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How to solve the water crisis by setting up a disruptive technology

Introduction

The domestic uses of water are the most vital for man. Domestic water consumption has long been reduced, not for reasons of economy, but for reasons of availability. Depending on where people live, water may be available at home or may not be easily accessible: they should go to the source, well or fountain, go to the wash-house to clean their laundry, and to the public bath to wash. Thus, all the populations of the globe do not have the same comfort. Domestic water consumption in the world is therefore very uneven, the more so as the standard of living of the populations is high. Although it is very difficult to evaluate because of the multiplicity of uses, the total domestic water consumption in the world is estimated at 40 liters of water per day and per inhabitant on average. The disparities in its use and volume are obvious: a Malagasy farmer consumes 10 liters of water a day, a Parisian needs 240 liters (for his personal use, urban commerce and crafts, maintenance of the streets) and an American citizen, consumes more than 600 liters on average (Source: CNRS). Thus, while a French consumer consumes an average of 137 to 150 liters of water per day, the average consumption in Asia and Latin America can be estimated between 50 and 100 liters / person / day and the average consumption in sub-Saharan Africa between 10 and 20 liters / person / day.

In developed countries, water use can fall into 8 main categories:

1. Bathrooms
2. Gardening
3. Miscellaneous household (car washing, washing of the house floors)
4. Laundry
5. Shower and bath
6. Dishes
7. Cooking
8. Beverages

Water quality according to the use category does not need to be the same and the energy expended (which has ecological and economic costs) could be greatly reduced if one could use water of suitable quality for different uses. For example, it is absurd to use drinking water for the evacuation of sanitary facilities, knowing the amount of energy spent to meet drinking water standards. By defining three water qualities according to its domestic use (see Table 1 below), it is possible to reduce the ecological impact of its treatment and to reduce its economic cost. This quality must be directly related to its food use; hygienic or not.

Table 1: the different qualities of water recommended according to its domestic use:

Water quality	Composition	Use
Non-drinkable water	Water, Colloidal material Inert particulate fraction Mineral (clays, silt) Organic (polysaccharides, proteins, RNA,) Living fraction (viruses, bacteria, plankton) Dissolved substances Minerals (metal ions ...) Organic (amino acids, fatty acids, humic / fulvic acid, pesticides, medicines ...)	1. Toilets 2. Gardening
Disinfected water	Water, Colloidal material Inert particulate fraction Mineral (clays, silt) Organic (polysaccharides, proteins) Dissolved substances Minerals (metal ions ...) Organic (amino acids, fatty acids, humic / fulvic acid, pesticides, medicines ...)	1. Miscellaneous household (car washing, washing of the house floors) 2. Shower and bath
Potable water	Water, Traces of mineral elements	6. Dishes 7. Cooking 8. Beverages

A radical change in the treatment of water would ensure the economic development and health security of citizens.

The Water Quality

The composition of both surface water and groundwater varies greatly from one region to another and depends on a multitude of parameters. Detergents, solvents, pesticides, nitrates, and drugs: all these pollutants end up to varying degrees in the environment. In France, however, treatment plants stop 85% of the 33 pollutants considered as priority by the Water Framework Directive, which requires the reduction or disappearance of these substances in aquatic environments. Thus, the study of 100 compounds sought in 2,000 samples of wastewater, taken from 21 sewage treatment plants in France, shows that many pollutants escape the meshes of the filtration systems ?. Either because they resist the types of treatments conventionally implemented; or because they are present in such large quantities that the 17,700 sewage treatment plants in Metropolitan France can only eliminate some of them, or because they are not regulated (Source: Amperes research report on water pollution, 2010). In the camp of these refractories are metals such as Li, B, V, Co, As, Rb, Sb, as well as herbicides such as diuron or glyphosate, as well as drug residues such as antidepressants. However, these medicinal micropollutants are not regulated since medicines are not considered as harmful products, whereas their impact on human health at these doses, and in relation to the multiple interactions, remains totally unknown. A total of 25% of the detected substances are not disposed of in sewage treatment plants - and as a result are found in river waters - and 50% are only partially recovered. These include solvents, plasticizers, detergents, pesticides or aspirin, the impact of some of these pollutants being totally unknown. This situation is not specific to France and may even become very worrying in other regions of the world.

More than 63 measurable parameters can be counted to determine water quality. These parameters define the standards of the European Union (1998) or those of the WHO (1993). A quick comparison between these standards includes parameters in the WHO standards that are not found in European standards and shows more stringent requirements of European standards for other parameters (see Table 2 and 3).

