

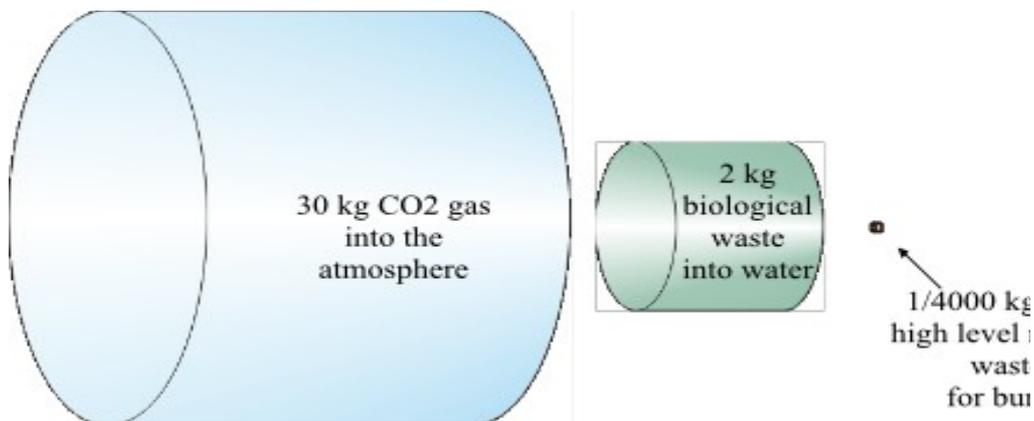
What a waste – what a complete misunderstanding!

Concern about high level nuclear waste is most strange -- it tops many lists of public worries about nuclear but on close examination is evidently unreasonable.

Like other technologies nuclear power produces waste, and, as for them, acceptable strategies are needed to prevent safety being compromised or the environment being spoiled. We may compare:

- for some the waste is dangerous and kills many people, but for others that is not so;
- in some cases the quantity of waste is large, but for others small;
- for some the waste can be treated or processed, but for others not;
- for some, but not all, the waste decays away over a period of time;
- for some the waste is a gas and not easily contained, and then it has traditionally been released into the environment;
- in some cases the waste is soluble or easily dispersed into the environment given adequate drainage;
- for others the waste is largely solid and therefore simpler to store.

Against these criteria we can compare the problems posed by different wastes. For simplicity we discuss three types produced by humans: combustion waste, biological waste and nuclear waste.



Canisters of a size to show the mass of waste produced for each person each day, based on UK figures

combustion waste

Combustion waste consists of ash and carbon dioxide. On the left of the diagram is shown the mass of carbon dioxide released into the atmosphere every day for each person -- the consequence of gas, oil and coal burning, including their contribution to transport, heating and electricity generation. This is large, especially considering how small the atmosphere is – it has the same mass as a layer of water just ten metres thick over the surface of the Earth. It should be no surprise that this

environmental mis-treatment which began at the start of the Industrial Revolution has upset the balance of the atmosphere. The details are another story of which we still have much to learn, but it is widely accepted that this waste is seriously affecting the climate. In addition the pollution from other chemicals and particulates released by the fossil fuel industries causes hundreds of thousands of deaths each year. This waste is out of control and endangers life on Earth.

biological waste

Biological waste is closer to home and, individually, management of it is a personal responsibility taught to children from an early age. Like many unpleasant problems it is not readily spoken of but nature, that is evolution, encourages everybody (and animals likewise) to keep the environment free of waste by making the waste smell bad, or rather by making man particularly sensitive to its chemicals. Where the resources are available, the waste is washed away with water into the environment. However, where this fails and the waste gets into drinking water or the food chain, a closed biological loop is set up which, once infected, can lead to a biological chain reaction of disease. In this way millions of people in the world die every year. With the necessary investment this waste problem can be contained by recycling and engaging the process of natural decay. The effluent is passed through filter “beds” and the solids aerated to rot or decay naturally before being spread on arable or pasture land.

nuclear waste

Nuclear waste is no different in principle from biological and combustion waste and there is no history of fatal accidents due to radiation from waste at nuclear power plants. The quantity of waste is tiny by comparison, as illustrated to the right in the diagram. This is directly related to the energy density of nuclear compared to carbon fuels – undiluted, a millionth of the fuel is needed per kWh, so generating a millionth of the waste. The waste is mainly solid and not discharged into the environment by default. It can be processed, differently from biological waste, but no less effectively. It is kept cool until ready for processing; then the fission products (which are truly spent) are separated from the heavy nuclei that can be used again as new fuel because these have not yet fissioned (uranium and transuranics); the fission products decay naturally with a half-life of 30 years or less, and can be embedded in glass or concrete and buried – within 300 years the activity falls by a factor one thousand and within 600 years by a million, becoming no more active than typical rock. The technology to vitrify the waste in this way is not new and has been perfected in past decades. (If, instead, the unused fuel is not separated or reused, the radioactivity lasts much longer -- but that is a waste of unused fuel anyway.) Buried in a mine or elsewhere waste can stay put securely for very much longer than 600 years, as demonstrated by the story of the waste left by the 2000-million-year-old natural Oklo Reactor, see for example http://en.wikipedia.org/wiki/Natural_nuclear_fission_reactor . Nuclear waste has had a bad press but that is nothing to do with safety. Comparing it with other wastes what is the worst that can be said of high level nuclear waste? That it does not smell?

costs

And the costs of nuclear energy? Well, if half of the work force in the nuclear industry is engaged working on safety, waste and decommissioning largely for public reassurance and if this requirement were drastically scaled back, the cost of nuclear energy should fall substantially. By 30 per cent? Anyway, there is no escaping the fact that the public clamour for greater safety brings increased costs, even where the fears are groundless and the increased costs are in the interest of no one. At Fukushima there was no loss of life at all due to radiation (as predicted within days <http://www.bbc.co.uk/news/world-12860842>). Apart from the need to ensure that emergency generators are better sited, no major changes should have been required. The task is one for education – the public should be encouraged to understand a little. Few of them know much because they were brought up to believe that nuclear was only for egg-heads!