

Rainwater for drinking

Regulatory and practical aspects of using rainwater for potable applications

A white Paper from RainWaterHarvesting.co.uk

The United Kingdom Building Regulations stipulate that rainwater is non-potable. Unless proper treatment of the water is assured, rainwater can therefore only be used for washing clothes, flushing toilets and in the bidet (yes, the regs and BREAAAM provide for bidets). This paper gives advice on the circumstances under which rainwater can be used for kitchen, bathing, showering and drinking uses.



In practice, it is vital to get your stored water tested by a competent testing company. This testing should be done before it first used for kitchen, bathing, showering and drinking uses and at prescribed intervals thereafter. There are two reasons for the testing. Firstly, you do not want to get ill (or worse) from the water. Secondly, you will have no argument to show the authorities (notably your council building inspector) that the water has sufficient quality to be safe. There are testing companies all over Britain and one can identify them locally when required, through the yellow pages if necessary. Most council inspectors will want to see test results and a confirmation from a supplier that the equipment will handle whatever might be polluting the water. The most common pollutants are as follows:

1) **Bacteria**

The most common pollutant of rainwater off the roof of a building is bird droppings and the bacteria that these carry. **Ultra-violet filtration** kills bacteria, and is dealt with below.

We would also comment that the British love of flat roofs has a rainwater harvesting drawback, not just the risk of leakage! Debris like leaves and any other vegetable or animal matter will tend to accumulate on a flat roof. Its reaction with air and water, during the time it is sitting on the roof, will promote decay and bacterial action. The bacteria will subsequently enter the rainwater storage and could cause, at least, discoloration of the water. A sloping roof flushes the debris down the gutter to the rainwater tank filter, whence the debris is diverted immediately to drain or soakaway. So if, in your planning process, you have the choice of making your roof slope, we would recommend that.

2) **Chemicals**

If the building is in the lee of an industrial zone, or close to fields where insecticides might have been sprayed, then testing might show that there is a level of chemicals in the water. A **carbon filter** is necessary to absorb such chemicals. "In the lee of" includes many hundreds of miles away from the offending source; acid rain from UK factories fell in Norway in the second half of the 20th century. So please do not assume if you live "in the country" that your water will be pure.

3) **Lead or copper roofs**

Research shows that lead and copper on a roof do not make rainwater harvesting impractical. There is nothing that shows that rain off a copper or lead roof would be destructive to garden plants, nor dangerous in vegetables and fruits consumed by humans.

In general, an academic study from the Technical Research Institute of Korea (references below) has confirmed that rainwater is both soft and non-corrosive. The corrosion rate of

rainwater at different collection steps of a harvesting system was measured with other factors that may affect corrosion rate, i.e., pH and chloride ion concentration. Rainwater samples at each collection step in a typical harvesting system were taken separately: 1) directly from precipitation, 2) from roof runoff, and 3) from the rainwater storage tank. The pH and corrosion rate of rainwater at each step were measured. The pH of the rainwater taken directly from precipitation was the lowest (4.6~8.3), while the roof runoff exhibited the highest pH values (6.4~9.7). On the other hand, the rainwater taken from the storage tank showed a neutral pH range (6.7~8.4).

This soft water is ideal for washing clothes because it lets the soap or detergent act more effectively... no need to install a water softener for the washing machine if you have rainwater harvesting.

3a) Lead

The surface of metallic lead is protected by a thin layer of lead oxide, PbO. Only upon heating lead to 600-800°C does lead react with oxygen in air to form lead oxide, PbO. Therefore rainwater off a lead roof will not have significant contaminants. The effect of lead leaching into water flowing inside pipes has not been shown to occur off roofs.



<http://www.lenntech.com/elements-and-water/lead-and-water.htm>

3b) Copper

Copper is a metal that does not react with water (H₂O). It is important to note that, in contrast to the oxidation of iron by wet air, the layer formed by the reaction of air with copper has a protective effect against further corrosion. On old copper roofs a green layer of copper carbonate, called *verdigris*, can often be seen. Water running off copper components on a roof will therefore not contaminate the water. Copper traces in small quantities have not been shown to be dangerous to humans.

We can conclude that neither lead nor copper on a roof will react with rainwater in normal circumstances. However, Lenntech's FAQ reminds us that "Lead can enter the water supply as it leaches from copper pipelines. As the water streams through the pipes, small amounts of lead will dissolve in the water, so that it becomes contaminated. Lead is a toxic substance that can be quickly absorbed in the human systems, particularly those of small children. It causes lead poisoning." But this is only mentioned, in accessible research, in the context of water flowing within pipes, not on roofs. This is because on a roof, the air creates the layer of PbO. There is no air in pipes, so often no protective PbO.

<http://www.lenntech.com/drinking-water-FAQ.htm>

In any case, if you plan to use rainwater off a roof with metals or materials that can, in any circumstance, contaminate the water, you would be well advised to ask a specialist to test the quality of water.

We would also comment that the British love of flat roofs has a rainwater harvesting drawback, not just the risk of leakage! Debris like leaves and any other vegetable or animal matter will tend to accumulate on a flat roof. Its reaction with air and water, during the time it is sitting on the roof, will promote decay and bacterial action. The bacteria will subsequently enter the rainwater storage and could cause, at least, discoloration of the water. A sloping roof flushes the debris down the gutter to the rainwater tank filter, whence the debris is diverted immediately to drain or soakaway. So if, in your planning process, you have the choice of making your roof slope, we would recommend that.

4) Heavy metals, nitrates and nitrites

If tests show a presence of heavy metals, then redox alloy **cartridges** are needed.

And here are the remedies...

a) **Ultra-violet filtration**

The bulk of tests in the UK show the presence of minute quantities of bacteria (as would spring or well water) for which Ultra-Violet filtration is ideal. Ultra-violet filtration kills bacteria, but remember that the filter must be turned on 24/7 and there must be a way of warning the users that a bulb is failing or has failed. Double bulb UV filters are available, as are ones with suitable alarms. A cartridge filter prior to the UV filter ensures that bacteria do not get through the UV filter hiding behind a particle; that's what authorities might be concerned about. If the rainwater has been filtered and stored in an underground tank with rodent protection, calming device at the input and floating intake to the pump, then a second filter in line with the UV filter is not required because the water will be particle free (as with the Carat systems).

Our recommendation is to install the Carat tank system complete with its filters and other water purity devices and then fit an ultra-violet filter in the building on the rainwater arrival pipe. Your building inspector will quite rightly insist on an initial water purity test immediately after commissioning, and then a similar annual check. The most popular UV filter from RainWaterHarvesting.co.uk for use in the home are the Silverline UV-DS15 and UV-DS30 delivering 8 and 21 litres of clean water per minute for between 2 and 3 hundred pounds.

b) **Reverse osmosis**

Reverse osmosis removes everything. If a small quantity of high quality drinking water is required then a reverse osmosis plant can deliver small quantities (glass-fulls) with everything removed (including the taste).

6) **Adding chlorine and other chemicals**

Chlorination devices are suitable for specialist applications, usually where mains water is not available and the purity of water must be guaranteed (field hospitals for example) and cost in the region of £10,000. We know of nobody who extensively recommends the installation of equipment for adding chemicals to rainwater in normal domestic and commercial buildings, but it's an option.

As for the official advice, the UK Government's requirements are at <http://www.opsi.gov.uk/SI/si2000/20003184.htm>.

The World Health Organisation's recommendations are at http://www.who.int/water_sanitation_health/dwq/gdwq3rev/en/index.html

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