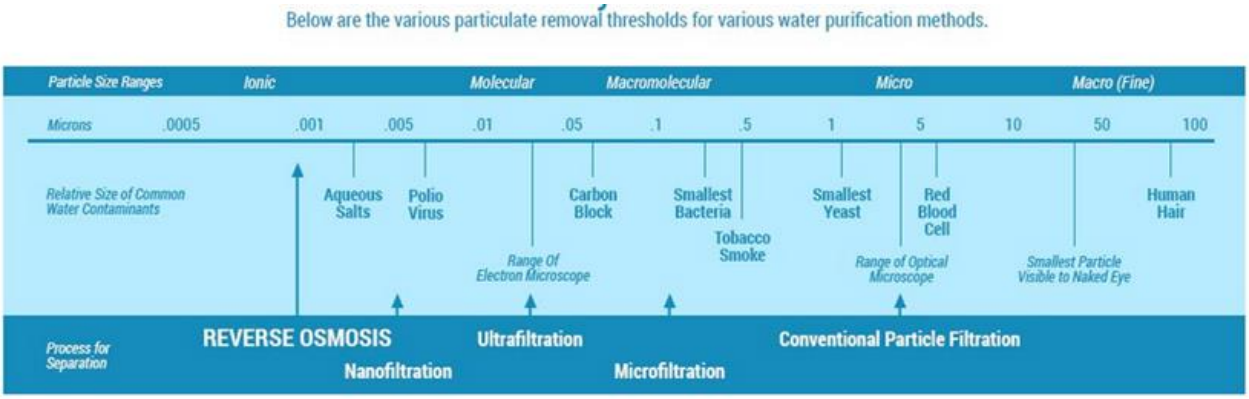
TECHNICAL DOCUMENTATION – WATER PURIFICATION/FILTRATION OPTIONS

1. SUMMARY



There is a large variety of water purification/filtration options available, with each system offering degrees of protection or effectiveness in cleansing/purifying water, along with different initial installation and on-going maintenance costs – the costs/effectiveness of each type depends on the condition of the source water and the volume used. Providing one chooses one of the well known brands, is aware of the limitations of a given system, and maintains that system over time, then there should be no unpleasant impacts from sourcing water from all over the world.

In general water filters/purification systems either aim to make water safe (i.e. to remove harmful contaminants, whether chemical or biological) or to remove unpleasant flavor or odours (including ‘safe’ chlorinated water common in shore based supplies), and so avoiding the need to purchase bottled water.

Water filtration/purification systems that we use in our expedition vehicles can be broken down into 3 main types (filters, UV & RO) and applied in 3 different installation configurations (pre-tank, post-tank, combined).

Gekkotruck recommends a number of systems (see later), but remains open to install any proven or reputable system that our customers request – whilst there exists a large price variation in systems available, it is quite possible to fit reasonably priced systems that offer sufficient protection and many years of good service.