Table 2: Comparison of some more demanding parameters required in the WHO standard

Substance	WHO Standard	EU standards
Cadmium (Cd)	**0.003 mg/l**	**0.005 mg/l**
Molybdenum (Mo)	**0.07 mg/l**	**Not mentioned**
Nitrogen (total N)	**50 mg/l**	**Not mentioned**
Uranium (U)	**1.4 mg/l**	**Not mentioned**
Zinc (Zn)	**3 mg/l**	**Not mentioned**

Table 3: Comparisons of some parameters more demanding in the European Union standard

Substance	WHO Standard	EU standards
Oxidizing power		**5.0 mg/l O_2**
Ammonia (NH4)	**No guidelines**	**0.50 mg/l**
Barium (Ba)	**0.3 mg/l**	**Not mentioned**
Bore (B)	**0.3 mg/l**	**0.001 mg/l**
Brome (Br)	**No guidelines**	**0.01 mg/l**
Cyanide (CN)	**0.07 mg/l**	**0.05 mg/l**
Sulfate (SO4)	**500 mg/l**	**250 mg/l**
Escherichia coli	**Not mentioned**	**0 in 250 ml**
Enterococci	**Not mentioned**	**0 in 250 ml**
aeruginosa	**Not mentioned**	**0 in 250 ml**
perfringens	**Not mentioned**	**0 in 100 ml**
bacteria coliform	**Not mentioned**	**0 in 100 ml**
Number of colonies at 22°C	**Not mentioned**	**100/ml**
Number of colonies at 37°C	**Not mentioned**	**20/ml**
Acrylamide	**Not mentioned**	**0.0001 mg/l**
Benzene (C_6H_6)	**Not mentioned**	**0.001 mg/l**
Benzo(a)pyrene	**Not mentioned**	**0.00001 mg/l**
Iron (Fe)	**No guidelines**	**0.2mg/l**
1,2-dichloroethane	**Not mentioned**	**0.003 mg/l**
Epichlorohydrin	**Not mentioned**	**0.0001 mg/l**
Pesticides	**Not mentioned**	**0.0001 mg/l**

Pesticides - Total	**Not mentioned**	**0.0005 mg/l**
PAHs	**Not mentioned**	**0.0001 mg/l**
Tetrachloroethene	**Not mentioned**	**0.01 mg/l**
Trichloroethene	**Not mentioned**	**0.01 mg/l**
Trihalomethanes	**Not mentioned**	**0.1 mg/l**
Tritium (H3)	**Not mentioned**	**100 Bq/l**
Vinyl Chloride	**Not mentioned**	**0.0005 mg/l**

A disruptive technology

In the developing countries, there is a well-off social class wishing to enjoy a level of comfort comparable to that of developed countries. If the cost of an individual production-oriented technology supplying drinking water and running water is within the financial reach of this fraction of the population, it is very likely that it will not hesitate to finance a system from which it benefits in priority and which will benefit the less fortunate populations by means of a lower financial contribution which will help them to make return their investment. The proposed solution is therefore the decentralization of water treatment systems with a pooling of individual resources.

The economic shortage of water is caused by a lack of investment in water infrastructure or insufficient human capacity to meet the demand for water in areas where the population cannot afford to use an adequate source of water supply. Symptoms of economic water shortage include a lack of infrastructure: people often have to get water from rivers or lakes for domestic and agricultural use (irrigation). Although the emphasis is on improving domestic and consumer water sources, evidence suggests that much water is reserved for other uses (such as bathing, washing, livestock and cleaning) not only for drinking and cooking. This suggests that too much emphasis is placed on drinking water requirements, which meets an insignificant part of the water resource problem and thus limits the range of solutions available. Large parts of Africa are suffering from the scarcity of economic water; the development of water infrastructure could therefore contribute to poverty reduction. Investing in water retention and irrigation infrastructures would also help increase food production, particularly in developing countries, which depend heavily on low-yielding agriculture. Being able to provide a community with adequate water for consumption would also benefit the health of the population. Overcoming this type of shortage may require more than new infrastructures; it requires socio-economic and socio-political interventions that address poverty and socio-economic inequalities in relation to the lack of funding opportunities.

Conclusions

The proposed breaking technology is capable of producing several dozens of liters of water per day. This water is released from all toxic substances, including persistent substances (pesticides, medicines).... This technology is able to separate at the source of the treatment, three qualities of water:

1. water that has undergone screening and sifting, this water being dedicated to unsanitary use (sanitary, gardening, etc.)

2. disinfected water (free of bacteria, viruses, parasites) but which may contain dissolved toxic substances, this water being dedicated to washing, body washing and all activities not related to food
3. drinking water, free from the vast majority of toxic, persistent and pathogenic substances through heat treatment.

It is possible to model the volumes involved by following the French model (see Table 4). It can be seen that the volumes involved for the consumption of drinking water are compatible with the production capacity

Table 4: Modeling daily water consumption according to its quality

Activity	Consumption	Need for quality	% of need	Volume Developed nations	Asia and Latin America	Sub-Saharan Africa
Toilets	20 %	Non drinkable water	Non drinkable water 32 %	44 -48 L	16 – 32 L	3,2 – 6,4 L
Gardening	6 %	Non drinkable water				
Domestic various (car, home)	6 %	Non drinkable water				
Laundry	12 %	Disinfected water	Disinfected water 51 %	70 - 76,5 L	25,5 – 51 L	5,1- 10,2 L
Showers and baths	39 %	Disinfected water				
Dishwashers	10 %	Drinking water	Drinking water 17 %	23,3 - 25,5 L	8,5 – 17 L	1,7 – 3,4 L
Cooking	6 %	Drinking water				
Drinking water	1 %	Drinking water				