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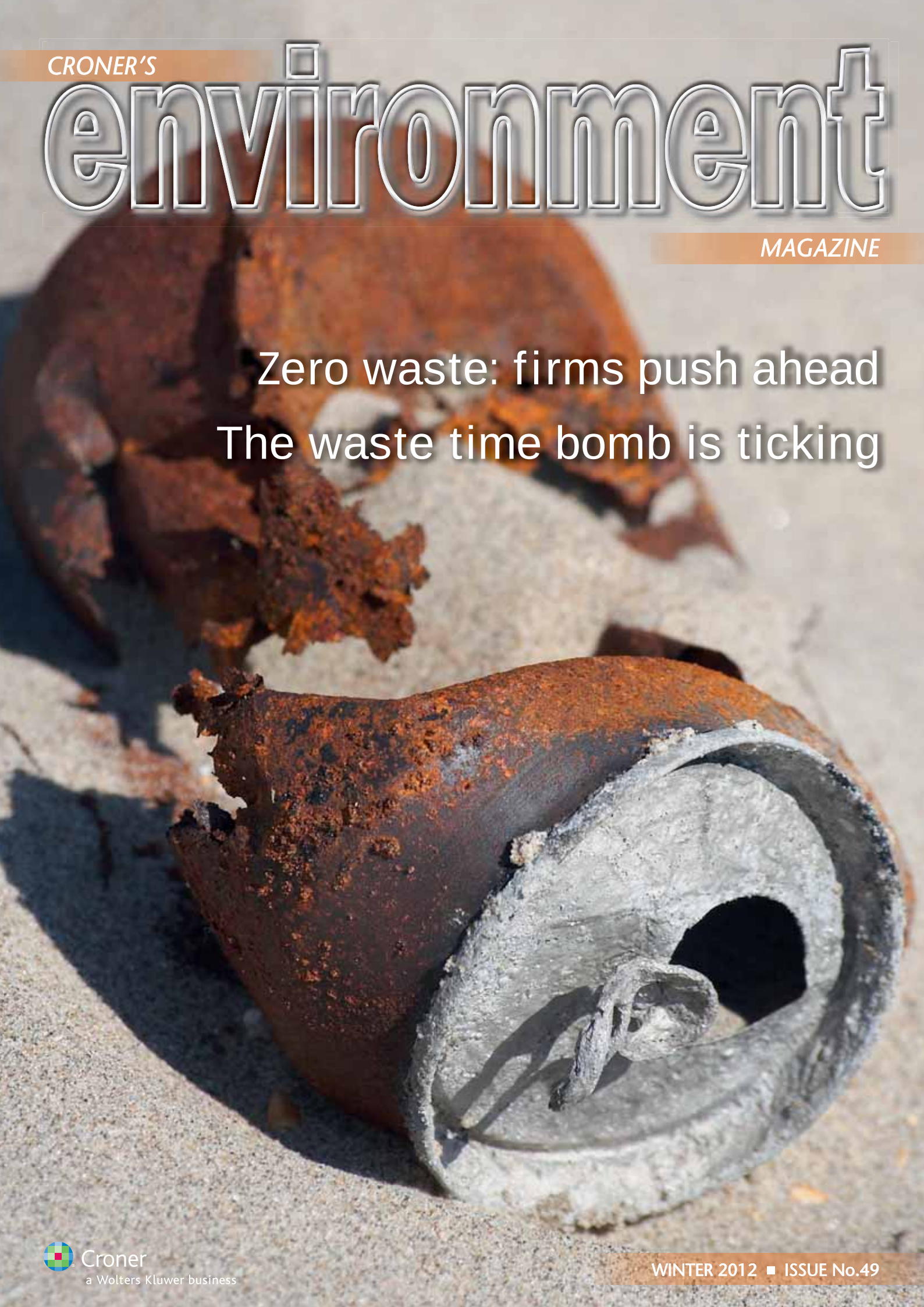
MAGAZINE

Zero waste: firms push ahead

The waste time bomb is ticking



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The waste time bomb within us

For eons, nature has worked hard refining all life on this planet to the highest engineering standards. We may be threatening that vital relationship: waste is invading our lives to a very personal level. ***Jon Herbert*** considers the implications.

Pollution has been a growing concern since the mid-twentieth century. But the degree to which our synthetic society could now be affecting us on an individual organic level has become concerning, if not frightening.

Gradually, the full implications of tinkering boldly with the world around us are becoming clearer. We affect the environment. We are the environment. Waste is part of us from birth to death. The question is, how is it changing our longevity and well-being? The ability to detect the path of worrying elements in miniscule quantities is giving us new insights.

There is increasing evidence that our current rate of progress may be creating "3D" contamination with the potential for future genetic mutations that we cannot possibly understand.

