Understanding waste – the first step in solving Waste Crisis - Part 1

By Asitha Jayawardena (BSc Eng, MPhil)

The so-called story of 'waste' need not be a stinking one. We have deliberately made it stink. We simply throw away a lot of things branding them as 'waste'. The result is a host of interconnected problems – economic, environmental and social – which, together, nurture an ever-growing waste crisis that has no solution in sight. Perhaps, there is a solution, right under our noses and we fail to see it. Hence, the need for proper understanding sans emotions!

"What we call 'waste' is not really waste but raw materials and energy sources," says Professor Ajith de Alwis (Head, Department of Chemical & Process Engineering, University of Moratuwa). No matter where we are – at home, at work, at hospitals, in school, on the street, at events, etc – we throw away lots of things that could have been made useful as raw materials and energy sources. We must handle waste – or rather all the stuff we term 'waste' – in an intelligent manner.

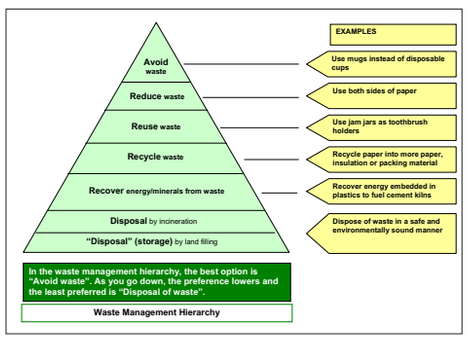
Based on a discussion with Professor Alwis, this article comprises three parts. Today, Part 1 looks at the range of options available under the 'waste management hierarchy'. Part 2 will discuss briefly each option, and Part 3 will finally highlight the importance of everyone's contribution for a successful endeavor on intelligent waste management.

WASTE MANAGEMENT HIERARCHY

What should we do about waste? Disposal? Throw away?? Not really! In fact, disposal is the least preferred option and it should be considered if everything else fails. Unfortunately, at present, what should be the last option has become our Nation's first option!

A pyramid called "waste management hierarchy" presents a range of options available, roughly in the order they should be considered if the idea is intelligent waste management. There is no one 'super' solution i.e.; the magic bullet! We should formulate instead an integrated solution through intelligent choices, depending on the factors at hand such as the type of waste. This is not rocket science, but simply disciplined living.

The options presented in the waste management hierarchy, in the preferred order of consideration, are:



1. Avoid waste
2. Reduce waste
3. Reuse waste
4. Recycle waste
5. Recover energy or minerals from waste
6. Dispose of waste

As highlighted by examples in the Figure of the Waste Management Hierarchy, the solutions are not complex.

If possible, avoid waste in the first place. Then there won't be any waste problem at all. This is the most preferred option. Unfortunately, however, we cannot avoid waste all the time. In day-to-day life, reduce waste generation and reuse materials and equipment so that less needs to be produced. The next two options, namely recycling and recovery (i.e., co-processing), allow us to utilize the energy and raw materials already embedded in waste. Although they are rather sophisticated and industry-based and require special facilities, there are ways we can promote these two options among the industries. Disposal is the final option, which should be considered only if the others fail.

This waste management hierarchy clearly displays that, instead of blindly disposing of waste, we should make maximum use out of it in a safe and environment-friendly manner. In fact we are so deeply buried in a stinking waste crisis mainly because we try to find a solution exclusively through disposal – the least preferred option! It's time we give up waste disposal and work our way out of the waste crisis through intelligent waste management.

While preventing harmful impacts on the environment and our health, we can use the waste management hierarchy to save money, preserve natural resources and mitigate the energy crisis.

In Part 2 of this article, let's consider the waste management options in more detail.

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Salty oceans provide early warning for climate change

Monitoring the saltiness of the ocean water could provide an early indicator of climate change. Significant increases or decreases in salt in key areas could forewarn of climate change in 10 to 20 years time. Presenting their findings at a recent European Science Foundation (ESF) conference, scientists predicted that the waters of the southern hemisphere oceans around South Africa and New Zealand are the places to watch.

Palaeoclimate data shows that the ocean's currents (like the Gulf Stream and its North Atlantic deep water partner) are capable of shifting gears very suddenly, but until now it wasn't clear how this occurred. Using a combination of modern observations, numerical models and palaeoclimate data scientists are increasingly realising that salt is the key.

Their results reveal that a build up of salty water can stimulate deep water circulation, while a diluting of the waters is linked to sluggish flow. "Salt plays a far more important role that we first thought," says Professor Rainer Zahn, a palaeoclimatologist at the Autonomous University of Barcelona in Spain.

Salt increases the density of water. Once a pocket of water becomes salty enough it sinks, drawing in additional water from surrounding areas, and initiates an ocean circulation loop called thermohaline overturning.

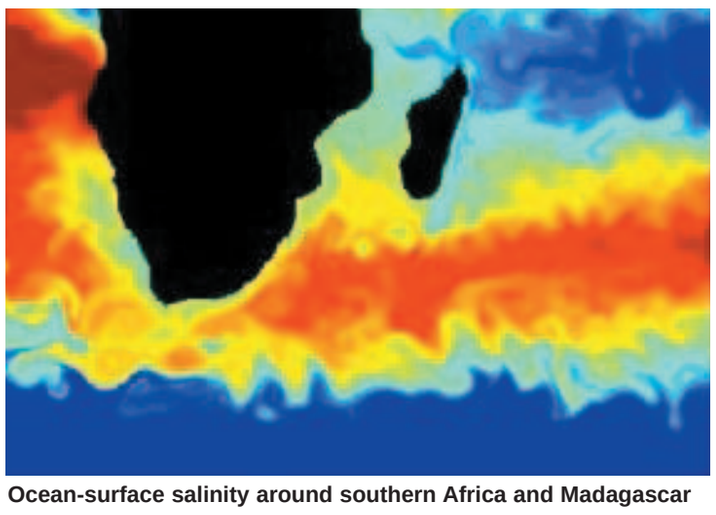
The scientists discovered that a build up of salt in the waters off the coast of South Africa could help to speed up ocean circulation in the North Atlantic, despite the two areas being thousands of kilometres apart. "A salt surge is enough to kick start circulation," says Zahn. Meanwhile, a decrease in saltiness in South African waters could be linked to a slowing down of the North Atlantic circulation.

