

The “4 principles” and “5 techniques” of water purification.

Five Methods Compared

SUBJECT	PRINCIPLES AND TECHNIQUES	SUBSTANCES
Five Methods Compared	4 and 5	30

Each of these systems purifies water in its own way.

A	FILTER	1. Activated carbon 2. Reverse osmosis
B	CHEMISTRY	3. Ion exchanger
C	LIGHT	4. UVC LIGHT
D	PHASE CHANGE	5. Distillation

TABLE THE 5 TECHNIQUES COMPARED

OVERVIEW

SUBSTANCE	● OF CONCERN	ACTIVATED CARBON	ION EXCHANGER	UV-C	REVERSE OSMOSIS	DISTILLATION
	● HARMLESS					
Acaricides	●	~ 60 %	0	0	~ 90.0 %	~ 99.9 %
Algal toxins	●	~ 60 %	0	0	~ 85.0 %	~ 99.9 %
Aluminium	●	0	~ 70 %	0	~ 93.0 %	~ 99.9 %
Antimony	●	0	~ 60 %	0	~ 85.0 %	~ 99.9 %
Arsenic	●	0	~ 50 %	0	~ 85.0 %	~ 99.9 %
Residues of medicines	●	~ 70 %	0	0	~ 90.0 %	~ 99.9 %
Asbestos fibres	●	~ 50 %	0	0	> 94.0 %	~ 99.9 %
Bacteria	●	0	0	~ 99.9 %	~ 93.0 %	~ 99.9 %
Barium	●	0	~ 80 %	0	~ 90.0 %	~ 99.9 %
Lead	●	~ 20 %	~ 90 %	0	~ 93.0 %	~ 99.9 %
Cadmium	●	0	~ 80 %	0	~ 93.0 %	~ 99.9 %
Chlorine	●	~ 90 %	0	0	~ 85.0 %	~ 99.9 %
Chromium	●	0	~ 70 %	0	~ 85.0 %	~ 99.9 %
Dioxins	●	~ 80 %	0	0	~ 90.0 %	~ 99.9 %
Fluoride	●	0	~ 40 %	0	~ 85.0 %	~ 99.9 %
Fungicides	●	~ 70 %	0	0	~ 90.0 %	~ 99.9 %
Glyphosate	●	~ 70 %	0	0	~ 93.0 %	~ 99.9 %
Hormones	●	~ 70 %	0	0	~ 90.0 %	~ 99.9 %
Insecticides	●	~ 70 %	0	0	~ 90.0 %	~ 99.9 %
Copper	●	~ 20 %	~ 90 %	0	~ 93.0 %	~ 99.9 %
Manganese	●	0	~ 80 %	0	~ 90.0 %	~ 99.9 %
Microplastics	●	~ 30 %	0	0	> 94.0 %	~ 99.9 %
Nitrate	●	0	~ 50 %	0	~ 80.0 %	~ 99.9 %
Nickel	●	~ 20 %	~ 80 %	0	~ 93.0 %	~ 99.9 %
PFAS	●	~ 40 %	0	0	~ 85.0 %	~ 99.9 %
Pesticides	●	~ 70 %	0	0	~ 90.0 %	~ 99.9 %
Mercury	●	~ 40 %	~ 60 %	0	~ 90.0 %	~ 99.9 %
VOCs	●	~ 70 %	0	0	~ 40.0 %	~ 90 %
Viruses	●	0	0	~ 99.9 %	~ 90.0 %	~ 99.9 %
Uranium	●	0	~ 70 %	0	~ 90.0 %	~ 99.9 %
Wear		very high	very high	medium	high	none
Recontamination		high	high	low	high	none
Cleaning effort		high	high	medium	high	low
Noise		inaudible	inaudible	inaudible	inaudible	barely audible
Purchase costs		low	low	low	high	high
Use		simple	simple	hazardous	simple	simple

DIFFERENCES

THE SEVEN DIFFERENCES

01

Filter

Every filter system is based on separation by holding the pollutants back in front of the sieve. Chemically modified and unknown compounds, however, get past these checks very easily and are not sieved out of the water.

DISTILLATION

Distillation works on a principle fundamentally different from that of a sieve.

In the evaporating flask the water passes into the gaseous state at 100 °C. The water molecules rise invisibly as pure vapour into the condenser. All salts, heavy metals and the majority of organic substances do not boil at 100 degrees. They are simply “too heavy” for this physical ascent and remain as residue in the evaporating flask.