The stuff bad dreams are made of

It was perhaps inevitable that while attacking many of our natural microscopic foes with new chemical formulations, increasing the sophistication of industrial processes, developing new medical products and, ironically, making life in general safer — as in the case of fire retardants — we have, little by little, let the by-products of progress seep into every aspect of the place where we live.

While developing in the womb, the average child is now subject to a complex chemical cocktail. This is likely to include bisphenol A taken in from "harmless" food and drink containers, phthalates found in PVC and other plastics, perfluorinated chemicals (PFCs), common about the house and used in non-stick pans, polychlorinated biphenyls (PCBs), now banned but once used in electrical equipment, and organochlorine pesticides (OCPs), also banned but persistent in the food chain. Other less than desirable substances are taken in during breast feeding.

Micro threats on a macro scale

One problem is that so many of the chemicals released into the environment are relatively new. Many have only quite recently begun to accumulate. There is no evidence yet of the effect of high concentrations, particularly where chemicals may morph and change over time before becoming embedded stably. In the absence of evidence, rumours persist. A current example is dark rumours emerging from the virgin "taiga" forests of eastern Siberia's Altai region. Local people rely on the untouched wilderness and their vegetable plots for their daily needs. Their lives are remote and isolated, except for the jettisoned first-stage parts of Proton space rockets used regularly to launch satellites into orbit from the Baikonur cosmodrome far to the west in Kazakhstan. Broken parts lie hidden in the endless trees.

Villages claim to suffer from an excessive occurrence of anaemia, allergies, sore throats, skin disease, high blood pressure, headaches and cancers. They attribute this to the release of the highly toxic rocket fuel component, unsymmetrical dimethylhydrazine (UDMH). This is known to penetrate soils, water, plants and animal tissue, causing burns, breathing problems, damage to the central nervous system and tumours.

Separating fact from fear is difficult. The local people complain about a complete lack of information. Russia's space agency says no significant level of toxicity has ever been found in the Altai forest. But if things vanish it doesn't mean that they have gone away.

Closer to home

Atrazine is a weed killer that has been used widely for some 50 years. Although thousands of scientific tests carried out on the crop protection product have not shown a link to the increased occurrence of gastroschisis in the young, US research has suggested that there might be a connection. Normally the condition, which causes the digestive tract to develop outside the abdomen, is found in only one in 7000 babies.

Now a group of mothers in the south of England living within a few hundred yards of each other fear that the abnormality in their children is caused by the chemical. They attribute dangerously high levels of atrazine found in groundwater tests near their homes for the non-hereditary condition which has resulted in long-term medical complications.

The high number of incidents must have an environmental cause, they argue. Atrazine was banned by the EU in 2004 to prevent it contaminating groundwater and drinking water. Again, it is the lack of information that is upsetting residents.

Testing times ahead

In recent years, there has been a rise in the number of research studies probing links between persistent chemicals and human, animal and plant well-being. What many feel is a major chink in the armour was the Government's decision to close down the Royal Commission on Environmental Pollution (RCEP) and save its relatively modest funding in 2011 as part of a drive for public spending efficiency.

One of the RCEP's strengths was its ability to act independently in gathering and creating information on which well-informed advice could be based. There is now broadening concern that we lack a dependable source of authoritative scientific advice on which government policy can be based confidently across many environmental issues.

In 2007, the EU introduced a comprehensive system to regulate the hazards associated with all chemicals used in industry and manufacturing. REACH (Registration, Evaluation and Authorisation of Chemicals) is expected to embrace some 30,000 individual compounds in common daily use; the world total is even higher, at an estimated 100,000.

Testing is a slow process. To date, only 3000 to 4000 compounds have been examined in depth, and then often with tests on an individual representative species of each living domain.

What kind of chemicals assail us now and where are we exposed to them? The answer can be as simple as contact with certain kinds of plastic containers. The near universal adoption of plastics is being tempered with new suspicions of what they might be doing to us deep inside.

We are grateful for new medicines. Yet the residues of common, over-the-counter painkillers, along with micro-leakages from manufacturing and distribution, are now found in measurable quantities throughout the environment. Vegetables contain vestiges of common drugs. The consumption of medicine is set to rise dramatically.

Rogues gallery

A leading culprit is bisphenol A (BPA). Used in the production of food and drink cans, plastic tableware, white dental sealants, lenses, phone and computer cases and even till receipts, it is already banned in babies' bottles. This is because infants in the womb and soon after birth are especially vulnerable to this endocrine disrupter, which is absorbed through food and perhaps via the skin and breathing in dust. Its detrimental effects are associated with

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reproductive problems, brain and immune system damage, diabetes, obesity and cancer.

