PAH's from Coal and Bitumen - the new Asbestos?

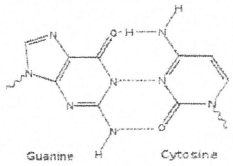
PAH's (polycyclic aromatic hydrocarbons) are likely to be some of the most potent carcinogens (chemicals that cause cancer) known to science. They are found in coal and all fossil fuel products including bitumen. Cold bitumen releases very little PAH's, but hot bitumen gives off fumes containing PAH's. Up until recently only coal miners and people living near mining operations have been affected. The fracking operations of unconventional Coal Seam Gas (uncCSG) mining and use of hot bitumen without containment are increasing PAH concentrations in our air and water.

With a potency greater than asbestos for causing cancer, these pose a huge threat to public health. This is being overlooked largely because few of these chemicals have been studied, or have "health risks" estimated. Commercial water and air testing (VOC assays) usually do not include these chemicals.

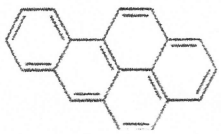
How PAHs cause Cancer.

PAH's are flat multi-ring structures that mimic DNA base pairs.

G-C DNA Base Pair



Benzo-α-pyrene



PAH's slip in between the base pairs in DNA (intercalation) disrupting DNA replication and causing mutations. Cancer is caused by a series of DNA mutations that change an ordinary cell in our body to a cancer cell which then replicates out of control to form tumours.

Only a handful PAH's have been studied. These have been shown to cause cancer in laboratory animals, but not in Humans. ***For most PAH's there are no "safe levels" defined, so they are largely overlooked in public health considerations.***

PAH's in Bitumen

Bitumen contains a complex mixture of organic compounds including hundreds of different PAH's. IRAC has classified "Occupational exposures to straight-run bitumens and their emissions during road paving" as "*possibly carcinogenic to humans (Group 2B)*". The PAH, benzo-a-pyrene which has bee most studied was measured in Bitumen fume at 180°C at 90ng/m^3.

Australian federal legislation - ***National Environment Protection (Ambient Air Quality) Measure*** does not list any "safe" levels for PAH's in air. Only a monitoring investigation level (MIL) for BaP: *0.3ng/m3* as an annual average. MIL merely triggers further investigation and action that apply at hot-spots.

Relative potency of air-borne carcinogens.

Benzene has been shown to cause Leukemia and cancer risks from humans exposed to benzene have been calculated. From their mutagenic potency and animal studies, ***PAH's like benzo(a)pyrene are estimated to be 10,000 times more potent carcinogens than benzene:***
Inhalation carcinogenic potency- lower figures are more potent carcinogens (WHO air guidence for Europe)

PAH – benzo(a)pyrene	8.7×10^{-2} unit risk/(µg/cu. m.)
Asbestos	7.7×10^{-3}
Benzene	6×10^{-6} " "

When inhaled, the carcinogenic potency of PAH's range from the same as asbestos to 1,000 more potent.

Air and water testing.

Coal and fossil fuels contain hundreds of Volatile Organic Compounds (VOC's) that can be assayed in a single gas cromatogram. Curent commercial air and water tests only list the results for top 5 or 10 compounds. PAH's that usually occur in the top 30 to 200 compounds are not listed in these assay results.
Where specific PAH assays are carried out, the assays are not sensitive enough to measure levels that can cause cancer. So even if PAH's are there at levels causing a health risk, they can be below the test detection level and are not listed in test results. ***Specific high-sensitivity PAH assays are needed to check PAH levels in air and water associated with hot bitumen production. These are available in Australia but are expensive.***

The New Asbestos?

When inhaled, PAH's have the similar or higher carcinogenic potency than asbestos.
(Inhalation potency of PAH's range from the same as asbestos to 1,000 more potent).

However the worst aspect of this is that few of the PAH's have been studied extensively, and most have not been listed as carcinogens as there are no practical experiments where they cause cancer in humans. Scientific knowledge indicates they can cause cancer at very, very low concentrations in air and water. ***PAH's should be treated as a serious health risk and air and water testing near petrochemical and hot bitumen plants should be manditory.***

PAH's are very stable and will remain in the environment for a long time increasing cancer in our children and grandchildren. Worldwide levels of PAH's in air and water are increasing and this correlates with an increase on oesophogical cancer. Governments should be working to prevent any release of PAH's into air or water.

Effie Ablett

The author's publications include papers in Nature, the Lancet, New England Journal of Medicine, Mutation Research, Neurology, Oncogene, Biochemical Pharmacology and Plant Science. Invited speaker at the Dibble Cancer Research Centre, UDMS, London, and the International Congress for In Vitro Biology, Portland, OR, USA. Over 30 years working as a molecular biologist in Cancer Research at University of Qld and Qld Institute of Medical Research, studying the effects of chemical carcinogens on cultured human cells.