2. WATER FILTRATION/PURIFICATION OPTIONS

OVERVIEW FOR ALL CHARACTERISTICS AND TECHNOLOGIES

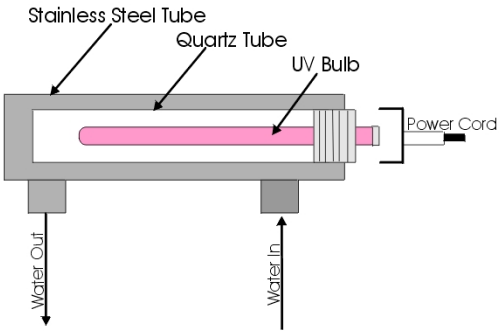
CHARACTERISTICS	TECHNOLOGIES							
	Activated Carbon	Ion exchange	UV Devices	Chlorine & Silverions	Hollowfiber	Katadyn Filtermedium Virupur	Katadyn Glassfiber 0.2 Micron	Katadyn Ceramic 0.2 Micron
Effective against protozoa	✗	✗	✓	✓	✓	✓	✓	✓
Effective against bacteria	✗	✗	✓	✓	✓	✓	✓	✓
Effective against viruses	✗	✗	✓	✓	✗	✓	✗	✗
Suitable for clear surface water without suspended solids	✗	✗	✓	✓	✓	✓	✓	✓
Suitable for slightly turbid surface water	✗	✗	✗	✗	✓	✓	✓	✓
Suitable for turbid and extremely turbid surface water	✗	✗	✗	✗	✗	✗	✗	✓
Makes the water clear (particles will be removed)	✗	✗	✗	✗	✓	✓	✓	✓
Suitable for questionable tap water	✗	✗	✓	✓	✓	✓	✓	✓
Suitable for safe tap water (drinking water quality)	✓	✓	✓	✓	✓	✓	✓	✓
Reduces chemicals and improves the taste of the water (chlorine)	✓	✓	✗	✗	✗	✓	✓	✗
Does not require batteries	✓	✓	✗	✓	✓	✓	✓	✓

2.1. Types of purification technologies

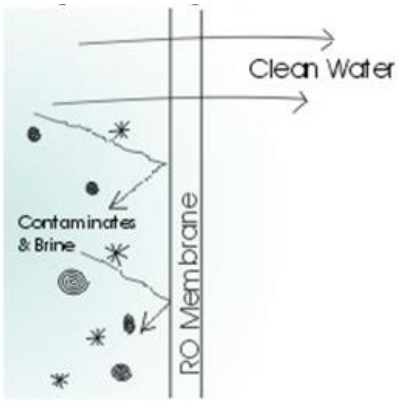
a. ‘Simple’ filtration (including Sediment, Carbon based , Ceramic & mixtures of these.



b. Ultra-violet (UV)

c. Reverse Osmosis (RO). The most effective systems (i.e. near ‘pure water’) combine a standard filter with either UV or RO.



The 4th type of water treatment, i.e. chemical additives are also not mentioned specifically in this document, although can be used in place of UV or RO or ‘in addition’ to these, and are commonly available/supplied from campervan and outdoor shops, suppliers and online ‘shops’ (the standard US army method is to chlorinate water following RO, to ensure that the water is not ‘re-contaminated’).

Micropur Forte MF 100F

Although travelers might adopt to use bought bottled water for drinking, rather than that contained within their water storage tanks, having permanently installed systems (or portable emergency) make sense given their relatively low cost especially when compared to the unpleasantness of sickness caused by contaminated water supplies.

2.2. Installation Configurations

1. Treat all water prior to filling the tanks (using simple filtration)

2. Treat only drinking water entering a designated tap in your vehicle

3. Combine 1) and 2), treat before and after your water storage tanks

Filters designed for the treatment only of drinking water (rather than all water delivered to the shower, macerator toilet etc.) can usually be smaller, and include a lower flow-rate than systems designed to fill the main tanks, where the filling of a 500 litre tank would otherwise be unbearably slow.

First filters in the line are generally simple ‘sediment filters’, which once applied reduce the need for a similar filter on the other side of the water tank, although given that biological contaminants may grow in the water tanks, re-use of similar filters on the inlet and the outlet of the water tanks is fairly common (especially if a carbon or ceramic based filter). Growth of algae within the filters themselves, which is more likely to happen when systems are not used often, is prevented by using filters that contain additives (usually zinc or copper based).

Filters can be portable, and can be directly connected to the shore tap, and/or be placed rigidly into the vehicle, which is then connected via a pipe to the shore tap – should a water source such as a lake or stream be used, then the addition of a pump within the vehicle and/or portable filter will be required.

2.3. Filter types, housings versus taps (faucets)

Systems can be fitted ‘under the sink’ connected to the kitchen tap, or connected to a dedicated ‘filtered water tap’ separate from the main tap/faucet. Some manufacturers supply systems that are simply and quickly attached to the end of the existing kitchen tap, which also make them portable to carry and be used outside of your expedition vehicle (i.e. between more than one vehicle, during walking trips, or in the home etc.) - so called ‘counter-top’ filters - given the nature of an expedition vehicle, permanently plumbed solutions are generally preferred.

