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Alice Geary,
Environment Agency
Bedford SPG
40-64 St Johns Street,
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MK42 0DL

16th February 2006
My Reference: CRC160206/006015/CM

Without Prejudice

Dear Ms Geary,

Reference: **Newhaven Energy From Waste Recycling Facility PPC application reference EA/PPC/BV8067IL by Onyx South Downs Ltd,**

On the 29th January 2006 I sent you a letter making 61 objections to the above PPC application, my Reference: CRC290106/006010/CM. On the 14th February 2006 I sent you a letter with further points (62 to 79) objecting to the above PPC application, my reference: CRC140206/006011/CM. Below I set out a further objection to the ONYX PPC application and I request that you reject their application. The points of objection continue with the numbering scheme used in the previous objection letter.

Summary of points I wish you to consider:

Point [80] The human health risk assessment takes no account of UFP and is thus invalid.
Point [81] The planned Newhaven incinerator will generate vast quantities of UFP, seriously damaging the health of the people and animals living in the Ouse Valley Area.

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1 *Point [80] The human health risk assessment takes no account of UFP and is thus invalid.*

The human health risk assessment, appendix F, and the assessment of acute health effects appendix G of the PPC application is invalid as these assessments take no account of the affects on health of Ultra Fine Particles (UFP). That is particles that are smaller than PM2.5. As can be seen below the Onyx filtration system will not be able to stop these nano-particles. A full explanation of how UFP or nano particles seriously damage health is given in Appendix (1), short extract below.

From Vyvyen Howard, full article in Appendix (1):

There is evidence that UFPs can gain entry to the body by a number of routes, including inhalation, ingestion and across the skin. There is considerable evidence that UFPs are toxic and therefore potentially hazardous. The basis of this toxicity is not fully established but a prime candidate for consideration is the increased reactivity associated with very small size. The toxicity of UFPs does not appear to be very closely dependent on the type of material from which the particles are made, although there is still much research to be done before this question is fully answered.

The Onyx gas filtration system is ineffective in removing PM2.5 and smaller particulate; see the extract from the PCC application below

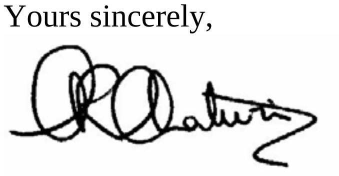
From IPPC Volume 2, section 4.9.3 Filter System and Gas Discharge

The efficiency of the bag house filter will depend on a combination of the choice of the filter material and the condition of the filter cake on the outside of the bags , the following values are based on typical commonly used filter materials alone without the additional beneficial effects of the filter cake.
The expected efficiency of the bag filters is as follows:
· PM10 between 95% and 98%
· PM2.5 between 65% and 70%
· < PM2.5 between 5% and 30%
It is not practical to accurately predict the actual filter efficiency or particle size distribution from the process, as this is largely linked to operating conditions as well as the factors detailed above. The thickness and the nature of the filter cake on the bag surface is important as this has a significant effect on the filter efficiency.
The ageing of the filter bags and frequency of cleaning also influence the overall efficiency.

2 ***Point [81] The planned Newhaven incinerator will generate vast quantities of UFP, seriously damaging the health of the people and animals living in the Ouse Valley Area.***

This is not a final statement by DOVE on its objections to this highly complex PPC application. We therefore reserve the right to submit further objections as we continue to digest the documents that have been supplied by Onyx.

Yours sincerely,



Professor C. R. Chatwin - Chairman of DOVE

Appendix (1)

Dr. Vyvyan Howard explains why harmless materials become dangerous when shrunk to the nanoscale

Nanotox

As nanotechnology is moving into producing tonnes of nanoparticles, Dr. Vyvyan Howard explains why harmless materials become dangerous when shrunk to the nanoscale.

A more technical fully referenced version of this article is posted on ISIS members' website. Details here.

2.1.1 Introduction

The nano-technology industry has begun the bulk production of nanoparticles, especially *ultrafine* particles for a range of commercial applications, from titanium dioxide in sunscreens to carbon nanotubes for molecular electronics (see "Nanotubes highly toxic" and "Nanoshells cure or curse?" this series). Manufacturers are moving into production levels in excess of 100 tonnes per annum.

Particles that can be breathed in are classified as: *coarse* (average diameter less than 10micron); *fine* (average diameter less than 2.5 micron); and *ultrafine* (average diameter less than one micron). One micron (μ) is one millionth of a metre and 1 000 nanometres (nm).

We have two defence mechanisms in the lung to deal with particles breathed in. The first is a carpet of mucus that lines all but the most peripheral parts of the lung. This carpet moves slowly upwards, carrying particles that have landed on it, and is then swallowed. Particles that make it through this carpet of mucus, which tend to be fine and ultrafine, get into the air sacs where gas exchange between the air and the blood takes place. The surfaces of the air sacs are patrolled by *macrophages*, scavenger cells that mop up particles. However, macrophages appear to have difficulty recognising particles less than 70nm in diameter, and in addition, they can be easily overwhelmed by too many particles.

It is illuminating to consider the types of particles we were exposed to throughout the course of evolution. These consisted mainly of suspended sand and soil particles and pollen grains; most of which are relatively coarse and are trapped in the mucus before getting to the alveoli. There have always been ultrafine particles (UFPs), mainly consisting of minute crystals of salt, which become airborne through the action of the sea waves. These salt particles are not toxic, however, because they are soluble in water. For particles less than 70 nm in diameter, there was nothing much in the air throughout our prehistory of particular concern until we harnessed fire for use in our everyday life.