Models and data both indicate that these changes in ocean circulation occur over very short time-scales, usually in less than a decade or two. Ocean water can't possibly travel this fast (it takes nearly a century for a parcel of water to move from the South Atlantic to the North Atlantic). Instead the scientists think that energy is transferred through the ocean along a deep pressure wave. "The surge of salt generates a pressure gradient in the ocean that sends energy to the north without water actually being transported," explains Zahn.

Regardless of whether ocean circulation speeds up or slows down it causes significant climate change, altering the hydrological cycle and affecting atmospheric circulation patterns too.

Currently there is no large-scale salt monitoring system in place in the southern hemisphere oceans. Zahn thinks that regular measurements taken in the waters around South Africa and New Zealand could be useful. "It could act as an early warning system for climate changes 10-20 years down the road," he says.

The work was presented at the Ocean Controls in Abrupt Climate Change conference, held at the University of Innsbruck Conference Centre in Obergurgl, Ötz Valley, Austria on 19-24 May 2007. The conference, which was attended by an international consortium of over 70 marine scientists and climate experts, was one of the series of research conferences organised by the ESF Research Conferences Scheme.



Ocean-surface salinity around southern Africa and Madagascar

(European Science Foundation)

Scientists discover way to prolong life

In a triumph for pests, scientists have figured out how to make the fruit fly live longer.

But humans still may get something out of the deal. As reported online in Nature Chemical Biology, the discovery that a single protein can inhibit aging holds implications for human longevity and for treatment of some of the world's most feared diseases.

"This work is important for two reasons," said study author Richard Roberts, associate professor of chemistry, chemical engineering and biology at the University of Southern California.

Could fruit flies such as these shed light on longevity and diseases in other organisms

"First, it demonstrates that a single inhibitor can dramatically alter lifespan, a very complex trait. It is remarkable that you can alter it with a single genetic change.

"We don't really need to make fruit flies live longer, but if we understand how to do this, our approach may have direct application to higher organisms, such as ourselves."

Secondly, Roberts said, the method used by his research group to make the inhibiting proteins "opens the possibility of developing a lot of new therapeutics."

The study describes a new method for blocking receptors involved in aging and disease across many species, including humans.

Receptors are proteins that transmit signals across a cell membrane. In the fruit fly, Roberts and his team manufactured short proteins that blocked a receptor involved in fruit fly aging, as previously demonstrated by co-author Seymour Benzer of Caltech.

Flies with a blocked receptor saw their lives extended by a third, with no apparent side effects.

The same blocking strategy should work in all such receptors, known as class B GPCRs (for G protein-coupled receptors). Many GPCRs figure prominently in disease as well as in normal development, Roberts said.

"It is the most targeted family of receptors" by drug manufacturers, Roberts said, estimating that a quarter of all pharmaceuticals focus on GPCRs.

"This approach should be generally applicable."

And generally powerful, given that GPCRs are notoriously unstable and difficult to work with. The Roberts group went around the problem by cutting off the unstable part of the receptor and running experiments only on the part of the receptor that sticks out of the cell.

Though there were no guarantees that inhibiting one part of the receptor would incapacitate the whole, the strategy succeeded.

Roberts' method builds on his co-discovery, in 1997, of a simple method for building libraries of trillions of short proteins, or peptides.

Unlike DNA, which can be copied and multiplied millions of times with polymerase chain reaction (PCR), proteins cannot be copied directly.

But Roberts and Jack Szostak of Massachusetts General Hospital thought of fusing peptides to the bits of messenger RNA that contained their sequence.

"Essentially, we developed a way to do PCR on proteins," Roberts said.

The use of RNA-peptide fusions allowed the easy creation and multiplication of randomly generated peptides. Roberts termed this approach "Irrational Design."

In the new study, Roberts and his group literally threw trillions of peptides at the receptor and saved the ones that stuck.

"We let the molecules themselves decide if they bind, rather than trying to design them rationally," he said.

After multiple cycles, the researchers had a group of peptides that stuck to the receptor and not to any other protein.

Fruit flies genetically altered to produce such peptides lived longer, suggesting that the peptides were interfering with the receptor's normal function.

Why these particular peptides work, and why the receptor they target plays such an important role in fruit fly aging, remain the bigger and as yet unanswered questions.

Print publication of the Nature Chemical Biology study is expected later this summer.

The other co-authors on the study are William Ja and Anthony West, postdoctoral fellows at Caltech; Pamela Bjorkman, professor with the Howard Hughes Medical Institute at Caltech; and Silvia Delker, postdoctoral fellow at the University of California, Riverside.

Funding for the research came from the National Institutes of Health, the Beckman Foundation, the Glenn Foundation, the American Federation for Aging Research, and the John Douglas French Alzheimer's Foundation.

In recognition of his work building libraries of proteins, Roberts received a Presidential Early Career Award in Science and Engineering from the National Science Foundation in 1999.

(University of Southern California)