Filters of a given size can be constructed with different mixtures of filtration substances, offering different performances in terms of flow-rates, longevity and effectivess against different forms of contaminants, and similarly prices can range from as little as 12 EUR to almost 200 EUR per filter, dependent on the type, with typically usable lives of 2 months to a maximum of 6 months, or even 2 years.

When filters (i.e sediment, carbon or ceramic canisters) are combined with UV or RO, they may be placed in special multiple filter housings/attachments, otherwise different separate filters within a series of individual filter housings can also be joined to produce ‘multi-filter’ characteristics. Some manufacturers provide filters placed in a transparent housing that allows for an easy visual inspection of the degree of clogging (which should then be placed in a non sunlit location, to reduce the growth of algae, whereas in other models, the filter/housing is combined into a single unit, and this whole unit is replaced by screwing into the ‘head plate’ (which connects to the inlet/outlet pipes).

2.4. Gekkotruck recommended configurations/systems/models

Gekkotruck is flexible towards customers individual water filtration/purification needs, but recommend the following options:

a) a portable combined 'pre-filter', used to clean the shore based supply prior to it entering the vehicle water tanks – this system allow for the removal of the majority of contaminants before entry into the vehicle – generally, we use a combination filter, offering a sediment, carbon and ceramic filtration, which already offers a very high protection against the majority of contaminants, and has the additional advantage that the filter can be bypassed if desired (i.e. when the shore supply is known to be safe, which speeds up the filling process, and reduces the frequency of pre-filter renewal) – we recommend the 'Naturepure' pre-filter:

610000 Dockside Prefilter

600001 Aqua-Polish AP10 Module

b) a dedicated kitchen drinking water tap, connected to an additional combination filter after the water tanks – this provides an easily changeable under-sink filter, combined with a permanently available near pure drinking water tap (filter is also based on sediment, carbon and ceramic technologies, hence if the main water tanks are for whatever reason contaminated, good, safe drinkable water will still be available – should the portable pre-filter as in a) above also be used, then the life if this second filter will be extended (this particular model filters down to 0.4 microns, hence removes the majority of micro-organisms including some viruses) – we recommend the 'Naturepure' brand:

420400 Nature Pure Quick Change with Faucet

Nature Pure "QC" Systems eliminate the need for traditional pressure vessel "housings". Instead, small, lightweight, replaceable canisters are handturned into compact stainless steel "interface units with integral stainless steel mounting brackets," which are easily and conveniently integrated into boat, motor home and other fresh water systems. There are no v-clamps, shear rods, toggles or similar closures.

The Nature Pure Quick Change System is recommended for residential use
Flow Rate: 2 .3 litres per minute
AVG Capacity: 3000 litres
Cartridge type: Ultrafine (Structured Matrix)
Particle Retention Rating: 0.4 Micron
Working Temperature: 0.5 oC - 38 oC
Customer Testimonial:
I have just returned from my boat having fitted the Nature Pure QC water filter.

c) for travelers who will use water that likely contains the smallest unpleasant and life threatening viruses, then we recommend in addition the use of a UV system – UV systems based around 12V (supplied by Sterilight), can be combined on the pre-water tank filling side, or situated after the water tank (either connected to the main kitchen tap or to a specific designated single drinking water tap).

d) as an alternative to item c), we recommend the use of a portable counter-top type RO system, although an undersink unit (either using the standard tap or a dedicated tap) is possible. For counter-top, we recommend the 'Nimbus water maker'.