Research is revealing that when normally harmless bulk materials are made into UFPs, they tend to become toxic. Generally, the smaller the particle, the more reactive and toxic it becomes. This should come as no surprise, because that is exactly how catalysts are prepared to enhance industrial chemical reactions. By making particles of just a few hundred atoms, you create an enormous amount of surface, which tends to become electrically charged and thus chemically reactive. The upper size limit for the toxicity of UFPs is not fully known, but is thought to lie between 65 and 200nm.

There is evidence that chronic exposure to particulate aerosols leads to long-term health effects, primarily on the cardiovascular system. Most of these studies have used coarse particles to assess the effects. More studies are now using fine particles, though the question of whether it is more predictive of harm than coarse particles is till being debated. There is also evidence that short term effects from poor air quality is due to particle overloading. The number of studies that have used UFPs is low, but there are indications that UFPs are more hazardous than fine particles.

The main questions on the safety of nanoparticles are:

1. By what routes do UFPs get into the body and then where do they travel to?
2. What is the mechanism of toxic action and how does the reactive surface of UFPs interact with the 'wet biochemistry' in the body?

3. What is the relative contribution of particle size versus particle composition in the overall toxicity of UFPs?

Evidence of potential harm associated with UFPs comes from studies on toxicology and absorption and fate of UFPs in whole animals and studies on mechanisms of toxicity in cells and tissues.

2.1.2 Question 1. Routes of access into, and travel around, the body

First, it should be noted that there appears to be a natural 'passageway' for nanoparticles to get into and subsequently around the body. This is through the openings in the natural membranes, which separate body compartments. These openings are between 40 and 100 nm in size and are thought to be involved in the transport of macromolecules such as proteins, and on occasion, viruses. They also happen to be about the right size for transporting UFPs. Most of the research on that has been performed by the pharmaceutical industry interested in finding ways of improving drug delivery to target organs. This is particularly so for the brain, protected by the 'blood brain barrier'. It appears that chemists are able to design UFPs that can hoodwink certain membranes into allowing 'piggybacking' of novel chemicals across membranes that would not be possible otherwise, and UFPs have already been made that can enhance drug delivery to the brain.

Although this can offer clear advantages, the obverse of this particular coin needs to be considered. When environmental UFPs (as from traffic pollution) gain unintentional entry to the body, it appears that there is a mechanism that can deliver them to vital organs. The body is then 'wide open' to any toxic effects that they can exert. The probable reason why we have not built up any defences is that such environmental UFPs were not part of the prehistoric environment in which we evolved and therefore there was no need to develop defensive mechanisms against them.

There is considerable evidence that inhaled UFPs can gain access to the blood stream and are then distributed to other organs in the body. This has been shown for synthetically produced UFPs such as bucky-balls – a form of carbon in which 60 carbon atoms are arranged like a football - which accumulate in the liver.

Another possible portal of entry into the body is via the skin. A number of sunscreen preparations now available have incorporated nanoparticle titanium dioxide. Recent studies have shown that particles of up to 1 μ in diameter (within the category of UFPs) can get deep enough into the skin to be taken up into the lymphatic system, while particles larger than that were excluded. The implication is that UFPs can and will be assimilated into the body through the skin. The exact proportion of those deposited on the skin, which will be absorbed, remains unknown. Using *post mortem* human skin, it has been shown that dextran beads 0.5 to 1μ can penetrate the rough outer layer (stratum corneum) of the skin when flexed. The penetration occurred in over 50 % of the samples if flexing was continued for 1 hour. In a small proportion of cases, the beads got as far as the dermis (inner layer of the skin).

2.1.3 Question 2. The mechanism of toxic action

Studies on laboratory animals have looked at the ability of UFPS to produce inflammation in lungs after exposure to UFP aerosols. The degree to which UFPs appear to be able to produce inflammation is related to the smallness of the particles, the 'age' of the aerosol and the level of previous exposure. It has been proposed that the chronic inhalation of particles can set up a low grade inflammatory process that can damage the lining of the blood vessels, leading to arterial disease.

Studies on cells have confirmed the increased ability of UFPs to produce free radicals that cause cellular damage. This damage can be manifested in different ways, including genotoxicity and altered rates of cell death.

2.1.4 Question 3. Particle size versus particle composition

Early indications were that certain metals might be more toxic as UFPs than other materials. Since then, other studies have shown very similar toxicities between different materials when presented as UFPs, for example latex and titanium dioxide. More recently, attention is being concentrated on the effects of ultrafine carbon black. What seems clear from all the papers is that exposure of living systems to UFPs tends to increase oxidative stress, and therefore, the effect of small size is considerably more important for UFP toxicity than the actual composition of the material.

2.1.5 Conclusions

There is evidence that UFPs can gain entry to the body by a number of routes, including inhalation, ingestion and across the skin. There is considerable evidence that UFPs are toxic and therefore potentially hazardous. The basis of this toxicity is not fully established but a prime candidate for consideration is the increased reactivity associated with very small size. The toxicity of UFPs does not appear to be very closely dependent on the type of material from which the particles are made, although there is still much research to be done before this question is fully answered.

Dr. Vyvyan Howard is histo-toxicologist at University of Liverpool. A version of this article first appeared as annex to "No Small Matter II: The Case for a Global Moratorium"
www.etcgroup.og