

ENVIRONMENT

Environmental issues at a micro-level

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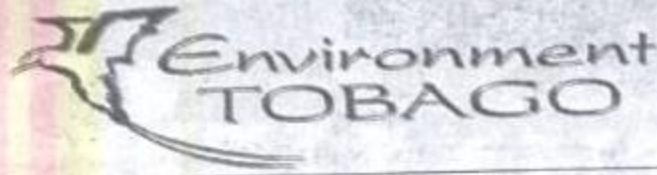


WE OFTEN think of pollution and other causes of environmental problems on a large scale; hectares of land with only tree stumps from deforestation, flooded rivers, piles of garbage and old tires, and emergency rooms filled with persons sick from the diseases caused by these environmental problems.

But what we fail to realise is that environmental problems and their causes can happen at a micro-level, the culprit in this case is nanotechnology. Nanotechnology is the study of the control of matter on an atomic and molecular level and with structures 100 nanometres (a nanometre is one billionth of a metre) or smaller in size. Most of us would associate "nanotechnology" with a science fiction movie, but nan-

otechnology is widely used to produce many of the materials and products we use everyday, for example, electronics, cosmetics and food. Just last year there was an estimated 800 products on the market where the manufacturer identified the presence of nanoparticles, and such products enter the market at a rate of about three to four per week. However, some of the nanoparticles used can have serious consequences on both human health and the environment, which will be discussed in more detail in the following paragraphs.

Before looking at the negative effects, I want to emphasize that nanotechnology is beneficial to environment. Examples of the positive influence of this technology include miniature sensors for early detection of pollutants in the environment and nanoparticle filters for their removal. Nanoparticles can also be incorporated into paint to give them infra-red radiation reflecting properties, thus reducing heat



loss.

It should be understood that certain nanoparticles from nanomaterials have these adverse effects and not all nanomaterials. The effects caused by these harmful nanoparticles are referred to as nanopollution. To better understand this new level of pollution we have to differentiate between two types of nanoparticles; nanocomposites and free nanoparticles. The first type of particles are incorporated into the material, substance or particle they make up, such as, electronics, whereas the second type can be either simple or complex in nature, for example, a substance or nanoparticle which is coated with another nanoparticle. However, it is the free nanoparticles that are cause for concern.

One also has to understand the properties of nanoparticles

some of these properties include the difference in behaviour between individual nanoparticles and aggregations of these particles. Also compounds that are powdery or liquid in nature may be composed of one type of nanoparticle but they will be of different sizes, therefore larger particles would behave differently and have different effects compared to smaller ones.

What makes nanopollution particularly disturbing is the minute size of the particles involved, which can easily be assimilated by the cells of plants and animals and causing ailments which may be detected years from now. Also, since a lot of nanoparticles are synthetic, many living organisms do not have any mechanisms to deal with nanowaste or the effects of nanopollutants.

An example of



nanopollution is the silver nanoparticles in socks to reduce foot odour which are inadvertently released when they are washed. These particles are bacteriostatic meaning that they can destroy the bacteria used by waste treatment facilities to breakdown organic matter, in this case the waste they are

treating.

With respect to human health one is caught in a dilemma as nanotechnology as there are many benefits to the health sector however, the effects of nanoparticles can be a health hazard.

Because of their size these particles are readily taken up by living organisms and

accumulate in tissues and organs causing adverse effects. For example, carbon nanotubes which if breathed in, in sufficient amounts have the same effect as asbestos which causes a form of skin cancer called mesothelioma as it grows in the mesothelium which is the protective tissue that is found around internal organs.

The influence of nanotechnology on human health has spawned the creation of "nanotoxicology" which focuses on the reactions of nanoparticles of different sizes, shapes and surface textures on the surrounding tissues.

Also there will be different reactions between biodegradable and non-degradable particles.

Another common misunderstanding that might arise is that because these particles are minute, one might deduce that their toxicity and the effects are negligible compared to their macro counterparts.

However, these nanoparticles are very different and so too are the effects they cause. The chemical composition of the material has to also be taken into account as it can be just as toxic in small amounts as in large amounts.

Therefore when we look at the environmental problems plaguing our planet we must look at it on a macro and micro level because all pollutants affect us and our environment no matter how big or small they are.