e) for travelers who require to fill their water tanks from a natural source such as a stream or lake, then the filtration/purification systems above provide adequate protection – if the water source is not good, the using both the pre-filter, and after water tank filtrations along with UV or RO will ensure safe near pure drinking water, whilst ensuring that the more expensive 'more complex' filters are saved in favour of earlier clogging by the pre-filters – here, there is also a requirement for a pump to be fitted on the inlet side of the water tank - we are happy to discuss such systems should customers require this option

f) whilst we have not included 'de-salination' systems, i.e. producing pure water from sea water, such systems are also available (similar to RO provided systems, this being where the RO technology originates from in any case) – we are happy to discuss such systems should customers require this option

Water filtration/purification systems do not remove the need for correct and regular servicing/cleaning of your water tanks.

Many travelers mainly use their on-board water for washing or cooking (where it is sterilized in any case) rather than for drinking, in which more sophisticated filtration/purification is then un-necessary, although at least basic sediment filters will remove the larger particles that might be present in even shore supply systems, and help to keep the expedition vehicle water system clean and free from silt.

Other considerations – shore side filter (pre-filter) systems and/or built in pre-tank systems typically have flow rates of 5 to 20 litres per minute maximum, so for a 500 litre water tank will take from 20 minutes to 1.5 hours to fill the tank. If this is unacceptable, or for expedition vehicles with larger than 500 litre tanks, then 'jumbo' pre-filters are also possible, providing better flow-rates, although the choice in filter types ie less extensive (although sediment, carbon and ceramic are available).

Filters have a usable life of between 6000 and 50,000 litres (or typically 2 to 6 month lives prior to replacement).

Type	When used	Advantage/characteristic	Flowrate
Sediment	As first filter in water line to remove largest particles (sand, minerals, metals) – can be combined with Carbon as a dual function filter	Relatively cheap and when used in addition to 'finer'/more sophisticated filters, prevents early clogging of those filters – filters available down to 5 and 1 microns	Up to 16 litres per minute
Carbon	Used combined with sediment filter (in a single filter) or as second filter to a sediment filter, also available with bacteria preventing additives (e.g KDF)	Removes many undesirable chemicals, including chlorine and heavy metals Relatively cheap and with different types available, is sufficient for the removal of most of the undesirable contaminants found in water, and together with the sediment filter is mainly responsible for removal of unpleasant tastes or odours	Up to 16 litres per minute
Ceramic	Sufficient for most users (when viral infection not high)	Remove pathogens/bacteria down to 0.9 microns – sufficient when used with sediment/carbon for most travelers (note many viruses sit on bacteria, in which case are also removed by these filters)	As low as 3 litres per minute
Ultra	Kills 99.99% of water	Creates virtually 100% safe water, and is available as a 12V unit (placed after simple filtration) – should	20 litres

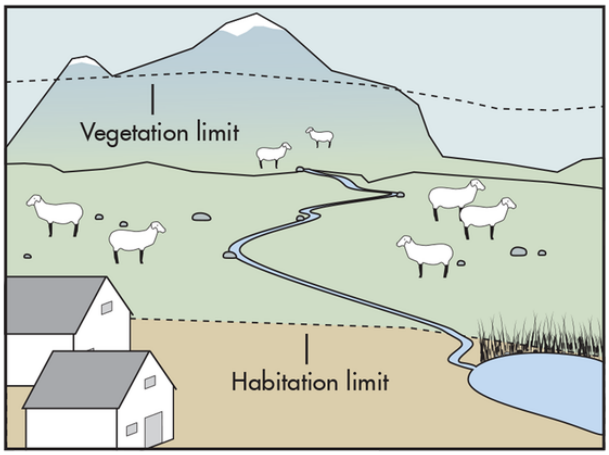
Violet	borne micro-organisms	replace bulbs annually	per minute
Reverse Osmosis	Removes minerals, salts, pathogens/ viruses and other chemical contaminants	Creates virtually 100% safe water	Up to 200 litres per day