Brominated flame-retardants (BFRs) have already been distributed widely across the North Sea from one land-based source. Their benefits can be seen in fire-safe textiles and furniture products, carpets, and electronic products. The downside is that they endure in air, water and soil and have been found in human blood, body fat and breast milk across the world. It is feared they can cause liver, thyroid and skin damage and may be carcinogenic. In animals they are known to affect reproductive and brain functions and to cause nervous system damage.

Worryingly, BFRs have been found in every type of food and, once ingested, can lie in body fat for years. Embryos can absorb them through the placenta.

Phthalates are also potential endocrine disrupters. While many are harmless, others are linked to lower male fertility, premature breast development in girls and reproductive abnormalities for boys, who absorb them through the womb. Diethylhexyl phthalate (DEHP) is a near universal long-term contaminant in soil, water, domestic dust, fish and animal life that could cause liver and kidney damage in the young.

Non-stick pans may make life easier. But through their use of PFCs, they could pose a direct threat to most of us. Endocrine disrupters are linked to birth defects, liver and thyroid damage and cancer; they also appear in waterproof clothing, paper coatings and floor wax products.

OCPs and PCBs have long had a bad name but are still with us. OCPs are no longer permitted in agriculture but persist in the ground for decades and accumulate in bird, fish, mammal tissues and food chains. The EU banned PCBs, which were used in electrical equipment extensively through the 1970s. They are probably carcinogenic and linked to vital organ and immune system damage, and every one of us has detectable amounts in our blood and fat that can be taken in as airborne particles or food.

Even scented perfumes, soaps, toiletry products, domestic cleaners, air fresheners,

detergents and fabric softeners harbour a dark side. Almost all contain synthetic musks that accumulate in living tissue after being absorbed through the skin.

What else might lurk in this complex probability soup? A group of persistent organic pollutants (POPs) includes some of the most toxic chemicals such as DDT, dioxins and PCBs. Statistics from a US national health survey showed that people with the highest POP concentrations are nearly 40 times more likely to develop diabetes than those with low concentrations.

Nano problems

Perhaps the greatest storehouse of unknown problems ahead of us lies in the incredibly small-scale world of nanotechnology. Arguably, the Internet and microchip technology aside, nanotechnology could prove to be the most far-reaching development that man "the industrial ape" has ever invented. One problem is the sheer number of nanoparticles being created — it is estimated that these could total nearly a third of a million for every one of the world's seven billion-plus population.

Another is the reality that properties that materials display on a normal or even micro-scale are not necessarily the same at a nano-scale. An example is gold. Valued for its inertness and stability as a precious metal, on a very small scale individual gold particles can be aggressive, to the extent that they kill cancer cells.

Yet another problem is that it is unclear what nanoparticles lying around in the environment for long periods will get up to with each other and other elements. Will they combine and vanish conveniently, or will they pose new invisible problems for the foreseeable future?

Nanoparticles just millionths of a millimetre across from two widely used horticultural chemicals have recently been shown to spread throughout the whole body of common crop plants where they could affect plant development and soil fertility. A University of California study has tested their effect on the growth of soybean — the world's fifth largest crop.

The first agent, zinc oxide, starts its journey in cosmetics before ending up in the solid component of sewage treatment where it can be widely used as an organic fertiliser. The second is cerium oxide, used in some diesel fuels to improve combustion and reduce hazardous particulate emissions.

Tested soybeans were grown in soil with increasing amounts of both agents and their dispersion throughout the plants was then tracked carefully. Plants with zinc oxide grew slightly better but accumulated in their edible parts nanoparticles shown to be toxic to mammalian cell growth under laboratory conditions. Effects on whole human bodies have yet to be examined closely.

Cerium entered plant roots. The roots of legumes host bacteria that fix atmospheric nitrogen in a form that helps plants to grow. Cerium nanoparticles appeared to block the ability of bacteria to fix nitrogen.

One fear is that a build-up of soil-based nanoparticles that inhibit crop growth could call for even more synthetic fertilisers. Yet the lure of nanotechnology is just so great that perhaps we won't be able to resist its economic benefit. For example, nano super-thin paints could make aircraft much lighter, much more fuel-efficient and, therefore, much more carbon friendly. But at what hidden cost?

I can't spy with my little eye

Nanoparticles already enter the environment in upwards of 1000 different products, including cosmetics, hair care products, textiles and fuel additives. There are currently no central records.

The Organisation for Economic Co-operation and Development is working towards developing tests for a limited number of nanomaterial categories. But the time taken to complete each successfully, versus the immense number of potential nanomaterials that could exist, threatens to make this a drop in the ocean.

Future history may prove our fears to have been allayed. The millennium bug never materialised. It could even be that vast accumulations of nanoparticles in the decades ahead neutralise each other, forming larger particles that have a more natural chemistry.

Let's hope so. Because hope — and intelligent vigilance — are probably our greatest protection at present. We may just have more to fear than fear itself. ■

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