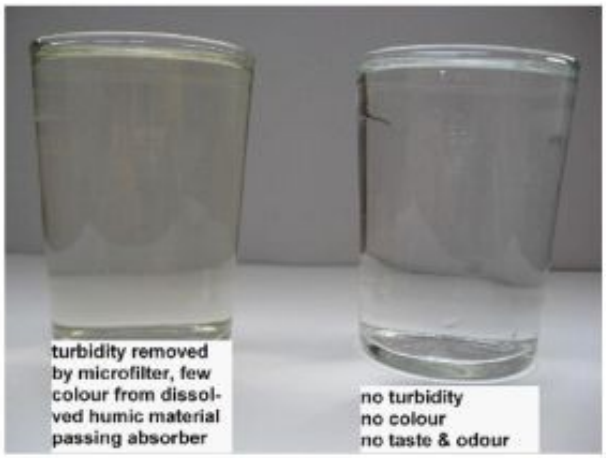
advantages

- no byproducts
- very reliable inactivation of germs after some pre-treatment
- no impact at odour and taste
- robust and cheap technology, easy to use
- needs no current chemicals delivered, no hazards by overdosing

disadvantages

- no depot action in distribution networks (therefore it should be used at the end of pipes)

Assessing treated water



have a look

- if all turbidity is removed by the filters
- if the colour is not more intensive than in the photo for example
- if odour and taste is O.K.
- if there is any hazard from toxic substances coming from the environment (cyanide or heavy metals for instance)

if it looks like the both examples in the photo, UV- disinfection is O.K.