3. COSTS and MAINTENANCE

Type	Initial Product Cost	Filter life/replacement – filter cost	Yearly cost
Sediment	75 EUR	From 8 EUR each, 6 per year	50 EUR
Carbon	75 EUR	On average 20 EUR each, 6 per year	120 EUR
Ceramic	75 EUR	70 to 170 EUR, 1 per 12 to 24 months	125 EUR
UV	125 to 450 EUR	Replacement bulb approximately 60 EUR	60 EUR
RO	200 to 500 EUR	Replacement membrane approximately 45 EUR, up to 3 per year depending on usuage	135 EUR

4. BACKGROUND

DANGERS



LOWEST DANGER OF INFECTION ABOVE VEGETATION LIMIT

The risk is much less, as there are fewer germs. At this altitude, the streams flow directly from the sources.

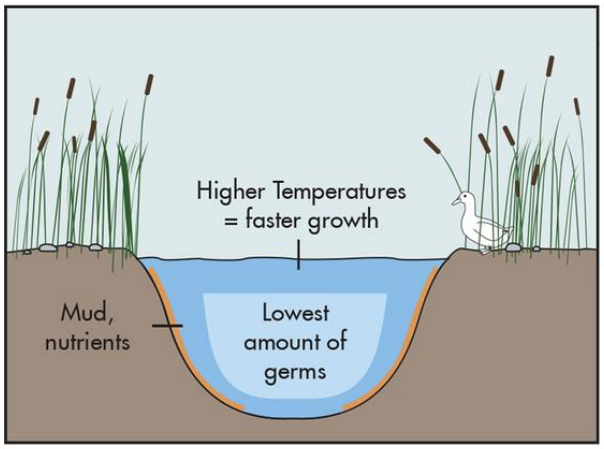
MEDIUM DANGER OF INFECTION BELOW VEGETATION LIMIT

Intensive farming increases the level of bacteria and protozoa contamination in natural waters.

HIGHEST LEVEL OF CONTAMINATION IN HABITATION ZONE

Insufficient treatment of sewage in inhabited areas of developing countries and in fast growing urban areas make the drinking water unsafe.

DISTRIBUTION IN WATER



NUTRIENTS

In the muddy bottom, bacteria will quickly multiply due to an excellent supply of nutrients. If possible, do not put the inlet filter into the mud when pumping.

WATER TEMPERATURE

Elevated temperatures promote the growth of bacteria. In standing and slow-moving waters, it is warmer on the surface. Deeper waters are not as contaminated.

CONCENTRATION

Quick-flowing waters are less contaminated since the water is more turbulent and is always being diluted. However disturbed sand may clog the filter.

PATHOGENIC MICROORGANISMS

PROTOZOA (AMOEBAE, GIARDIA, LAMBLIA, CRYPTOSPORIDIA)

- Animal single-cell organisms, 1 - 15 microns* in size, which like bacteria get into drinking water through animal and human feces
- These hard-shelled parasites form cysts, which lead to acute gastrointestinal diseases in humans
- Common in unfiltered surface water. Have also been found in drinking water (Milwaukee, London, Sydney)
- A single cell is all it takes for an infection

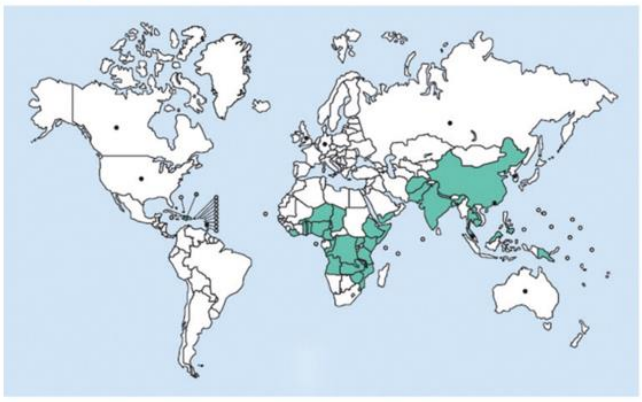
BACTERIA (E-COLI, SALMONELLA, CHOLERA)

