

LIQUID ENGINEERING

– HOW TECHNOLOGY
CAN HELP COMBAT WATER SCARCITY

We take it for granted, and it's so cheap that most of us barely notice the cost. Yet clean water is our most precious resource – and one that's becoming increasingly scarce. One in nine people worldwide lacks access to safe drinking water and rising demand is outpacing supply in some parts of the world. But smart new technologies hold out hope we can tackle the growing water crisis.

TEXT: **GREG MCIVOR** PHOTOS: **GETTY** ILLUSTRATION: **HANS VON CORSWANT**



THEME WATER



There are roughly

1.38 bn
cubic km of water
on the planet



**Total water withdrawal
per capita, highest and lowest:**

United States of America
1,630m³ per year

Democratic Republic of the Congo
11m³ per year

When Hollywood star Tom Selleck found himself accused of water-stealing this summer, the news travelled far beyond

his home state of California, currently enduring its fourth year of severe drought. The case, which the ex-Magnum actor settled out of court, underlined how water scarcity knows no boundaries and can afflict the wealthiest societies as well as the poorest.

Around 880 million people are without access to safe drinking water and 2.5 billion lack basic sanitation. Astoundingly, more people own a mobile phone than have access to a working toilet. Bad water causes more than 2 million deaths a year, most of them children.

Such statistics have prompted the United Nations to declare access to clean, safe water a human right. But fulfilling that right is getting ever harder. Over the next 50 years, population growth, urbanisation and changing lifestyles will require 55 per cent more water than currently available.

AS THE GLOBAL population soars and agriculture – by far the largest consumer of water – expands to feed our constantly growing towns and cities, intensive extraction is depleting water tables from the US to India and China to Brazil.

According to McKinsey, by 2030 water supplies will satisfy only 60 percent of global demand, and less than 50 percent in many developing regions where water supply is already under stress.

“We must transform the way we think about water. By 2025, 1.8 billion people will be living in regions without enough water. Water scarcity is the greatest challenge we face today,” says Peter Brabeck, chairman of the Swiss multinational Nestlé.

How to respond? The starting point, Brabeck believes, is to put a proper value on water. “We need to start recognizing that water is a precious resource. It needs to be better managed, better valued and better preserved.”

“We’ve made enormous progress improving the water supply. But you’re always playing catch-up as you try to reach the last billion people on the planet.”

ADRIAN McDONALD, PROFESSOR OF GLOBAL WATER SECURITY AT THE UNIVERSITY OF LEEDS.



One way is to use water more efficiently. Even in developed countries like the UK, many homes lack water meters. This means people can use as much water as they like at no extra cost.

Adrian McDonald, professor of global water security at the University of Leeds, notes that metering rates are gradually improving, in the UK at least, but stresses wide-ranging measures are needed – at global level – to tackle water scarcity effectively.

“We’ve actually made enormous progress,

improving the water supply to tens of millions of people. But the population has been increasing at roughly the same rate so you’re always playing catch-up as you try to reach the last billion people on the planet.”

There is no magic bullet and a raft of initiatives is needed. These include making supply more resilient, reducing inequalities in access to water and sanitation services, strengthening systems and planning, and promoting sustainable development by integrating water, sanitation and hygiene with water resource and waste management.

Across these areas, technology has a pivotal role to play – whether in the home, in industry or in water distribution systems. At household level, waterless toilets are just one of multiple innovations that can help to improve hygiene and reduce water use. Toilets account for some 30 percent of household water use. Each flush of a conventional toilet requires 11 litres of water.

One of prime movers is the Bill and Melinda Gates Foundation, whose Reinvent the Toilet Challenge aims to bring sustainable sanitation to the 2.5 billion people lacking safe, affordable sanitation by introducing innovative toilet systems that do not require water.

Such toilets are already being used in Africa, including in Kenya and Uganda, and scientists want to expand their use to India and China. One toilet, developed by scientists at the University of Colorado Boulder, uses solar power to transform faeces into biochar that can then be used as agricultural fertiliser.



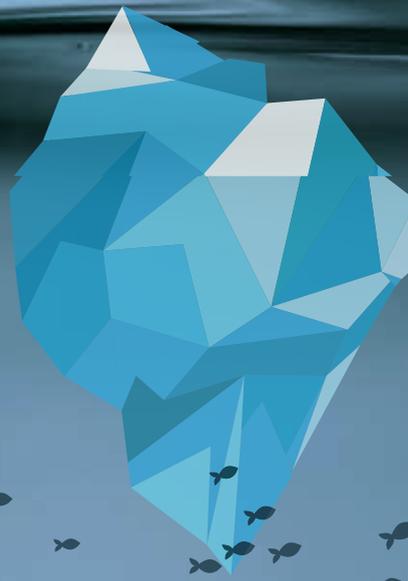
1% of all the world's water is drinkable (two-thirds of freshwater is inaccessible)



One in 9 people lacks access to an improved water source (i.e. tap)



97 percent is salty and non-drinkable and 3 percent is freshwater



Antarctica stores

90% of the world's freshwater

About

3,600km³

of water is withdrawn for human use annually



70% irrigation



20% industry



10% households



It takes about

11,000

litres of water to make a single pair of jeans

2/3 of the water used in the average home is used in the bathroom



WATER PURIFICATION IS another key area. One of the more ingenious innovations currently being touted is a vortex bioreactor developed by Plymouth Marine Laboratory (PML) in the UK and part-funded by the Bill and Melinda Gates Foundation.

