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Micropollutants: Tiny particles with toxic potential

Traditional water treatment technologies are not designed to treat micropollutants

Micropollutants (MP) are the by-products of convenience in modern life. They are small chemical and biological compounds used in the millions of products produced by advanced economies. Conventional water treatment technologies are not designed to treat MP and their concentrations are increasing in ground waters and aquatic environments. Marine life are already suffering negative effects. Humans could follow.

Fortunately, cost-effective technologies exist.

From obscurity to ubiquity

Though microscopic, micropollutants (MP) have out-sized potential for wreaking havoc on ecosystems and human health. They are tiny chemical and biological particles that make their way into the waterways of an increasingly sophisticated developed world. To the experts, they bear obscure names like Atenolol, Clarithromycin, Diclofenac, Diethyltoluamide, Isoproturon, Acesulfame and Methyl-benzotriazole.

We know them by their end-products — beta-blockers, antibiotics, anti-inflammatory drugs, fertilizers, insecticides, artificial sweeteners, laundry detergent. They are used to save lives, ease pain, enhance taste, protect crops, and promote well-being, alongside a host of other attributes of modern life.

More than 143,000 chemical compounds were registered for commercial use in the EU alone.[1,2] The US Toxicology Program reported 80,000 registered chemicals with an estimated 2,000 added each year.[3] The list grows longer when you consider that new combinations are formed when these "registered compounds" are released in nature.

Major sources of micro-pollution

Households alone flush or dump 70% of the pharmaceutical-related MP present in municipal waterways.[4] In the same way chemicals from personal care and cleaning products enter the system. Other sources include herbicides and insecticides from agricultural effluent as well as wastewater from industrial sources used to manufacture things like textiles and tires, paints and plastics, fuels and fragrances.

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Conventional waste water treatment systems were never designed to detect and filter these micro-sized contaminants, which means MP concentrations in oceans, ground water, estuaries, and even drinking water are increasing. With dwindling clean water supplies, water recycling and re-use will increase and micro-pollution along with it.

Damaging effects

Biological MP can be blamed for spreading antibiotic resistance in organisms, animals and humans—the UN estimates deaths from drug-resistant infections will rise to 10 million by 2050.[5] Other micropollutants like endocrine disruptive chemicals (EDC) in wastewaters are responsible for estrogenicity (or "feminization") of fish in marine environments and chemically-induced genetic mutations. They also impact the genetic integrity of DNA in organisms – a condition known as genotoxicity. EDCs are commonly found in pesticides, metals, food additives, and personal care products.

Though evidence is still inconclusive, in humans, EDCs have the potential to alter reproductive health, increase the incidence of cancers, impair immune systems, and delay neural-developmental in children.[6] The World Health Organization believes the human health risks of EDCs may be significantly underestimated.[7] Known MP effects on marine life and the environment are concerning, but the unknown effects are even more distressing. Many fear we are releasing lethal compounds that could have catastrophic consequences for human health and ecosystems.[8]

A view from the ground

Typical waste water and sewage water plants were designed for treating large particulate pollutants. As a result, most treatment plants are not equipped to filter and prevent the release of smaller and smaller MP into water environments. As a result, water treatment plants themselves have become major source points for MP in industrialized countries. As populations and economies grow, MP concentrations and pollution levels will increase in step without intervention.

Moreover, many industrialized nations are unable to cope with even traditional water pollutants. The UK's water utilities were recently told to clean up their act after reports showed heightened pollution

levels in rivers, ground water and drinking water. [9] Next to these, micropollutants represent an even bigger challenge.

Meanwhile, across the Channel, governments are worried about water quality. The EU Commission announced proposed revisions to its outdated drinking water directives which involve higher quality, tighter controls and greater public access to water data.[10] Even Switzerland, with arguably the world's highest water quality, carried out a study between 2006-2010 that resulted in regulatory changes and investments in MP removal technologies.[11]

Emerging Markets—Sinking further and faster

As industrialization expands to developing economies—already grappling with water shortages and water pollution—the outlook is worsening by the metric^3 volume. According to Global Risk Insights, more than 90% of China's underground aquifers, supplying the country's drinking water, are polluted. India—another high growth country—shares a similar gloomy outlook.[12]

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Long-term trends like population growth, urbanization, and industrialization ensure that water shortages in emerging markets will persist. Treated wastewater is already an important strategy for reducing water stress in emerging markets. But as in developed markets, current MP loads in wastewater will only add to water toxicity if investments in the right technologies are not made.

