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Perspective

Chemistry and the end of waste: Towards sustainability in a post-trash age

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What is a major contributor to global warming, ozone depletion, rain and ocean acidification, the mass extinction of species and the depletion of Earth's natural resources? The answer is waste.

Waste includes not only the solid material we throw away and that ends up in landfill sites and incinerators, or is simply scattered across our environment, but also the gasses that we emit into the atmosphere and the materials we wash away, flush into sewage, or allow to leak into waterways from our agricultural, domestic and industrial activities. And 'waste' not only refers to these materials we throw away, but also to our actions in consuming raw materials on an ever-increasing scale, depleting natural resources as if there was an infinite supply available on our planet.

The problem is that there is no such thing as 'away'. As Leonard and Conrad succinctly expressed it The Story of Stuff,[1] when we throw anything away, it must go somewhere. Of course, every scientist knows this basic principle, encapsulated in the Law of Conservation of Mass – matter cannot be created or destroyed in a chemical reaction, it can only change its form. But on a planetary scale, we have behaved as if the land, water and air around us are infinite sinks, an 'away' that is effectively 'nowhere', with an inexhaustible capacity to absorb our waste. And we have now reached – in many case cases already surpassed – the limits of capacity.[2]

The solution to this problem is that we must fundamentally change our approach to waste. First, by doing as much as we can to reduce the consumption of materials that generate the waste. Second, by ensuring we capture ALL the waste (solid, liquid and gas) we generate as we grow, make and consume all the products we require for our daily living. And third, by not discarding or burning the materials we don't immediately require, but valuing them as resources, as starting points for the next cycle of their use.

The IOCD action group, *Chemists for Sustainability*[3] (C4S) has recently been focusing on the challenge of waste and the role that chemistry must play in contributing to a more sustainable future. The group has argued for a shift in thinking in a post-trash age[4] and inputs from the chemical sciences that assist[5] to (1) clean up (dealing with historic waste on land and in the atmosphere and aquatic systems); (2) catch up (dealing with outputs/waste from materials currently in use and in production) and (3) smarten up (progressively improving design, planning and management based on sustainable chemistry). To ensure that chemistry, working with many other fields, is able to make its optimum contribution, the group has emphasised[6] the need to adopt systems thinking[7] and cross-disciplinary[8] working.

Further work on the crucially important subject of waste is under way and will be presented in future publications from C4S.

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7 *Systems Thinking in Chemistry Education*. **International Organization for Chemical Sciences in Development.** http://www.iocd.org/Systems/intro.shtml

8 *Cross-Disciplinary Approaches.* **International Organization for Chemical Sciences in Development.** http://www.iocd.org/OWC/approaches.shtml