Currently being tested in India, the bioreactor decontaminates wastewater by spinning it through beads of copper alloy – a process that destroys bacteria.

Mike Allen, microbial biochemist at PML, believes it has the potential to revolutionize the treatment of wastewater in the developing world.

“The beauty of the system is it’s completely scalable: we can design and build systems that work at the toilet block, village or city scale depending on the requirement. Depending on the size of the system, it can be driven by hand, bicycle or by motor,” he says.

Erik Harvey, a specialist at the global non-profit organisation WaterAid, adds: “What really impresses me [with the vortex bioreactor] is that you’re taking 100 litres of water at one end and purifying it in the space of a few minutes and essentially with no chemical input. This is highly unusual.”

More established technologies, including micro and ultra filtration and reverse osmosis (also used in desalination), are already part of the water purification armoury.

“Increasingly, we are seeing a lot of innovation in this space in terms of making water clean, available and potable. This is both on the recycling side – getting used water back into use in a way that is eco-friendly and quick – and also closing the gap

by increasing supply, for instance through desalination and using sand dams to harvest rainwater in areas like the Sahel in Africa,” Harvey says.

In agriculture, Adrian McDonald highlights the bioengineering of water-efficient plants, drip irrigation technologies and the use of only partially cleansed water as ways to enhance water husbandry.

The great paradox of the water crisis is that there is more than enough fresh water in the world to meet everyone’s needs. Indeed, we only use a tiny proportion of available fresh water. The problem is that the water is not available in sufficient quantities where people need it.

ON THE DISTRIBUTION SIDE, man has been moving water from one place to another since the Romans built their aqueducts 2,000 years ago. More adventurous solutions in a modern context range from transnational water pipelines to towing Antarctic icebergs to arid nations.

But such arrangements are expensive and energy-intensive. Increasing supply through transporting surface water or drilling deep wells will be extremely difficult and expensive, warns Giulio Boccaletti, a former McKinsey partner who now leads the Nature Conservancy’s global freshwater programme. More likely, he says, governments will need to manage demand by raising the price of water or by capping the amount of it that users can draw.

Doing this in tandem with smart technologies that save water and treat it more effectively offers our best chance of meeting the global water challenge.



Things you may not know about water:

■ Your bones are composed of 31% water

■ Hot water is heavier than cold water

■ There is a reservoir of water in space that has 140 trillion times more water than the world’s oceans, according to Nasa.

■ Water itself does not conduct electricity well but the impurities in it do.

■ Your probability of finding in any glass of water at least 1 molecule of water once drunk by Cleopatra is practically 100%.

■ Water is light turquoise-blue due to weak absorption in the red part of the visible spectrum.

CLEAN WATER IS A HUMAN RIGHT – AND AN OPPORTUNITY

“It’s sobering to know that so many people lack the right to clean water, something that’s a basic need for survival,” says Catarina Paulson, Alfa Laval Head of Corporate Social Responsibility.

As water security climbs up the global agenda, the United Nations has made “the availability and sustainable management of water and sanitation for all” one of its new goals for achieving sustainability by 2030.

Alfa Laval aims to play its part in helping to achieve this target in a variety of ways, Catarina says. “Knowing that Alfa Laval has products that can help clean wastewater and reduce the water used in processing gives me hope.”

She adds: “We also have to take care of how we do things and consider this in the way we manufacture, sell and service all our products. Even if Alfa Laval’s own relative use of water is very low in our production process, we work to use water even more efficiently, especially in areas where water is scarce.”

INDUSTRIES ARE FACING increasing challenges in accessing clean water and disposing of wastewater, says Thomas Møller, Alfa Laval Segment Manager, Process Water & Waste Treatment. The lack of clean water is both due to water scarcity and because the water that factories extract from watercourses for use in production is increasingly dirty due to rampant pollution.

“River water in China, India and many countries is a very different animal from 10 years ago. Earlier, you could maybe take up groundwater that was perfectly clean, but surface water is much more polluted now. Your water intake system has to be quite sophisticated over multiple steps compared to in the past. This situation, combined with tougher legislation on wastewater disposal, also drives business cases for water re-use,” Møller says.

This explains the growing demand for technologies that can purify water before it enters the industrial process or recover clean water from effluent.

For instance, India in 2015 set a three-year target to rejuvenate the chronically polluted River Ganges by installing sewage treatment plants and adopting zero liquid discharge technology (ZLD), which reuses all industrial wastewater (after appropriate treatment) without discharging a single drop into any river.

IN THEIR QUEST for clean input water, countries from China to Australia and regions from South East Asia to Europe are investing billions of dollars in

desalination – a former niche industry now expanding rapidly.

Technology has developed so far that the major challenge today is not so much how to purify water and wastewater but how to do it affordably. “There are technologies available that clean the dirtiest water you could ever imagine. But it comes down to what is the most cost-efficient way of doing it, and

that’s where the big innovation driver is,” Møller says.

“There are so many embryo technologies around and literally thousands of projects and billions of euros being spent on R&D. The end use is also very important – whether you want the water for drinking, food processing and cleaning or for oil and gas refining and process industries. All these have very different demands on water quality. There is no single solution that fits all.”

Here, Alfa Laval offers a wide spectrum of solutions – from desalination and water supply systems to biological wastewater and sewage sludge treatment and systems for enhanced water efficiency and ballast water treatment.

“We have a lot of products that will fit into UN’s new sustainable development goals,” Paulson says.

“On the business side, it’s an opportunity and on the human rights side it’s a way of acknowledging that access to clean water is something we simply must work towards.” ■



Thomas Møller and Catarina Paulson