The regulatory solution

Given their ubiquitous use and obvious benefits for health, business and society, MP bans are not politically or economically viable. MP in the form of fertilizers, herbicides and other organic materials provide valuable protection for crops and livestock that ensures food for billions. Similarly, banning certain MP would deny life-saving drugs and wellness-enhancing products to billions of patients and consumers worldwide.

Moreover, the regulatory hurdles are notoriously difficult and the process long and convoluted. Recall the recent failed attempt to ban the now infamous micropollutant, glyphosate.[13]

Advanced Solutions to reduce micro-pollution

A better approach is to reduce MP and prevent their entry into natural and municipal waterways at their source points (i.e. wastewater treatment plants). Fortunately, water treatment technologies have advanced over the past decade and a number of alternatives are available including: reverse osmosis (RO), advanced oxidation (ozonation), membrane bioreactors, powdered activated carbon adsorption (PAC), and ultraviolet disinfection (UV).

Of these, scientific and industry studies confirm and favor, PAC and ozonation as the most *cost-effective* and *technologically-feasible* technologies for the job.[14]

In the short-turn, additional investments to upgrade existing water infrastructure will incur costs. However, maintenance upgrades to current systems even in the absence of MP would also be necessary while far less effective at reducing the toxicity of effluent. Seen in this way, investments in MP reduction technologies like ozonation and PAC are extremely cost-efficient.

In contrast, the cost of inaction for life under the sea and life on land may be too high to ignore.

We invest in the companies that ensure our water cycle flows smoothly so that society can function optimally and planetary life can flourish abundantly.

Dieter Küffer, CFA
Senior Portfolio Manager

> The water theme offers long-term growth opportunities that are already materializing including investments in wastewater treatment technologies.

> For more information visit:
www.robecosam.com/en/sustainability-insights/focus-themes/water

Endnotes

1 Micropollutants in Wastewater: Fate and Removal Processes, S. Das, N.Mitra Ray et al., Chapter from book, Physico-Chemical Wastewater Treatment and Resource Recovery

2 For a comprehensive listing of registered chemical substances within the EU https://echa.europa.eu/information-on-chemicals/registered-substances

3 US National Toxicology Program, US Department of Health and Human Services, https://ntp.niehs.nih.gov/about/

4 Reducing the Discharge of Micropollutants in the Aquatic Environment: The Benefits of Upgrading Wastewater Treatment Plants, Environmental Science & Technology, 2014, 48, 7683-7689

5 Antibiotic waste is polluting India and China's rivers; big pharma must act, October 25, 2016

6 Report on the State of Science of Endocrine Disrupting Chemicals 2012, World Health Organization

7 Ibid, p. 22

8 UN Environment Programme (UNEP), Global Chemicals Outlook: Towards sound management of chemicals, 2012

9 Water companies warned on failure to reduce pollution incidents, Financial Times, February 19, 2018

10 Available at http://ec.europa.eu/environment/water/water-drink/review_en.html

11 Reducing the Discharge of Micropollutants in the Aquatic Environment: The Benefits of Upgrading Wastewater Treatment Plants, Environmental Science & Technology, 2014, 48, 7685-86

12 Water Wars: China's new weapon against India, September 26, 2017, Global Risk Insights

13 Glyphosate, Top-selling Weed Killer, Wins EU Approval for 5 years, New York Times, November 27, 2017

14 Reducing the Discharge of Micropollutants in the Aquatic Environment: The Benefits of Upgrading Wastewater Treatment Plants, Environmental Science & Technology, 2014, 48, 7686

About RobecoSAM
Founded in 1995, RobecoSAM is an investment specialist focused exclusively on Sustainability Investing. It offers asset management, indices, impact analysis and investment, sustainability assessments, and benchmarking services. Together with S&P Dow Jones Indices, RobecoSAM publishes the globally recognized Dow Jones Sustainability Indices (DJSI) as well as the S&P ESG Factor Weighted Index Series, the first index family to treat ESG as a standalone performance factor using the RobecoSAM Smart ESG methodology. As of December 31, 2017, RobecoSAM had client assets under management, advice and/or license of approximately USD 20 billion.

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