- Single-cell organism 0.2 - 5 microns* in size
- Propagate quickly in warm environments and particular in water,depending on the supply of nutrients
- Become dangerous if they are mixed together with human and animal feces in the drinking water

VIRUSES (HEPATITIS A, NORWALK VIRUS, ROTA VIRUS, POLIO VIRUS)

- Tiny parasites 0.02 - 0.2 microns*
- Can only propagate in living cells since they do not possess their own metabolism
- Animal single-celled organisms, which like bacteria get into drinking water through animal and human feces
- Near populated areas, where wastewater can get into drinking water

CHOLERA



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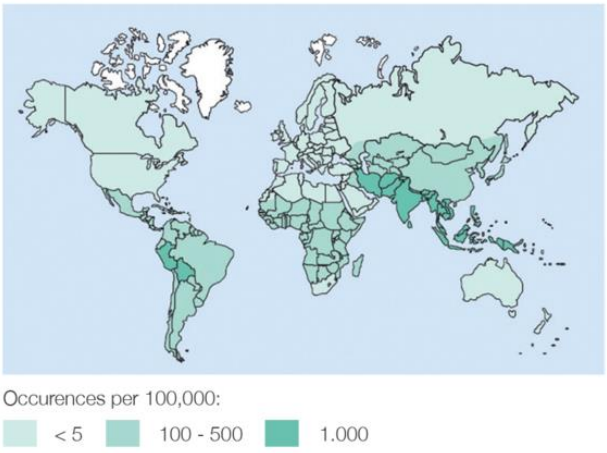

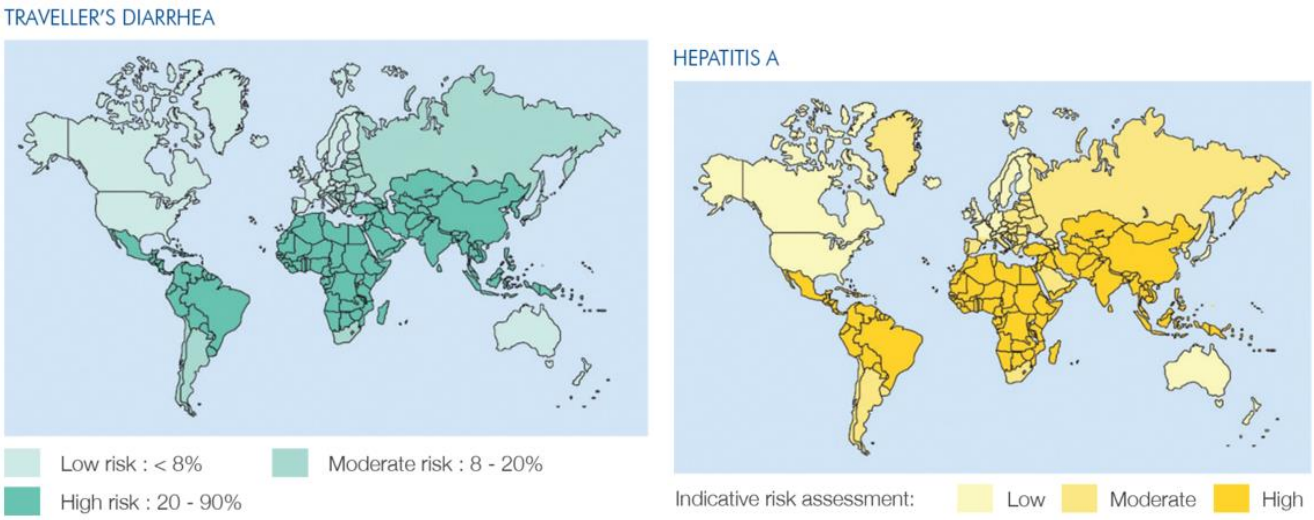

5. LINKS AND REFERENCES

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