02

UVC light

UVC light is a blessing for sterilising all “biological germs”. This means that UVC light destroys their DNA and so renders them harmless. The substances dissolved in the water, however, remain untouched by this method.

The use of UV light is limited to combating “viruses and bacteria” in the water, but it reduces no material residues. Salts, heavy metals and chemical compounds pass through the light barrier unharmed and remain in the drinking water.

DISTILLATION

Distillation accomplishes “two tasks” simultaneously. On the one hand the boiling heat sterilises the water, and on the other the simultaneous “molecular phase change” separates the water molecules from their ballast.

03

TDS & TOC

A low TDS reading (Total Dissolved Solids) is no proof of pure water. A TDS meter can only measure the electrical conductivity of the water, for instance minerals such as calcium or magnesium.

All toxic residues, however, remain completely “silent” to the TDS meter. These include all those substances of serious concern, such as the PFAS known as forever chemicals, hormones, drug residues and so on. These substances have hardly any weight of their own, yet already affect our body at millionths of a gram per litre. These powerful substances can only be measured with the TOC method (Total Organic Carbon). Such an instrument, however, costs as much as a detached house and requires trained specialists.

DISTILLATION

The distillation process also cleanses the water of the pollutants of concern that are “silent” to TDS measurement. They remain in the evaporation boiler. The principle of distillation makes a TOC measurement unnecessary.

04

Recontamination

Every filter system accumulates the retained substances only temporarily. Once the capacity limit is exceeded, the dreaded “reversal of the filter effect” looms.

A saturated filter releases the collected substances back into the flowing water uncontrolled, so that the pollutant concentration can rise significantly again. In the specialist literature this phenomenon is described as “recontamination”.

DISTILLATION

The distillation method eliminates this danger completely. A glass still needs no regular servicing. Even after the thousandth run it delivers the same purity as on the first day. The water circulates in a closed glass circuit, and the heat cleanses the system in the same run.

05

Maintenance

Stagnant water in filters favours the settlement of germs. The boiling heat of glass distillation eliminates this microbiological danger completely.

Standing water forms an ideal breeding ground for bacteria. Without thermal barriers, organisms spread unhindered during idle periods.

For the production of medical pure water, the World Health Organization demands strict control of all types of filters.

DISTILLATION

Glass distillation resembles a self-cleaning system. The same heat energy that drives the evaporation sterilises the entire apparatus “at the same time”. It is a hygienic protective system that works entirely without wear. The molecular phase change in a glass still guarantees identical purity in the first run and in the thousandth.

06

Reference class

For the vital processes of its medicines, medicine has always relied on “the pharmaceutical standard”, distillation.

Water for injections defines the absolute gold standard of perfect purity. For this gold standard, the WHO and all medical codes demand distillation “alone”. Since 2020 an amendment of these guidelines has also permitted reverse osmosis. This approval, however, is tied to strict conditions with highly developed filters.

DISTILLATION

Distillation is still regarded worldwide as the benchmark of quality. All alternative methods can reach the native purity of a still only by means of technical add-ons. The European Pharmacopoeia enshrines these criteria as a binding standard for Switzerland as well.

07

Multiple purification

Every further purification continuously increases the purity of the water. The “only system” capable of this multiple purification is multiple distillation. It forms the technological pinnacle of all purification methods.

DISTILLATION

Conventional filter systems quickly reach their limits when repeated. A downstream filter merely repeats the previous barrier. A further UV lamp produces no additional effect. A multi-stage distillation process, however, demonstrably refines the result and makes possible the highest form of water purification.

SOURCES

SOURCES

- BAFU, PFAS im Grundwasser, Nationale Grundwasserbeobachtung NAQUA, Swiss Federal Office for the Environment
- BLV, Per- und polyfluorierte Alkylverbindungen (PFAS), Federal Food Safety and Veterinary Office
- Swissmedic, Pharmacopoeia
- UBA, Trinkwasserverordnung 2023, Summe PFAS-20, German Drinking Water Ordinance
- AGES and BMASGPK, Ionentauscher und Filtermedien zur nicht ortsfesten Wasseraufbereitung, Schwerpunktaktion A-034-24, Vienna 2025
- WHO, Guidelines for Drinking-water Quality, 4th edition incorporating addenda, Geneva 2022

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